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United States Nuclear Regulatory Commission
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NUREG-1943, Vol. 1

Environmental Impact Statement for Combined Licenses (COLs) for Comanche Peak Nuclear Power Plant Units 3 and 4

Final Report

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

U.S. Army Corps of Engineers
U.S. Army Engineer District, Fort Worth
Fort Worth, TX 76102-6199

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Manuscript Completed: May 2011
Date Published: May 2011

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Abstract

This environmental impact statement (EIS) has been prepared to satisfy the requirements of the National Environmental Policy Act of 1969, as amended. This EIS has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Luminant Generation Company LLC (Luminant), acting for itself and as agent for Nuclear Project Company LLC (subsequently renamed Comanche Peak Nuclear Power Company LLC), for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the Luminant application are (1) NRC issuance of COLs for two new nuclear power reactor units (Units 3 and 4) at the Comanche Peak Nuclear Power Plant (CPNPP) site in Hood and Somervell Counties, Texas, and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit to perform certain construction activities on the site. The Corps is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the analysis by the NRC and Corps staff that considers and weighs the environmental impacts of building and operating two new nuclear units at the CPNPP site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts.

The EIS includes the evaluation of the proposed action's impacts to waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Appropriation Act of 1899. The Corps will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the Corps' permit decision document, will include an alternatives analysis to determine the Least Environmentally Damaging Practicable Alternative.

After considering the environmental aspects of the proposed action, the NRC staff's recommendation to the Commission is that the COLs be issued as requested. This recommendation is based on (1) the application, including the Environmental Report (ER) submitted by Luminant and Luminant's responses to the NRC and Corps staff's requests for additional information (RAIs); (2) consultation with Federal, State, Tribal, and local agencies; (3) the NRC and Corps staff's independent review; (4) the NRC and Corps staff's consideration of public comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The Corps permit decision will be made following issuance of the final EIS, and the Corps will issue its Record of Decision based, in part, on this EIS.

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Executive Summary

By letter dated September 19, 2008, the U.S. Nuclear Regulatory Commission (NRC) received an application from Luminant Generation Company LLC (Luminant), acting for itself and as agent for Nuclear Project Company LLC (subsequently renamed Comanche Peak Nuclear Power Company LLC), for combined construction permits and operating licenses (combined licenses or COLs) for two new nuclear reactor power units (the proposed Units 3 and 4) at the Comanche Peak Nuclear Power Plant (CPNPP) site, which is located in Hood and Somervell Counties, Texas. The NRC staff's evaluation is based on Luminant's November 2009 revision to the application, responses to requests for additional information (RAIs), and supplemental letters.

The proposed actions related to the CPNPP Unit 3 and 4 application are (1) NRC issuance of COLs for two new nuclear power reactor units at the CPNPP site and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) and Section 10 of the Rivers and Harbors Act to perform certain construction activities on the site. The Corps is participating as a cooperating agency with the NRC in preparing this environmental impact statement (EIS) and participates collaboratively on the review team. The reactor specified in the application is a Mitsubishi Heavy Industries, Ltd. (MHI), U.S. Advanced Pressurized-Water Reactor (US-APWR) design (hereafter referred to as US-APWR in this EIS).

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.) directs that an EIS be prepared for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

The purpose of Luminant's requested NRC action is to obtain COLs to construct and operate two new baseload nuclear power units. These licenses are necessary but not sufficient for construction and operation of the units. A COL applicant must obtain and maintain the necessary permits from other Federal, State, Tribal, and local agencies and permitting authorities. Therefore, the purpose of the NRC's environmental review of Luminant's application is to determine the impacts on the human environment if two new nuclear power units of the proposed US-APWR design are constructed and operated at the CPNPP site. The purpose of Luminant's requested Corps action is to obtain a permit to perform regulated activities that would have an effect on waters of the United States.

Upon acceptance of the Luminant application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* (FR) a Notice of Intent (73 FR 9604) to prepare an EIS and to conduct scoping. On January 6, 2009, the NRC held two scoping meetings in Glen Rose, Texas, to obtain public input on the scope of the environmental review. The staff reviewed the comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments.

To gather information and to become familiar with the sites and their environs, the NRC, its contractors [the Oak Ridge National Laboratory (ORNL) and Information Systems Laboratories, Inc. (ISL)], and the Corps visited the CPNPP site in February 2009 to examine the ecological resources of the site and to conduct an environmental site audit. The NRC and its contractors also visited three alternative sites (the Coastal site, the Pineland site, and the Tradinghouse site) in Texas in February 2009. During the site visits, the NRC staff and its contractors met with Luminant staff, public officials, and the public.

Included in this EIS are (1) the results of the joint NRC/Corps review team's analyses, which consider and weigh the environmental effects of the proposed actions; (2) potential mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's recommendation regarding the proposed action.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels – SMALL, MODERATE, and LARGE:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

In preparing this EIS, the review team reviewed the application, including the Environmental Report (ER) submitted by Luminant; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NUREG-1555, *Environmental Standard Review Plan* and Staff Memorandum on Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements. In addition, the NRC staff considered the public comments related to the environmental review received during the scoping process. Comments within the scope of the environmental review are included in Appendix D of this EIS.

A 75-day comment period began on August 13, 2010, when the U.S. Environmental Protection Agency (EPA) published a Notice of Availability of the draft EIS to allow members of the public and agencies to comment on the results of the NRC and Corps staffs' review. During this period, the NRC and Corps staff conducted two public meetings in Glen Rose, Texas, to describe the results of the environmental review, respond to questions, and receive public comments on the draft EIS. All comments received on the draft EIS are included in Appendix E. Changes made in response to public comments, updates to the material, and other substantive changes are identified by change bars in the margins of this final EIS.

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs be issued as requested. This recommendation is based on (1) the application, including the ER submitted by Luminant and Luminant's supplemental letters and responses to the review team's RAIs; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the review team's consideration of public comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The Corps permit decision will be made following issuance of the final EIS, and the Corps will issue its Record of Decision (ROD) based, in part, on this EIS.

The NRC staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the NRC's Safety Evaluation Report, which is still being developed. The reactor specified in the application is the MHI US-APWR design, which is currently undergoing a design certification review. The NRC staff's evaluation of the design certification is currently in progress.

Abbreviations/Acronyms

μg	micrograms
μS	microsiemens
X/Q	dispersion values
°C	degree(s) Celsius
°F	degree(s) Fahrenheit
A/B	auxiliary building
AADT	Annual Average Daily Traffic
ABWR	Advanced Boiling Water Reactor
ac	acre(s)
AC	alternating current
ACHP	Advisory Council on Historic Preservation
AD	Attainment Demonstration
AEC	Atomic Energy Commission
AEP	Archaeology and Ethnography Program
ALARA	as low as reasonably achievable
AML	abandoned mine land
AMUD	Acton Municipal Utility District
AN	ammonia nitrogen
APE	Area of Potential Effect
APLIC	Avian Powerline Interaction Committee
ASLB	Atomic Safety and Licensing Board
AWEA	American Wind Energy Association
BA	bioliquid assessment
BDTF	Blowdown Treatment Facility
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand
Bq	Becquerel(s)
BRA	Brazos River Authority
BRM	Brazos River mile
Btu	British thermal unit(s)
BUL	balancing up load
BWR	boiling-water reactor
C/V	containment vessel
CAA	Clean Air Act
CBC	Christmas Bird Count
CBOD	carbonaceous biochemical oxygen demand
CCD	Census County Division
CCWS	component cooling water system
CDC	Center for Disease Control and Prevention

CDF	core damage frequency
CDP	census-designated place
CDR	Capacity, Demand, and Resources Report
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second (water flow)
cfu	colony forming units
Ci	Curie(s)
CLNGT	Calhoun Liquefied Natural Gas Terminal
cm	centimeters
cm^2	centimeter(s) squared
CMP	Coastal Management Program
CMZ	Coastal Management Zone
CO	carbon monoxide
CO_2	carbon dioxide
COL	combined license
Corps	U.S. Army Corps of Engineers
CP	construction permit
CPCN	Certificate of Public Convenience and Necessity
CPNPP	Comanche Peak Nuclear Power Plant
CPS	Energy City Public Service Board of San Antonio, Texas
CPUE	catch per unit effort
CR	County Road (CR 360, CR 392)
CREZ	Competitive Renewable Energy Zones
CS	containment spray
CVCS	Chemical and Volume Control System
CVDT	containment vessel reactor coolant drain tank
CWA	Clean Water Act
CWIS	circulating water intake structure
CWS	circulating water system
d	day
D/Q	annual normalized total surface deposition rates
DA	Department of the Army
dBA	decibel(s) (acoustic)
DBA	Design Basis Accident
DBH	diameter at breast height
DC	direct current
DCD	Design Control Document
DDT	dichlorodiphenyltrichloroethane
DFPS	Department of Family Protective Services
DFW	Dallas–Fort Worth
DHV	design hourly volume
DNL	day-night average sound levels
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation

DSM	demand side management
DSWG	Demand Side Working Group
DWS	demineralized water system
EAB	Exclusion Area Boundary
ECP	essential cooling pond
EFH	Energy Future Holdings Corporation
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
ELCC	effective load carrying capacity
ELF	extremely low frequency
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ERCOT	Electric Reliability Council of Texas
ESA	U.S. Endangered Species Act of 1973, as amended
ESP	early site permit
ESRP	Environmental Standard Review Plan
ESWS	essential service water system
FAA	Federal Aviation Administration
FAC	free available chlorine
FC	fecal coliform
FDA	final design approval
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement
FM	Farm-to-Market Road
FPS	fire protection system
FR	Federal Register
FRA	Federal Railroad Administration
FSAR	Final Safety Analysis Report
ft	foot or feet
ft^3	cubic feet
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
GAM	general area monitoring
GATF	Generation Adequacy Task Force
GBq	gigabecquerel
GBRA	Guadelupe-Blanco River Authority
GCC	global climate change
GCD	Groundwater Conservation District
GCRP	Global Change Research Program
GE	General Electric
GED	Global Energy Decisions, Inc.
GEIS	generic environmental impact statement

GEIS-DECOM	GEIS-Decommissioning of Nuclear Facilities (NUREG-0586)
GHG	greenhouse gas
GIT	Georgia Institute of Technology
GIWW	Gulf Intracoastal Waterway
gpd	gallon(s) per day
gpm	gallon(s) per minute
GPS	global positioning system
GTG	gas turbine generator
GWMS	Gaseous Waste Management System
ha	hectare(s)
HCLPF	high confidence of low probability of failures
HCP	Ham Creek Park
hr	hour(s)
HT	holdup tank
HUD	U.S. Department of Housing and Urban Development
HVAC	heating, ventilation, and air conditioning
Hz	hertz
IA	Interconnection Agreement
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
INL	Idaho National Laboratory
IOU	investor owned utility
ISD	Independent School District
ISFSI	Independent Spent Fuel Storage Installation
ISL	Information Systems Laboratories, Inc.
ISO	independent system operator
JPPP	E.S. Joslin Power Plant Project
KC	Keystone Center
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)
kWh	kilowatt-hour(s)
L	liter(s)
LaaR	load acting as resource
lb	pound(s)
LC_{50}	concentration lethal to 50% of the sample population
LCRA	Lower Colorado River Authority
LCRWPG	Lower Colorado Regional Water Planning Group
Ldn	day-night average sound level
LEDPA	least environmentally damaging practicable alternative
lin ft	linear foot (feet)

LLMW	low-level mixed waste
LLW	low-level radioactive waste
LOCA	loss of coolant accident
LOS	Level of Service
LPSD	low power shutdown
LPZ	low population zone
LRF	large release frequency
LSI	Langelier Saturation Index
LST	local standard time
LTSF	Long-Term Storage Facility
LVW	low volume waste
LWA	Limited Work Authorization
LWMS	liquid waste management system
LWR	light-water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mA	milliampere
MBq	megabecquerel
MCCI	molten corium-to-concrete interaction
mcf	million cubic feet
mCi	millicurie
MCR	main cooling reservoir
MDC	main drainage channel
MDCT	mechanical draft cooling tower
MEI	maximally exposed individual
mG	milligauss
mg	milligram(s)
MGD	million gallon(s) per day
MHI	Mitsubishi Heavy Industries, Ltd.
MHz	megahertz
mi	mile(s)
mi^2	square mile(s)
min	minute
MIT	Massachusetts Institute of Technology
mL	milliliter(s)
MMS	Minerals Management Service
MNES	Mitsubishi Nuclear Energy Systems
mo	month
MOU	Memorandum of Understanding
MOX	mixed oxide (fuel)
mph	mile(s) per hour
mpn	most probable number
mR	milliroentgen
mrad	millirad(s)
mrem	millirem(s)

MSA	Metropolitan Statistical Area
MSL	above mean sea level
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s) of uranium
MW	megawatt(s)
MW(e)	megawatt(s) electrical
MW(t)	megawatt(s) thermal
MWd	megawatt-day(s)
MW-h	megawatt-hour(s)
MWS	makeup water system
N	nitrogen
NAAQS	National Ambient Air Quality Standard
NCA	Noise Control Act
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection & Measurements
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NESWS	nonessential service water system
NGO	nongovernmental organization
NHPA	National Historic Preservation Act of 1966, as amended through 2000
NIEHS	National Institute of Environmental Health Sciences
NMM	navigation mile marker
NO_2	nitrite
NO_3	nitrate
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWPCC	Northwest Power and Conservation Council
O&M	operations and maintenance
ODCM	offsite dose calculation manual
OECD	Organization for Economic Cooperation and Development
OPO4	orthophosphate
ORNL	Oak Ridge National Laboratory
OSF	Onsite Staging Facility
OSHA	Occupational Safety and Health Administration
P	phosphorous
PAM	primary amoebic meningoencephalitis
PBS&J	Post, Buckley, Schuh & Jernigan, Inc.
pCi	picocuries
PGC	Power Generation Company

PGMA	Priority Groundwater Management Plan
PIR	Public Interest Review
PKL	Possum Kingdom Lake
PM	particulate matter
PM_{10}	particulate matter with a diameter of 10 microns or less
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
PNNL	Pacific Northwest National Laboratory
ppm	parts per million
ppt	parts per thousand
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
PSWS	potable and sanitary water system
PUCT	Public Utility Commission of Texas
PURA	Public Utilities Regulatory Act
PWR	pressurized-water reactor(s)
Q	flow
QSE	qualified scheduling entity
R/B	reactor building
RAI	Request for Additional Information
RCDT	reactor coolant drain tank
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCW	Reactor Building Cooling Water
rem	Roentgen equivalent man (a special unit of radiation dose)
REMP	radiological environmental monitoring program
REP	retail electric provider
RFP	Reasonable Further Progress
RHR	residual heat removal
RIMS	Regional Input-Output Model System
RLE	review level earthquake
RMPF	Reservoir Makeup Pumping Facility
RMR	reliability must run
ROD	Record of Decision
ROI	region of interest
ROW	right-of-way
rpm	revolutions per minute
RRY	reference reactor year
RSICC	Radiation Safety Information Computational Center
RSW	Reactor Service Water
RV	recreational vehicle
RWST	refueling water storage tank
Ryr	reactor-year
s	second(s)
SACTI	Seasonal and Annual Cooling Tower Impacts Prediction Code
SAMA	severe accident mitigation alternative

SAMDA	severe accident mitigation design alternative
SAWS	San Antonio Water System
SB	Senate Bill
SCR	Squaw Creek Reservoir
SCWD	Somervell County Water District
SER	Safety Evaluation Report
SES	Steam Electric Station
SFSI	Spent Fuel Storage Installation
SG	steam generator
SGBD	Steam Generator Blowdown
SGIA	signed generation permit agreement
SGTR	steam generator tube rupture
SH	state highway
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMA	Seismic Margin Analysis
SNDC	summer net dependable capability
SO_2	sulfur dioxide
SOP	System Operation Permit
SO_x	sulfur oxide
SPP	Southwest Power Pool
SSC	structure, system, or component
STP	South Texas Project Electric Generating Station
STPNOC	STP Nuclear Operating Company
SWATS	Surface Water and Treatment System
SWMS	Solid Waste Management System
SWPPP	Stormwater Pollution Prevention Plan
SWWTS	sanitary wastewater treatment system
T&D	transmission and distribution
TAC	Texas Administrative Code
TBEG	Texas Bureau of Economic Geology
TBq	terabecquerel(s)
TCC	Texas Central Company
TCEQ	Texas Commission on Environmental Quality
TCS	turbine component cooling water system
TCWP	Texas Coastal Watershed Program
TDS	total dissolved solids
TDSHS	Texas Department of State Health Services
TEDE	total effective dose equivalent
Temp	temperature
THC	Texas Historical Commission
THPO	Tribal Historic Preservation Office
TIS	Texas Interconnected System
TLD	thermoluminescent dosimeter
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System

TPWD	Texas Parks and Wildlife Department
TPWP	Texas Prairie Wetlands Project
tpy	tons per year
TRC	total residual chlorine
TSDC	Texas State Data Center
TSS	total suspended solids
TSWQS	Texas Surface Water Quality Standard
TUGC	Texas Utilities Generating Company
TW	terawatt
TWC	Texas Water Code
TWDB	Texas Water Development Board
TW-h	terawatt-hour(s)
TX	Texas
TxDOT	Texas Department of Transportation
TXNDD	Texas Natural Diversity Database
UC	University of Chicago
U_3O_8	triuranium octaoxide ("yellowcake")
UF_6	uranium hexafluoride
UFC	uranium fuel cycle
UHS	ultimate heat sink
UO_2	uranium oxide
USACE	U.S. Army Corps of Engineers (Corps)
US-APWR	U.S. Advanced Pressurized Water Reactor
USCB	U.S. Census Bureau
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program National Assessment
USGS	U.S. Geological Survey
VCNS	Victoria County Nuclear Station
VCT	volume control tank
VFD	Volunteer Fire Department
VOC	volatile organic compound
WBR	Wheeler Branch Reservoir
WDA	Workforce Development Area
WHO	World Health Organization
WMA	Wildlife Management Area
WWS	wastewater system
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

1.0 Introduction

By letter dated September 19, 2008, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from Luminant Generation Company LLC (Luminant), acting for itself and as agent for Nuclear Project Company LLC (subsequently renamed Comanche Peak Nuclear Power Company LLC), for combined construction permits and operating licenses (combined licenses or COLs) for Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4, to be located in Hood and Somervell Counties, Texas (Luminant 2008). The NRC staff and the U.S. Army Corps of Engineers (Corps or USACE) staff review is based on Revision 1 of the application (Luminant 2009a, 2009b), responses to the NRC staff's requests for additional information (RAIs), and supplemental information from Luminant.

The location of the proposed Units 3 and 4 is in Hood and Somervell Counties, Texas, adjacent to the existing CPNPP Units 1 and 2, about 5 mi north of Glen Rose. The CPNPP site and existing facilities are owned by Luminant, and Luminant is the licensee and operator of the existing Units 1 and 2. In its application, Luminant specified the U.S. Advanced Pressurized-Water Reactor (US-APWR) as the proposed reactor design for Units 3 and 4.

The proposed project will require issuance of a permit by the Corps pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act [CWA]) (33 USC 1251 et seq.) and Section 10 of the Rivers and Harbors Appropriation Act of 1899, as amended (33 USC 403, et seq.) to perform certain construction activities on the site, including building a new water intake and discharge structure on the nearby Lake Granbury and possible disturbance to a wetland area near the proposed cooling towers for Units 3 and 4. The Corps is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency and participates collaboratively on the review team.

The proposed actions related to the CPNPP Units 3 and 4 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the CPNPP site and (2) the Corps issuance of a permit pursuant to Section 404 of the CWA and Section 10 of the Rivers and Harbors Act.

1.1 Background

A COL is Commission approval for the construction and operation of a nuclear power facility. NRC regulations related to COLs are found primarily in Title 10 of the Code of Federal Regulations (CFR) Part 52, Subpart C.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.), requires preparation of an EIS for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

According to 10 CFR 52.80(b), a COL application must contain an Environmental Report (ER). The ER provides input that the staff evaluates in preparing the NRC's EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51. Part 3 of Luminant's application (Luminant 2009a) contains the ER, which provides a description of the proposed actions related to the application and the Luminant's analysis of the potential environmental impacts of construction and operation of proposed Units 3 and 4.

The Luminant application references Mitsubishi Heavy Industries, Ltd.'s (MHI's) US-APWR Design Control Document for the two proposed nuclear units (MHI 2009). Subpart B of 10 CFR

Part 52 contains NRC regulations related to standard design certification. MHI submitted the documentation for design certification of its US-APWR to the NRC in December 2007 (MHI 2007). An application for a standard design certification undergoes an extensive review, usually taking several years, which may result in a rulemaking certifying the reactor design. Where appropriate, this EIS incorporates the information provided in the design certification as submitted by MHI and as referenced in Luminant's COL application.

1.1.1 Application and Review

The purpose of Luminant's requested NRC action is to obtain COLs to construct and operate a baseload nuclear power plant whose energy would be generated by two new nuclear power reactors. These licenses are necessary but not sufficient by themselves for construction and operation of the new nuclear power reactors. In addition to the COLs, Luminant must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The purpose of Luminant's requested Corps action is to obtain a permit to perform regulated activities that would impact waters of the United States, including jurisdictional wetlands.

1.1.1.1 NRC COL Application Review

Luminant submitted an ER as part of its COL application (Luminant 2009a). The ER focuses on the environmental effects of construction and operation of two US-APWR units. The NRC regulations setting standards for review of a COL application are listed in 10 CFR 52.81. Detailed procedures for conducting the environmental portion of the review are found in guidance set forth in NUREG-1555, *Environmental Standard Review Plan* (NRC 2000) and recent updates, hereafter referred to as the ESRP. Additional guidance on conducting environmental reviews is provided in Revision 1 of the NRC Staff Memorandum *Addressing Construction and Preconstruction, Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011).

In this EIS, the NRC staff evaluates the environmental effects of two US-APWR reactors, each with a thermal power rating of 4451 MW(t), at the CPNPP site. The new units would use mechanical draft cooling towers (two such towers for each of the proposed new nuclear units). In addition to considering the environmental effects of the proposed action, the NRC considers alternatives to the proposed action, including the no-action alternative and the construction and operation of new reactors at alternative sites. Also, the benefits of the proposed action (e.g., need for power) and measures and controls to limit adverse impacts are evaluated.

Upon acceptance of the Luminant application, the NRC began the environmental review process by publishing in the *Federal Register* (FR) on December 18, 2008, a Notice of Intent to prepare an EIS and to conduct scoping in compliance with requirements set forth in 10 CFR Part 51 (73 FR 77076). On January 6, 2009, the NRC held two public scoping meetings in Glen Rose, Texas, to obtain public input on the scope of the environmental review and contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A listing of the agencies and organizations contacted is provided in Appendix B. The staff reviewed the comments received during the scoping process, and responses were developed for each comment. Comments within the scope of NRC's environmental review and the associated responses are included in Appendix D. A complete listing of the scoping comments and responses is documented in the Comanche Peak Nulcear Power Plant, Units 3 and 4 combined license application scoping summary report (NRC 2009).

To gather information and to become familiar with the proposed and alternative sites and their environs, the NRC and its contractors, Oak Ridge National Laboratory and Information Systems

Laboratories, Inc., visited the CPNPP site and the three alternative sites (the Coastal site, the Pineland site, and the Tradinghouse site) in February 2009. During the site visits, the NRC staff and its contractors met with Luminant staff, public officials, and the public. Documents related to the CPNPP site and alternative sites were reviewed and are listed as references where appropriate.

The draft EIS was published on August 12, 2010 (NRC 2010). A 75-day comment period commenced on August 13, 2010, when the U.S. Environmental Protection Agency (EPA) *Notice of Availability* of the draft EIS appeared in the FR (75 FR 49486) to allow members of the public and agencies to comment on the results of the NRC and Corps staffs' review. Two public meetings were held in Glen Rose, Texas, on September 21, 2010, to describe the preliminary results of the environmental review, provide members of the public with information to assist them in formulating comments on the EIS, respond to questions, and receive comments on the draft EIS. When the comment period ended on October 27, 2010, the review team considered all of the comments received. All comments received on the draft EIS are included in Appendix E. Changes made in response to public comments, updates to the material, and other substantive changes are identified by change bars in the margins of this final EIS.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels established by the NRC—SMALL, MODERATE, and LARGE:

> SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the CPNPP site, including the environmental impacts associated with constructing and operating the two new power reactors at the site, the cumulative effects of the proposed action and other actions, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's recommendation to the Commission regarding the issuance of COLs for proposed Units 3 and 4 at the CPNPP site.

1.1.1.2 Corps Permit Application Review

The Corps is part of the review team that makes a determination based on the three significance levels established by the NRC. The Corps' independent Record of Decision (ROD) regarding the aforementioned permit application will reference the analyses in the EIS and will present any additional information required by the Corps to support its permit decision. The Corps' role as a cooperating agency in the preparation of this EIS is to ensure that the information presented is adequate to fulfill the requirements of Corps regulations applicable to construction of the preferred alternative identified in the EIS. The CWA Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230), which contains the substantive environmental criteria used by the Corps in evaluating discharges of dredged or fill material into waters of the United States, and the Corps' Public Interest Review (PIR) (33 CFR 320.4) direct the Corps to consider a number of factors as part of a balanced process. A discussion of those factors is provided below. The Corps' PIR will be part of its permit decision document and thus will not be addressed in the EIS.

This EIS includes the Corps' evaluation of construction and maintenance activities that impact waters of the United States. The Corps' permit decision will reflect the national concern for both protection and use of important resources. The benefit, which reasonably may be expected to accrue from the proposal, must be balanced against its reasonably foreseeable detriments. Public interest factors that may be relevant to the proposal will be considered. These factors include conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and cumulative impacts thereof. Evaluation of the impact on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the CWA. The Corps will address these issues in its permit decision document.

As part of the Corps' permit evaluation process, the Corps will issue a public notice to solicit comments from the public about Luminant's proposal to perform site preparation activities and to construct supporting facilities at the CPNPP site.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations (LWAs) for Nuclear Power Plants" (72 FR 57416), the Commission defined "construction" (10 CFR 50.10 and 51.4) as those activities within its regulatory authority. Many of the activities required to construct a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for a COL is submitted, during the NRC staff's review of a COL application, or after a COL is granted. Although preconstruction activities are outside the NRC's regulatory authority, nearly all of them are within the regulatory authority of local, State, or other Federal agencies.

Because the preconstruction activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities that propose to construct structures in and under navigable waters and to discharge dredged, excavated, and/or fill material into waters of the United States, including jurisdictional wetlands that require permits from the Corps, are viewed by the Corps as direct effects related to its Federal permitting action. Chapter 4 describes the relative magnitude of impacts related to construction and preconstruction activities.

1.1.3 Cooperating Agencies

NEPA lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may have special expertise regarding an environmental issue or jurisdiction by law. These other agencies are referred to as "cooperating agencies." Cooperating agencies have the responsibility to assist the lead agency through early participation in the NEPA process, including scoping, by providing technical input to the environmental analysis and by making staff support available as needed by the lead agency.

In addition to a license from the NRC, most proposed nuclear power plants require a permit from the Corps if work is proposed in navigable waters or the activity involves a discharge of dredged or fill material into the waters of the United States. The NRC and the Corps decided that the most effective and efficient use of Federal resources in the review of new nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, the NRC and the Corps signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (Corps and NRC 2008), and the Fort Worth District of the Corps is participating as a cooperating agency as defined in 10 CFR 51.14.

As described in the MOU, the NRC is the lead Federal agency, and the Corps is a cooperating agency in the development of the EIS. Under Federal law, each agency has jurisdiction related to portions of the proposed project as major Federal actions that could significantly affect the quality of the human environment. The goal of this cooperative agreement is the development of one EIS that serves the needs of the NRC license decision process and the Corps permit-decision process. While both agencies must comply with the requirements of NEPA, both agencies also have independent or individual mission requirements that must be met. The NRC makes license decisions under the Atomic Energy Act of 1954, as amended (42 USC 2011 et seq.), and the Corps makes permit decisions under the Rivers and Harbors Appropriation Act of 1899 and the CWA. The Corps is cooperating with the NRC to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of Corps regulations, the EPA's CWA Section 404(b)(1) guidelines, which contain the substantive environmental criteria used by the Corps in evaluating discharges of dredged or fill material into waters of the United States, and the Corps PIR process.

As a cooperating agency, the Corps is part of the NRC review team, involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. For the purposes of assessment of environmental impact under NEPA, the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.1.1 of this EIS; this approach has been vetted by the Council on Environmental Quality when the NRC established its environmental review framework for the renewal of operating licenses. A cooperating agency may adopt the EIS of a lead Federal agency without recirculating it when the cooperating agency concludes, after an independent review of the EIS, that its comments and suggestions have been satisfied and issues a ROD. One of the goals of the process is that the Corps will have all the information necessary to make a permit decision when the final EIS is issued. However, it is possible that the Corps may still need some information from Luminant to complete the permit documentation, information that Luminant could not make available by the time of final EIS issuance.

1.1.4 Concurrent NRC Reviews

In reviews that are separate from, but parallel to, the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in a Safety Evaluation Report (SER) issued by the NRC. The SER presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two US-APWR reactors can be constructed and operated at the CPNPP site without undue risk to the health and safety of the public, (2) whether the emergency preparedness program meets the applicable requirements in 10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73, and 10 CFR Part 100, and (3) whether site characteristics are such that adequate security plans and measures as referenced in the above CFRs can be developed. The Final SER for the Luminant COL application has not yet been issued but will be issued following publication of the Final EIS. The Final SER for Luminant's COL application is currently under development.

The reactor design referenced in the application is the MHI US-APWR, which is undergoing design certification review. The design certification process is separate from the EIS process. If the final design of the US-APWR is different from the design considered in the EIS, the NRC staff will determine whether the changes are significant enough to warrant an additional environmental review. The NRC staff's evaluation of the design certification and final rulemaking is currently in progress.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52, of COLs authorizing the construction and operation of two new US-APWR units at the CPNPP site. This EIS provides the NRC's analyses of the environmental impacts that could result from building and operating two proposed new units at the CPNPP site or at one of the three alternative sites. The NRC staff analyzes these impacts to determine whether the proposed site is suitable for the addition of the new units and whether any of the alternative sites is considered obviously superior to the proposed site.

The Corps' Federal action is the decision whether to issue a permit pursuant to Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899 to authorize certain construction activities potentially affecting waters of the United States and is based on an evaluation of the probable impacts, including cumulative impacts, of the proposed construction activities on the public interest. These impacts are analyzed by the Corps to determine whether there is a practicable alternative with less adverse impact on the aquatic ecosystem, provided that the alternative does not have other significant adverse consequences.

1.3 The Purpose and Need for the Proposed Actions

The purpose and need of the proposed action is to provide 3200 MW(e) of additional baseload electrical power for use in the current regional markets and/or for potential sale on the wholesale market in the Electric Reliability Council of Texas (ERCOT) region to meet the demand projected for 2016 and to maintain the reserve margin that is needed to maintain system reliability (Luminant 2009a, ERCOT 2007). ERCOT is one of eight North American Electric Reliability Corporation regions in the United States and geographically lies wholly within the state of Texas. The need for additional baseload power is discussed in Chapter 8 of this EIS. Chapter 9 of this EIS discusses alternatives to the proposed action, including the no-action alternative.

Two COLs from the NRC are needed to construct and operate the proposed two units. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COLs are granted. Luminant must obtain and maintain permits or authorizations from other Federal, State, and local agencies and permitting authorities before undertaking certain activities. The ultimate decision whether or not to build the new units and the schedule for building are not within the purview of the NRC or the Corps and would be determined by the license holder if the authorizations are granted.

1.4 Alternatives to the Proposed Actions

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement analyzing alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 9 of this EIS addresses five categories of alternatives to the proposed action: (1) the no-action alternative, (2) energy source alternatives, (3) alternative sites, (4) system design alternatives, and (5) onsite alternatives to reduce impacts to natural and cultural resources.

In the no-action alternative, the proposed action would not go forward. The NRC would deny Luminant's request for the COLs. The no-action or permit denial alternatives are also available to the Corps. The no-action alternative is one which results in no construction requiring a Corps permit. If the request was denied, the construction and operation of the two new units at the CPNPP site would not occur nor would any benefits intended by the approved COLs be realized. Energy source alternatives include alternative energy sources, focusing on those alternatives that could meet the purpose and need of the project to generate baseload power. The alternative selection process to determine alternate site locations for comparison with the CPNPP site is addressed in the next paragraph. System design alternatives include heat dissipation and circulating water systems, intake and discharge structures, and water-use and treatment systems. Finally, onsite alternatives evaluated by the Corps to reduce potential impacts to wetlands and shoreline resources are described.

In its ER, Luminant defines a region of interest for use in identifying and evaluating potential sites for power generation (Luminant 2009a). The NRC staff evaluated the region of interest, the process by which alternative sites were selected by Luminant, and the review team evaluated the environmental impacts of construction and operation of two new power reactors at those sites using reconnaissance-level information. The three alternative sites identified by Luminant in the ER include the Tradinghouse site, approximately 10 mi east of Waco, Texas, and two undeveloped sites, the Coastal site (approximately 20 mi south of Victoria, Texas) and the Pineland site (near Pineland, Texas) (Luminant 2009a). The Tradinghouse site is near two existing natural-gas-fired power-generating units and is owned by Luminant. The two other sites are each owned by private landowners. The objective of the comparison of environmental impacts is to determine whether any of the alternative sites are obviously superior to the proposed CPNPP site.

As part of the evaluation of permit applications subject to Section 404 of the CWA, the Corps is required by regulation to apply the criteria set forth in the 404(b)(1) guidelines (33 USC 1344; 40 CFR Part 230). These guidelines establish criteria that must be met in order for the proposed activities to be permitted pursuant to Section 404. Specifically, these guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, provided the alternative does not have other significant adverse consequences (40 CFR 230.10(a)).

1.5 Compliance and Consultations

Before building and operating new units, Luminant is required to obtain certain Federal, State, and local environmental permits, as well as meet applicable statutory and regulatory requirements. Luminant provided a list of environmental approvals and consultations associated with the proposed CPNPP Units 3 and 4 (Luminant 2009a). Potential authorizations, permits, and certifications relevant to the proposed COLs are included in Appendix H. The NRC staff reviewed the list and contacted the appropriate Federal, State, Tribal, and local agencies to identify any consultation, compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the acceptability of the CPNPP site for building and operating the two proposed US-APWR units. A chronology of the correspondence is provided in Appendix C. A list of the key consultation correspondence is provided in Appendix F, which also contains a biological assessment.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the addition of proposed CPNPP Units 3 and 4. Chapter 3 describes the power plant layout, structures, and activities related to the building and operation to be used as the basis for evaluating the environmental impacts. Chapters 4 and 5 examine site acceptability by analyzing the environmental impacts of construction (Chapter 4) and operation (Chapter 5) of the proposed units. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning. Chapter 7 discusses the cumulative impacts of the proposed action as defined in 40 CFR Part 1508. Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action and analyzes energy sources, alternative sites, and system design alternatives and compares the proposed action with the alternatives. Chapter 10 summarizes the findings of the preceding chapters, provides a benefit-cost evaluation, and presents the NRC staff's recommendation with respect to the Commission's approval of the proposed site for the COLs based on the NRC staff's evaluation of environmental impacts.

The appendixes to the EIS provide the following additional information:

- Appendix A – Contributors to the Environmental Impact Statement
- Appendix B – Organizations Contacted
- Appendix C – Chronology of NRC and Corps Staff Environmental Review Correspondence Related to Luminant Generation Company LLC's Application for Combined Licenses at the CPNPP Site
- Appendix D – Scoping Meeting Comments and Responses
- Appendix E – Draft Environmental Impact Statement Comments and Responses
- Appendix F – Key Consultation Correspondence Regarding the CPNPP Units 3 and 4 COLs
- Appendix G – Supporting Documentation
- Appendix H – List of Authorizations, Permits, and Certifications
- Appendix I – Severe Accident Mitigation Alternatives
- Appendix J – Carbon Dioxide Footprint Estimates for a 1000 MW(e) Light Water Reactor (LWR)

1.7 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

10 CFR Part 73. Code of Federal Regulations, Title 10, *Energy*, Part 73, "Physical Protection of Plants and Materials."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Parts 320-330, "General Regulatory Policies to Nationwide Permit Program."

33 USC 1344. 2003. U.S. Code Title 33, *Navigation and Navigable Waters*, Sec. 1344, "Permits for Dredged or Fill Material."

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 230, "Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

72 FR 57416. October 9, 2007. "Limited Work Authorizations for Nuclear Power Plants," *Federal Register*. U.S. Nuclear Regulatory Commission.

73 FR 77076. December 18, 2008. "Luminant Generation Company LLC; Comanche Peak Nuclear Power Plant Units 3 and 4 Combined License Application; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*. U.S. Nuclear Regulatory Commission.

75 FR 49486. August 13, 2010. "Environmental Impact Statements; Notice of Availability." *Federal Register*. U.S. Environmental Protection Agency.

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Clean Water Act. (Federal Water Pollution Control Act) 33 USC 1251, et seq.

Electric Reliability Council of Texas (ERCOT). 2007. Meeting Texas' Future Energy Demands. Sam Jones, President and CEO. February 13; as cited in Chapter 1 of Luminant Generation Company LLC (Luminant). 2009a. *Comanche Peak Nuclear Power Plant Units 3 and 4, COL Application; Part 3, Environmental Report* (Rev. 1). Luminant Generation Company LLC, Glen Rose, Texas, November 20. Accession No. ML100081557.

Luminant Generation Company (Luminant). 2008. Letter from M.L. Lucas, Luminant Power to U.S. Nuclear Regulatory Commission, Washington, D.C., "Combined License Application for CPNPP Nuclear Power Plant, Units 3 and 4, Project No. 0754," Log # TXNB-08024, September 19. Accession No. ML 082680250.

Luminant Generation Company (Luminant). 2009a. *Comanche Peak Nuclear Power Plant Units 3 and 4, COL Application; Part 3, Environmental Report* (Rev. 1). Luminant Generation Company LLC, Glen Rose, Texas, November 20. Accession No. ML100081557.

Luminant Generation Company (Luminant). 2009b. *Comanche Peak Nuclear Power Plant Units 3 and 4, COL Application; Part 2, Final Safety Analysis Report* (Rev. 1). Luminant Generation Company LLC, Glen Rose, Texas, November 20. Accession No. ML100082110.

Mitsubishi Heavy Industries (MHI). 2007. Letter from M. Kaneda, MHI, Tokyo, Japan, to U.S. Nuclear Regulatory Commission, Washington, D.C., "Submittal of US-APWR Design Control Document in Support of Mitsubishi Heavy Industries, Ltd.'s Application for Design Certification of the US-APWR Standard Plant Design," MHI Reference No. UAP-HF-07170, December 31. Accession No. ML080140503.

Mitsubishi Heavy Industries (MHI). 2009. *Design Control Document for the US-APWR, Tier 1*, MUAP-DC020, Rev. 2, Docket No. 52-021, Mitsubishi Heavy Industries, Ltd., Tokyo, Japan, October 27. Accession No. ML093070208.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

Rivers and Harbors Appropriation Act of 1899, as amended. 33 USC 403, et seq.

U.S. Army Corps of Engineers and U.S. Nuclear Regulatory Commission (Corps and NRC). 2008. *Memorandum of Understanding: Environmental Reviews Related to the Issuance of*

Authorizations to Construct and Operate Nuclear Power Plants. September 12, 2008. Accession No. ML082540354.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*. NUREG-1555, Washington, D.C. Includes 2007 revisions.

U.S. Nuclear Regulatory Commission (NRC). 2009. *Environmental Impact Statement, Scoping Process, Summary Report, Comanche Peak Nuclear Power Plant, Units 3 and 4, Combined License Application, Hood and Somervell Counties, Texas*. U.S. Nuclear Regulatory Commission, Rockville, Maryland. Accession No. ML091390849.

U.S. Nuclear Regulatory Commission (NRC). 2010. *Draft Environmental Impact Statement for Combined Licenses (COLs) for Comanche Peak Nuclear Power Plant Units 3 and 4 – Draft Report for Comment*. NUREG-1943, Washington, D.C. Accession Nos. ML102170030 and ML102170036.

U.S. Nuclear Regulatory Commission (NRC). 2011. Staff Memorandum from Scott Flanders, DSER Division Director, to Brent Clayton, RENV Branch Chief. Subject: "Addressing Construction and Preconstruction Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues In Environmental Impact Statements." Revision 1, March 4, 2011. Accession No. ML110380369.

2.0 Affected Environment

The site proposed by Luminant Generation Company LLC (Luminant) for Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4 is located in north-central Texas near the border of Hood and Somervell Counties, about 40 mi southwest of Fort Worth (see Figure 2-1). Luminant currently operates two nuclear generating units (existing CPNPP Units 1 and 2) on the CPNPP site. The proposed Units 3 and 4 location is described in Section 2.1, followed by descriptions of the land, water, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, and nonradiological and radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects, and references are presented in Section 2.13.

2.1 Site Location

The CPNPP site lies approximately 5 mi north of Glen Rose, Texas, and approximately 9 mi south of Granbury, Texas, outside the city limits of either city (see Figure 2-2). The 7950-ac CPNPP site is owned by Luminant, and Luminant's selected location for the proposed Units 3 and 4 is entirely within the CPNPP boundary, approximately 2200 ft northwest of the location of the existing Units 1 and 2 (see Figure 2-3). The proposed new units would be located in areas with a history of previous ground disturbance during development of Units 1 and 2 including former construction lay down areas and temporary parking areas, along with some previously undisturbed areas of land.

Figure 2-1 shows the location of the CPNPP site in relationship to the counties and major cities and towns within a 50-mi radius of the site. The population center nearest the proposed site that has more than 25,000 residents is Cleburne, which is located 24 mi to the east. The proposed location for CPNPP Units 3 and 4 is bounded on the north, east, and south by Squaw Creek Reservoir (SCR) (see Figure 2-4). The proposed location for CPNPP Units 3 and 4 directly abuts the western boundary of the CPNPP site. Farmland and rural residential properties lie just outside of the boundary.

The CPNPP site, including the proposed location for Units 3 and 4, is accessible by both road and rail; however, access to the site and to SCR is restricted to those persons granted access rights by Luminant. The site is accessible from the west by Farm-to-Market Road (FM) 56, which connects to U.S. Highway 67, and by County Road 213 (also known as Coates Road), which connects to Texas State Highway 144 (SH 144). The site is also accessible by a rail spur, which connects to the Fort Worth and Western Railroad Company main line at Tolar, Texas, approximately 9 mi to the northwest.

SCR is located entirely within the CPNPP site boundary. The reservoir has an approximate pool elevation of 775 ft above mean sea level (MSL), and it is owned by Luminant. It does not provide barge access to the site. SCR is an impoundment on Squaw Creek, a tributary of the Paluxy River, which flows into the Brazos River. Upstream of the confluence of the Paluxy River and the Brazos River lays Lake Granbury, an impoundment on the Brazos River. Cooling water for CPNPP Units 1 and 2 is supplied from Lake Granbury into SCR through existing pipelines (see Figure 2-5).

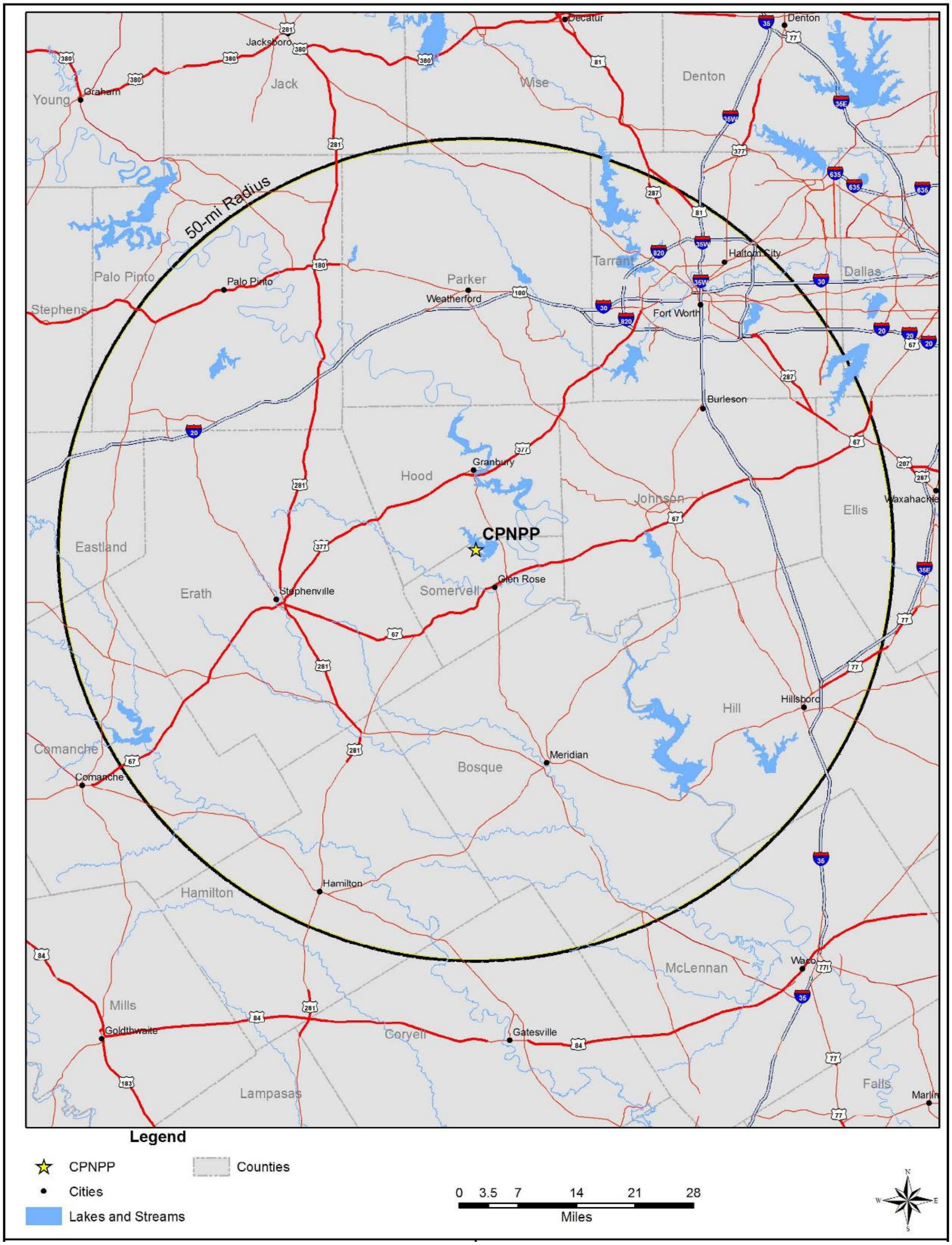


Figure 2-1. 50-mi Regional Location of the CPNPP Site (Luminant 2009a)

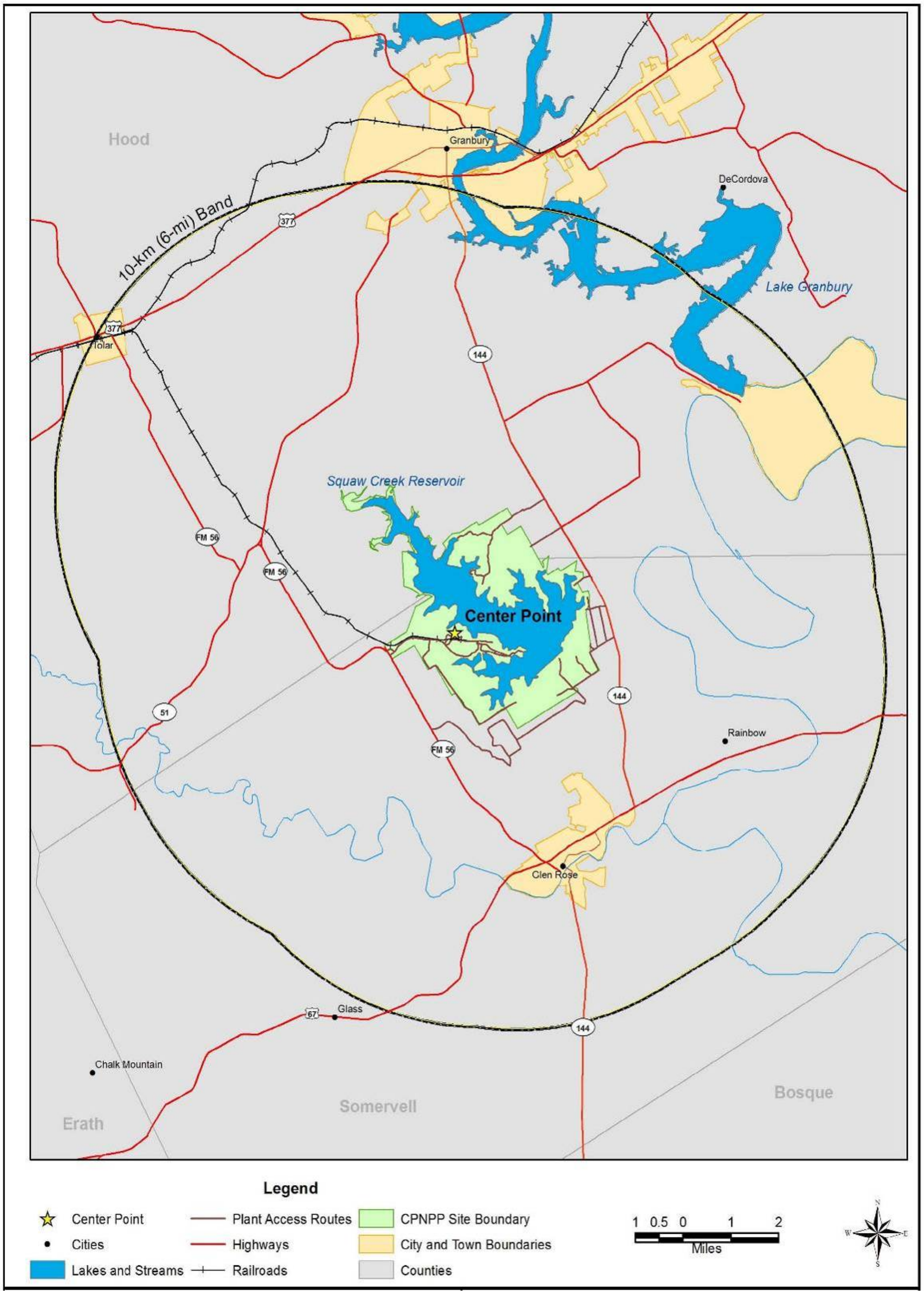


Figure 2-2. Location of the CPNPP Site Within Hood and Somervell Counties, Texas (Luminant 2009a)

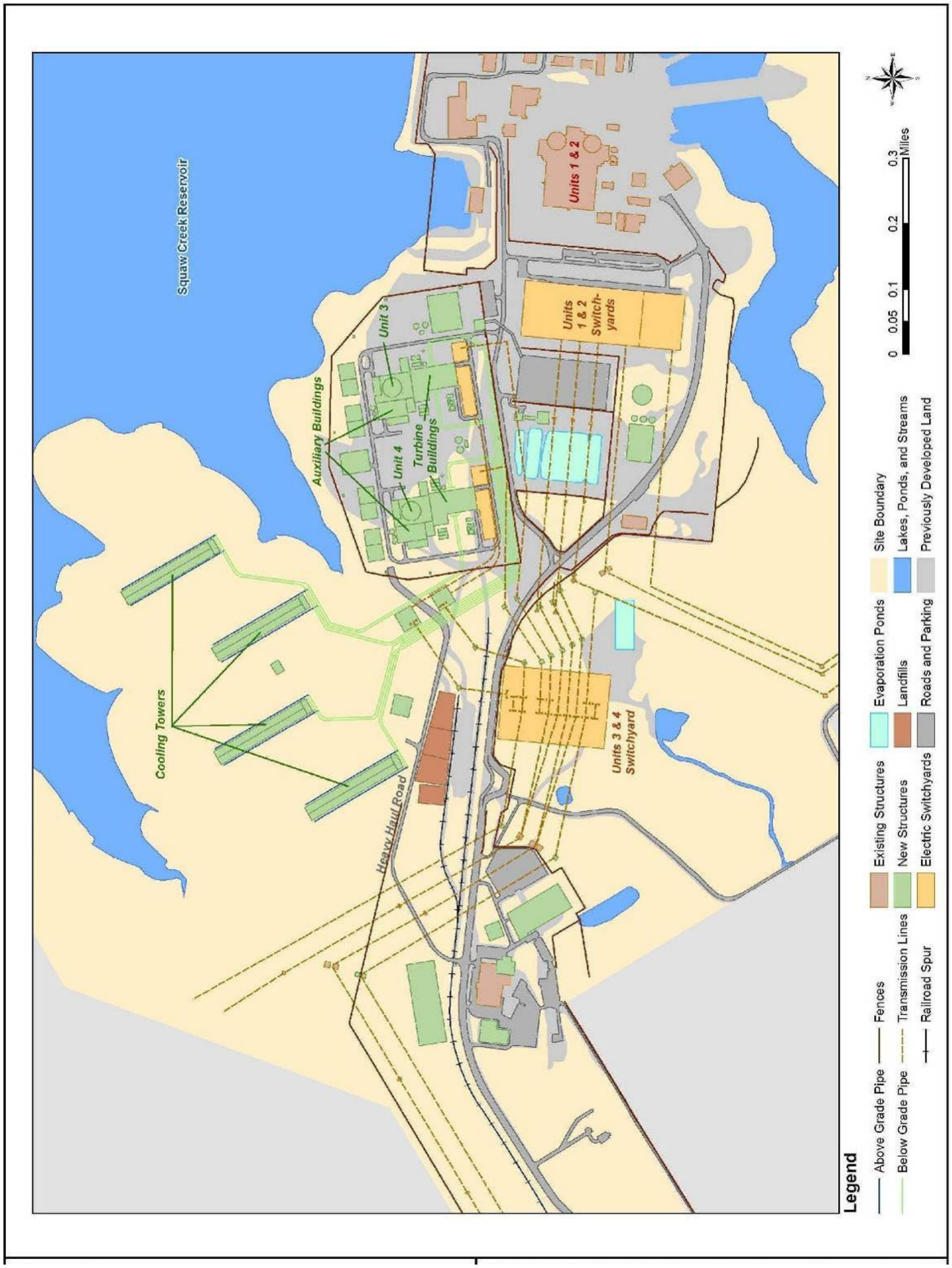


Figure 2-3. The Site Plan for CPNPP Units 3 and 4 (Luminant 2009a)

Figure 2-4. Location of Proposed CPNPP Units 3 and 4 in Relation to Existing Units 1 and 2 on the CPNPP Site (Luminant 2009a)

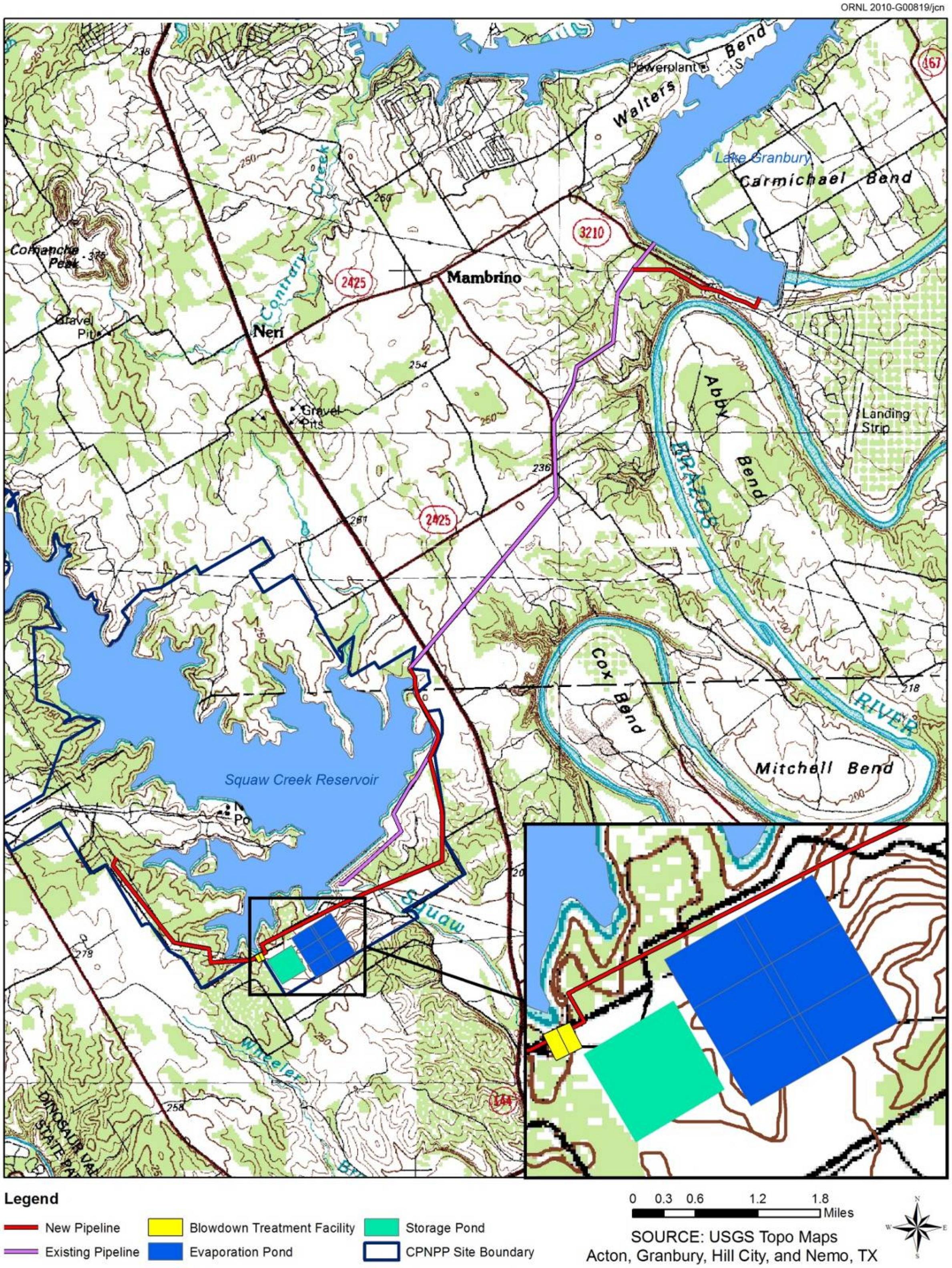


Figure 2-5. Existing and Proposed Water Pipelines from Lake Granbury to the CPNPP Site (Adapted from Luminant 2010c)

2.2 Land Use

This section discusses existing land uses and land-related issues for the CPNPP site, including the proposed location for Units 3 and 4. Section 2.2.1 describes the site and vicinity, which is defined as the area encompassed within 6-mi radius of the CPNPP. Section 2.2.2 discusses the existing and proposed transmission line and pipeline corridors, portions of which traverse the vicinity and portions of which extend into the region outside the vicinity. Section 2.2.3 discusses the region, defined as the area within 50 mi of the CPNPP site boundary.

2.2.1 The Site and Vicinity

The CPNPP site comprises approximately 7950 ac in an unincorporated area of Hood and Somervell Counties, Texas. The site is approximately 40 mi southwest of Fort Worth and approximately 5 mi north of the City of Glen Rose (Luminant 2009a). The site, including the center point of the proposed Unit 3 and 4 facilities, is shown in Figure 2-4. SCR, which was constructed to provide cooling water for CPNPP Units 1 and 2, is entirely within the site boundary. The site is owned by the project Applicant, Luminant Generation Company LLC (Luminant 2009a).

Figure 2-6 depicts existing land use on the CPNPP site. The site contains two existing nuclear generating units, CPNPP Units 1 and 2, which are licensed by the U.S. Nuclear Regulatory Commission (NRC) and which have a combined net electric generating capacity of approximately 2300 MW(e). Unit 1 began commercial operation in 1990, and Unit 2 began commercial operation in 1993. Together, the two existing nuclear units and supporting facilities occupy approximately 203 ac of the CPNPP site. Based on the U.S. Geological Survey's (USGS's) National Land Cover Database, approximately 3328 ac (42 percent) of the site are covered by the waters of SCR. Other major land cover categories on the site include evergreen forest (1870 ac or 23 percent of the site), grassland/herbaceous vegetation (1101 ac or 14 percent, developed areas including the 203 ac noted above (846 ac or 10 percent), deciduous forest (732 ac or 9 percent),and woody wetlands (100 ac or 1 percent) (Luminant 2009a). Approximately 1064 ac of the site are classified as prime farmland according to U.S. Department of Agriculture soil survey criteria; however, none of this land is currently used for agricultural purposes. Some subsurface mineral rights on the site are not owned by Luminant; however, deed restrictions would prevent the placement of drill rigs or other mining equipment within the perimeter of the Exclusion Area Boundary (EAB) of proposed Units 3 and 4 (Luminant 2009a). The proposed site of Units 3 and 4 is outside 100-year and 500-year floodplains (Luminant 2009a).

Primary vehicular access to the site is provided by an access road connecting to FM 56. A rail spur line, dating from construction of Units 1 and 2, connects the site to the Fort Worth and to the Western Railroad Company main line at Tolar, Texas, approximately 6 mi north-northwest. Eight natural gas pipelines and one crude oil pipeline are located in the vicinity. None of the natural gas or crude oil pipelines serve the CPNPP facilities. Four of these pipelines cross the CPNPP site, including a 26-in. crude oil pipeline, which encroaches on the western edge of the EAB of proposed Units 3 and 4.

Figure 2-7 shows features in the vicinity of the CPNPP site. The NRC defines the vicinity of a site for a nuclear power plant as areas within a 6-mi radius (NRC 2000). Notable public facilities in the vicinity include Dinosaur Valley State Park, a 1525-ac scenic park on the Paluxy River approximately 3 mi southwest of the site; Wheeler Branch Reservoir (WBR), a potable water supply and developing recreation area approximately 1 mi south of the site; and Oakdale Park, a small municipal park approximately 5.2 mi south of the site in the City of Glen Rose. A significant non-public land use in the vicinity is the Fossil Rim Wildlife Center, a 1700-ac facility located about 6.6 mi to the south. This not-for-profit facility specializes in captive breeding of indigenous and exotic endangered and threatened species, efforts which are partly financed from fees charged for recreational use of the site (Fossil Rim Wildlife Center 2010).

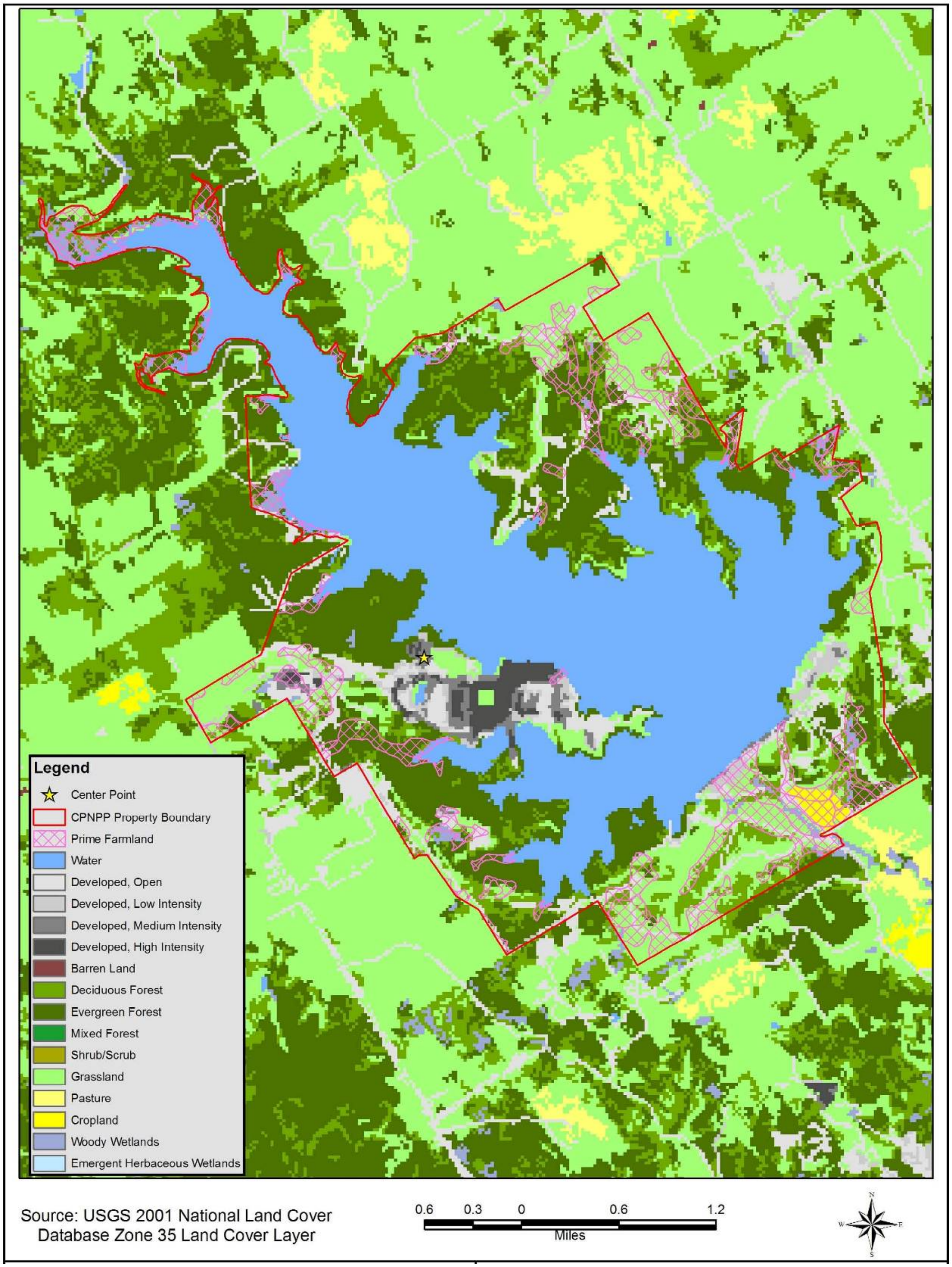


Figure 2-6. Land Use on CPNPP Site (Luminant 2009a)

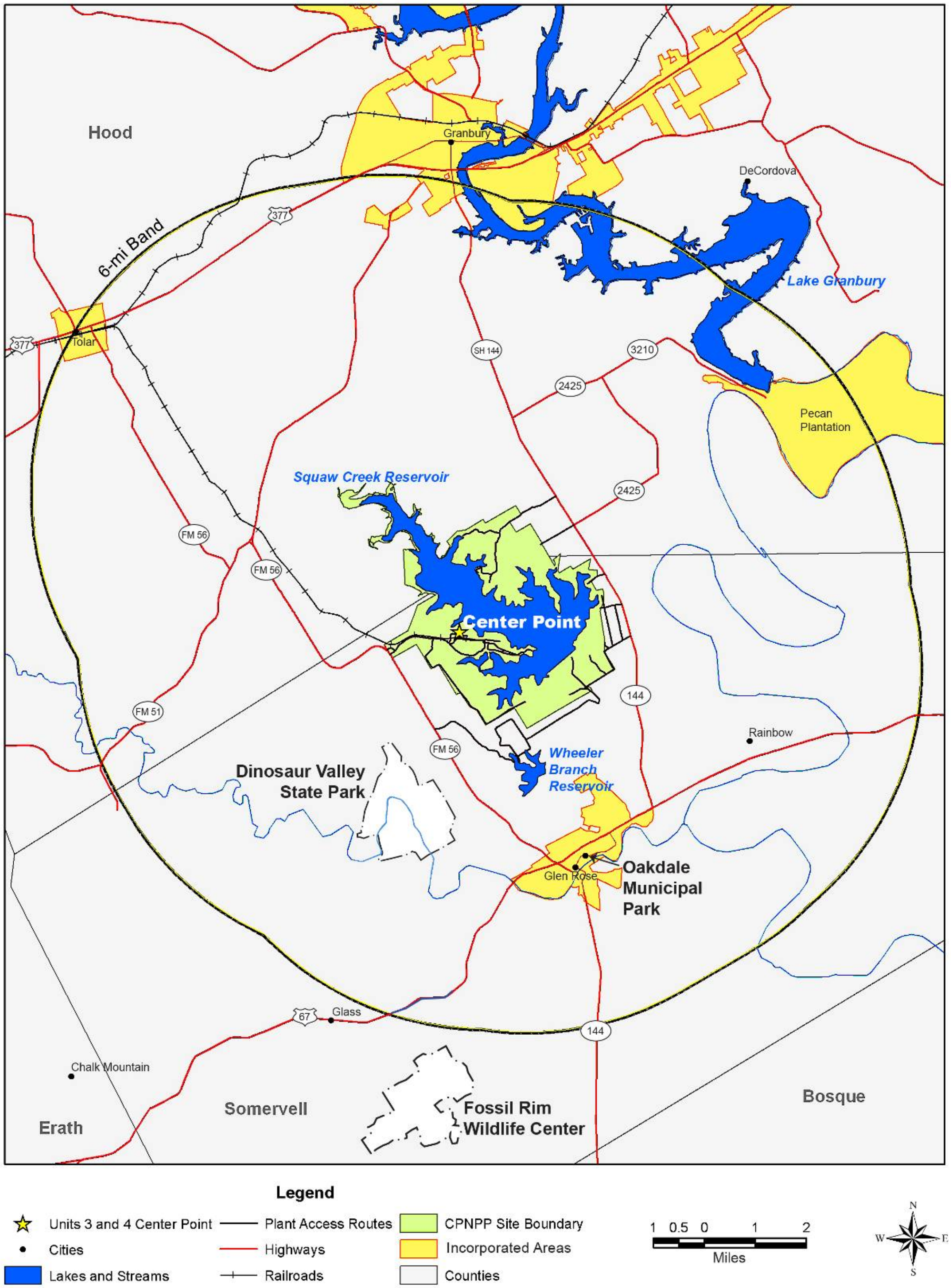


Figure 2-7. Land Use Features in Project Vicinity (Adapted from Luminant 2009a)

Communities within the vicinity include the City of Glen Rose (population 2771), and portions of the cities of Tolar (population 658), Granbury (population 8029), and Pecan Plantation (USCB 2009c).

Land use in the vicinity of the CPNPP site is depicted on Figure 2-8. Reflecting the rural character of the area, principal land uses in the vicinity are grasslands/herbaceous (50 percent), evergreen forest (18 percent), deciduous forest (13 percent), developed areas (approximately 8 percent), open water (approximately 5 percent), pastures and cultivated lands (approximately 5 percent), and woody wetlands (approximately 2 percent) (Luminant 2009a). In the immediate vicinity of the site, a rural residential area of approximately 310 ac is located along FM 56, immediately south of the site entrance. At its nearest point, this community of mobile homes and single-family dwellings is about 0.8 mi from the center point of proposed Units 3 and 4. A second nearby rural residential area is located along County Roads 313 and 313 Loop immediately south and west of the proposed Blowdown Treatment Facility (BDTF) for Units 3 and 4 [see Section 3.2.2 of this Environmental Impact Statement (EIS)]. This rural residential area covers approximately 620 ac and includes mobile homes and single-family dwellings. Several of the residential properties abut the proposed BDTF boundary and security fence.

Land use plans and zoning ordinances in Somervell and Hood Counties are limited to incorporated areas and therefore do not address land use on the CPNPP site or unincorporated portions of the vicinity.

2.2.2 Transmission Lines and Other Offsite Corridors

Section 2.2.2.1 below discusses transmission lines and Section 2.2.2.2 discusses pipelines.

2.2.2.1 Transmission Lines

The existing power transmission system for CPNPP Units 1 and 2 is owned by Oncor Electric Delivery Company and comprises four circuits. One 345-kV circuit and a 138-kV circuit follow parallel rights-of-way (ROWs) to connect CPNPP to the DeCordova Switching Station in Hood County. A second 345-kV circuit runs to the Parker Switch in Parker County, and a third runs to the Venus Switch in Johnson County (AEC 1974, NRC 1981, Luminant 2009a). Lattice-type galvanized steel towers are used for the 345-kV lines, and wooden poles are used for the 138-kV circuit.

As described in Section 3.2.2.3 of this EIS, power generated by the proposed CPNPP Units 3 and 4 would be carried from the site using several existing transmission line corridors described above plus two new transmission lines on new corridor locations. While specific routes have not been identified for the proposed new lines, land use in the areas they would traverse is typical of the CPNPP region, consisting mostly of grassland with lesser amounts of deciduous forest, evergreen forest, and developed land (Luminant 2009a). Approximately 149 ac of ROW would be acquired for a 17-mi transmission line to the DeCordova Switch, of which approximately 108 ac is covered by grassland, 11 ac by water, 11 ac by open development, and 10 ac by deciduous forest, 3 ac by evergreen forest, 2 ac by woody wetlands, 1 ac by high density development, 1 ac by pasture, 1 ac by barren land, and 1 ac by other uses. A proposed 45-mi transmission line corridor to the Whitney Switch would require acquisition of approximately 954 ac of ROW, of which approximately 550 ac is covered by grassland, 176 ac by deciduous forest, 137 ac by evergreen forest, 36 ac by pasture, 23 ac by woody wetlands, 20 ac by open development, 8 ac by cropland, 3 ac by water, and 1 ac by low-density development, (Luminant 2009a).

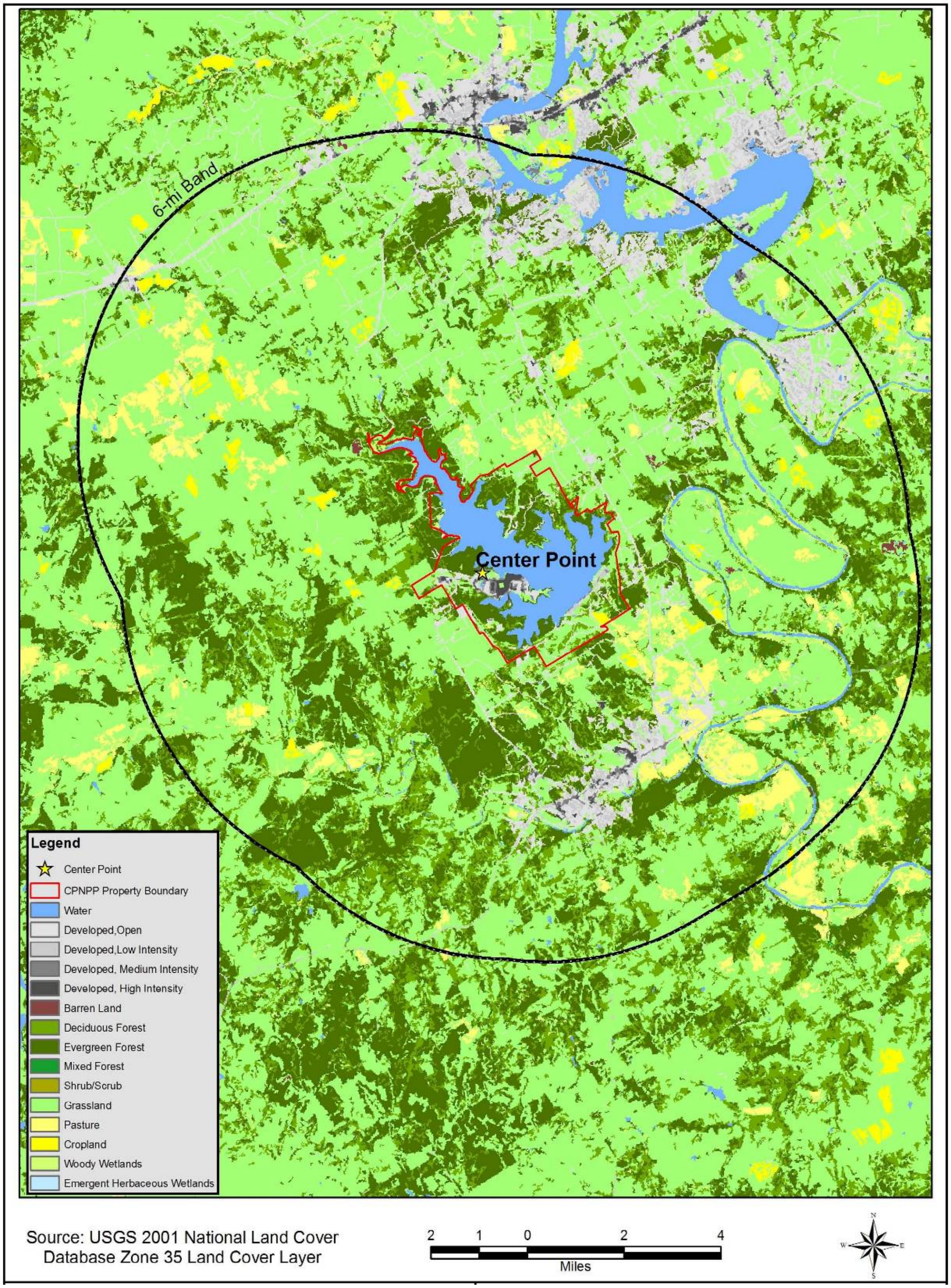


Figure 2-8. Vicinity Land Use (Luminant 2009a)

2.2.2.2 Pipelines

As part of the cooling system for CPNPP Units 1 and 2, an existing buried pipeline carries makeup water to SCR from Lake Granbury. A second existing buried pipeline, running adjacent to the first, was constructed to return water to Lake Granbury, but this pipeline has never been used and is not expected to be used in the future (Luminant 2009a). These pipelines occupy a 50-ft wide ROW over a distance of approximately 8 mi.

Section 3.3.1.13 of this EIS describes proposed new intake and discharge water pipelines that would be installed between Units 3 and 4 and Lake Granbury to provide cooling water to the new units. The new pipelines would share the ROW of the existing pipelines. Approximately 50 ac would be affected by installation of the pipelines, of which approximately 31 ac is covered by grassland, 6 ac by deciduous forest, 6 ac by open development, 4 ac by evergreen forest, 1 ac by low-intensity development, and 1 ac by other land covers (Luminant 2009a).

2.2.3 The Region

Figure 2-1 depicts incorporated areas, county boundaries, water bodies, and principal highways within the 50-mi region surrounding the CPNPP site. All or portions of 19 counties are within 50 mi of the site. Figure 2-9 shows federal land holdings in the region. These holdings include the Naval Air Station Fort Worth (formerly Carswell Air Force Base) and four lakes developed by the U.S. Army Corps of Engineers (USACE): Benbrook Lake, Aquilla Lake, Proctor Lake, and Lake Whitney. State parks within 50 mi of the CPNPP site include Cleburne State Park, Dinosaur Valley State Park, Lake Whitney State Park, Meridian State Park, Lake Mineral Wells State Park and Trailway, Possum Kingdom State Park, and Cedar Hill State Park. The Eagle Mountain State Recreation Area is also within the region.

Regional land use is shown on Figure 2-10. Land cover categories in the region include grassland/herbaceous (50 percent), evergreen and deciduous forest (21 percent), shrub/scrub (7 percent), pasture/hay (6 percent), cultivated crops (5 percent), developed open space (4 percent), low-intensity development (3 percent), open water (2 percent), woody wetlands (2 percent), medium-intensity development (1 percent), and high-intensity development (1 percent) (Luminant 2009a).

Woody wetlands cover approximately 1.5 percent of the region (Luminant 2009a). There are no lands of Tribal entities recognized and eligible for funding and services from the U.S. Bureau of Indian Affairs within the region (73 FR 18553).

2.3 Water

This section describes the surface and groundwater features of the CPNPP site and the surrounding region that could be affected by construction and operation of proposed CPNPP Units 3 and 4. Subsections cover hydrology (Section 2.3.1), water use (Section 2.3.2), and water quality (Section 2.3.3).

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could be affected by construction and operation of the proposed CPNPP Units 3 and 4. A description of the site's hydrological features was presented in Section 2.3.1 of the Environmental Report (ER) (Luminant 2009a). Hydrological features of the site related to site safety (e.g., probable maximum flood) are described by Luminant in the final safety analysis report (FSAR) (Luminant 2009b). A summary of the hydrologic conditions of the site for the proposed CPNPP Units 3 and 4 is provided in Section 2.3 of the ER (Luminant 2009a). Both the FSAR and the ER were informed by the hydrologic characterization conducted for the construction of existing CPNPP Units 1 and 2, as well as the results of investigations performed in support of the COL application for the proposed Units 3 and 4. The following descriptions are based on information from these sources.

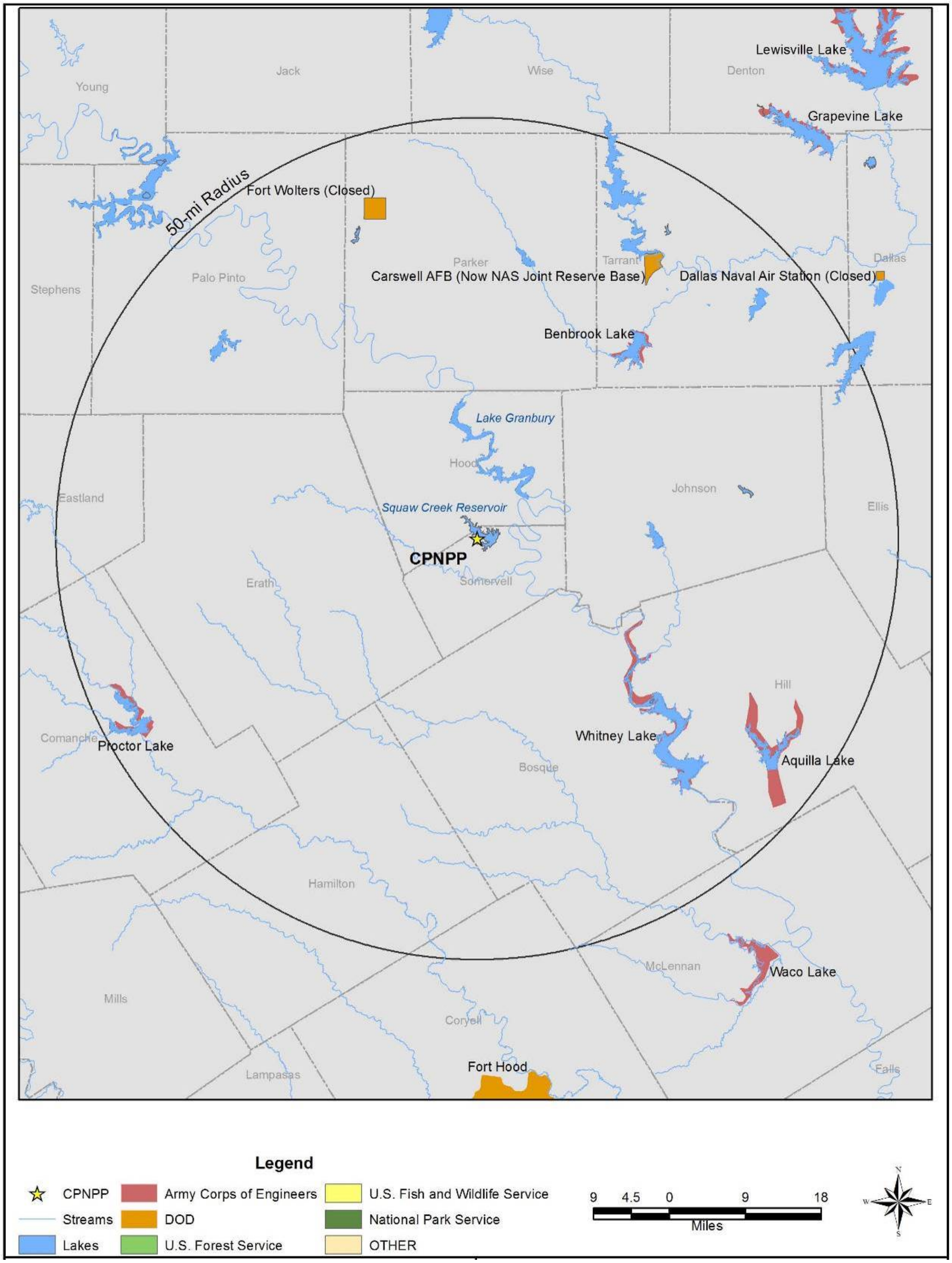


Figure 2-9. Federal Lands Within the CPNPP Region (Luminant 2009a)

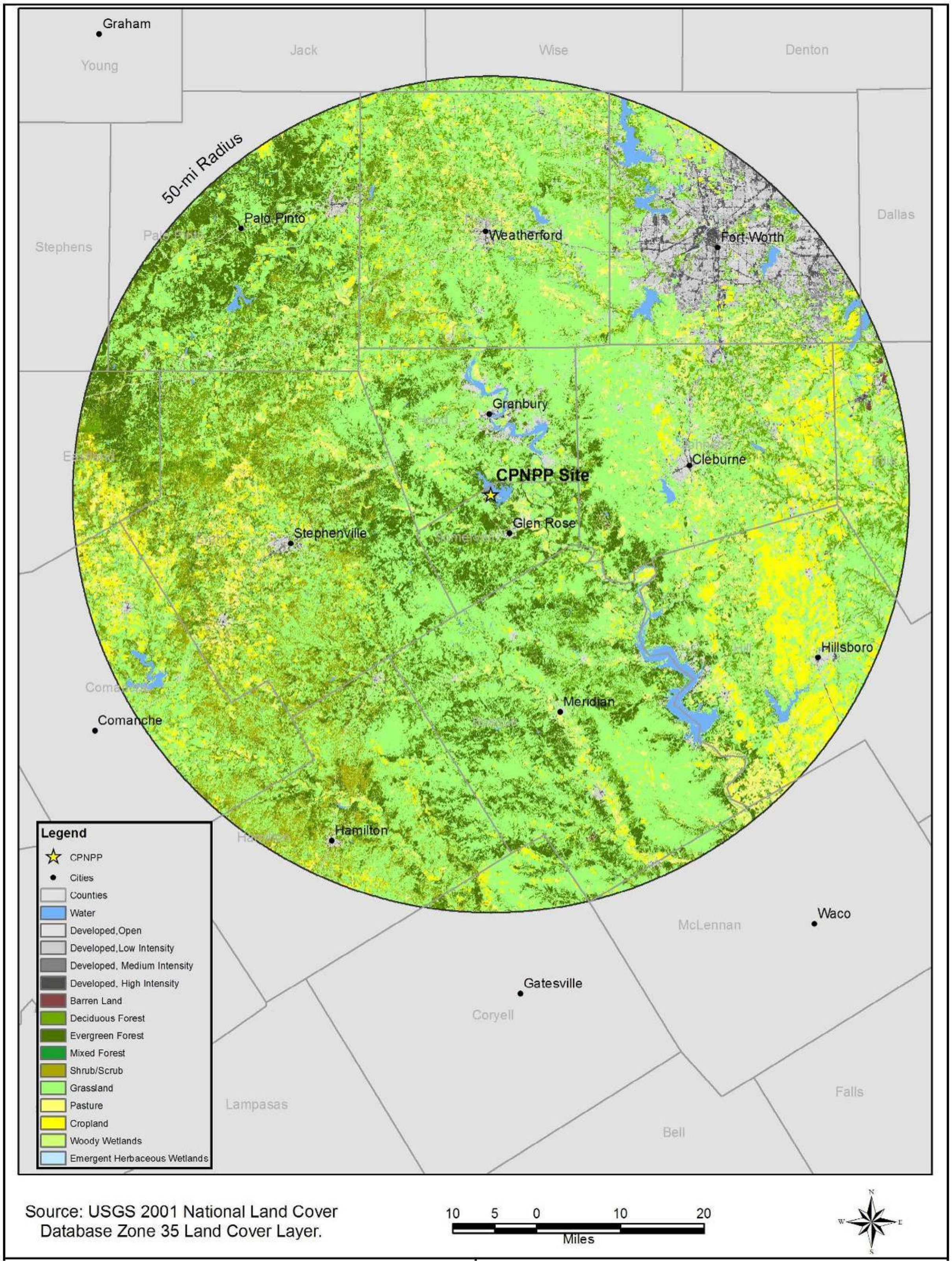


Figure 2-10. Regional Land Use (Luminant 2009a)

2.3.1.1 Surface-Water Hydrology

The site for the proposed CPNPP Units 3 and 4 is on the northwestern portion of a peninsula that extends into the west side of SCR, between the southern shore of the reservoir and the CPNPP Units 1 and 2 Safe Shutdown Impoundment (Figures 2-3 and 2-4). SCR is formed by the impoundment of Squaw Creek, a tributary of the Paluxy River. Squaw Creek enters the Paluxy immediately upstream from the confluence of the Paluxy with the Brazos River. Makeup water to replace that used for the Units 3 and 4 cooling tower blowdown would be obtained from Lake Granbury, an impoundment of the Brazos River. Figure 2-11 shows the predominant surface-water hydrologic features of the CPNPP site area, Lake Granbury, and SCR.

The Brazos River and its tributaries drain a total area of about 45,700 mi^2, of which about 9570 mi^2 in the upper part of the basin does not contribute to streamflows. Streamflow in the Brazos River is regulated by a series of dams that were built on the river and its tributaries beginning in the 1940s. Upstream from the CPNPP site on the main stem of the Brazos River is the Morris Sheppard Dam, which was completed in 1941 and forms Possum Kingdom Lake (PKL). Figure 2-12 shows the locations of PKL (reservoir) and several other Brazos River reservoirs. PKL has a storage capacity of approximately 750,000 ac-ft of water.

About 7.5 mi northeast of the CPNPP site, is DeCordova Bend Dam on the Brazos River main stem. This dam, which was completed in 1969, forms Lake Granbury. Lake Granbury has a total drainage area of 16,113 mi^2 and a storage capacity of 136,823 ac-ft. Approximately 100 river mi below DeCordova Dam is Whitney Dam, which forms Lake Whitney, a USACE flood-control reservoir with a capacity of 1.3 million ac-ft.

Two principal streams enter the 145-mi-long segment of the Brazos River between PKL and DeCordova Bend Dam. Palo Pinto Creek is 60 mi long, has a drainage area of 461 mi^2, and enters at Brazos River Mile (BRM) 609.5. Rock Creek is 24 mi long, has a drainage area of 63 mi^2, and enters at BRM 599.7. In addition, six named intermittent streams are minor tributaries to Lake Granbury.

Squaw Creek has a drainage area of 70.3 mi^2, of which approximately 64 mi^2 is above Squaw Creek Dam. SCR has a surface area of 3297 ac at its conservation pool level of 775 ft MSL and a storage capacity of 151,418 ac-ft. Six intermittent streams, five named and one unnamed, flow into SCR within a 6-mi radius of the proposed locations for CPNPP Units 3 and 4. Squaw Creek enters the Paluxy River at Glen Rose, immediately upstream from the Paluxy's confluence with the Brazos River.

The Paluxy River is a 38-mi-long stream that flows from northeastern Erath County through Hood and Somervell Counties (TPWD 1974) and enters the Brazos River at Glen Rose, approximately 37 river mi below DeCordova Bend Dam. At USGS Gauge 08091500 near Glen Rose, 5.1 river mi upstream from the Brazos, the Paluxy River has a drainage area of 410 mi^2 (USGS 2007).

The nearest upstream gauge on the Brazos River, USGS Gauge 08090800 in the Brazos River near Dennis, Texas, is approximately 45 river mi northwest of DeCordova Bend Dam (Figure 2-11). It is below Morris Sheppard Dam and above Lake Granbury and has a drainage area of 15,671 mi^2. Streamflow at this location is controlled by reservoir releases from PKL at Morris Sheppard Dam. The average mean monthly streamflow at this gauge for the period May 1968 through September 2006 was 975 cfs. The maximum monthly mean flow during this period was 17,690 cfs (in October 1981) and the minimum monthly mean flow was 15 cfs (in September 1984). The maximum recorded streamflow at the Brazos River Dennis station for the period of record was 96,640 cfs (recorded on October 14, 1981) and the minimum daily streamflow was 1.2 cfs (recorded on August 2, 1978).

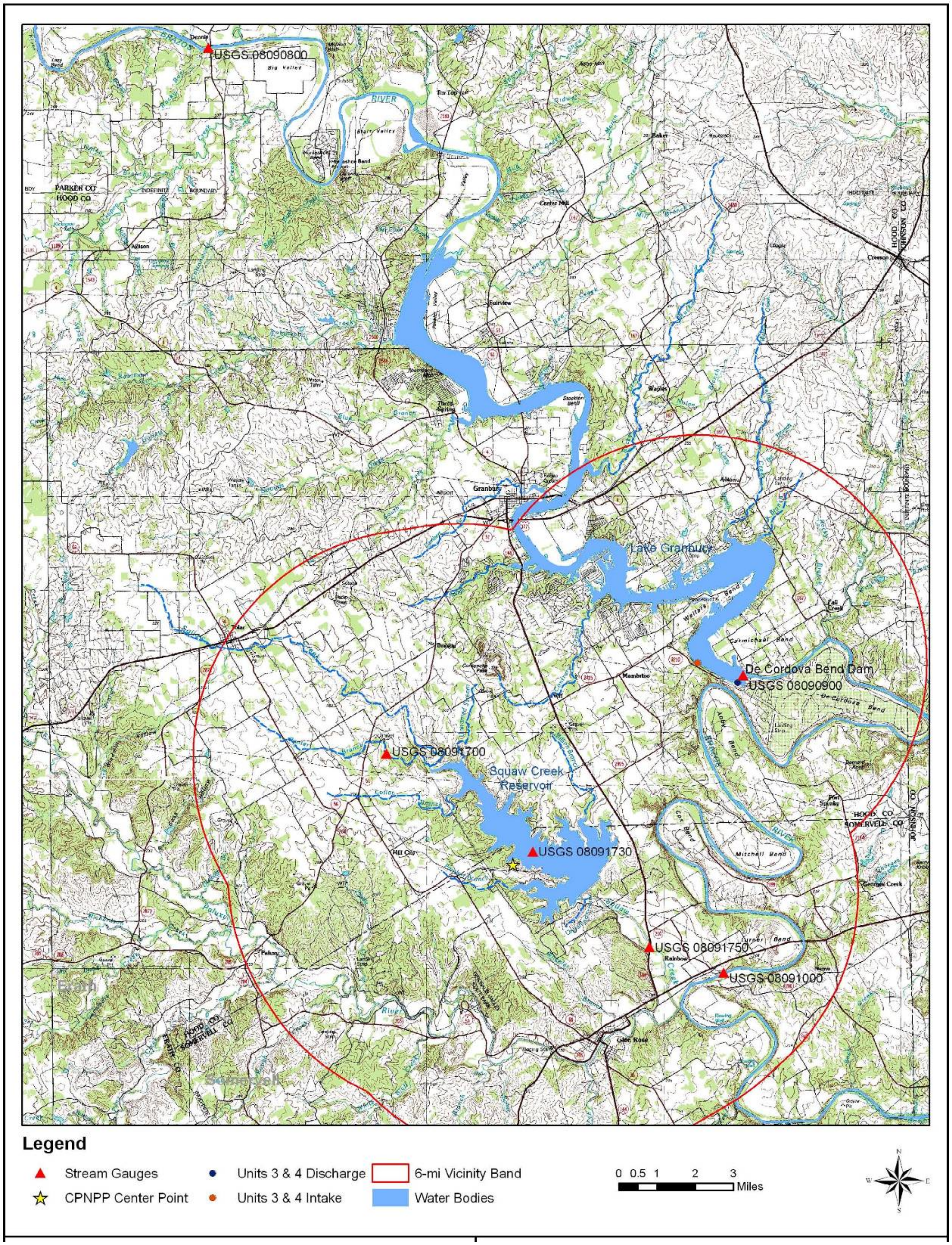


Figure 2-11. Predominant Surface-water Hydrologic Features of the CPNPP Site Area, Including Locations of Gauging Stations (Luminant 2009a)

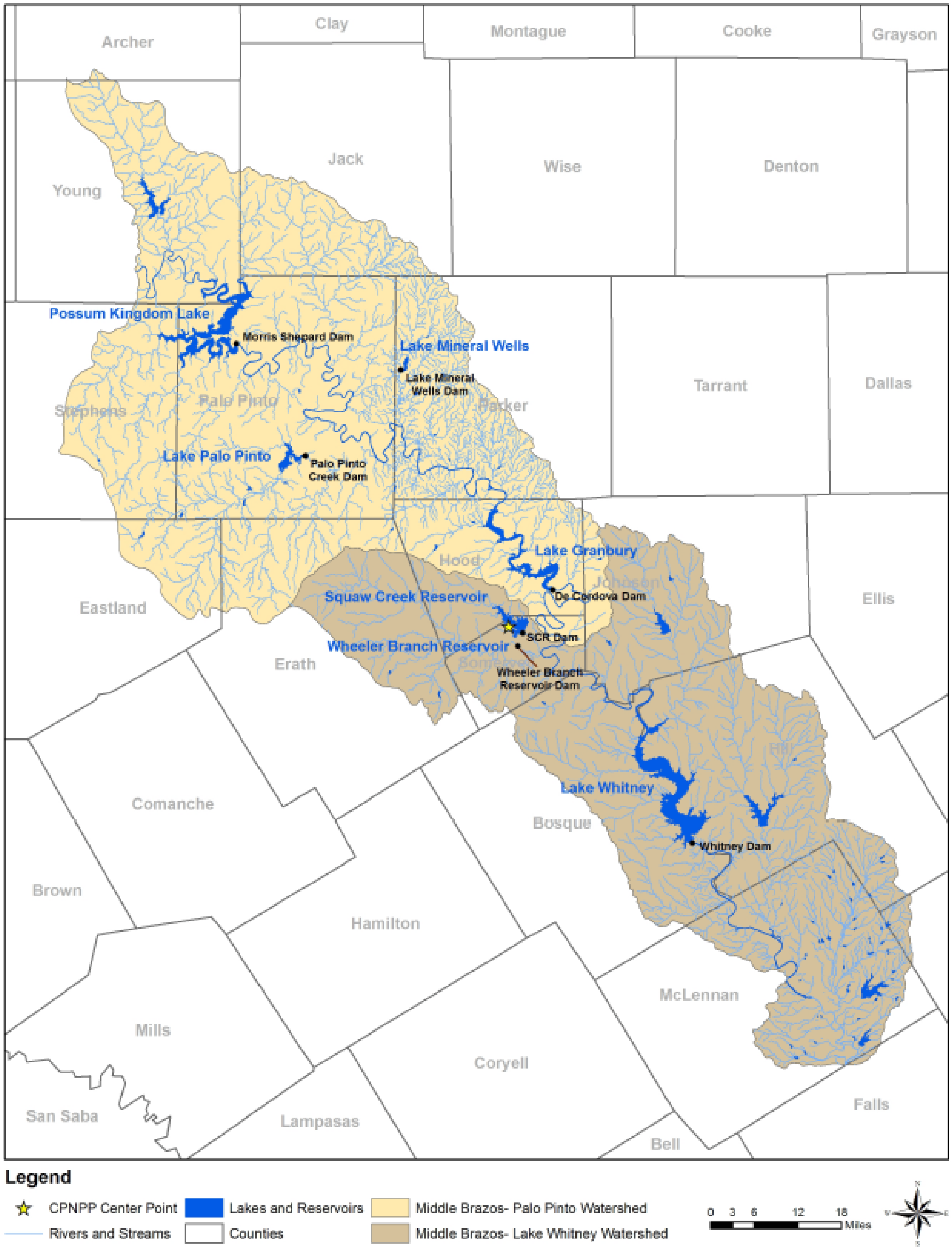


Figure 2-12. Map of the Middle Brazos River Watershed, Including Locations of Possum Kingdom Lake (Reservoir), Lake Granbury, Lake Whitney, and Several Other Brazos River Reservoirs (Luminant 2009a)

The calculated 7Q10 flow rate for the Brazos River Dennis station is 14.7 cfs [CPNPP Units 3 and 4 FSAR Subsection 2.4.11 (Luminant 2009b)]. The 7Q10 flow rate is defined as the lowest streamflow that occurs over a period of 7 consecutive days once every 10 years on average.

At USGS Gauge 08090900 at DeCordova Dam, the average monthly mean streamflow for the period October 1969 through December 2006 was 1031 cfs. The maximum monthly mean flow was 19,269 cfs (in June 1982) and the minimum monthly mean flow was 15 cfs (in September 1988). The maximum recorded flow for the period of record was 72,585 cfs, on October 15, 1981. Minimum flows are controlled by the Brazos River Authority (BRA). There is no minimum flow requirement at this dam, but under normal operating conditions, the BRA maintains a flow of at least 28 cfs. Lower flows can, however, occur during dam maintenance. Extended periods of the 28 cfs minimum flow are evident in the historical record for this gauge.

The nearest gauging station on the Brazos River downstream from DeCordova Bend Dam is USGS Gauge 08091000, near Glen Rose, approximately 35 river mi south of DeCordova Bend Dam and 2 mi upstream from the mouth of the Paluxy River. The station has a contributing drainage area of 16,252 mi^2. Record-keeping at the site began in 1924. The average mean monthly streamflow from October 1940 through September 2006 is 1234 cfs. The maximum streamflow at Gauge 08091000 before completion of the Morris Sheppard Dam was 97,600 cfs, on May 18, 1935. The maximum streamflow from 1942 to 1969 (after Morris Sheppard Dam was built but before DeCordova Bend Dam formed Lake Granbury) was 87,400 cfs, on May 27, 1957. The maximum streamflow from the completion of DeCordova Bend Dam through 2006 was 89,600 cfs, on December 21, 1991. There were several days of zero or minimal streamflow at this site during the period of record. Based on flow data from 1969 through 2006, the calculated 7Q10 flow rate for the Brazos River Glen Rose station is 6.3 cfs.

Streamflow in Squaw Creek below SCR was measured at USGS Gauge 08091750 near Glen Rose from 1977 to 2006. The average mean monthly flow during this period was 21 cfs. This flow is controlled by SCR operations.

Mean annual streamflow in the Paluxy River at USGS Gauge 08091500 near Glen Rose from 1982 to 2008 was 94.1 cfs (USGS 2007). Zero-flow periods of 7 days or longer were recorded during 4 of the 13 years from 1983 to 1995 (Raines and Asquith 1997).

Evaporation is the principal cause of water loss from both Lake Granbury and SCR. Based on USACE pan evaporation data for Lake Granbury for the years 1993–2006, the estimated water loss from Lake Granbury due to evaporation is 61.74 in/yr. No evaluations of leakage or seepage have been performed for either reservoir. Both reservoirs are on bedrock of the Glen Rose Formation, which lacks evidence of dissolution effects and has been tested and found to have low permeability [FSAR, Section 2.5.4.6.10 (Luminant 2009b)]. Luminant has concluded that significant loss of water from seepage is improbable.

The CPNPP site has gently to steeply rolling topography. The majority of the proposed site for CPNPP Units 3 and 4 drains in a northerly direction into SCR.

No portions of the proposed site for CPNPP Units 3 and 4 or the pipeline corridor between Lake Granbury and the CPNPP site are within 100- or 500-year floodplains (Luminant 2009a).

Erosion and sedimentation patterns in free-flowing reaches of the Brazos River are typical of a meandering stream, with erosion occurring on the outside bends of meanders and deposition occurring on the inner bends. The river carries an increased sediment load during high-flow periods after rainfall events, but sediment loads quickly return to baseline conditions after these events. There is an area of deltaic accretion in Lake Granbury where the Brazos River enters the reservoir. Volumetric surveys of Lake Granbury found that it lost only about 2 percent of its volume due to sedimentation between 1993 and 2003.

The existing CPNPP water intake on Lake Granbury is a reinforced concrete box-type structure located 1.31 mi upstream from the DeCordova Bend Dam. The bottom of the intake structure is at elevation 666 ft MSL, which is 9 ft below the minimum pool elevation of 675 ft MSL [FSAR Section 2.4.1 (Luminant 2009b)]. At the conservation pool elevation of 693 ft MSL, water depth in this area is approximately 50 ft. The proposed CPNPP Units 3 and 4 cooling water intake structure would be located adjacent to this intake on the southwest bank of Lake Granbury [ER Section 2.3.1.2.5 (Luminant 2009a)].

Lake Granbury and SCR bathymetry data and temperature profiles are found in ER Section 2.3.1.2.5 (Luminant 2009a).

2.3.1.2 Groundwater Hydrology

This section provides all physical information on the site needed to support an assessment of potential groundwater impacts in the areas of hydrological alterations, groundwater use, and groundwater quality. The geology of the CPNPP site region is described in Section 2.8.

Groundwater Occurrence

Most of the groundwater in the site region occurs in bedrock. The principal groundwater source in the vicinity of the CPNPP site is the Trinity Group aquifer, a bedrock aquifer composed in the site vicinity of the Cretaceous-age Paluxy, Glen Rose, and Twin Mountains Formations. Some groundwater is also present in the shallow floodplain alluvium along stream valleys and undifferentiated fill beneath the CPNPP site, but it is not withdrawn for use.

The Trinity aquifer is characterized by the Texas Water Development Board (TWDB) as a major aquifer. The aquifer occurs in a north-south-trending band in a region that extends from central Oklahoma through central Texas and into Mexico. The CPNPP site is located on the aquifer's outcrop area, which occurs mostly in Callahan, Eastland, Erath, Hood, Somervell, Comanche, Hamilton, Coryell, and Lampasas Counties. Most aquifer recharge occurs in the outcrop belt. East (down-dip) of its outcrop belt the aquifer is present in the subsurface as a confined aquifer, mostly in Johnson Hill, Bosque, McLennan, Coryell, Bell, and Williamson Counties. In the Trinity aquifer, groundwater percolates slowly along bedrock joints and fractures, and through interstices in the rock fabric. Regional movement of water is down-dip to the east. At distances of 20 to 50 mi down-dip from the outcrop, the groundwater becomes saline, and the formations lose their importance as sources of fresh water.

In the CPNPP site vicinity, the Twin Mountains Formation, the lowermost unit in the Trinity aquifer, is the only moderately productive bedrock zone, though the Paluxy Formation has nominal pumpage near the site. The Glen Rose Formation yields very little water in the site area.

Locally, CPNPP and SCR are situated on the Glen Rose Formation outcrop, which, in turn, is underlain by the Twin Mountains Formation. The Glen Rose Formation is approximately 230 ft thick beneath unexcavated portions of the site, but excavation has reduced its thickness to approximately 160 ft beneath CPNPP Units 1 and 2. This unit produces very little groundwater and therefore, has very few production wells constructed within it. Field testing of the Glen Rose Formation found it to have low permeability. Slug tests measured hydraulic conductivities of 6×10^{-6} to 1×10^{-5} cm/s (Luminant 2009b). Vertical hydraulic conductivity, which in layered rock typically is lower than the overall conductivity, ranged from 1×10^{-9} cm/s to 4×10^{-7} cm/s (Luminant 2009b). The Glen Rose Formation is not used for groundwater supply in the vicinity of the CPNPP site.

Most local production wells are constructed within the 220-ft-thick Twin Mountains Formation located beneath the Glen Rose Formation. The nearest offsite well is located about 1-1/4 mi to the west. There are no sole source aquifers in the vicinity of the CPNPP.

At the proposed site for CPNPP Units 3 and 4, shallow groundwater occurs within perched aquifers consisting of undifferentiated fill, regolith, and the upper Glen Rose Formation. These perched zones are not used for groundwater supply in the vicinity of the CPNPP site.

Twelve existing water wells were identified on the CPNPP site. The wells include: seven potable water wells that support CPNPP Units 1 and 2 operations; an inactive potable water well associated with Squaw Creek Park; and four observation wells, one of which was identified as a converted domestic well. Onsite groundwater withdrawal information for 2006 was obtained from an annual report provided by Luminant (Luminant 2007). The report indicated onsite withdrawals of 27.9 ac-ft (9,092,700 gal) from five active wells in 2006, which is a use rate of 24,900 gpd or approximately 17 gpm, primarily from the Twin Mountains Formation.

2.3.2 Water Use

This section describes existing water uses, and projected future water uses and projected future water uses in the region that could be affected by water use and discharges from the proposed CPNPP Units 3 and 4. Consideration is given to both non-consumptive water uses, which do not result in a reduction in the available water supply, and consumptive uses, which result in a net reduction of supply because water is consumed by processes such as evaporation.

The CPNPP site is located in the TWDB Brazos Region G, one of 16 water management planning regions established under Texas State law and given responsibility for developing regional water plans. Brazos Region G is a 37-county area that extends generally along the Brazos River from Kent, Stonewall, and Knox Counties in the northwest to Washington and Lee Counties in the southeast. Over 90 percent of the region is in the Brazos River basin.

Surface water sources account for over 75 percent of the existing water supply in Brazos Region G (TWDB 2007b). Principal surface water sources in the region are the Brazos River, its tributaries, and 41 major reservoirs. The TWDB's annual survey of surface water and groundwater use by Texas municipal and industrial entities identifies consumptive withdrawals for six categories of uses: (1) municipal; (2) manufacturing; (3) steam-electric power; (4) mining; (5) livestock; and (6) irrigated agriculture. The survey covers only consumptive withdrawals; it does not include non-consumptive water uses or return flows. In 2006 water consumption in Brazos River Region G totaled 783,495 ac-ft, of which 42, 31, and 11 percent was used by municipalities, irrigated agriculture, and steam-electric power plants, respectively (TWDB 2009a) The TWDB has projected that annual consumptive water demand in the region would increase to 835,691 ac-ft in 2010, with requirements for steam-electric power plants increasing to 147,734 ac-ft per year, or nearly 18 percent of the total demand (TWDB 2007b). Potential requirements for CPNPP Units 3 and 4 and for expanded development of natural gas from the Barnett Shale (Section 2.8) are future water uses that are not included in these regional water demand projections for 2010.

Total water supply in the region as of 2010 is estimated at 1,150,098 ac-ft annually, of which 76 percent is surface water. Available supply is projected to decline about 3 percent between 2010 and 2060, to 1,112,155 ac-ft annually, due to sedimentation in surface-water reservoirs and increased emphasis on long-term sustainability in groundwater management (TWDB 2007b). During the same period, annual demand is expected to increase to 1,150,098 ac-ft, with the majority of the increase due to increased municipal use to serve a growing population (TWDB 2007b).

2.3.2.1 Surface-Water Use

In 2006, surface water withdrawals (including both consumptive use and return flows) in the six-county region of Bosque, Hill, Hood, Palo Pinto, Parker, and Somervell Counties totaled 3,601,774 ac-ft. Somervell County accounted for more than 93 percent of this total, with withdrawals from SCR, Panther Branch, and Lake Granbury that totaled 3,367,805 ac-ft [Table 2-1 (Luminant 2009a)]. Withdrawals by the BRA in Hood County accounted for 1.6 percent of the total.

Lake Granbury is an important source of drinking water and recreation to the surrounding communities. The BRA has rights to store up to 155,000 ac-ft in the reservoir and divert up to 64,712 ac-ft annually for municipal, irrigation, industrial, and mining uses. Up to 100,000 ac-ft may be diverted annually under a System Operation Order that authorizes the BRA to manage its several reservoirs as a system (Albright 2010a). According to the BRA, in 2006, surface water diversions from Lake Granbury totaled 59,816 ac-ft, of which approximately 77 percent was for steam electric use, about 6 percent was for other industrial uses, 11 percent was for municipal use, 6 percent was for irrigation, and less than one percent was for mining. The principal municipal user is the Lake Granbury Surface Water and Treatment System (SWATS), which is operated by the BRA to supply Lake Granbury water to five municipal water systems (Luminant 2009a). The SWATS water intake is approximately 3.45 mi upstream of the CPNPP Intake Structure. Water is treated by reverse osmosis to make it suitable for municipal use (TWDB 2007b).

Steam-electric users reported in 2006 included CPNPP Units 1 and 2, the Wolf Hollow electric power plant, and the DeCordova Bend power plant. Water for use at CPNPP Units 1 and 2 is withdrawn from SCR, which is replenished by water from Squaw Creek and by water diverted from Lake Granbury. In 2006, water diversions from Lake Granbury for use in CPNPP Units 1 and 2 totaled 46,750 ac-ft. The Wolf Hollow electric power plant has an intake located approximately 150 ft downstream from the existing CPNPP Lake Granbury intake, and the DeCordova Bend electric power plant withdraws water through an intake located approximately 1.56 mi upstream from the CPNPP Lake Granbury intake.

A total of 3,321,000 ac-ft was withdrawn from SCR for CPNPP Units 1 and 2 in 2006. Of this total, 19,900 ac-ft was consumed by evaporation and 3,301,000 ac-ft was discharged back to SCR. Discharge from SCR to Squaw Creek for the year totaled 21,100 ac-ft.

WBR, located approximately 2 mi south of the site for CPNPP Units 3 and 4, is a water-supply reservoir on Wheeler Branch, a minor tributary of the Paluxy River. The reservoir, which is owned and operated by the Somervell County Water District (SCWD), was completed in 2007 to provide water for the City of Glen Rose, other smaller Somervell County communities, and some private users in Somervell County. It has a surface area of 180 ac and a capacity of 4118 ac-ft, and is filled primarily by water diverted from the Paluxy River. The SCWD has rights to divert 5000 ac-ft/yr from the Paluxy River for storage in WBR and to use 2000 ac-ft/yr of water from the WBR (Albright 2010b), The reservoir is expected to supply water for municipal, industrial, and irrigation users [ER Section 4.2.1.3 (Luminant 2009a)]. Luminant is being allocated 350 gpm (about 565 ac-ft/yr) from WBR (Albright 2010b). Other expected allocations of WBR water under the Texas Water Plan include 340 ac-ft/yr to the City of Glen Rose and 200 ac-ft/yr to other Somervell County users (TWDB 2009b). Unallocated portions of the 2000 ac-ft/yr authorized diversion could be available for use following future completion of additional pipelines, treatment facilities, and related projects (Freese and Nichols, Inc. 2008).

Table 2-1. Surface Water Withdrawals in the Vicinity of the CPNPP Site in 2006 (Numerical Values Are in Acre-feet)

County	User Name	Stream Name	Use Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Palo Pinto	Brazos River Authority	Brazos River	1,2,3, 4,5,6	4852	1761	4657	7436	32,815	12,630	24,703	21,601	1298	30,973	11,882	5703	160,311
Palo Pinto	Palo Pinto MWD 1	Palo Pinto Creek	1	365	288	322	366	416	497	561	577	385	377	323	324	4800
Palo Pinto	Rocking W Ranch, LP	Brazos River	3	0	0	0	0	18	0	217	231	133	47	0	0	647
Palo Pinto	W. J. Rhodes	Brazos River	3	0	0	0	0	0	8	10	5	0	0	0	0	23
Parker	City of Mineral Wells	Rock Creek	1	0	2	0	0	0	6	19	27	0	0	0	0	54
Parker	TXI Operations, LP	Brazos River	2,3	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hood	Brazos River Authority	Brazos River	1,2,3,	1542	2769	2966	5399	5410	6775	7155	7710	6771	5574	4123	610	56,815
Somervell	TXU Electric	Squaw Creek Reservoir, Panther Branch, Lake Granbury	2	227,102	210,025	269,807	296,577	305,253	297,050	306,579	306,898	297,130	253,082	295,190	303,111	3,367,805
Somervell	Somervell County Water District	Paluxy River	1,2,3	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table 2-1. (contd)

County	User Name	Stream Name	Use Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Bosque	City of Clifton	North Bosque River	1	63	8	65	38	0	26	0	0	0	9	28	21	256
Bosque	City of Meridian	North Bosque River	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bosque	Chisholm Trails Ventures, LP	Brazos River	3	141	141	345	345	576	576	576	435	345	141	0	0	3621
Bosque	Lakeview Recreation Association Inc.	Brazos River, Rock Branch	3	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Bosque	John McPherson	Brazos River	3	0	0	0	0	0	35	35	35	35	0	0	0	140
Bosque	Smith Bend Ranch, Ltd.	Brazos River	3	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hill	Brazos River Authority	Brazos River	1,2	109	107	122	113	120	140	184	229	5854	137	69	118	7302

Notes:

Total 2006 reported surface water withdrawals for the six county area is 3,601,774 acre-feet.

Use Types

1 – Municipal

2 – Industrial

3 – Irrigation

4 – Mining

5 – Hydroelectric

6 – Other

NR – Not Reported

Source: Luminant 2009a.

Recreation is a major non-consumptive use of surface water in the area. Water-related recreational activities on Lake Granbury include boating, camping, fishing, and swimming. Navigation on Lake Granbury and the Brazos River in the vicinity of Lake Granbury is limited to use of small watercraft, primarily for recreational uses such as waterskiing, cruising, and fishing. In 2005 Lake Granbury had 6000 private boat slips and boat ramp access at 12 launch ramps (Luminant 2009a). In June of 2010, Luminant opened the SCR for limited public use to include boating and fishing. Flow in the Paluxy River typically is insufficient for recreational use, but the river can support whitewater boating during high-flow periods after a rainfall event (TPWD 1974).

2.3.2.2 Groundwater Use

Groundwater use in Texas is managed locally by Groundwater Conservation Districts (GCDs) that have their own rules, permitting programs, and permit records. Hood County is within the jurisdiction of the Upper Trinity GCD and Somervell County is part of the Prairielands GCD, which was formed by the state legislature in 2009. Although groundwater from the Trinity aquifer is regionally important as a source of drinking water for numerous communities, homes, and farms in central Texas, and irrigation water for many farms, especially in Comanche and Erath Counties, it is a relatively minor source of water supply in the CPNPP site area.

The primary groundwater source for Hood and Somervell Counties is the Twin Mountains Formation in the Trinity aquifer. Groundwater from the Twin Mountains Formation currently is the source of municipal water supply for the City of Glen Rose, located 5.2 mi south of the CPNPP site. Additional future municipal water supply for the City of Glen Rose is planned to be obtained from surface water in the WBR. TWDB identifies a total of 394 wells in Somervell and Hood Counties, with total pumpage from the Trinity aquifer in 2003 of 1726 ac-ft in Somervell County and 5729 ac-ft in Hood County. Municipal uses accounted for 82 percent of the groundwater withdrawals in the two counties.

There are twelve existing water wells on the CPNPP site, including seven potable water wells used to support CPNPP Units 1 and 2 operations and four observation wells. Groundwater withdrawals for Units 1 and 2 operations totaled 28 ac-ft in 2006 (equivalent to an average withdrawal rate of about 17 gpm). Conservation implemented at CPNPP through voluntary environmental commitments with the Texas Council on Environmental Quality (TCEQ) Clean Texas Program and the U.S. Environmental Protection Agency (EPA) Performance Track Program has reduced site groundwater use from approximately 50 gpm in the mid-1990s to approximately16 gpm in 2007. Further reductions in groundwater use are expected within the next few years, as Luminant plans to supply all CPNPP site potable water needs with water from WBR.

2.3.3 Water Quality

The following sections describe the water quality of surface-water and groundwater resources in the vicinity of the proposed CPNPP Units 3 and 4 sites. Monitoring programs for thermal and chemical water quality are also described.

2.3.3.1 Surface-Water Quality

Surface-water quality throughout the Brazos River basin is strongly influenced by conditions in the upper Brazos River basin where saline water enters the river from natural salt deposits. As a result, surface waters in the basin are often characterized by high concentrations of chloride and other dissolved solids. High water temperatures and high concentrations of nutrients also are common. Some of the water quality criteria established by TCEQ for specific stream reaches and reservoirs within the Brazos River reflect the natural conditions of the stream segments, rather than statewide criteria based on general water quality objectives.

Total dissolved solids (TDS) levels in Lake Granbury have varied from 500 to nearly 3000 mg/L (Ward 2008). The highest TDS concentrations occurred during a long period of low flow in 2005–2006, but dissolved solids concentrations are generally not correlated with flow rate (Ward 2008). Chemical analyses of surface water samples collected in Lake Granbury from 2001 to 2008 are reported in the ER. Table 2-2 summarizes some of the analyses from a sampling station in the reservoir near DeCordova Dam (Luminant 2009a). The high nutrient levels (nitrogen and phosphorus) and temperatures in turn may support excessive growths of algae. Designated uses of Lake Granbury (Brazos River Segment 1205) are for public water supplies, fish consumption, general use, the support of aquatic life, and contact recreation. TCEQ water quality standards for Lake Granbury include a maximum chloride concentration of 1000 mg/L and a maximum TDS concentration of 2500 mg/L. Several areas within Lake Granbury do not meet these Texas water quality standards because of high chloride levels (TCEQ 2008). Chloride concentrations exceeding the water quality standard of 1000 mg/L were found in all three sampled areas of Lake Granbury (see Table 2-2), and the reach of the Brazos River between PKL and the headwaters of Lake Granbury (Brazos River Segment 1206) is also impaired because of chloride concentrations (TCEQ 2008). The high chloride levels require increased treatment of public water supplies, including operation of the Lake Granbury SWATS, a desalinization-type water treatment plant (BRA 2008a). Lake Granbury was identified by the TCEQ as a candidate on the 2008 303(d) list of impaired waters because of chloride concentrations (MNES and Enercon 2009).

Rapid population growth in Hood County has resulted in developments around Lake Granbury that do not have centralized sewage collection systems (BRA 2008b). Instead, many of the developments (unincorporated subdivisions) rely on septic systems. Approximately 9000 septic tanks are located around Lake Granbury, particularly around man-made coves. Sewage from the drainage fields of the septic systems contributes to elevated concentrations of *E. coli* bacteria and nutrients and localized impairment of State water quality standards for contact recreation. A Lake Granbury Watershed Protection Plan is being developed to address the concerns about high levels of bacteria found in certain coves. The elevated *E. coli* concentrations appear to be limited to coves and canals that have little mixing or interaction with the main body of the reservoir.

Seven sewerage systems discharge to Lake Granbury with a combined mean daily flow limit of 2.962 million gallon(s) per day (MGD) (Table 2-3). Other discharges include the DeCordova Steam Electric Station (SES) with a permitted daily discharge (once-through cooling) of 1041.48 gpd and the Lake Granbury SWATS facility with an average daily discharge of 2.5 MGD. There are presently no swimming advisories, fish consumption advisories, or fish consumption bans in Lake Granbury or CPNPP area.

Table 2-2. Chemical Analysis of Surface Water Samples Collected in Lake Granbury Near DeCordova Dam, January 2001 Through September 2006
11860—Lake Granbury DeCordova Dam (01/01–09/06)

Analysis	Units	N	Minimum	Maximum	Mean	Median	Texas Surface Water Quality Criteria	N Exceeding	% Exceeding
Water temperature	°C	372	9.2	29.96	19.2	19.9	34	0	0%
Specific conductance	μS/cm^2	372	1047	4712	2678	2572	N/A		
Dissolved oxygen	mg/L	245	1.4	11.4	8.02	8.2	5.0	15	6%
pH		372	6.9	8.59	7.93	8.06	6.5–9.0	0	0%
Salinity	ppt	372	0.81	2.58	1.45	1.4	N/A		
Total suspended solids	mg/L	53	2	120	11.21	6	N/A		
Nitrite nitrogen	mg/L N as NO_2	47	0.01	0.03	0.01	0.01	N/A		
Nitrate nitrogen	mg/L N as NO_3	43	0.01	0.11	0.02	0.01	0.37		
Nitrite + nitrate nitrogen	mg/L N	47	0.01	0.12	0.03	0.02	0.32	0	0%
Total Kjeldahl nitrogen	mg/L	13	0.1	4.23	1.38	1.38	N/A		
Total phosphorus	mg/L	13	0.03	0.2	0.07	0.03	0.18	2	15%
Orthophosphate phosphorus	mg/L P as OPO_4	21	0.02	0.05	0.02	0.02	0.05	0	0%
Chlorophyll a	μg/L	25	7.6	78.6	22.8	17.9	21.4	10	40%
Fecal coliform	cfu/100 mL	18	1	16	3	2	200	0	0%
Escherichia coli	mpn/100 mL	17	1	24	2	2	126	0	0%
Chloride	mg/L	52	409	1783	925	867	1000		
Sulfate	mg/L	52	146	595	295	279	600		
Total dissolved solids	mg/L	27	836	2734	1590	1494	2500		

Source: Luminant 2009a.

Table 2-3. TPDES-Permitted Discharges to Lake Granbury and the Brazos River Below Lake Granbury

Facility Name	Discharge Type	Distance (mi) Upstream or Downstream from Proposed CPNPP Units 3 and 4 Discharge	Average Daily Flow Limit (mgd)	Water Quality Parameters Monitored(a)
Monarch (Oak Trail Shores)	Sewerage system	22.45 upstream	0.16	pH, Q, Al, TDs
City of Granbury	Sewerage system	11.75 upstream	2.00	pH, Q, TSS, AN, FC, CBOD
Acton MUD 1 (DeCordova Bend Estates)	Sewerage system	6.25 upstream	0.60	pH, Q, TSS, AN, CBOD
TXU (DeCordova Steam Electric Station)	Utility wastewater	7.30 upstream	1041.48	pH, Q, Temp, TRC
Texas H_2O (Canyon Creek)	Sewerage system	7.65 upstream	0.042	pH, Q, BOD, TSS
Lake Granbury SWATS	Water treatment waste	4.50 upstream	2.5	pH, Q, chlorides, sulfates
Hood County (Aqua Utilities, Inc.)	Sewerage system	1.70 upstream	0.088	pH, Q, BOD, TSS
Ridge Utilities	Sewerage system	1.45 upstream	0.06	pH, Q, BOD, TSS
Fall Creek	Sewerage system	Unknown upstream	0.012	pH, Q, BOD, TSS, DO
Aquasource—Treaty Oaks	Sewerage system	Unknown downstream	0.055	pH, Q, CBOD, AN TSS
Acton MUD 2 (Pecan Plantation)	Sewerage system	13.00 downstream	0.487	pH, Q, BOD, TSS
Wolf Hollow	Utility wastewater	16.00 downstream	1.10	pH, Q, Temp, TRC, CBOD, TDS, sulfates, chlorides
Unimin Corporation (George's Creek)	Groundwater	Unknown downstream	1.50	pH, Q, TSS
Tolar via Squaw Creek	Sewerage system	35.00 downstream	0.10	pH, Q, BOD, TSS
CPNPP 1&2 via Squaw Creek	Power generation	35.00 downstream	3168	pH, Q, Temp, FAC, TRC, TSS, O, FC, TDS, Fe, Cu
Bill Briley Inactive	Sewerage system	Unknown downstream	Unknown	Unknown
Glen Rose (via Paluxy River)	Sewerage system	35.00 downstream	0.60	pH, Q, DO, TSS, CBOD, TRC, AN
Tarrant Baptist	Sewerage system	41.00 downstream	0.06	pH, Q, DO, TSS, BOD, TRC

(a) Q = flow; DO = dissolved oxygen; FAC = free available chlorine; TRC = total residual chlorine; TSS = total suspended solids; O = oil and grease; BOD = biochemical oxygen demand; CBOD = carbonaceous biochemical oxygen demand; FC = fecal coliform; AN = ammonia nitrogen; Fe = Iron; Cu = copper; Al = aluminum; Temp = temperature.

Source: MNES and Enercon 2009.

The Brazos River immediately below Lake Granbury (Brazos River Segment 1204) is designated for aquatic life use, contact recreation use, general use, and fish consumption. This 52-mi-long river reach fully supports all designated uses, and the TCEQ has not identified any water quality concerns (TCEQ 2008). Table 2-4 displays the ranges of water quality constituents measured in water samples collected in Lake Granbury (near the dam) and four river sites downstream from Lake Granbury. Owing to dilution of dissolved salts by tributary inflows, the salinity of the Brazos River below Lake Granbury is lower than within the lake, and the water quality standard for chloride is set at a lower value of 750 mg/L (MNES and Enercon 2009). Other related parameters, such as conductivity, salinity, and TDS, are also lower in the Brazos River below Lake Granbury, reflecting dilution from tributary inflows such as the Paluxy River. The majority of water use in Segment 1204 is for irrigation and mining, and is not used for public water supply.

Table 2-3 shows the Texas Pollutant Discharge Elimination System (TPDES)-permitted discharges to the Brazos River below Lake Granbury. Six sewerage systems discharge to the Brazos River below Lake Granbury (Segment 1204) either directly or by way of a reservoir or stream; these discharges have a combined daily flow limit of 1.302 million gpd (MNES and Enercon 2009). Other discharges to Segment 1204 include groundwater discharges from a mining operation on George's Creek and effluents from the Wolf Hollow Power Plant and CPNPP Units 1 and 2 by way of Squaw Creek.

2.3.3.2 Groundwater Quality

Potable groundwater in the CPNPP site area occurs in the Paluxy, Glen Rose, and Twin Mountains Formations of the Trinity Group aquifer. In the vicinity of the CPNPP site, the Paluxy Formation is present only on ridge tops in the immediate site area and is not a source of groundwater, but there are several domestic water wells completed within the formation south of the Paluxy River. It typically delivers hard calcium bicarbonate type water. The quality of water obtained from the Glen Rose Formation is variable; in some localized areas it is not potable. Water in the Twin Mountains Formation is a sodium bicarbonate type with TDS content typically between 200 and 900 mg/L.

Onsite groundwater quality was investigated in a baseline monitoring program conducted in 2007. Water samples were collected quarterly during 2007 from 10 monitoring wells in 8 of the 20 monitoring well clusters that were installed in October and November 2006. (Other wells were dry or did not yield quantities of water consistently enough to permit sampling.) Most of the sampling points are in fill or regolith. The water samples were analyzed for a standard list of water quality parameters. The analytical results show a large variation in water quality, both between wells and between sampling dates (Luminant 2009a).

2.3.4 Water Monitoring

2.3.4.1 Surface-Water Monitoring

The USGS monitors water quantity at stream-gauging stations in several locations in the vicinity of the CPNPP site (USGS 2007). The nearest upstream stream gauge on the Brazos River is the USGS Gauge 08090800 near Dennis, Texas, and the nearest gauging station downstream of DeCordova Dam is USGS Gauge 08091000 near Glen Rose, Texas and upstream of the confluence of the Paluxy River. Record keeping at these stations began in 1968 and 1924 respectively. USGS Gauge 08090900 is located at the DeCordova Dam on Lake Granbury, and record keeping at this site began in 1972. USGS Gauge 08091750 is located on Squaw Creek downstream the SCR near Glen Rose, Texas. Record keeping has been conducted at this site since 1973. USGS Gauge 08091730 is located on the SCR near the CPNPP site.

Measurements of reservoir storage and elevation of reservoir water surface have been conducted since 1994. The TWDB uses data from these gauges as part of the water resource planning for the State of Texas (TWDB 2007a).

Table 2-4. Range of Concentrations of Chemical Constituents in Water Samples Collected in Lake Granbury and Other Monitoring Stations in the Brazos and Paluxy Rivers (Data from BRA for the Period Between January 1, 1997 and September 29, 2009. Applicable Texas Surface Water Quality Criteria are Shown in Parentheses Below the Range Values.)

Chemical Constituent	**Monitoring Station 11860—Lake Granbury Near Dam (Segment 1205)**	**Monitoring Station 11856—Brazos River at US 67 (Segment 1204)**	**Monitoring Station 11976—Paluxy River in City Park (Segment 1257)**	**Monitoring Station 12044—Brazos River at FM 2114 (Below Lake Whitney) (Segment 1257)**	**Monitoring Station 12030—Brazos River at SH 105 (Below Lake Whitney) (Segment 1242)**
Chloride (mg/L)	646–1783 (1000)	109–1030 (750)	6–39 (450)	29–1121 (450)	10–821 (350)
Chlorophyll a (µg/L)	4–79	4.9–8.9	–	–	–
Conductivity (µS/cm)	661–4712	600–3912	290–603	775–3492	104–2199
Dissolved oxygen (% saturation)	1–>100	59–>100	33–>100	22–>100	29–>100
Dissolved oxygen (mg/L)	<0.5–11.7 (5.0)	4.–11.6 (5.0)	2.6–15.1 (5.0)	1.9–13.5 (5.0)	3.0–16.9 (5.0)
E. coli (mpn/100 ml)	<1–326 (126)	3–8 (126)	1–816 (126)	3–2400 (126)	<1–1986 (126)
Nitrate (mg/L)	<0.02	<0.05–0.52	<0.02–0.66	<0.02–1.52	<0.02–2.53
pH	6.9–8.7 (6.5–9.0)	7.7–8.6 (6.5–9.0)	7.7–9.3 (6.5–9.0)	7.3–8.6 (6.5–9.0)	7.3–8.6 (6.9–9.0)
Phosphate, ortho (mg/L)	<0.04–0.05	<0.05–0.74	<0.04–0.05	<0.04–0.1	<0.04–0.36
Salinity (ppt)	0.34–2.58	0.3–2.1	0.14–0.3	0.3–1.9	0.1–1.35
Sulfate (mg/L)	253–595 (600)	54–369 (380)	9–71 (250)	59–372 (250)	14–291 (200)
Total dissolved solids (mg/L)	416–2734 (2500)	1576–2222 (1600)	32–405 (1450)	442–882 (1450)	– (1000)
Turbidity (NTU)	1.1–103.5	3.0–3.6	1.4–2.0	1.2–332	7.7–323
Temperature (^{o}C)	7.8–29.7 (34)	5.9–29.2 (33)	4.1–35.5 (35)	5.4–30.8 (35)	6.7–32.5 (35)

The TCEQ is responsible for the administration of TPDES monitoring requirements in the State of Texas (Luminant 2009a). Table 2-3 lists TPDES permitted facilities that discharge to Lake Granbury and the Brazos River below Lake Granbury and the water quality parameters that they monitor in their effluents. CPNPP Units 1 and 2 discharge to the Brazos River below Lake

Granbury via Squaw Creek and are required by their TPDES permit to monitor water quality parameters at six effluent streams.

As part of the Radiological Environmental Monitoring Program (REMP) for surface water and surface drinking water in the vicinity of CPNPP Units 1 and 2, Luminant performs analysis for: gamma emitters, tritium, gross beta radioactivity, and iodine-131 at six locations on Lake Granbury, the SCR, and the Brazos River (Luminant 2009a). Of these radiological parameters only tritium in the SCR is present in quantities that exceed the lower limits of detection that can be attributed to CPNPP Units 1 and 2. The results of the analyses are reported annually to the NRC.

2.3.4.2 Groundwater Monitoring

Seventeen piezometers are installed near CPNPP Units 1 and 2 to investigate groundwater conditions in the upper Glen Rose Formation. Water levels were monitored for a period of 1 year. Water levels observed in these wells are variable and representative of perched conditions. In 2005, radiological water quality monitoring was initiated in several of these piezometers to monitor potential radionuclide releases in the immediate vicinity of CPNPP Units 1 and 2. Groundwater samples were collected for analysis to determine possible presence of gamma-emitting radionuclides and tritium. No other water quality parameters were measured. All radiological parameters were found to be below detection limits or below minimum detected activity levels (Luminant 2009a).

Twenty 100-ft-deep well clusters were installed in the fall of 2006 for baseline groundwater monitoring for CPNPP Units 3 and 4. Eleven of the well clusters include wells to measure water conditions at multiple depths within the fill, the regolith, the shallow Glen Rose Formation, and the deeper Glen Rose Formation; five include two wells at different depths; and four have just one well. Water-level monitoring has been conducted from late 2006 through mid-2008. Water levels in these wells also indicate perched conditions; water levels in some of the wells have not reached equilibrium levels and are still increasing.

2.4 Ecology

This section describes the terrestrial, aquatic and wetland ecology of the site and vicinity that might be affected by the design, siting, building, operation, and maintenance of two additional units at the CPNPP site. Most of the site is located within Somervell County. The northern portion of SCR extends the site into neighboring Hood County, and all of Lake Granbury is in Hood County. These counties are in north central Texas, within the Western Cross Timbers subdivision of the Grand Prairie physiographic province (Texas Bureau of Economic Geology 1996). This area is also classified as part of the Cross Timbers ecoregion (Griffith et al. 2004).

Sections 2.4.1 provides a general description of the terrestrial environment, and Section 2.4.2 provides a general description of aquatic and wetland environments on and in the vicinity of the CPNPP site and corridors for proposed water pipeline and transmission line ROWs (Luminant 2009a). Two double-circuit transmission line expansions would require the erection of new towers on a 160-ft-wide transmission ROW. The first would be a 45-mi line to Whitney, and the second, a 17-mi line to DeCordova. Three additional circuits, named Parker, Johnson, and Everman, would be added on a presently maintained ROW and therefore do not require additional ROWs (see Figure 2-13).

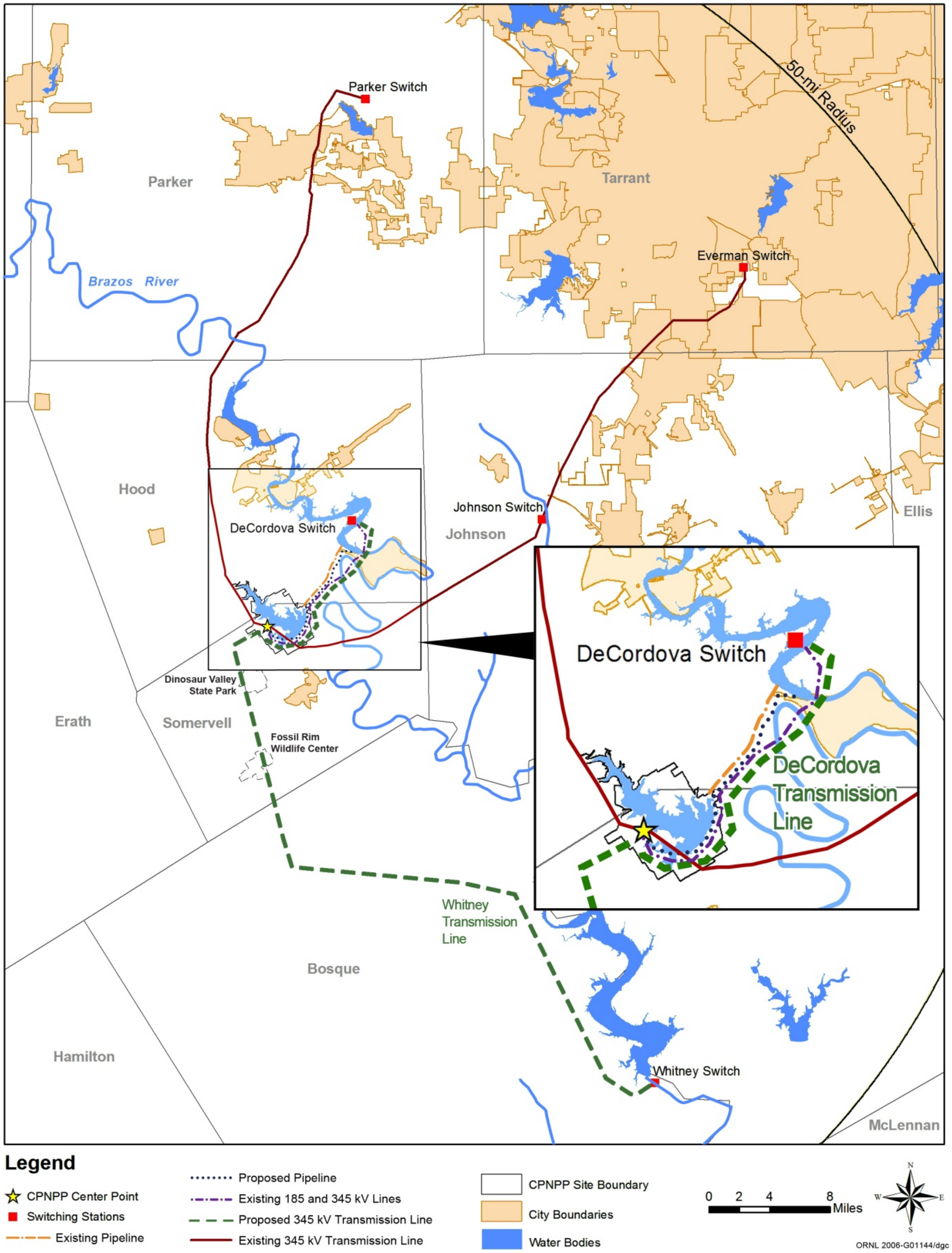


Figure 2-13. Existing and Proposed Transmission Line ROWs and Pipeline Routes. Note: All Routes are Approximate, and the Proposed Routes Have Yet to Be Determined. The Existing 185 and 345-kV Transmission Lines Would not Be Modified (Adapted from Luminant 2009a)

Additional cooling water intake and discharge pipelines would be constructed for CPNPP Units 3 and 4 extending from the proposed units to Lake Granbury. The new pipelines would generally follow an existing 48-in water pipeline for Units 1 and 2 that connects Lake Granbury to SCR (Figure 2-5), and would be placed within the existing 50-ft ROW. New ROWs for the discharge pipeline between the intake and discharge structures would be required (see Figure 2.5).

Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from building, operation, and maintenance of new nuclear power generating facilities and the new transmission line and pipeline ROWs. These descriptions also support the evaluation of mitigation activities and monitoring programs identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts.

2.4.1 Terrestrial Ecology

This section identifies terrestrial ecological resources and describes species composition and other structural and functional attributes of biotic assemblages that could be affected by the building, operation, and maintenance of the proposed CPNPP Units 3 and 4 and associated water intake and discharge pipelines and transmission lines. It also identifies important terrestrial resources, such as wildlife sanctuaries and natural areas that might be affected by the proposed action.

2.4.1.1 Terrestrial Resources-Site and Vicinity

Vegetation

The CPNPP site is approximately 7950 ac in size (Luminant 2009a) within the Western Cross Timbers subdivision of the Grand Prairie physiographic province (Texas Bureau of Economic Geology 1996). The province is transitional between the vast prairies to the west and the forested hills or low mountains to the east. It is characterized by a mosaic of forest, woodland, savanna, and prairie with dominant vegetation that includes little bluestem (*Schizachyrium scoparium*) with scattered stands of blackjack oak (*Quercus marilandica*) and post oak (*Q. stellata*) (Griffith et al. 2004). Historical records indicate that much of the region existed as a grassland or open live oak savanna that supported herds of bison (*Bison bison*) and other herbivores dependent on the tall grasses that dominated the region (TPWD 2007a). The introduction of domestic livestock, farming operations, and wildfire control changed the landscape of much of the region. These practices created a landscape that experienced invasion and domination in some areas by problematic brush species such as mesquite (*Prosopis* spp.), Ashe juniper (*Juniperus ashei*), and other native woody species. Overgrazing by livestock and elimination of naturally occurring fire also reduced native grass cover and allowed the invasion of other, less-desirable annual grasses and forbs.

Vegetation communities, also referred to as vegetation cover types, found at CPNPP are common elements of the Cross Timbers physiographic province. Two general vegetation cover types that currently dominate the region are (1) silver bluestem (*Bothriochloa saccharoides*)-Texas wintergrass (*Nassela* (=*Stipa) leucotricha*) grassland and (2) oak-mesquite-juniper savanna and woodlands. Species characterizing the silver bluestem-Texas wintergrass cover type are listed in Table 2-5; those characterizing the oak-mesquite-juniper savanna and woodlands cover type are listed in Table 2-6.

Silver bluestem-Texas wintergrass grasslands are a medium-tall, rather dense grasslands that have as dominants the two species for which the cover type is named. A variety of other prairie grasses occurs as well, along with forbs such as Texas bluebonnet (*Lupinus texensis*).

Table 2-5. Species Characterizing the Silver Bluestem – Texas Wintergrass Grassland Cover Type

Common Name	Genus and Species	Growth Form
Silver bluestem	*Bothriochloa saccharoides*	Perennial grass
Texas wintergrass	*Nassela* (=*Stipa) leucotricha*	Perennial grass
Little bluestem	*Schizachyrium scoparium*	Perennial grass
Sideoats grama	*Bouteloua curtipendula*	Perennial grass
Texas grama	*Bouteloua rigidiseta*	Perennial grass
Hairy grama	*Bouteloua hirsuta*	Perennial grass
Tall dropseed	*Sporobolus compositus* var. *compositus*	Perennial grass
Buffalograss	*Buchloe dactyloides*	Perennial grass
Windmillgrass	*Chloris verticillata*	Perennial grass
Hairy tridens	*Erioneuron pilosum*	Perennial grass
Tumblegrass	*Schedonnardus paniculatus*	Perennial grass
Western ragweed	*Ambrosia psilostachya*	Perennial herb
Broom snakeweed	*Gutierrezia sarothrae*	Perennial herb
Texas bluebonnet	*Lupinus texensis*	Annual herb
Live oak	*Quercus virginiana*	Tree
Post oak	*Quercus stellata*	Tree
Mesquite	*Prosopis* spp.	Tree

Source: Luminant 2009a.

Table 2-6. Species Characterizing the Oak-Mesquite-Juniper Savanna and Woodlands Cover Type

Common Name	Genus and Species	Growth Form
Post oak	*Quercus stellata*	Tree
Ashe juniper	*Juniperus ashei*	Tree
Shin oak	*Quercus harvardii*	Tree
Texas oak	*Quercus buckleyi*	Tree
Blackjack oak	*Quercus marilandica*	Tree
Live oak	*Quercus virginiana*	Tree
Cedar elm	*Ulmus crassifolia*	Tree
Agarito	*Berberis trifoliata*	Shrub
Soapberry	*Sapindus saponaria* var. *drummondii*	Tree
Sumac	*Rhus* spp.	Shrub, tree
Hackberry	*Celtis* spp.	Tree
Texas pricklypear	*Opuntia engelmannii* var. *lindheimeri*	Cactus, erect or spreading
Mexican persimmon	*Diospyros texana*	Shrub or small tree
Purple three-awn	*Aristida purpurea*	Perennial grass
Hairy grama	*Bouteloua hirsuta*	Perennial grass
Texas grama	*Bouteloua rigidiseta*	Perennial grass
Sideoats grama	*Bouteloua curtipendula*	Perennial grass
Mesquite	*Prosopis* spp.	Tree
Texas wintergrass	*Nassela* (=*Stipa) leucotricha*	Perennial grass

Source: Luminant 2009a.

Oak-mesquite-juniper savanna and woodlands occur on uplands and prairies as a mixture of individual stands of woody species with interspersed grasses and forbs (Diggs, Lipscomb, and O'Kennon 2000; Stubbendieck, Hatch, and Butterfield 1994; McMahan, Frye, and Brown 1984). Due to protection from fire since the 1970s, some areas have developed into thick woodlands, and juniper-dominated stands have increased (Luminant 2009a). Although Ashe juniper is an important native species for wildlife food and cover, it is also invasive and can form dense thickets.

Species composition of the CPNPP site has remained generally unchanged since construction of existing Units 1 and 2 (Luminant 2009a). An ecological vegetation cover type map was created and updated in 2006 through 2009 based on interpretation of aerial photographs showing the current spatial distribution of vegetation types and aquatic habitats at the CPNPP site (Figure 2-14). The two general regional vegetation cover types (oak-mesquite-juniper savanna and woodlands and silver bluestem-Texas wintergrass) were further classified into more site-specific descriptions using 1999 infrared aerial photography and ground-truthing in 2006 and 2007 (Luminant 2009a). Table 2-7 summarizes the total acres occupied by each cover type. Figure 2-14 also shows that terrestrial cover of the site consists mostly of juniper woodland and open fields.

Ashe Juniper Woodland - Savanna. Stands of Ashe juniper woodland - savanna are evergreen, dominated by mature Ashe juniper trees or a combination of mature and immature Ashe juniper trees and saplings. Mature Ashe juniper trees are over 15 ft high with 5 in. or more diameter at breast height (DBH), approximately 4.5 ft above the ground. Hardwood species occupy 10 percent or less of the tree canopy. This cover type is the most common terrestrial habitat type at CPNPP and occupies a total of about 3071 ac or approximately 39 percent of the site (Table 2-7). Protection of the CPNPP site from wildfire has created the current unnatural condition where Ashe juniper woodland has replaced oak-juniper savanna and, in some cases, prairie grassland over time. This has resulted in lowering the overall wildlife habitat value of the site by decreasing both vertical structure within individual stands and species diversity across the site as a whole (Luminant 2009a). Ashe juniper woodland-savanna covers most of the peninsula where new cooling towers for Units 3 and 4 would be located. This area, just to the northwest of, and adjacent to, the peninsula on which existing Units 1 and 2 are located (Figures 2-5 and 2-14), is an area of major proposed project development activities.

Mixed Hardwood Forest. Mixed hardwood forests are dominated by a combination of hardwood tree species including live oak (*Quercus virginiana*), cedar elms (*Ulmus crassifolia*), mesquite, hackberry (*Celtis spp.*), Texas ash (*Fraxinus texensis*), chittamwood (*Sideroxlyon lanuginosa*), and occasional persimmon (*Diospyros texana*) trees. Ashe junipers comprise 30 percent or less of the tree canopy in mixed hardwood stands. The shrub layer includes buckbrush (C*eanothus cuneatus*), agarito (*Berberis trifoliata*), lemon sumac (*Rhus aromatica*), and Mexican buckeye (*Ungnadia speciosa*). These are the most biologically diverse natural terrestrial communities on the CPNPP site. They are often found on south-facing slopes and along drainages within the site.

Mixed hardwood forest occupies a total of about 528 ac at CPNPP or approximately 7 percent of the site (Table 2-7). Quantitative vegetation data were collected along 100-m (109-yd) line-intercept transects on the peninsula where new cooling towers would be located. These data show that mixed hardwood forest covers approximately 16 percent of the transect lines surveyed (Luminant 2009a).

Grassland. Grasslands on the site are dominated by either a variety of native grasses, such as big (*Andropogon gerardii*), little, and silver bluestem; gramas (*Bouteloua spp*.); Texas wintergrass; and some forbs, or by monocultures of introduced turf grasses such as Bermuda grass (*Cynodon dactylon*) or fescues (*Festuca spp*.).

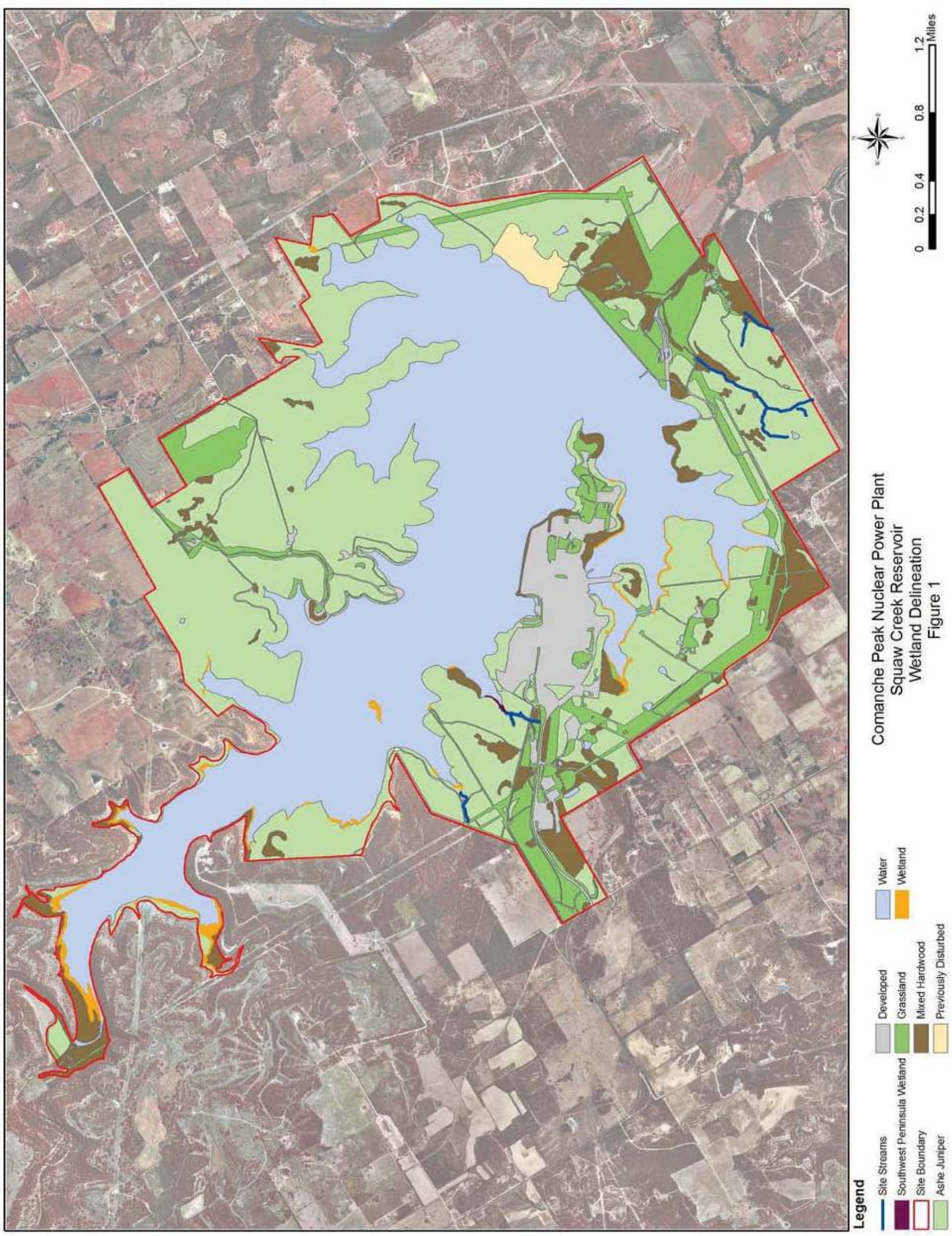


Figure 2-14. Ecological Cover Type Vegetation Map (Luminant 2009a; Enercon 2009)

Table 2-7. Distribution of Cover Types and Acreage Totals at CPNPP

Vegetation Type	Total Acres	Percent Cover
Open Water	3125	39
Ashe Juniper Woodland - Savanna	3071	39
Grassland	698	9
Mixed Hardwood Forest (Including Bottomlands)	528	7
Developed	439	6
Previously Disturbed	60	<1
Wetland	53	<1
Total	7974[(a)]	

(a) Total differs from that of 7950 ac reported elsewhere in Luminant ER; the difference is assumed to be due to a rounding errors.

Source: Luminant 2009a.

Bermuda grass lawns are common at the site near the facility entrance and around buildings. Fescue is a genus of more than 300 species of tufted grasses commonly planted to supplement pastures. Native grasslands are found dotted across the site and are intermixed with the juniper forests. In addition to grasses, forb species found in this cover type include Indian paintbrush (*Castilleja indivisa*), ragweeds (*Ambrosia spp*.), milkweeds (*Asclepias spp*.), wild carrot (*Daucus carota*), fleabanes (*Erigeron spp*.), rose verbena (*Glandularia canadensis*), spiderwort (*Tradenscantia sp.*), cut-leaf germander (*Teucrium laciniatum*), trailing ratany (*Krameria lanceolata*), liatrises (*Liatris spp*.), skullcaps (*Scuttelaria spp*.), black-eyed Susan (*Rudbeckia hirta*), wooly vervain (*Verbana stricta*), yuccas (*Yucca spp.),* and prickly pear cactus (*Opuntia macrorhiza*). This cover type occupies a total of about 698 ac at CPNPP or approximately 9 percent of the site (Table 2-7). Transect data collected on the peninsula where new cooling towers would be located show that grassy openings cover about 24 percent of the transect lines surveyed.

Previously Disturbed. These are areas within the site that are either mechanically or naturally disturbed and consist either of bare ground or are dominated by weedy plant species that are indicators of disturbance. This cover type occupies a total of about 60 ac at CPNPP or less than 1 percent of the site (Table 2-7).

Developed Areas. Developed areas within the site consist of office buildings, reactors, and related facilities, switchyards, and storage facilities as well as pavement or gravel for parking lots and roads. Also included within this cover type are the dam, spillway, structures related to the dam, and the Safe Shutdown Impoundment and its equalization channel. This cover type occupies a total of about 439 ac at CPNPP or approximately 6 percent of the site (Table 2-7).

Open Water. The open water at CPNPP consists mostly of SCR, the Safe Shutdown Impoundment, evaporation ponds for nonradioactive waste water, and an emergency spillway. Because of SCR, open water is the dominant cover type and occupies a total of about 3125 ac or approximately 39 percent of the site (Table 2-7). As an aquatic habitat, the ecology of SCR is discussed in more detail in Subsection 2.4.2.

Wetlands. Wetlands are areas transitional between land and open water. At CPNPP small areas of wetland occur primarily along the shoreline of coves on SCR, totaling an estimated 53 ac (less than 1 percent of the site). Wetlands are discussed in detail in Subsection 2.4.2.

Wildlife

The diversity of habitat types at the CPNPP site support a wide diversity of wildlife species. Luminant supplemented data collected in the 1970s, prior to the construction of Units 1 and 2, with new field surveys conducted from 2007 to 2009.

Mammals. In 1974 and 1975, 24 native and 2 non-native mammals were observed through surveys at the CPNPP site (TUGC 1974, TUGC 1975). In part due to larger body size and resulting ease in observation, opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), blacktail jackrabbit (*Lepus californicus*), white-tailed deer (*Odocoileus virginianus*), and nine-banded armadillo (*Dasypus novemcinctus*) were readily reported (TUGC 1974). Small mammals trapped on the site include deer mice (*Peromyscus* spp.) and cotton rats (*Sigmodon* spp.) (TUGC 1974).

Direct observation of numerous mammal species or species signs occurred during fieldwork in 2007 and included white-tailed deer, bobcat, nine-banded armadillo, eastern cottontail (*Sylvilagus floridanus*), black-tailed jackrabbit, fox squirrel (*Sciurus nigra*), and domestic cat (*Felis domesticus*). Indirect signs indicated that additional mammals on the site included raccoon, opossum, striped skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), and coyote.

Birds. As many as 421 species of birds can occur in Somervell and Hood Counties (Freeman 2003). Many are either at the southern or northern extreme of their range within central Texas. Most of these birds prefer specific habitat types and are not found throughout the entire Cross Timbers Ecoregion (Freeman 2003). Some with specific breeding habitat requirements are present on or near the site only during the breeding season; others are temporary residents on the CPNPP site as they migrate through the area twice each year. From August to December 1972, a total of 118 species were observed at CPNPP during directed field surveys (TUGC 1974). General field surveys for birds were conducted at CPNPP during February, April, May and July of 2007 (Luminant 2009a). A comparison between the number of bird species observed during the general field surveys and the number that have the potential to occur at the site showed lower diversity than expected. A combination of factors, including habitat losses due to impoundment of SCR, lack of active Ashe juniper control, and the subsequent near monoculture of this invasive, native tree species may contribute to this relatively low diversity of bird species (Yiming and Wilcove 2005, Drake and Todd 2002).

SCR provides habitat for an array of shorebirds, wading birds, and waterfowl. Water-dependent species observed during general field surveys in 2007 are listed in Table 2-8 (Luminant 2009a). Texas lies within the Central migratory flyway (Birdnature 2010), and SCR would be expected to support significant numbers of waterfowl during migration. Upland game birds, perching birds, birds of prey, and woodpeckers (Table 2-9) were also observed at CPNPP in 2007 (Luminant 2009a).

Table 2-8. Water-Dependent Bird Species Observed at CPNPP in 2007

Common Name	Genus and Species
Great blue heron	*Ardea herodias*
Green heron	*Butorides virescens*
Black-crowned night heron	*Nycticorax nycticorax*
Great egret	*Ardea alba*
Snowy egret	*Egretta thula*
Cattle egret	*Bubulcus ibis*
Belted kingfisher	Megaceryle (=*Ceryle) alcyon*
Double crested cormorant	*Phalacrocorax auritus*
Neotropic cormorant	*Phalacrocorax brasilianus*
Spotted sandpiper	*Actitis macularius*
Killdeer	*Charadrius vociferus*
Blue-winged teal	*Anas discors*
Wood duck	*Aix sponsa*
Eared grebe	*Podiceps nigricollis*
American coot	*Fulica americana*

Source: Luminant 2009a.

Table 2-9. Upland Game Birds, Birds of Prey, and Woodpeckers Observed at CPNPP in 2007

Common Name	Genus and Species
Upland Game Birds	
bobwhite quail	*Colinus virginianus*
wild turkey	*Meleagris gallopavo*
Perching Birds	
American robin	*Turdus migratorius*
barn swallow	*Hirundo rustica*
Carolina wren	*Thryothorus ludovicianus*
purple martin	*Progne subis*
red-winged blackbird	*Agelaius phoeniceus*
savanna sparrow	*Passerculus sandwichensis*
Birds of Prey	
turkey vulture	*Cathartes aura*
Black vulture	*Coragyps atratus*
red-tailed hawk	*Buteo jamaicensis*
osprey	*Pandion haliaetus*
Woodpeckers	
red-bellied	*Melanerpes carolinus*
northern flicker	*Colaptes auratus*

Source: Luminant 2009a.

Reptiles. During surveys of the CPNPP site prior to, and during, development of CPNPP Units 1 and 2, five turtle, seven lizard, and nine snake species were observed on the site (TUGC 1974, TUGC 1975). During general field surveys conducted in 2007, the only reptiles observed were the western diamond-backed rattlesnake (*Crotalus atrox*), diamondback water snake (*Nerodia rhombifera*), slider (*Trachemys scripta*), and the American alligator (*Alligator mississippiensis*), which occurs at CPNPP outside its normal range (Luminant 2009a).

Amphibians. Five species of amphibians, all toads and frogs, were found in surveys conducted in 1973. During those surveys, Woodhouse's toad (*Bufo woodhousii*) and the Gulf Coast toad (*Bufo valliceps*) were collected on the CPNPP site. Along Squaw Creek (in the reach now inundated by SCR), cricket frogs (*Acris* spp.), bullfrogs (*Rana catesbeiana*), and Rio Grande leopard frogs (*Rana berlandieri*) were captured. During general field surveys conducted in 2007 all these species except the Gulf Coast toad were observed.

Nuisance Species. Nuisance species are those of concern because they are disease vectors or pests. These include a large number of terrestrial wildlife species that can be pests in urban/ suburban or even rural settings such as raccoons, white-tailed deer, moles (*Scalopus aquaticus*), voles (*Microtus* sp.), beavers, feral hogs (*Sus scrofa*), gophers (*Geomys* spp.), snakes, American crow (*Corvus brachyrhynchos*), pigeons (*Columba livia*), starlings (*Sturnus vulgaris*), nutria (*Myocastor coypus*), and others. Large- and medium-size mammals such as deer and coyote that occur in the vicinity have limited opportunity to move across.

A chain-link fence encloses a portion of the site. Should beaver and deer populations show substantial increases onsite, biological control of these species at CPNPP may become necessary. Nuisance species also include mosquitoes, ticks, wasps, and termites. Field reconnaissance in 2007 and 2008 failed to reveal any noticeable evidence of serious infestations of nuisance species such as mosquitoes or ticks or potential vectors for such diseases as West Nile virus and Lyme disease (Luminant 2009a).

Travel Corridors

Travel corridors provide numerous essential functions needed for the survival of wildlife species. Corridors can be viewed at three scales: (1) local, (2) regional, and (3) migratory corridors. Local corridors are travel lanes linking daily resource needs such as food, water, and bedding sites. Local corridors exist within CPNPP for numerous species. High-perimeter fencing likely diminishes travel offsite of larger mammalian species. Birds, reptiles, and amphibians, on the other hand, are not impeded by fencing and can move about more freely within the landscape. Localized fragmentation of the area surrounding CPNPP due to residential development is expected to act as a barrier to more habitat-specialized species.

Regional travel corridors enable travel of animals between core areas and help to ensure genetic diversity of wildlife species by allowing new individuals into the populations. No known regional corridors exist for large mammals in the vicinity of CPNPP.

Migratory corridors are used as seasonal migration routes for large-ranging mammals and migratory birds. Migratory stop-over by bird species, especially waterfowl, occurs on the CPNPP site. Within Texas, the federal- and state-listed endangered whooping crane (*Grus americana*) utilizes a 200-mi wide primary migration corridor. The CPNPP site occurs within the central-most 60-mi-wide corridor within which 75 percent of migration sightings have been documented. (TPWD 2010b). However, no occurrences of whooping cranes have been reported within a 10-mi radius of the CPNPP site or the proposed transmission line and pipeline corridors (TPWD 2009f).

Wildlife Sanctuaries, Refuges, and Preserves

Table 2-10 lists ecologically oriented recreational areas within the 50-mi radius of CPNPP, and four of these are wildlife protection areas (Luminant 2009a). These are: (1) Dinosaur Valley State Park, (2) Glen Rose Bird Sanctuary, (3) Fossil Rim Wildlife Center, and (4) Quail Ridge Ranch/Chalk Mountain Conservation Area. The closest of the listed areas to CPNPP, Dinosaur Valley State Park, is approximately 3 mi southwest of the site.

In addition, the Paluxy River and the portions of the Brazos River below the Lake Granbury dam down to its confluence with Camp Creek are identified by Texas Parks and Wildlife Department (TPWD) as ecologically significant stream segments (ESSs). ESSs were identified throughout the state to assist regional water planning groups in designating ecologically unique stream segments under Texas Administrative Code Title 31 Section 357.8. The ESS title is not a legal definition, however the designation signifies that the segment encapsulates unique ecological values (TPWD 2010i).

2.4.1.2 Terrestrial Resources—Transmission Lines and Cooling Water Pipelines

Electric transmission lines originating from CPNPP cross forested and grassland habitats typical of north-central Texas, predominantly grassland with patches of deciduous and evergreen forest, as discussed in Section 2.4.1.1. Transmission line ROWs are maintained in an open grassland successional stage. Acreages of vegetation types likely to be crossed by new or expanded transmission line ROW are shown in Table 2-11.

The acreage likely to be impacted by new or expanded transmission line ROWs will be determined once actual ROW boundaries are finally determined with precision. No information has been collected on important species for these areas. Oncor will perform terrestrial ecology surveys and collect the information required by the State of Texas for approval of the transmission lines once the ROW boundaries are formally determined, and before initiation of ground disturbing activities on the ROWs.

The new water intake and discharge pipelines for Units 3 and 4 will follow an existing 48-in. water pipeline for Units 1 and 2 that connects Lake Granbury to SCR (Figure 2-5). This route follows existing transmission/pipeline ROWs generally consisting of grassland and Ashe juniper or previously disturbed areas. A new ROW would be required for a discharge structure at Lake Granbury, and within the CPNPP site.

The existing pipeline for Units 1 and 2 is located along the centerline of a ROW that is approximately 8 mi long. Approximately 7 mi of the new pipeline will be built within the existing pipeline ROW. The remaining 1.2 mi will be built within a new ROW extending to Lake Granbury. The entire length of the pipeline ROW was surveyed for potential wetlands and habitat for protected wildlife species in April and July 2007. No wetlands or habitat for protected wildlife species were found (Luminant 2009a). Acreages of vegetation types, which are predominantly grasslands, are shown in Table 2-12 (Luminant 2009a).

2.4.1.3 Important Terrestrial Species and Habitats

Important Terrestrial Species—Site and Vicinity

This section describes important species and habitats as defined by the NRC in NUREG 1555 that may occur in the vicinity of the CPNPP site and new transmission line and pipeline ROWs. Important species as defined by the NRC include, but are not limited to, commercially and recreationally valuable species, ecologically important species, Federally and State-listed, proposed, and candidate threatened and endangered terrestrial species, and designated and proposed critical habitats.

Table 2-10. Ecologically Oriented Public Recreation Areas Within a 50-mi Radius of CPNPP

Name of Property	Type of Property	Approximate Distance and Direction from the Site
Recreation Area	Dinosaur Valley State Park	3.5 mi SSW
	Somervell County Park	4.4 mi S
	Big Rocks City Park	4.7 mi S
	Tres Rios Ranch River Resort	4.8 mi S
	Cleburne State Park	13 mi E
	Meridian State Park	28 mi S
	Lake Whitney State Park	35 mi SE
	Lake Mineral Wells State Park	38 mi NNW
	Aquila Wildlife Management Area	38 mi SE
Campground	Dinosaur Valley State Park	See above
	B Street RV Park	4.5 mi S
	Oakdale Park	See above
	Glen Lake Methodist Camp	4.7 mi SSE
	Leslie's RV Park Campground	4.8 mi SSW
	Tres Rios Ranch River Resort7	See above
	Cleburne State Park	See above
	Meridian State Park	See above
	Lake Whitney State Park	See above
	Lake Mineral Wells State Park	See above
Fishing	Dinosaur Valley State Park	See above
	Big Rocks City Park	See above
	Lake Granbury	7 mi NE
	Cleburne State Park	13 mi E
	Meridian State Park	28 mi S
	Lake Whitney State Park	35 mi SE
	Lake Mineral Wells State Park	38 mi NNW
	Aquila Wildlife Management Area	38 mi SE
Heritage Preserve	Glen Rose Heritage Park	4.8 mi S
	Somervell County Courthouse	5.0 mi S
	Barnard's Mill	5.0 mi S
	Acton State Historical Park	13 mi NE
Boating Areas	Lake Granbury	See above
	Cleburne State Park	13 mi E
	Meridian State Park	28 mi S
	Lake Whitney State Park	35 mi SE
	Lake Mineral Wells State Park	38 mi NNW
	Aquila Wildlife Management Area	38 mi SE
Wildlife Viewing	Dinosaur Valley State Park	See above
	Glen Rose Bird Sanctuary	4.8 mi S
	Fossil Rim Wildlife Center	8 mi SSW
	Quail Ridge Ranch/Chalk Mountain Conservation Area	9 mi SW
	Vivian J. Malone Preserve	25 mi E

Source: Luminant 2009a.

Table 2-11. Acreages of Vegetation Types that Would Be Crossed by Expanded Existing Transmission Lines on Existing Towers

Vegetation Type	Transmission Corridor									
	DeCordova[(a)]		Whitney[(a)]		Parker[(b)]		Johnson[(b)]		Everman[(b)]	
	Acreage	**Percent**	**Acreage**	**Percent**	**Acreage**	**Percent**	**Acreage**	**Percent**	**Acreage**	**Percent**
Water	11.0	7.4	3.1	0.3	3.3	0.4	1.6	0.4	0.0	0.0
Developed, Open	11.0	7.4	19.8	2.1	28.4	3.6	4.0	1.1	46.4	10.5
Developed, Low Intensity	0.2	0.2	0.9	0.1	8.4	1.1	0.2	0.1	9.6	2.2
Developed, Medium Intensity	0.4	0.3	0.0	0.0	0.9	0.1	0.0	0.0	0.2	0.1
Developed, High Intensity	1.3	0.9	0.0	0.0	1.1	0.1	0.0	0.0	0.9	0.2
Barren Land	0.9	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deciduous Forest	10.1	6.8	176.1	18.5	116.5	14.9	28.9	8.0	47.8	10.8
Evergreen Forest	3.1	2.1	137.0	14.4	55.2	7.1	29.4	8.1	0.2	0.1
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scrub/Shrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.7
Grassland	107.5	72.3	550.0	57.7	520.2	66.7	266.4	73.5	262.9	59.4
Pasture	1.3	0.9	35.8	3.8	31.9	4.1	22.5	6.2	63.8	14.4
Cropland	0.0	0.0	7.6	0.8	3.1	0.4	5.8	1.6	7.1	1.6
Woody Wetlands	1.6	1.1	22.9	2.4	10.4	1.3	3.8	1.0	0.9	0.2
Total	**148.7**	**100.0**	**953.6**	**100.0**	**779.6**	**100.0**	**362.6**	**100.0**	**442.7**	**100.0**

(a) New ROWs.
(b) Existing ROWs.

Source: Luminant 2009a.

Table 2-12. Pipeline Corridor Land Use and Cover Types

Land Use Type	Acreage	Percent
Water	0.2	0.4
Developed, Open	6.2	12.4
Developed, Low Intensity	1.2	2.3
Developed, Medium Intensity	0.3	0.5
Barren Land	0.2	0.4
Deciduous Forest	6.3	12.6
Evergreen Forest	3.7	7.5
Grassland	31.4	63.1
Cropland	0.4	0.7
Woody Wetlands[(a)]	0.1	0.1
Total	49.7	100.0

(a) Field check of the entire ROW in April and July of 2007 showed no wetlands to be present (Luminant 2009a).

Source: Luminant 2009a; USGS 2001.

Commercially and Recreationally Valuable Species

TPWD divides the State of Texas into eight wildlife districts. CPNPP is located within the Cross Timbers Wildlife District. Hunting regulations for the district are set by TPWD to specify the methods of harvest, bag limits, and other requirements for hunting on wildlife management areas and private land (TPWD 2007d).
Commercial trapping or hunting of furbearers is permitted in the district all year. TPWD's regulations (TPWD 2007b) legally classify badger (*Taxidea taxus*), beaver, fox, mink (*Neovison vison*), nutria, opossum, otter (*Lutra canadensis*), raccoon, ring-tailed cat (*Bassariscus astutus*), spotted skunk (*Spilogale* spp.), and striped skunk as furbearers subject to commercial harvest by hunting and trapping. Coyotes and bobcats are not considered furbearers. Bobcat pelts require tagging with a TPWD-issued Convention on International Trade in Endangered Species tag. Except for otter and badger, most of these furbearer species are likely to inhabit the site, based on the availability of suitable habitat (Davis and Schmidly 1994).

CPNPP does not allow hunting or trapping within the site boundary. State-protected game potentially occurring at the CPNPP site include habitat generalists such as bobcat, white-tailed deer, red fox (*Vulpes vulpes*), opossum, eastern cottontail, and weasel (*Mustela frenata*); species associated with brushy and disturbed areas such as feral hog, black-tailed jackrabbit, and striped skunk; forest species such as gray fox (*Urocyon cinereoargenteus*), raccoon, spotted skunk, and squirrel (*Sciurus* spp.); and species associated with aquatic habitat such as mink, and muskrat (*Ondatra zibethicus*). Avian game species include waterfowl (i.e., goose [*Branta* spp.], double-crested cormorant [*Phalacrocorax auritus*], or duck [Family *Anatidae*]); bobwhite quail (*Colinus virginianus*); mourning dove (*Zenaida macroura*), rails (*Rallidae* spp.); American coot (*Fulica americana*); gallinule (*Porphyrio* spp.); American crow; and wild turkey (*Meleagris gallopavo*) (Freeman 2003, Davis and Schmidly 1994). Of these species, white-tailed deer and wild turkey are highly sought after by hunters and are considered important species.

Species Critical to Structure and Function of the Ecosystem

As discussed in Subsection 2.4.1.1, the western Cross Timbers ecoregion is a mosaic of forest, woodland, savanna, and grasslands of highly variable floristic composition. Active and abandoned agricultural fields and pastures are also common. Most species at CPNPP are common in southern plains and woodlands and associated streams that flow through them. Regionally, the plant communities are highly variable and offer habitat for a wide variety of animal species that vary in abundance depending primarily on local physiography.

Because of the wide variety of ecological communities within the region, individual species abundance, especially plants, can vary significantly from location to location where different species serve similar ecological roles in the community. Accordingly, there is no evidence suggesting that any individual species is critical to structure or function at the ecosystem level.

Species that Serve as Indicators

The EPA describes biological indicators as groups or types of biological resources that can be used to assess environmental conditions (EPA 2007). Typically, such organisms at or near a site can be selected to characterize the current ecological status of the site or to track or predict significant change in the future.

Terrestrial organisms that inhabit the CPNPP site are common inhabitants of southern plains and woodlands. There is little population information available for those that are less common to track possible changes in their status in the future. There are no species at the site that might function as true biological indicators.

Federally and State-Listed Species

Table 2-13 presents the terrestrial species that are (1) State listed as threatened or endangered; (2) species of State concern and designated as rare, but with no regulatory listing [In Texas species of concern are priority species in greatest need of conservation as determined by the Texas Wildlife Action Plan (TPWD 2009a, 2009l)]; or (3) Federally listed as threatened or endangered or are candidates for listing in counties within which CPNPP Units 3 and 4 (Somervell and Hood Counties) and the proposed new transmission and pipeline ROWs (Somervell, Hood, and Bosque Counties) would be located. This list is composed of the following.

- species listed for these counties on the TPWD website (TPWD 2009h);
- species listed for these counties on the U.S. Fish and Wildlife Service (USFWS) website (USFWS 2009);
- species with recorded occurrences in the Texas Natural Diversity Database (TXNDD) that are within 10 mi of CPNPP and new power transmission ROWs (TPWD 2009f); and
- species potentially present when suitable habitat is present in the project area (USFWS 2006,TPWD 2007c).

No designated USFWS critical habitat for threatened or endangered species exists on the CPNPP site and vicinity or within or adjacent to existing or new transmission or pipeline corridors (USFWS 2007b). No Federally or State-listed threatened or endangered species were detected during informal site surveys conducted in spring, summer, and fall 2007 (Luminant 2009a).

Federally listed species. This section describes the Federally-listed threatened and endangered species in the vicinity of the site and the proposed new transmission and pipeline ROWs. The terrestrial species that are Federally listed as threatened or endangered, or that are designated as candidates for listing, in counties within which CPNPP Units 3 and 4 (Hood and Somervell Counties) and the proposed new transmission and pipeline ROWs (Hood, Somervell and Bosque Counties) would be located are presented in Table 2-13). Of the Federally-listed species, only two birds, black-capped vireo, and golden-cheeked warbler (both endangered), have recorded occurrences in these counties (TPWD 2009f). These species are also State-listed as endangered. In support of the Section 7 consultation with the USFWS, the Biological Assessment for these two species is in Appendix F. Although without recorded occurrences in Hood, Somervell, or Bosque counties (NatureServ 2009, TPWD 2009f), the whooping crane (endangered, also State-listed as endangered) could possibly be a migrant over the proposed project location since its migratory corridor extends over these counties (TPWD 2010b).

Table 2-13. Threatened, Endangered, or Rare Terrestrial Plant and Animal Species Listed in Somervell, Hood, and Bosque Counties

Species Group	Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]
Birds	American peregrine falcon	*Falco peregrinus anatum*	–	T
	Arctic peregrine falcon	*Falco peregrinus tundrius*	–	Rare
	Baird's sparrow			Rare
	Bald Eagle	*Haliaeetus leucocephalus*	–	T
	Black-capped vireo	*Vireo atricapillus*	E	E
	Golden-cheeked warbler	*Dendroica chrysoparia*	E	E
	Interior least tern	*Sterna antillarum athalassos*	E	E
	Mountain plover	*Charadrinus montanus*	–	Rare
	Western burrowing owl	*Athene cunicularia hypugaea*	–	Rare
	Whooping crane	*Grus americana*	E	E
Mammals	Black bear	*Ursus americanus*	T/SA	T
	Gray wolf	*Canis lupus*	E	E
	Plains spotted skunk	*Spilogaes putorius interrupta*		Rare
	Red wolf	*Caniu rufus*	E	E
Reptiles	Texas garter snake	*Thamnophis sirtalis annectens*	–	Rare
	Texas horned lizard	*Phrynosoma cornutum*	–	T
	Timber (Canebreak) Rattlesnake	*Crotalus horridus*	–	T
Plants	Comanche Peak prairie clover	*Dalea reverchonii*	–	Rare
	Glen Rose yucca	*Yucca necopina*	–	Rare

(a) Federal Status: E = Endangered; T/SA = Threatened by Similarity of Appearance.
(b) State Status: E = endangered; T = Threatened; Rare = Rare, but with no regulatory listing.

Sources: USFWS 2006, 2009a; TPWD 2007c, 2009f, 2009h.

Black-capped vireo (*Vireo atricapillus*) (Federally and State-listed as endangered). Black-capped vireos are small, about 4.5 in. in size, insectivorous songbirds found within the United States only in Oklahoma and Texas, and in three states in Mexico (USFWS 2007a). Black-capped vireos prefer patchy woodlands or shrublands. Males are characterized by olive-green backs, white stomachs, and black caps with a white patch around a reddish eye. Females are more cryptic in color than males with dark coloration along their backs (Campbell 2003, Grzybowski 1995, USFWS 1991).

Black-capped vireos nest in areas with 30 to 60 percent cover of deciduous trees. Their preferred habitat contains trees in excess of 6 ft high with cover extending to the ground. Open grasslands play an important role in habitat, providing foraging areas for the vireos (Campbell 2003, Graber 1961). Male vireos return to nesting areas starting in mid-March, and females arrive shortly thereafter. Home ranges vary from 3 to 10 ac (Campbell 2003, Graber 1961).

Males and females both contribute to nest building and site selection, often in a fork of a deciduous branch. Habitat modifications from range management practices and fire suppression, along with cowbird (*Molothrus alter*) nest parasitism, have probably led to their decline (Grzybowski 1995).

This species has been observed foraging and nesting in Dinosaur Valley State Park within about 3.5 mi of the CPNPP site, and at Fossil Rim Wildlife Center, which is 8 mi south-southwest of the CPNPP site (TPWD 2010b), both of which tentatively occur within the proposed corridor of the 45-mi Whitney transmission line.

However, no individual black-capped vireos or nests have been identified at the CPNPP (Luminant 2009a). Informal surveys for the black-capped vireo were conducted during April 2007 at various times of day over the course of 3 days over the CPNPP site, concentrating on the peninsula area proposed for construction of the new cooling towers. Survey methods consisted of walking transects on east/west axes spaced approximately 100 m (109 yd) apart. Black-capped vireos were not observed, and no suitable breeding habitat was noted (Luminant 2009a).

Golden-cheeked warbler (*Dendroica chrysoparia*) (Federally and State-listed as endangered). Upland sites within CPNPP may provide appropriate habitat for the golden-cheeked warbler. Golden-cheeked warblers winter in Mexico and Central America but breed only in Texas. They are small migratory songbirds, about 5 in. long and are characterized by yellow cheeks bisected by a black streak extending across the eye. Males and females are similar in appearance, although females are drabber (Campbell 2003, Ladd and Gass 1999).

Golden-cheeked warblers are dependent on Ashe juniper, but also require stands mixed with oaks, elms, and other hardwoods in relatively moist (mesic) areas such as steep canyons and slopes, and adjacent uplands (USFWS 1992). Kroll (1980) reported that occupied golden-cheeked warbler habitats had a lower juniper-oak ratio (1.35:1), contained junipers over 40 years old, and had lower understory diversity than unoccupied areas. Older Ashe junipers have peeling bark, an important component of golden-cheeked warbler nest construction. Older Ashe junipers are utilized as calling sites during mating.

After females arrive in March, mating begins and extends until April or May. Decline of golden-cheeked warblers is attributed to habitat loss and fragmentation due to range improvement practices, rapid urban development, flood control, and construction of impoundments (Ladd and Gass 1999). Nest parasitism by the brown-headed cowbird and competition with blue jays has also contributed to population declines (Campbell 2003, Engels and Sexton 1994). The USFWS along with TPWD have implemented landowner management plans and Safe Harbor Agreements to protect and enhance existing and potential golden-cheeked warbler habitat (Campbell 2003, Ladd and Gass 1999, USFWS 1992).

The golden-cheeked warbler has been observed foraging and nesting in Dinosaur Valley State Park within about 3.5 mi of the CPNPP site, but no individuals or nests have been identified at the CPNPP (Luminant 2009a). This species was not observed on the site during a survey in April 2007 (PBS&J 2007), or during a targeted presence or absence survey conducted in May 2007. A study was conducted using USFWS protocol during breeding season in April/May 2008, concentrating on the peninsula area proposed for construction of the new cooling towers, to determine the presence or absence of the species and whether suitable habitat was present (PBS&J 2008). Neither golden-cheeked warblers nor suitable habitat was present (PBS&J 2008). Most of the habitat present lacked the 20-percent mixture of hardwoods considered necessary for the species (PBS&J 2007); a 3.7 ac area along a stream confluence exhibited more favorable characteristics, but was considered too highly fragmented and small in size to support favorable nesting conditions (PBS&J 2008). In the area proposed for development of the BDTF, a habitat survey was performed in November 2007 and compared to a reference site where known golden-cheeked warbler populations exist. Additional site reconnaissance was performed on February 4, 2009. Both surveys confirmed that favorable golden-cheeked warbler habitat is absent from the area of the BDTF (Luminant 2009a). Canopy cover in and adjacent to the BDTF was found to be only about 20 percent, which is less than the minimum thought to be required of 35 percent (Luminant 2010a). See the Biological Assessment in Appendix F for further details.

Whooping crane (*Grus americana*) (Federally and State-listed as endangered). The whooping crane is the tallest bird in North America and has a wingspan of 7.5 ft. Whooping cranes are white with rust colored patches on the top and on the back of the head. They lack feathers on both sides of the head, and have yellow eyes, and long black legs and bills. The only remaining wild population of whooping cranes (the Wood Buffalo-Aransas population) breeds in the wetlands of Wood Buffalo Park in northern Canada and spends the winters on the Texas coast at Aransas National Wildlife Refuge near Rockport (TPWD 2009m). While the whooping crane could possibly be a migrant over the proposed project location, and while the USFWS states that the whooping crane is known to stop over at wetlands, water bodies, and croplands in Hood and Somervell Counties during its annual migration (DOI 2010), no natural heritage records of occurrences exist for Hood, Somervell, or Bosque Counties (NatureServe 2009, TPWD 2009f). No known occurrences of whooping cranes have been reported within a 10-mi radius of the CPNPP site, or the proposed new transmission line and pipeline corridors (TPWD 2009f), and they are not likely to use the inland habitats found on the CPNPP site for foraging, roosting, or nesting.

State-listed species. This section describes the Texas State-listed threatened and endangered terrestrial species in the vicinity of the site and the proposed new transmission and pipeline ROWs. Table 2-13 presents the terrestrial species that are State-listed as threatened or endangered, or that are species of concern and designated as rare, but with no regulatory listing, in counties within which CPNPP Units 3 and 4 (Somervell and Hood Counties) and the proposed new transmission and pipeline ROWs (Somervell, Hood and Bosque Counties) would be located. The State-listed and rare species potentially occurring in the vicinity of the proposed CPNPP Units 3 and 4, and the proposed new transmission line ROWs (Somervell, Hood, and Bosque Counties) are described below. A species is described only if there is a recorded occurrence in one of the three counties, or if the TPWD stated that it could be present where suitable habitat exists in one of the three counties even though there have been no recorded occurrences (TPWD 2007c).

Two birds, the black-capped vireo and the golden-cheeked warbler, are the only State-listed species with recorded occurrences (TPWD 2009f) in the counties potentially affected by the proposed CPNPP Units 3 and 4 facilities (Somervell and Hood Counties) or the two proposed new transmission line ROWs (Somervell, Hood, and Bosque Counties). These two bird species are also Federally-listed as endangered and have been described above. Three other State-listed species, bald eagle (*Haliaeetus leucocephalus*), Texas horned lizard (*Phrynosoma cornutum*), and timber (canebreak) rattlesnake (*Crotalus horridus*), although without recorded occurrences, could be present and affected by the project where suitable habitat is present (TPWD 2007c).

Occurrences of three species that are species of concern and designated as rare, but with no regulatory listing, have been reported from the counties crossed by the new ROWs: one reptile, the Texas garter snake (*Thamnophis sirtalis annectens*), and two plants, Comanche Peak prairie clover (*Dalea reverchonii*), and Glen Rose yucca (*Yucca necopina*).

Bald eagle (*Haliaeetus leucocephalus*) (State-listed as threatened). The bald eagle is a large predatory bird that occupies large trees along major water bodies such as lakes and rivers (Buehler 2000). Bald eagles nest in tall (40–120 ft) trees, usually within 1 or 2 mi of large rivers and streams where fish are abundant. SCR and Lake Granbury may provide appropriate habitat for the bald eagle. Wintering bald eagles are reported by CPNPP site personnel to forage and perch along the shore of SCR. No nests have been identified in the trees along the shoreline (Luminant 2009a). Bald eagles have dark body feathers, a distinctive white head, and a yellow beak at maturity. Adult female body size can reach 3 ft head to tail with an 8-ft wingspan. Males are slightly smaller (Campbell 2003, Buehler 2000).

Over-wintering bald eagle range extends into central Texas, including Hood and Somervell Counties (Campbell 2003). Fish are the main prey. Waterfowl, mammals, and carrion are other bald eagle food sources (Campbell 2003, Buehler 2000).

Habitat loss, shooting, and use of the insecticides such as DDT are the primary factors contributing to the historic decline of the bald eagle (Campbell 2003, Buehler 2000). Protection through laws and extensive conservation efforts led to recovery of the bald eagle. The bald eagle is currently listed as State-threatened in Texas. It was Federally delisted on July 9, 2007 (72 FR 37346). Bald eagles are still provided protection by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. This species had previously been observed at CPNPP, but was not observed on the site during field visits conducted in 2006 and 2007 (Luminant 2009a).

Texas garter snake (*Thamnophis sirtalis annectens*) (Considered Rare by TPWD, but with no regulatory listing). The Texas garter snake has a greenish black back with a broad orange stripe down the center and yellowish stripes on either side of the body. They are usually found in marshy, flooded pastureland or meadows and grassy or brushy terrain near hill country streams and ponds in eastern and central Texas, with an isolated population in southwestern Kansas. According to NatureServe, there are no existing natural heritage records of Texas garter snake occurrences for Hood, Somervell, or Bosque Counties (NatureServe 2009). However, TPWD recorded an occurrence of the Texas garter snake within 10 mi of one of the proposed new power transmission line ROWs (TPWD 2009f).

Texas horned lizard (*Phrynosoma cornutum*) (State-listed as Threatened). The Texas horned lizard is dorsoventrally flattened and cryptically colored with two occipital spines on the head (Pianka and Hodges 1998). Texas horned lizards are found in arid to semiarid sandy areas with bunchgrass and low vegetation cover of around 60 percent (Henke and Fair 1998). Adult Texas horned lizards are small (>2.75 in. long from snout to vent) and breed from March to July (Henke and Fair 1998, Pianka and Parker 1975).

Texas horned lizards feed only on harvester ants (*Pogonomyrmex* sp.). Insecticide use and interspecific competition from imported red fire ants reduce harvester ant density. Reduced prey availability may contribute to the decline of Texas horned lizard populations in Texas. Other factors that may contribute to population decline include habitat loss and overcollecting (Henke and Fair 1998). During a May 2007 survey harvester ant colonies were identified in certain areas on site. These areas were carefully examined for presence of the Texas horned lizard. None was found then or in a follow-up visit in July 2007 (Luminant 2009a).

Timber (canebrake) rattlesnake (*Crotalus horridus*) (State-listed as Threatened). The timber or canebreak rattlesnake is the second largest pit viper found in Texas. Adults range between 40 and 60 in. long (TPWD 2007e, Werler and Dixon 2000). They have lightly colored bodies with darker colored jagged stripes and solid black tails, culminating with a rattle. Though venomous, timber rattlesnakes rely on their cryptic coloration or avoidance when presented with danger, biting only when escape is not possible (TPWD 2007e, Werler and Dixon 2000).

Timber rattlesnakes are most frequently associated with riparian and bottomland forest or in partially wooded hillsides. Timber rattlesnakes are sit-and-wait predators, sometimes waiting for several hours by fallen trees for small mammals, their primary food source, to come along (TPWD 2007e, Werler and Dixon 2000). Ground-nesting birds, frogs, and other small vertebrates are also eaten.

Population decline of timber rattlesnakes has been blamed on habitat destruction, hunting, logging, and mortality induced while crossing roads (TPWD 2007e, Werler and Dixon 2000). This species was not observed on the site during field visits in 2007 (Luminant 2009a).

Comanche Peak prairie clover (*Dalea reverchonii*) (Considered Rare by TPWD, but with no regulatory listing). The Comanche Peak prairie-clover is endemic to Texas and is a low, spreading perennial, which appears as a dense, mat-forming rosette up to 16 in. in diameter. Numerous thick, 3-in. long spikes of rose-pink to magenta-purple flowers bloom from May through June (CPC 2009, TPWD 2009j). It is often found among sparse vegetation in barren, exposed sites, sometimes in roadway ROWs (TPWD 2008). The species is restricted to shallow-soil prairies where the Western Cross Timbers meet the Grand Prairie of north-central Texas, occurring mostly where Goodland Limestone lies at or near the surface (Poole et al. 2007). This prairie-clover is only known from about 20 occurrences within a very small geographic area in north central Texas and is considered extirpated from the Comanche Peak area (NatureServe 2009). One occurrence of Comanche Peak prairie clover is within 10 mi of the CPNPP site, but is more than 3 mi to the north of areas to be affected by project activities based on the map provided by TPWD (TPWD 2009f).

Glen Rose yucca (*Yucca necopina*) (Considered Rare by TPWD, but with no regulatory listing). The Glen Rose yucca is endemic to Texas and is found in the sandy soils of the Western Cross Timbers. It is easily distinguished by its white leaf margins bearing white curly threads and its branched flower stalk. The stalk may rise to 9 ft with white to greenish white flowers. It flowers in April through June (TPWD 2009j). The Glen Rose yucca is on the Watch List as a rare species, having either low population numbers or a restricted range in Texas (TNPD 2009). This yucca occurs in grasslands on sandy soils and limestone outcrops (TPWD 2009k). This species was not observed during informal field surveys conducted in 2007 by Enercon Services, Inc. However, three recorded occurrences of Glen Rose yucca were in the vicinity of the the proposed DeCordova transmission line and cooling water pipeline ROWs (TPWD 2010b). Glen Rose yucca may occur wherever suitable habitat is present.

Important Terrestrial Habitats

Important terrestrial habitats as defined in NUREG 1555 (NRC 2000) include:

- wildlife sanctuaries, refuges, and preserves;
- habitats identified by State or Federal agencies as unique, rare, or of priority for protection;
- land areas designated as critical habitat for species listed as threatened or endangered by USFWS; and
- wetlands if these areas might be adversely affected by plant or transmission or pipeline construction or operation (NRC 2000).

Wetlands are discussed in Section 2.4.2. The other groups are discussed further below.

Wildlife Sanctuaries, Refuges, and Preserves

Of the four wildlife protection areas discussed in Section 2.4.1.1 (see Table 2-10), which also function as ecologically oriented recreational areas and occur within the 50-mi radius of CPNPP, two could potentially be affected by new transmission line construction: Dinosaur Valley State

Park and Fossil Rim Wildlife Center. The Whitney transmission line ROW might pass through the northwest corner of Dinosaur Valley State Park and through Fossil Rim Wildlife Center (see Figure 2-13).

Unique and Rare Habitats or Habitats with Priority for Protection

Literature review, map review, and field reconnaissance performed by Luminant (Luminant 2009a), revealed no unique or rare habitats with priority for protection on or in the vicinity of CPNPP or potential new or expanded transmission line ROWs (USFWS 2007b).

Critical Habitat

Although there is the potential presence of Federally and State-listed species, such as the black-capped vireo and golden-cheeked warbler, within Somervell, Hood, and Bosque Counties, no critical habitat has been designated for either of these species within a 50-mi radius of the site, and transmission and pipeline ROWs (USFWS 2007b).

2.4.1.4 Terrestrial Monitoring

Additional environmental review would be conducted prior to development of transmission lines on new ROW and cooling water pipeline on expanded ROW. After Oncor secures State approval, the new ROWs would be subjected to pre-disturbance investigations as required by Federal and State regulatory requirements.

Other than the above, no additional preoperational or operational terrestrial ecological monitoring is planned or necessary for construction and operation of CPNPP Units 3 and 4, unless required as a condition of a non-NRC permit or regulatory approval from another government agency (Luminant 2009a).

2.4.2 Aquatic Ecology

This section describes the aquatic environment and biota in the vicinity of the CPNPP site and other areas likely to be affected by the building, operation, or maintenance of the proposed Units 3 and 4 and the associated transmission line and pipeline ROWs. This section describes the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages on which the proposed action and the associated transmission line and pipeline ROWs could have an impact, and the section identifies important or irreplaceable aquatic natural resources that might be affected by the proposed action. The physical characteristics, including hydrology and water quality, of the aquatic resources in the vicinity of the CPNPP site are described in Section 2.3.

The aquatic resources associated with the CPNPP site include reservoirs, rivers, creeks, and wetlands. The CPNPP site is located on SCR approximately 7 mi southwest of Lake Granbury, which is the largest and most important aquatic resource in the vicinity of the facility and the one with the greatest potential to be affected by the proposed action. Farther away, over 100 mi upstream of Lake Granbury, is the dam for PKL (Figure 2-12). PKL may be affected by the proposed action indirectly through changes in water management within the Brazos River Basin as a result of the proposed withdrawal from Lake Granbury for the proposed Units 3 and 4. Other aquatic resources in the vicinity of the site include the streams on which these reservoirs were constructed—Squaw Creek and the Brazos River. In addition, SCWD recently built the WBR on a tributary of the Paluxy River approximately 1 mi south of SCR, and CPNPP (including the proposed units) would be among the users it would supply. There are no sanctuaries or preserves that could be affected by the proposed action. The nearest such managed area is Dinosaur Valley State Park on the Paluxy River, 3.3 mi southwest of the CPNPP site.

2.4.2.1 Aquatic Resources—Site and Vicinity

Lake Granbury

Lake Granbury was created in 1969 by completion of the DeCordova Bend Dam on the Brazos River. The reservoir was built by the BRA to provide water for industrial, municipal, and irrigation uses. Lake Granbury is approximately 35 mi long and has a drainage area of 16,113 sq mi. It has an average depth of about 18 ft and a maximum depth of 74 ft (Luminant 2009a). Lake Granbury has a volume of 129,011 ac-ft and a surface area of 7945 ac at the conservation pool elevation of 693 ft MSL (Luminant 2009a). It is located between two other major Brazos River impoundments: PKL, whose dam is approximately 120 river mi upstream of the upper reaches of Lake Granbury to the northwest, and Lake Whitney, whose upper reaches are approximately 75 river mi downstream of the DeCordova Bend Dam to the southeast (TPWD 1974).

Surface water is withdrawn from Lake Granbury and diverted to SCR to supplement water losses associated with the operation of CPNPP Units 1 and 2 and to assist in maintaining the elevation and temperature of SCR. Proposed CPNPP Units 3 and 4 would utilize Lake Granbury as the source of their cooling water, so future withdrawals for that purpose would be in addition to the ongoing withdrawals of makeup water for Units 1 and 2. Blowdown from the cooling towers for Units 3 and 4 would be discharged back into Lake Granbury. During operation of all four reactors, the net consumptive loss from Lake Granbury would be approximately 95,745 ac-ft/yr (Luminant 2009a).

An ecological study was conducted to characterize the aquatic community of lower Lake Granbury throughout the four seasons. This study involved four sampling events (in May, September, and November 2007 and January 2008) at four locations along the west bank in the most-downstream reach of the lake, the area encompassing the proposed intake and discharge locations (Bio-West 2008a). The locations of the sample sites ranged from 330 m (1083 ft) to 2.6 km (1.6 mi) upstream of the dam. The site nearest the dam (LG-4) was sampled from shore to 11 m out into the lake, where depths were 5 m to 7 m. The next site upstream was an open-water site (LG-3) that was 110 m to 120 m offshore with depths of 13 m to 15 m. The third site upstream of the dam (LG-2) was 10 m to 30 m from shore with depths of 7 m to 9 m, and the most upstream site (LG-1) was 12 m from shore with depths of 11 m to 17 m.

The aquatic biological community of Lake Granbury comprises plankton, benthic macroinvertebrate, and fish communities, which are discussed below.

Plankton Community. Plankton are very small organisms (plants and animals) that float or swim weakly and move within a body of water mainly at the mercy of waves and currents (Goldman and Horne 1983). Data on the plankton community of Lake Granbury were collected in conjunction with a 9-month ecological study of Lake Granbury completed in 2008 (Bio-West 2008a). Zooplankton were sampled at four locations in lower Lake Granbury in May, September, and November 2007 and January 2008 using a vertically towed plankton net with 80-micron mesh. In addition, an extra sample was collected at one location (LG-1) during the summer (September) sampling event to look for golden alga (*Prymnesium parvum*), but golden alga cells were not found. The dominant planktonic organisms collected in all four seasons were copepods (crustaceans of the subclass Copepoda), with the majority in the larval (nauplius) stage. Copepods were followed in abundance by rotifers (phylum Rotifera) in summer and winter, and by water fleas (crustaceans of the order Cladocera) in spring and fall (Bio-West 2008a).

The alga *P. parvum* is the plankton species of predominant concern in Lake Granbury due to its history of causing toxic effects in other aquatic organisms in the reservoir. *P. parvum* has become common in western Texas and other parts of the American Southwest, where it is referred to as "golden alga." Golden alga is a single-celled, microscopic, primitive plant that swims using a pair of flagella and usually occurs suspended in the water column. It also has a shorter, stiff, hair-like structure (haptonema) with which it can attach to surfaces. When stressed by unfavorable conditions, golden alga, like many other algae, can form a resting cyst and become dormant. Resting cysts typically sink to the bottom. When conditions improve, cysts may be able to become active cells again, with the ability to swim and produce toxins, but very little is known about the characteristics of golden alga cysts. The yellow-green color of the golden alga comes from the pigment within its two chloroplasts. In addition to performing photosynthesis, it can engulf and digest bacteria and algae. Golden alga cells release toxins that may assist them in catching and ingesting these other cells (Sager et al. 2007, TPWD 2009c).

The toxins released by golden alga also affect nonprey organisms that breathe using gills. Susceptible organisms in inland Texas include all fish species, bivalve mollusks (such as clams), gill-breathing amphibians (such as tadpoles), crustaceans (such as crayfish), and some plankton (Sager et al. 2007). Golden alga releases at least two compounds that become toxic when they combine with positively charged ions (cations) in the water [such as calcium (Ca^{+2}), magnesium (Mg^{+2}), and potassium (K^{+1})]. Thus, the nature of the toxins formed is dependent on local water chemistry, and there usually is a combination of toxins present in the water (TPWD 2009c).

The golden alga toxins affect gill-breathing organisms by disrupting the selective permeability of exposed cells, such as those on the surface of the gills. The outer cell layers are damaged initially as excess water and chemicals enter the cells, causing them to die or rupture. As the damage extends inward, the gills become unable to function, their blood vessels leak, and the gills hemorrhage into the water. Bleeding also occurs from other exposed tissues, such as the fins. Cells of internal tissues can be damaged as well through exposure to toxins that have entered the fish's systemic circulation. The toxins have not been shown to affect humans or other organisms without gills. Wildlife have been observed to be unaffected by contacting or drinking water or eating fish containing the toxin, probably because of the protection provided by their relatively impermeable skin and the breakdown of the toxins by the acidic conditions in the stomach (TPWD 2009c).

P. parvum occurs worldwide in estuarine waters, and it also occurs in certain bodies of fresh water that have relatively high salt or mineral content, as is the case for the inland waters where it has caused fish kills in Texas. Fish kills described in Texas as early as the 1950s may have been caused by golden alga. This species was first documented in the United States in 1985 in conjunction with a fish kill on the Pecos River in Texas, and it has since caused fish kills in the Brazos, Canadian, Colorado, and Red River basins of Texas. It is not known if golden alga is native or an invasive species that was introduced to North America unintentionally, but it was not identified prior to 1985 (TPWD 2009c).

A bloom is an explosive increase in the population of one or more alga species. As the percentage of golden alga within the algal community of a waterbody increases beyond 50 percent and the species becomes dominant, there is a possibility of a golden alga bloom, which may result in a fish kill. However, a fish kill may not occur even when golden alga dominates the phytoplankton community, depending on whether certain conditions are present (TPWD 2009c).

The conditions that promote fish kills by golden alga are not well understood and are the subject of ongoing research by scientists. Certain conditions that are stressful to golden alga have been found to be associated with increased toxicity, such as low temperatures, low nutrient levels, low salinity, and high pH (TWRI 2009, Wythe 2008). It is an apparent paradox that golden alga grows optimally at warm temperatures of 25 to 30°C (77 to 86°F), yet it blooms in Texas mainly in winter. Thus, the majority of fish kills due to golden alga take place during winter when the water is cold. This may be because such conditions are not favorable for the growth of green algae, resulting in reduced competition for golden alga under cold conditions (TPWD 2009c). Recent field experiments in the area of Lake Granbury also suggest that cyanobacteria (often referred to as blue-green algae), which produce a variety of cyanotoxins that impair competitors, may suppress the growth of golden alga and prevent or reduce golden alga blooms in lakes with high cyanobacteria populations (TWRI 2009, Wythe 2008). Thus, if cyanobacteria proliferate in warmer water, golden alga blooms could be suppressed.

Golden alga has been reported in at least 16 states, and blooms appear to have been occurring with increasing frequency in inland waters, particularly in west Texas. Golden alga has caused fish kills in five major river systems in Texas. In the Brazos River basin, fish kills have occurred in Possum Kingdom Reservoir, Lake Granbury, Lake Whitney, and the Brazos River itself, as well as in two smaller lakes and two creeks. Millions of fish have been killed by golden alga in the Brazos River basin since the 1980s. Lake Granbury has relatively recently experienced major fish kills as a result of golden alga blooms. Over 4 million fish died in a bloom on Lake Granbury in the winter and spring of 2005 (TPWD 2009c, TWRI 2009). However, recent inventories completed by the TPWD indicate that the fisheries may not be as adversely affected by blooms as they once were. There currently is no effective method for controlling golden alga blooms in large reservoirs and rivers (TPWD 2009c).

Benthic Macroinvertebrate Community. The community of bottom-dwelling, macroscopic invertebrates inhabiting Lake Granbury was sampled in conjunction with a 9-month ecological study of the lake completed in 2008 (Bio-West 2008a). This study involved four seasonal sampling events (in 2007 and 2008) at four sites in the lower reach of the lake, as described above. The survey included five sampling sites based on information indicating that these locations are the most likely to be affected by operation of the proposed cooling system. Four of the sites are located in Lake Granbury, and one site is located in the Brazos River downstream of DeCordova Bend Dam. The lake sites encompassed different types of habitats and substrates and include a pelagic location located 110- to 120 m from shore. The Brazos River site was approximately 75 m of stream length that was chosen to adequately characterize the assortment of aquatic habitats in the area. At each of the open-water sites, the benthic invertebrate community was sampled using a Ponar sampler to collect three grab samples of substrate from the lake bottom. The three grab samples were combined to produce one composite sample representative of each site. The bank-side site was sampled using a D-frame net along the bank edges and within the channel to collect organisms. At a laboratory, the benthic invertebrates present in the composite samples were identified and counted. Insects were identified to the level of genus, and non-insects were identified to the lowest taxonomic level possible.

The 2007–2008 survey of the lower reach of Lake Granbury (Bio-West 2008a) resulted in findings that the benthic macroinvertebrate community was limited in diversity and abundance. The organisms collected were dominated by three families of Dipteran insects: midges (Chironomidae), phantom midges (Chaoboridae), and black flies (Simuliidae). Other insect orders were represented by only a few individuals. Similarly, only one or two individuals were collected from other major invertebrate taxa: water fleas (class Crustacea), snails (class Gastropoda), and segmented worms (phylum Annelida) (Bio-West 2008a).

Populations of invertebrates in Lake Granbury have been adversely affected by golden alga (TPWD 2009c). Most aquatic insects are not affected by golden alga toxins. Invertebrates inhabiting ponds and reservoirs in Texas that may be susceptible to the toxins include bivalve mollusks, such as clams, and crustaceans, such as crayfish (Sager et al. 2007).

Fish Community. The fish community of Lake Granbury has been characterized since 1998 by routine surveys conducted by the TPWD in conjunction with its Statewide Freshwater Fisheries Monitoring and Management Program. The most recent TPWD survey was performed in 2009–2010 (TPWD 2010a), which followed a survey completed in 2005–2006 (Baird and Tibbs 2006). The 2009–2010 survey relied upon random electroshocking and gill net collection methods throughout the lake while the 2005–2006 survey collected data at 38 sampling stations in the middle reaches of Lake Granbury. Both survey results estimated the catch per unit effort (CPUE) by method and species. The most downstream TPWD station during the 2005–2006 survey was located about 7 mi upstream of the dam.

The 2009-2010 TPWD survey relied upon methods that were not species specific; therefore, a comprehensive inventory was conducted. Results indicated that the prey species numbers were at or near an all-time high. Catfishes were collected in high numbers while bass species (temperate and largemouth [*Micropterus salmoides*]) had improved in numbers. White crappie (*Pomoxis annularis*) numbers were low, but this measure may have been attributable to the methods employed. The results from this survey showed positive trends for the majority of species inventoried and the potential need to reinstate the use of trap netting (TPWD 2010a).

The 2005–2006 TPWD survey focused on major sport fish species and important prey species. The TPWD report described the habitat of Lake Granbury as moderately eutrophic (waters containing moderate levels of nutrients), with few species of aquatic vegetation. A few parts of the upper reservoir support areas of emergent vegetation such as cattail (*Typha* spp.) and bulrush (*Scirpus* spp.), but there is little to no submerged vegetation, and nuisance macrophytes are not a problem in the lake. Physical structure providing habitat within the littoral zone of the lake includes extensive shoreline bulkheads; riprap; natural bluffs; boat docks; and stumps, dead trees, and standing timber (Baird and Tibbs 2006).

Lake Granbury was initially stocked in 1969 with largemouth bass and channel catfish (*Ictalurus punctatus*). Largemouth bass subsequently were stocked in 1970, 1972, and 1993. A subspecies, the Florida largemouth bass (*M.s. floridanus*) also was stocked on a limited basis in 1986 and extensively in 1989, 1994, 1995, 2003, 2004, and 2008. Channel catfish were stocked only one additional time in 1993. Striped bass (*Morone saxatilis*) fingerlings were stocked into Lake Granbury in 1972 and, with few exceptions, have been stocked annually since then. Blue catfish (*I. furcatus*) were stocked, with limited success, only in 1991. Prey species of fish were never stocked into Lake Granbury (Baird and Tibbs 2006, TPWD 2009e).

The 2005–2006 TPWD survey utilized three methods, trap netting, gillnetting, and electrofishing, to collect fishes from multiple locations randomly selected within the middle reaches of Lake Granbury. Gillnetting and trap netting were each conducted for ten nights at ten stations, and CPUE was recorded for each method as the number of fish caught per net night. Electrofishing was conducted for 5 minutes at each of 18 stations (a total of 1.5 hr), and CPUE was recorded as the number of fish caught per hour of electrofishing.

Table 2-14 summarizes catch rates from the surveys since 1998 and, as an indication of relative numbers collected recently, provides the numbers of fish of each target species collected in 2005–2006. The sport fishes collected included the stocked species identified above (except for blue catfish) as well as white bass (*Morone chrysops*), white crappie, bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), longear sunfish (*L. megalotis*), and redear sunfish (*L. microlophus*). The forage species collected were gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*) (Baird and Tibbs 2006).

Fish populations in Lake Granbury have been adversely affected since 2001 by golden alga (TPWD 2009c), as discussed above as part of the plankton community. The monitoring results indicated that catch rates for largemouth bass were reduced to well below the levels from before 2001. Catch rates for striped bass also were reduced considerably. White bass catch rates historically have been highly variable, and 2005 rates were slightly above average. White crappie catch rates were low and indicative of a low-density population, although the individuals were relatively large and similar in size to those in previous surveys. Channel catfish catch rates in 2006 were reduced relative to previous years, although the population continues to recruit young fish to legal sizes. Bluegill catch rates were much reduced in 2005, and the population continued to be dominated by smaller fish. Other sunfish were a minimal component of the prey base of the lake. The prey base was dominated by the gizzard shad population, which had returned to a level similar to that present before golden alga fish kills began, while threadfin shad catch rates remained low (Baird and Tibbs 2006).

Table 2-14. Fish Numbers and Catch Rates from TPWD Surveys of Lake Granbury

Species	Total CPUE and Number of Fish Collected[a]						
	2009-2010	2005–2006	2004	2003	2002	2001	1998
Gizzard shad	240.7 (361)	99.3 (149)	–	68.0 (102)	55.3 (83)	102.7 (154)	84.7 (127)
Threadfin shad	30.0 (45)	14.0 (21)	–	–	–	–	–
Channel catfish	22.0 (220)	2.4 (24)	4.8 (48)	4.5 (49)	5.0 (50)	5.5 (55)	3.9 (39)
White bass	3.8 (38)	2.7 (27)	5.6 (56)	0.5 (6)	2.3 (23)	1.9 (19)	2.3 (23)
Striped bass	2.9 (29)	0.2 (2)	1.7 (17)	0.2 (2)	1.9 (19)	0.4 (4)	1.7 (17)
Green sunfish	25.33 (38)	8.7 (13)	–	–	–	–	–
Warmouth	6.0 (9)	2.0 (3)	–	–	–	–	–
Bluegill	278.7 (418)	103.3 (155)	–	151.3 (227)	232.7 (349)	194.7 (292)	239.3 (359)
Longear sunfish	82.7 (124)	8.0 (12)	–	–	–	–	–
Redear sunfish	10.0 (15)	4.0 (6)	–	–	–	–	–
Largemouth bass	40.7 (61)	30.7 (46)	–	65.3 (98)	44.0 (66)	60.0 (90)	83.3 (125)
Blue catfish	2.30 (23)	-	-	-	-	-	-
White crappie	–	2.5 (25)	–	2.0 (20)	4.4 (44)	3.3 (33)	9.3 (93)

Sources: Baird and Tibbs 2006; TPWD 2010a..
(a) CPUE is followed by the number of fish collected (in parentheses).

Additional fisheries data were collected separately in conjunction with a 9-month ecological study of Lake Granbury completed in 2008 (Bio-West 2008a). This study involved four seasonal sampling events (in 2007 and 2008) at four locations in the lower reach of the lake, as described above. The area of the reservoir sampled in this study is about 5 mi downstream of the area included in the 2005–2006 TPWD study. The fish community of the lake was sampled in three of the four sampling events, but not in spring 2007. The fish community was sampled at each of the four sample sites using an experimental gill net with a length of 38.1 m (125 ft) and mesh sizes ranging from 2.5 to 7.6 cm (1.0 to 3.0 in.). The nets were set and left overnight for a duration of 13 hr to 16 hr. For each fish captured, total length (mm) and weight (gm) were recorded prior to release (Bio-West 2008a). The fish species known to currently occur in Lake Granbury based on this study and the 2005–2006 TPWD survey are summarized in Table 2-15.

All fish species in the lake potentially are susceptible to being affected and killed by the toxins released by golden alga blooms. The numbers of fish killed is dependent on the amount of toxin present in the water, which is affected by the duration of the bloom. Fish kills can last for days, weeks, or months, and the locations in a waterbody that are affected can change rapidly, even daily. All populations of the fish community may be reduced if a toxic bloom lasts many months and fish are killed in large portions of the waterbody (TPWD 2009c). Algal blooms have been found not to occur simultaneously throughout Lake Granbury (Wythe 2008), and most fish kills do not affect an entire lake for the entire duration of the event (TPWD 2009c). When a toxic bloom lasts only a month or less, the fish community usually is only partially affected and can recover more quickly (TPWD 2009c).

Table 2-15. Fish Species Occurring in Lake Granbury

Scientific Family	Scientific Name	Common Name
Catostomidae	*Ictiobus bubalus*	Smallmouth buffalo [c]
Centrarchidae	*Lepomis cyanellus*	Green sunfish [a, b]
	Lepomis gulosus	Warmouth [a, b]
	Lepomis macrochirus	Bluegill [a, b, c]
	Lepomis megalotis	Longear sunfish [a, b, c]
	Lepomis microlophus	Redear sunfish [a, b]
	Micropterus salmoides	Largemouth bass [a, b]
	Pomoxis annularis	White crappie [b, c]
Clupeidae	*Dorosoma cepedianum*	Gizzard shad [a, b, c]
	Dorosoma petenense	Threadfin shad [a, b]
Cyprinidae	*Cyprinus carpio*	Common carp [b]
Ictaluridae	*Ictalurus punctatus*	Channel catfish [a, b, c]
	Ictalurus furcatus	Blue catfish [a]
Moronidae	*Morone chrysops*	White bass [a, b, c]
	Morone saxatilis	Striped bass [a, b, c]
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum [c]

Species were collected in recent surveys:
(a) in 2009-2010 (TPWD 2010a)
(b) in 2005–2006 (Baird and Tibbs 2006)
(c) in 2007-2008 (Bio-West 2008a).

Small forage fish (such as shad, sunfish, and minnows) usually are the first to die. The numbers of fish killed in Texas have been dominated by forage species, mainly gizzard shad and threadfin shad. Forage fish produce large numbers of eggs and grow quickly, allowing their populations to recover rapidly if there is sufficient time between golden alga blooms that cause fish kills (TPWD 2009c). Thus, the populations of smaller fish composing the prey base of these sport fish generally have rebounded each year from the effects of golden alga toxicity. Although the gizzard shad population in 2005 had returned to pre-golden-alga levels, populations of threadfin shad, as well as bluegill and other sunfish, remained relatively low (Baird and Tibbs 2006). Larger species, including most game fishes (such as largemouth bass, striped bass, white bass, crappie, and catfish), reproduce more slowly and are dependent on forage fishes for food, so recovery of the populations of larger species can take years and may require stocking

(TPWD 2009c). Populations of game fish in Lake Granbury have been reduced annually since 2001 by toxic golden alga blooms. To mitigate these losses to the most important game fish species in the lake, striped bass have been stocked annually, and Florida largemouth bass have been stocked intermittently, including in 2008 (Baird and Tibbs 2006). However, recent TPWD inventory information indicates that Lake Granbury fish populations are showing improved trends. Of particular interest is the recovery of catfishes, which tend to be affected readily by the golden alga (TPWD 2010a).

Squaw Creek Reservoir

SCR was formed when a dam on Squaw Creek was completed in 1977 at a point approximately 7 mi southwest of the DeCordova Bend Dam on Lake Granbury. From the Squaw Creek Dam, Squaw Creek flows approximately 4.3 mi southeast to the Paluxy River, immediately above its confluence with the Brazos River, about 35 river mi downstream of Lake Granbury. When at its conservation pool elevation of 775 ft MSL, SCR is approximately 5 mi long and has 36 mi of shoreline, a volume of 151,418 ac-ft, and a surface area of 3297 ac (Luminant 2009a). SCR has an average depth of about 46 ft and a maximum depth of 135 ft and drains an area of 64 mi^2 (Luminant 2009a). Squaw Creek is a small stream with seasonal flows and provides very little inflow to SCR. Water is routinely discharged from the lake via the spillway to maintain a minimum flow of 1.5 cfs in Squaw Creek below SCR (Luminant 2009a). As described in Chapter 3, CPNPP Units 3 and 4 would not utilize SCR for cooling water; consequently, the proposed facility would have only a minimal potential to affect the aquatic ecology of SCR or Squaw Creek.

An ecological study was conducted in 2007-2008 to characterize the aquatic community of SCR throughout the four seasons. This study involved four principal sampling events, in February, May, September, and November 2007, at six locations within the lake, as well as one location on Squaw Creek 1.4 km below the dam. The six lake locations included three in shallow, littoral areas in coves (depths ranging from less than 1 m to 7 m) and three in deeper, open-water areas (depths ranging from 8 m to 22 m) of the lake (Bio-West 2008b). The aquatic biological community of SCR includes plankton, benthic macroinvertebrate, and fish communities, which are discussed below.

Plankton Community. Data on the plankton community of SCR were collected in conjunction with a 9-month ecological study of SCR completed in 2007 (Bio-West 2008b). Plankton were sampled in February, May, September, and November 2007 using a vertically towed plankton net with 80-micron mesh. Rotifers were the dominant planktonic animals collected in all seasons except summer. Juvenile copepods were by far the most abundant species in summer and were the next most numerous species in other seasons. Two families of water fleas (crustaceans of the order Cladocera) also were represented. Additional samples were collected at all seven sites during the summer sampling event to look for golden alga, but no golden alga cells were found (Bio-West 2008b).

Benthic Macroinvertebrate Community. The invertebrate community of SCR was sampled in February, May, September, and November 2007 using a Ponar sampler and D-frame nets. Six locations in the lake were sampled: three shallow-water (littoral) and three deep-water (open-water) sites. The most abundant invertebrates collected in all seasons were insects of the order Diptera (flies), which were dominated by midges (family Chironomidae). The next most numerous taxa by season were snails in winter, amphipods in spring, other Dipteran insect families in summer, and damselflies (family Coenagrionidae) in fall. Benthic macroinvertebrates were rare at the open-water sites; only midges were collected. The littoral sites exhibited greater abundance and diversity, with highest numbers in spring (Bio-West 2008b).

Fish Community. Data characterizing the fish community of SCR were collected in conjunction with the four-season ecological study of SCR completed in 2008 (Bio-West 2008b). Fishes were collected at the six lake sampling locations in two seasons, winter (February 2007) and summer (September 2007). In addition, a supplemental winter survey (January 2008) was performed at the two locations, one littoral and one open-water, nearest the CPNPP facility. The fish community was sampled at each of the four sample sites using an experimental gill net with a length of 38.1 m (125 ft) and mesh sizes ranging from 2.5 to 7.6 cm (1.0 to 3.0 in.). The nets were set and left overnight for a duration of 14 to 17 hr. Captured fish were identified to species, and their total length and weight were recorded before their release (Bio-West 2008b). The fishes collected in this 2007-2008 survey are identified in Table 2-16.

Table 2-16. Fish Species Occurring in Squaw Creek Reservoir[(a)]

Scientific Family	Scientific Name	Common Name
Atherinopsidae	*Menidia beryllina*	Inland silverside [(b)]
Catostomidae	*Carpiodes carpio*	River carpsucker [(b)]
	Moxostoma carinatum	Redhorse sucker [(b)]
Centrarchidae	*Lepomis auritus*	Redbreast sunfish [(b)]
	Lepomis cyanellus	Green sunfish [(b, c)]
	Lepomis gulosus	Warmouth [(b)]
	Lepomis macrochirus	Bluegill [(b, c)]
	Lepomis megalotis	Longear sunfish [(b)]
	Lepomis microlophus	Redear sunfish [(b)]
	Micropterus dolomieui	Smallmouth bass [(b)]
	Micropterus salmoides	Largemouth bass [(b, c)]
	Pomoxis annularis	White crappie [(b)]
Clupeidae	*Dorosoma cepedianum*	Gizzard shad [(b, c)]
	Dorosoma petenense	Threadfin shad [(b, c)]
Cyprinidae	*Cyprinus carpio*	Common carp [(b, c)]
	Notemigonus crysoleucas	Golden shiner [(b)]
Ictaluridae	*Ameiurus melas*	Black bullhead [(b)]
	Ameiurus natalis	Yellow bullhead [(b)]
	Ictalurus furcatus	Blue catfish [(c)]
	Ictalurus punctatus	Channel catfish [(b, c)]
	Pylodictis olivaris	Flathead catfish [(c)]
Moronidae	*M. saxatilis X M. chrysops*	Hybrid striper [(b)]
	Morone chrysops	White bass [(b)]
Percidae	*Etheostoma chlorosoma*	Bluntnose darter [(b)]
	Etheostoma gracile	Slough darter [(b)]
	Percina caprodes	Log perch [(b)]
	Sander vitreus	Walleye [(b)]
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum [(b, c)]

(a) These species were collected in the two most recent surveys:
(b) In 1987 (Luminant 2009a).
(c) In 2007–2008 (Bio-West 2008b).

A previous survey of the fish community of SCR was performed in 1987, prior to operation of CPNPP Units 1 and 2 (Luminant 2009a). The species identified in that study also are included in Table 2-16, providing an indication of species that were present in the reservoir historically. Some of these species, although not collected in the most recent survey, potentially could still be present. However, many species (including walleye [*Sander vitreus*], smallmouth bass [*Micropterus dolomieui*] and hybrid striper [*Morone saxatilis* X *M. chrysops*]) likely are no longer present due to temperatures in the lake during the summer that exceed their upper tolerances. The dominant species in terms of the number of individuals collected in all locations and both seasons was the channel catfish (270 individuals). The next most common species collected were freshwater drum (*Aplodinotus grunniens)* (25) at the open-water locations and largemouth bass (45) at the littoral locations.

The fish community of Squaw Creek downstream of SCR was surveyed in conjunction with the four-season ecological study of SCR completed in 2008 (Bio-West 2008b). One location on Squaw Creek, 1.4 km below the dam, was sampled when the reservoir was sampled, in winter (February 2007) and summer (September 2007). Sampling took place within a 55 m reach of the creek using a backpack electrofisher and several types of seines with variable mesh sizes. Captured fish were identified to species, and their total length (millimeters) and weight (grams) were recorded before their release. The most numerous species collected in the creek was gambusia (*Gambusia* sp.), of which 60 individuals were found only in winter. The next most numerous species at the creek location was inland silverside (*Menidia beryllina*), of which 6 individuals were found only in winter. Other species collected in the creek included bluegill (5), largemouth bass (2), and green sunfish (1) (Bio-West 2008b).

Brazos River

The Brazos River is the longest river in Texas. Its main stem originates at the confluence of its two upper forks, the Double Mountain Fork and Salt Fork, in Stonewall County and is joined downstream by the Clear Fork. From its origin in northwestern Texas, the Brazos flows generally southeast to its mouth on the Gulf of Mexico near Freeport, extending about 840 river mi across the state. Its watershed, which reaches from New Mexico to the Gulf, covers over 44,600 sq mi (Hendrickson 2002).

Water released to Squaw Creek from SCR flows into the Paluxy River near its confluence with the Brazos River. During the period 1994 to 2006, an average of 34,128 ac-ft/yr was diverted from the Brazos River at Lake Granbury and pumped to SCR to provide makeup water. Also during this period, an average of 21,678 ac-ft/yr of surface water from SCR was released through the spillway to flow back into the Brazos River near Glen Rose (Luminant 2009a), about 35 river mi downstream of Lake Granbury. Thus, the operation of CPNPP Units 1 and 2 resulted on average in the net removal of approximately 12,450 ac-ft/yr from the Brazos River drainage.

The Brazos River below Lake Granbury and above the backwaters of Lake Whitney has been described as being scenic and meandering extensively as it flows through rolling hills covered with oaks and cedar. Substrates in this reach are mainly sand and rocks, with several limestone outcroppings present, especially near the mouth of the Paluxy River (TPWD 1974).

In conjunction with the 2007–2008 survey of Lake Granbury, an ecological study was conducted to characterize the aquatic community of the Brazos River downstream of Lake Granbury throughout the four seasons. One location (BR-1) on the river 2.9 km (1.8 mi) below the DeCordova Bend Dam was sampled. As for the lake, the survey of the river location involved four seasonal sampling events (in May, September, and November 2007 and January 2008). Site BR-1 extended approximately 75 m along the river to encompass a range of riverine habitats, including riffles, runs, pools, backwaters, and side channels. Substrates in these habitats included gravel, cobble, and bedrock in the main channel and silt in the backwaters. The width of the river in this reach ranges from 33 m to 115 m and varies with flow conditions (Bio-West 2008a).

The aquatic biological community of the Brazos River includes plankton, benthic macroinvertebrate, and fish communities, which are discussed below.

Plankton Community. Data on the plankton community of the Brazos River were collected in conjunction with the 2007–2008 ecological study of Lake Granbury (Bio-West 2008a). Zooplankton were sampled at site BR-1 in May, September, and November 2007 and January 2008. A vertically towed plankton net with 80-micron mesh was utilized. The dominant planktonic organisms collected in all four seasons were copepods, with the majority in the larval (nauplius) stage. As in Lake Granbury, copepods were followed in abundance by rotifers and water fleas (crustaceans of the order Cladocera) (Bio-West 2008a).

Invertebrate Community. To characterize the invertebrate community downstream of the DeCordova Bend Dam, benthic invertebrates were collected in conjunction with the 2007–2008 ecological study. Benthic invertebrates were sampled at site BR-1 in May, September, and November 2007 and January 2008 using D-frame nets in the various habitats within the site reach, including riffles, runs, pools, backwaters, and side channels. All organisms collected were preserved in the field and identified in the laboratory. Insects were identified to genus, non-insects were identified to the lowest taxon possible, and the number of individuals in each taxon was recorded (Bio-West 2008a).

The invertebrate sampling in the Brazos River downstream from Lake Granbury identified insects as the dominant class. The greatest insect diversity was recorded in the summer sampling, with 29 genera identified. The greatest abundance of aquatic insects was recorded in the fall, when the preponderance of individuals counted were black flies (family Simuliidae) and caddisflies (family Hydropsychidae). The abundance and diversity of caddisflies (Order Trichoptera) and mayflies (Order Ephemeroptera) observed are considered indications of a relatively healthy aquatic environment in this reach of the river. Other than insects, the only invertebrates collected were freshwater snails and a mud crab (*Rhithropanopeus* sp.) (Bio-West 2008a).

Fish Community. The fish community within the middle reaches of the Brazos River has been affected by habitat alterations downstream of three major reservoirs: PKL, Lake Granbury, and Lake Whitney. PKL is impounded by the Morris Sheppard Dam, which contains hydroelectric generators. Depending on pool elevation and the local need for power, the dam releases colder water from the hypolimnion of the reservoir to generate power. These releases have altered the thermal regime of the river up to 75 mi downstream and, in conjunction with the associated effects on water chemistry, are likely responsible for the extirpation of at least four fish species downstream. Lakes Granbury and Whitney also have contributed to habitat modifications within the middle and lower Brazos River and affected the ability of river habitats in these reaches to support certain native fishes (USFWS 2008a).

To characterize the species composition of the fish community in the Brazos River between Lake Granbury and Lake Whitney, the review team initially identified a list of fish species that occur in the greater Brazos River drainage, extending from the headwaters to the coast (Hassan-Williams and Bonner 2007). A subset of species then was identified by reviewing range maps for these species (Lee et al. 1980) to determine their potential for occurrence in the vicinity of the river reach between Lakes Granbury and Whitney. This group of species was further refined by evaluating the degree of similarity between their preferred habitats (Hassan-

Williams and Bonner 2007) and the habitats likely to be available in this river reach. The potentially occurring fishes thus identified are listed in Table 2-17.

To characterize the fish community immediately downstream of the DeCordova Bend Dam, fish were collected in conjunction with the 9-month ecological study of Lake Granbury completed in 2008 (Bio-West 2008a). As described above, this study involved four seasonal sampling events (in 2007 and 2008) at four sites in the lower reach of the lake, and it also included one site (BR-1) on the Brazos River 2.9 km (1.8 mi) below the dam. The fish community was sampled at site BR-1 using a backpack electrofisher and several types of seines, including bag seines and straight seines. For each fish captured, total length and weight were recorded prior to release (Bio-West 2008a). Fish identified in this survey are included in Table 2-14.

Possum Kingdom Lake

PKL was created in 1941 by completion of the Morris Sheppard Dam on the Brazos River northwest of Fort Worth in Palo Pinto County, with the upper reaches of the lake extending into Stephens and Young Counties. The reservoir was built primarily for water conservation and flood control, but it also is a hydroelectric generating facility, with two 11,250-kW generators that supply electricity during periods of peak demand. The dam is 190-ft high and 2700-ft long. PKL has a surface area of approximately 17,700 ac, 310 mi of shoreline, and a drainage area of 14,030 sq mi. It has an average depth of about 37 ft, a maximum depth of 145 ft, and a depth of approximately 100 ft at the dam (BRA 2010; TPWD 2009g). The volume of PKL is 556,200 ac-ft, and its conservation pool elevation is 1000 ft MSL (BRA 2010). The PKL dam is approximately 122 river mi upstream of the upper end of Lake Granbury to the southeast (TPWD 1974).

Most of the shoreline of PKL is covered by cobble and larger-size rock. The lower portion of the lake has rock cliffs and bluffs, while the upper reaches extend into shallower areas with vegetation along the shoreline. Points and drop-offs occur throughout the lake, and there are many boat docks present. Physical structure providing habitat within the littoral zone of the lake includes natural rock and riprap; natural bluffs; boat docks; and stumps, fallen dead trees, and standing timber. Aquatic vegetation in PKL includes emergent rushes at depths of 2 ft to 3 ft in the middle to upper portions of the lake, and submerged vegetation throughout littoral areas of the lake in late summer and fall (TPWD 2009g). PKL has no significant history of vegetation/habitat management and has no problems with noxious vegetation (Howell and Mauk 2007).

The aquatic biological community of PKL comprises plankton, benthic macroinvertebrate, and fish communities that are likely to be similar to those described above for Lake Granbury, including the presence of golden alga in the plankton community. As is the case for Lake Granbury, the fish community of PKL has been characterized since 1999 by routine surveys conducted by the TPWD in conjunction with its Statewide Freshwater Fisheries Monitoring and Management Program. The most recent TPWD survey was performed in 2006–2007. It collected data in PKL by gill netting and net trapping at 15 sampling stations and by electrofishing at 24 stations (Howell and Mauk 2007).

Table 2-17. Fish Species Potentially Occurring in the Brazos River Between Lake Granbury and Lake Whitney[(a)]

Scientific Family	Scientific Name	Common Name
Atherinopsidae	*Menidia beryllina*	Inland silverside[(b)]
Catostomidae	*Carpiodes carpio*	River carpsucker
	Ictiobus bubalus	Smallmouth buffalo
Centrarchidae	*Lepomis cyanellus*	Green sunfish[(b)]
	Lepomis macrochirus	Bluegill[(b)]
	Lepomis megalotis	Longear sunfish[(b)]
	Lepomis microlophus	Redear sunfish[(b)]
	Micropterus punctulatus	Spotted bass
	Micropterus salmoides	Largemouth bass[(b)]
Clupeidae	*Dorosoma cepedianum*	Gizzard shad[(b)]
	Dorosoma petenense	Threadfin shad
Cyprinidae	*Campostoma anomalum*	Central stoneroller
	Cyprinella lutrensis	Red shiner[(b)]
	Cyprinella venusta	Blacktail shiner[(b)]
	Cyprinus carpio	Common carp[(b)]
	Hybognathus placitus	Plains minnow
	Notropis buchanani	Ghost shiner
	Notropis potteri	Chub shiner
	Notropis volucellus	Mimic shiner
	Pimephales vigilax	Bullhead minnow[(b)]
Fundulidae	*Fundulus zebrinus*	Plains killifish
Ictaluridae	*Ameiurus melas*	Black bullhead
	Ameiurus natalis	Yellow bullhead
	Ictalurus furcatus	Blue catfish[(b)]
	Ictalurus punctatus	Channel catfish[(b)]
	Noturus nocturnus	Freckled madtom
	Pylodictus olivaris	Flathead catfish[(b)]
Lepisosteidae	*Atractosteus spatula*	Alligator gar
	Lepisosteus osseus	Longnose gar[(b)]
Moronidae	*Morone chrysops*	White bass[(b)]
Percidae	*Etheostoma spectabile*	Orangethroat darter[(b)]
	Percina sciera	Dusky darter[(b)]
Poeciliidae	*Gambusia* sp.	Gambusia[(b)]
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum[(b)]

(a) Species list developed by identifying from a list of species occurring in the greater Brazos River drainage (Hassan-Williams and Bonner 2007) those species that may occur in this reach based on range maps (Lee et al. 1980), then considering the potential presence in this river reach of habitat types preferred by each species (Hassan-Williams and Bonner 2007).

(b) These species were identified in fish surveys in 2007–2008 at a sample location on the Brazos River 1.8 mi downstream of the Lake Granbury dam (Bio-West 2008a).

The TPWD survey focused on major sport fish species and important prey species. PKL has been stocked at irregular intervals since 1966 with largemouth bass, Florida largemouth bass, smallmouth bass, striped bass, channel catfish, and blue catfish. A prey species, threadfin shad, was stocked into PKL in 1980 and 2001 (Howell and Mauk 2007, TPWD 2009g). The fish species collected in the TPWD survey included the species identified above for Lake Granbury in Tables 2-12 and 2-13 as well as small numbers of black crappie (*Pomoxis nigropunctatus*), blue catfish, longnose gar (*Lepisosteus osseus*), and river carpsucker (*Carpiodes carpio*). As was discussed for Lake Granbury, fish populations in PKL also have been adversely affected since at least 2001 by fish kills resulting from golden alga. In particular, striped bass populations have been reduced drastically by golden alga (Howell and Mauk 2007).

Wheeler Branch Reservoir

WBR is shown in Figure 2-7 and discussed in Section 2.3.2.1. This water supply reservoir was built by the SCWD to provide water for the City of Glen Rose, the CPNPP site, and other Somervell County users. The allocation for the CPNPP site is 28 percent of the total available annual supply from the reservoir. WBR was built on a small tributary of the Paluxy River, and a low channel dam was built on the Paluxy River at Glen Rose to allow water to be pumped from the river to help fill and maintain the water level of the reservoir. The Wheeler Branch Dam was completed in 2007, and filling of the reservoir was completed in 2008. The reservoir has a surface area of 180 ac and a depth of 80 ft at the dam. Florida largemouth bass, smallmouth bass, bluegill, and channel catfish fingerlings were first stocked in WBR in 2007. These species were again stocked in 2008, and in 2009 smallmouth bass fingerlings and walleye fry were released (TPWD 2010h).

2.4.2.2 Aquatic Resources—Transmission Lines and Cooling-Water Pipelines

This section describes the aquatic resources with the potential to be affected by the transmission lines and cooling-water pipelines proposed for installation and operation in conjunction with CPNPP Units 3 and 4. These transmission lines are described in Section 3.4, and the land uses within the ROWs are described in Section 2.2.2. Of the four new transmission lines, two would be added to vacant positions on existing towers, and two would require ROW clearance and tower building. The exact routes to be followed by the two new lines (DeCordova and Whitney) have not been determined pending completion of transmission routing studies, so this description is based on the approximate routes shown in Figure 2-14. The transmission line ROWs would not cross any designated critical habitats for aquatic species.

As it leaves the CPNPP Units 3 and 4 switching station, the DeCordova transmission line would cross Squaw Creek and several inlets along the shoreline of SCR (Figure 2-14). Its northern end would cross the Brazos River near the DeCordova Bend Dam and Lake Granbury approximately 1.7 mi upstream of the dam. Based on an ROW width of 160 ft, the total water area within this ROW would be approximately 11 ac, 7.4 percent of the total ROW area (Table 2-11). The areas of wooded wetlands that would be crossed are small, totaling about 1.6 ac, 1.1 percent of the ROW area (Table 2-11).

The Whitney transmission line would cross only one major waterbody, the Paluxy River. In addition, it likely would cross several small tributaries of the Brazos River and Lake Whitney (Figure 2-14). Based on an ROW width of 160 ft, the total water area within this ROW would be approximately 3.1 ac, 0.3 percent of the total ROW area (Table 2-11). The areas of wooded wetlands that would be crossed total about 23 ac, 2.4 percent of the ROW area (Table 2-11).

The cooling-water intake and blowdown discharge pipelines for the proposed CPNPP Units 3 and 4 mainly would follow an existing ROW containing the 48-in. water pipeline for Units 1 and 2 that connects Lake Granbury to SCR (Figure 2-5). ROWs for the new pipelines would diverge from the existing ROW at each end: where they would extend around the south side of SCR, and where the discharge pipeline would extend southeast from the intake location on Lake Granbury to the discharge location near the dam. Aquatic resources within the ROW areas where the pipelines potentially would be installed include stock ponds, several small tributaries of the Brazos River, and Squaw Creek. The stock ponds are small, isolated, man-made impoundments that provide minimal habitat for aquatic species. The tributaries are small, intermittent streams (HDR 2008), which typically lack surface flow during dry periods and support minimal aquatic communities. Squaw Creek immediately below the dam is a small stream in which a minimum flow of 1.5 cfs is maintained by routine discharges from the dam (Luminant 2009a). The pipeline ROWs would not cross any designated critical habitats for aquatic species. A field check of the entire pipeline ROW in April and July of 2007 showed no wetlands to be present (Luminant 2009a).

2.4.2.3 Aquatic Resources—Wetlands

Wetlands include swamps, marshes, and similar areas that are transitional between aquatic and terrestrial communities. Wetlands are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that normally do support, a prevalence of vegetation adapted for life in saturated soil conditions (Cowardin et al. 1979). Thus, a wetland typically exhibits the following three characteristics (Mitsch and Gosselink 2000): water at the surface or within the root zone, unique soil conditions different from adjacent uplands, and hydrophytic vegetation with an absence of species intolerant of flooding.

Near Lake Granbury, wetlands have not been identified along the western bank in the areas where the CPNPP Units 3 and 4 intake or discharge structures would be located. Near SCR, emergent wetland vegetation along the shore of the SCR peninsula was delineated using Global Positioning System (GPS) point coordinates obtained during a survey of the lake shoreline by boat in February and May 2007 (Luminant 2009a). An April study focused on evaluating emergent wetlands associated with the on-site ponds and SCR (Luminant 2009a). Wetlands at the CPNPP site are dominated by a variety of emergent plant species. The herbaceous layer is dominated by southern cattail (*Typha domingensis*) and broadleaf cattail (*T. latifolia*), along with Roosevelt weed (*Bacharris neglecta*), bushy bluestem (*Andropogon glomeratus*), and spikerush (*Eleocharis* sp.). The tree and shrub layers are dominated by black willow (*Salix nigra*), buttonbush (*Cephalanthus occidentalis*), cottonwood (*Populus deltoides*), and saltcedar (*Tamarix chinensis*).

A subsequent wetland delineation was undertaken to identify wetlands and other waterbodies subject to the jurisdiction of the USACE in the vicinity of the proposed action (Enercon 2009). These investigations documented the locations in SCR of emergent, littoral wetlands, which occur in shallow water along the edges of lakes and reservoirs. Forty-eight littoral wetlands, with a cumulative area of approximately 53 ac, were found to occur along the shoreline of SCR (Figure 2-15). Due to inundation, a complete soil profile could not be obtained for all wetlands. Thus, inundated wetlands were conservatively assumed to be hydric on the basis of the other two positive indicators – hydrophytic vegetation and hydrology (Enercon 2009). Luminant has not requested a wetland jurisdictional determination from the USACE (Luminant 2009a).

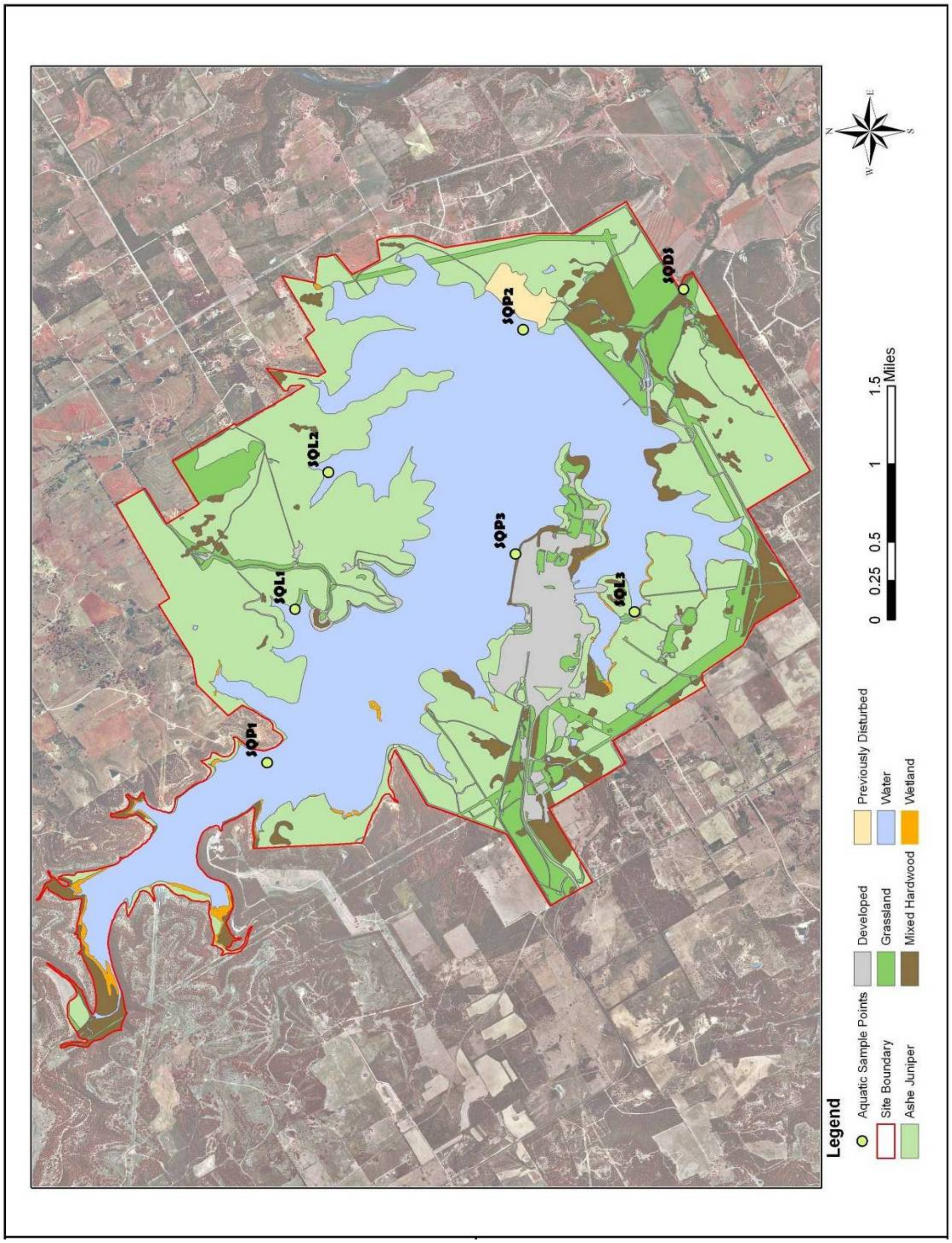


Figure 2-15. Vegetative Cover of the CPNPP Site (Luminant 2009a)

The majority of the wetlands associated with SCR are located along the shore of the reservoir and are dominated by cattails. Wetland functionality is influenced by the time necessary for water to move through the wetland, the size of the wetland, and the diversity of vegetation the wetland supports. The functionality of the narrow, littoral wetlands on SCR is limited, and they are considered to be of relatively low quality (Enercon 2009). Wetlands that are located at the inlets of streams that consistently flow into SCR, such as those at the north end of SCR where Squaw Creek enters the reservoir, are larger in area, have greater plant species diversity, support aquatic plant and animal species, and help to stabilize sediments. These wetlands are considered of higher quality than the narrower, fringe wetlands along the SCR shoreline (Enercon 2009).

In the area of the proposed construction for CPNPP Units 3 and 4, one littoral wetland with an area of 0.78 ac (Figure 2-16) was identified at the mouth of an intermittent stream along the southeast shoreline of the peninsula where the proposed cooling tower structures would be located. Portions of this wetland would be affected by construction activities. Dominant vegetation associated with this wetland includes black willow, saltcedar, and Texas ash in the tree and shrub layer. The herbaceous layer includes southern cattail, broadleaf cattail, bushy bluestem, and Roosevelt weed. Although this wetland is likely jurisdictional, it is considered to be a marginally functional wetland because it is dominated by cattails, is small in size, and the stream leading through the wetland into SCR has only intermittent flow (Enercon 2009).

Field reconnaissance in the area where a proposed BDFT would be located west of the Squaw Creek dam identified a small area (0.25 acre) that may be affected by seepage below a dam that created an old stock pond. The pond itself is isolated and likely non-jurisdictional, having no hydrological connection to any potentially jurisdictional waterbody (Enercon 2009). The area below the pond does not appear to have wetland characteristics. The most common vegetation species in this area include an unidentified rush, annual ragweed (*Ambrosia psilostachya*), and smartweed (*Polygonum* sp.).

In the vicinity of the proposed location of CPNPP Units 3 and 4 on SCR, there are two intermittent streams that drain into the lake, one on either side of the peninsula on which the cooling towers would be constructed (Enercon 2009) (Figure 2-16). In addition, two intermittent streams in the area of the proposed BDTF drain into Squaw Creek below the SCR dam.

2.4.2.4 Important Aquatic Species and Habitats

Fishery Species

There are no commercial fisheries in Lake Granbury, SCR, PKL, the Brazos River between Lake Granbury and Lake Whitney, or WBR. Recreational fishing historically has occurred in all of these waterbodies except WBR, which was recently completed and first stocked with immature game fish in 2007 so its recreational fishery is in development. Although SCR was stocked with fish and opened for public fishing soon after its completion, fishing by the public was banned in SCR for security reasons in September 2001. CPNPP employees and certain invited groups were allowed to fish from the banks of SCR, but boats were not permitted (Luminant 2009a). In June 2010, the SCR was reopened to the public for recreational uses, including fishing and boating, but access will be controlled. Water-based recreation is among the uses for which Lake Granbury is operated by the BRA, and five public access areas are maintained to facilitate its use by recreational fishermen (BRA 2009). There also are several private boat ramps, but access for bank fishing is poor (Baird and Tibbs 2006). The overall fishing opportunities provided by Lake Granbury are rated by TPWD as good for largemouth bass, striped bass, white bass, catfish, and sunfish and fair for crappie (TPWD 2009e). As discussed above in describing the fish community of Lake Granbury, game fish populations have been reduced annually since 2001 by toxic blooms of golden alga, and stocking has been used to mitigate the losses of striped bass and largemouth bass (Baird and Tibbs 2006). PKL also is used for recreational fishing, and available facilities include eight public boat ramps, 15 private boat ramps, two fishing piers, and publicly accessible areas for bank fishing. Similar to Lake Granbury, PKL has been affected since 2001 by golden alga blooms, and stocking is used to maintain striped bass and largemouth bass numbers (Howell and Mauk 2007). The overall fishing opportunities provided by PKL are rated by TPWD as fair for largemouth bass, crappie, striped bass, and sunfish; good for catfish; and excellent for white bass (TPWD 2009g). The Brazos River below Lake Granbury supports recreational fishing from its banks, by wading, or from canoes. Descriptions of five species representative of the recreational fisheries of Lake Granbury, SCR, PKL, and/or the Brazos River below Lake Granbury are provided below.

Largemouth Bass

The largemouth bass is a large member of the family Centrarchidae (sunfish and black basses), and a top predator in freshwater ecosystems. It is native to most of the United States east of the Rocky Mountains, including many rivers and lakes in Texas. It is the most popular game fish in Texas, which has led to its introduction into many waterbodies. The native subspecies in Texas is *Micropterus salmoides salmoides*, but the Florida subspecies (*M. salmoides floridanus*) also has been introduced into many Texas lakes, including Lake Granbury. This bass matures at 22 to 25 cm (9 to 10 in.) in length and in the southeastern United States can reach a length of up to 50 cm (20 in.) by 6 years of age. The diet of the largemouth bass when young consists mainly of small invertebrates and, as the fish increases in age and size, transitions to mainly fish (such as shads, sunfishes, and darters) and larger invertebrates. Its reproductive strategy involves the male building a nest in a shallow, protected area; deposition of eggs and sperm over the nest; and the demersal eggs adhering to and remaining in the nest, where they are guarded by the male. The male guards the nest for several weeks, and during this period, the eggs hatch after about 3 days, the newly hatched larvae remain within the nest substrate for up to 7 days, and the larvae grow and begin to feed in the water column (Hassan-Williams and Bonner 2007). The largemouth bass is the most preferred sport fish among licensed anglers in Texas (TPWD 2009b).

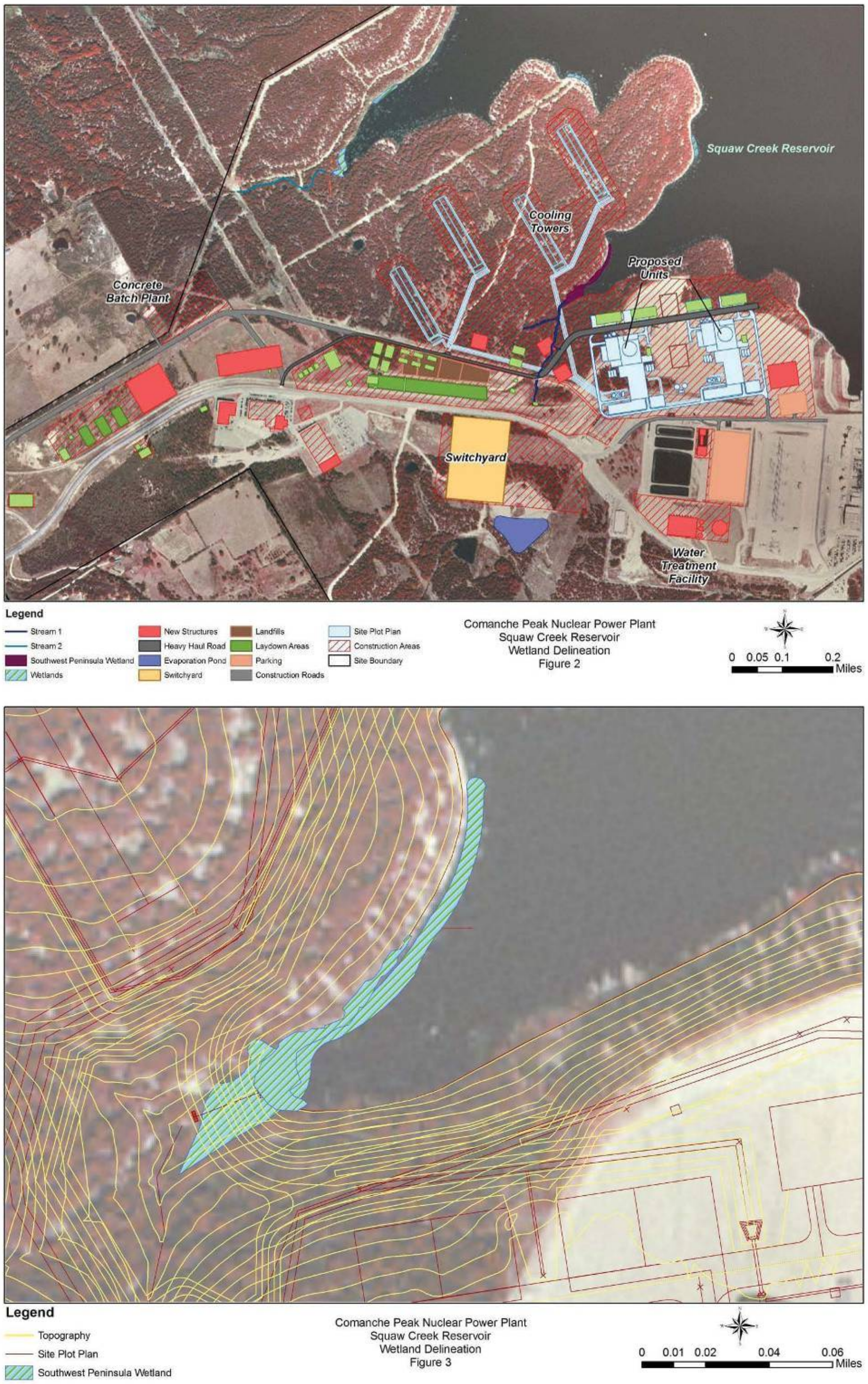


Figure 2-16. Squaw Creek Reservoir Wetland Delineation. Upper: Proposed Cooling Tower Locations on the Peninsula to the North of the Proposed Site of Units 3 and 4. Lower: Closeup of Wetland in Inlet South of the Peninsula (Enercon 2009)

Striped Bass

The striped bass is the largest member of the family Moronidae (true or temperate basses). It is a marine and coastal species that moves upstream into freshwater rivers during spawning migrations. Due to its popularity as a game fish and its ability to live in fresh water, it has been introduced into lakes for sport fishing. Although it is not native to Texas, it has been stocked extensively, and fisheries are maintained in many reservoirs, including Lake Granbury. The striped bass matures at 17 to 43 cm (7 to 17 in.) in length and in Florida lakes were found to reach a length of up to 105 cm (41 in.) by 12 years of age. The diet of the striped bass when young consists mainly of small invertebrates and, as the fish increases in age and size, transitions to mainly fish (especially shads) and larger invertebrates. Its reproductive strategy involves producing very large number of eggs (up to tens of millions) that are semibuoyant, nonadhesive, and broadcast by the female into the water column, where they are fertilized by males. Spawning occurs in upstream portions of rivers, frequently where the current is strong and turbulent and the substrate is rock and/or gravel. Survival of the fertilized eggs largely depends on a current sufficient to keep the eggs suspended in the water column until hatching. Although eggs that settle on a coarse substrate can hatch, eggs that settle on silt, clay, or mud and detritus rarely hatch (Hassan-Williams and Bonner 2007). At least 50 mi of stream generally are required to allow successful hatching. Consequently, most reservoir populations, including those in Lake Granbury, are not self-sustaining and must be maintained by stocking. The striped bass is the fourth most preferred sportfish among licensed anglers in Texas (TPWD 2009b).

White Bass

The white bass also is a member of the family Moronidae (temperate basses). It is a freshwater species that is native to the central United States, extending southwest to the Red River drainage in Texas. It has been widely introduced into reservoirs and other waterbodies in Texas, including Lake Granbury. The white bass matures at 23 to 26 cm (9 to 10 in.) in length and in the southeastern United States can reach a length of up to 44 cm (17 in.) by 5 years of age. The diet of the white bass when young consists mainly of small invertebrates and, as the fish increases in age and size, transitions to mainly fish (especially shads) and larger invertebrates. Its reproductive strategy involves producing large number of eggs (approaching a million) that are demersal, adhesive, and released by the female into the water column, where they are fertilized by males then sink to the bottom and adhere to rocks, plants, and other substrates. Spawning occurs in shallow water (usually 3 m or less) that has a coarse substrate in small streams or on shoals or points of reservoirs (Hassan-Williams and Bonner 2007; TPWD 2009b). The white bass is the fifth most preferred sport fish among licensed anglers in Texas (TPWD 2009b).

White Crappie

The white crappie is a member of the family Centrachidae (sunfish and basses). It is native to the central United States, including the eastern two-thirds of Texas, and has been introduced statewide except for the upper portions of the Pecos and Rio Grande River basins. The white crappie matures at 17 to 22 cm (7 to 9 in.) in length and in Mississippi was found to reach a length of up to 36 cm (14 in.) by 8 years of age. The diet of the white crappie when young consists mainly of small invertebrates and, as the fish increases in age and size, transitions to mainly small fish and insects. Its reproductive strategy involves the male clearing a nest in a shallow area (less than 1.5 m) near shore (generally within 10 m) on hard clay, gravel, or plant roots; deposition of eggs and sperm over the nest; and the demersal eggs adhering to and remaining in and near the nest, where they are guarded by the male (Hassan-Williams and

Bonner 2007). Crappies, including both white and black crappies, are the third most preferred sport fishes among licensed anglers in Texas (TPWD 2009b).

Channel Catfish

The channel catfish is a member of the family Ictaluridae (bullhead catfishes). It is native to most of the United States east of the Rocky Mountains, including most of Texas, with the possible exception of the upper portions of the Pecos and Rio Grande River basins. The channel catfish matures at about 30 cm (12 in.) in length and in Mississippi reservoirs was found to reach a length of about 42 cm (17 in.) by 7 years of age. The diet of the channel catfish when young consists mainly of small invertebrates and, as the fish increases in age and size, expands to include larger invertebrates (insects, mollusks, crustaceans), small fishes, and some plant material. Its reproductive strategy involves the male locating a suitable hole for nesting in a cavity or crevice of a stream channel or the muddy bottom of a reservoir; deposition of eggs by the female in the bottom of the nest; and the demersal eggs remaining in the nest, where they and the fry are guarded by the male (Hassan-Williams and Bonner 2007, TPWD 2009b). After basses and crappie, the channel catfish is the most preferred fish to be caught by anglers in Texas (TPWD 2009b).

Non-Native and Nuisance Species

With the exception of golden alga, nonnative and nuisance species of aquatic plants are not currently a problem in Lake Granbury (Baird and Tibbs 2006), SCR, PKL, WBR, or the Brazos River in the vicinity of the CPNPP site (Luminant 2009a). It is uncertain whether golden alga is non-native. However, as described in detail above when discussing the plankton community of Lake Granbury, golden alga is a nuisance species that can develop toxic blooms that cause extensive fish kills.

An aquatic animal that is both a non-native and a nuisance species and is known to occur in three waterbodies of the study area is the Asian clam (*Corbicula fluminea*). Its presence has been reported throughout the Brazos River system, including SCR (Luminant 2009a), Lake Granbury, and the Brazos River below Lake Granbury (USGS 2009). The Asian clam is native from southern Asia to the Mediterranean, Africa, and Australia. It was first collected alive in the United States in 1938 and has since spread to at least 38 states and the District of Columbia. It likely was introduced to North America as a result of its use as a food item by Chinese immigrants, and the primary means of its dispersal has likely been human transport, either intentionally for food or unintentionally such as in bait buckets or in containers with other aquaculture specimens. Once introduced to a waterbody, it can move passively with the current (Foster et al. 2007). The Asian clam was first collected in Texas in 1958 in the Neches River, and by 2005 it was present in 180 of 257 counties in both flowing and still waterbodies. It has been found in Texas more often in larger reservoirs and streams. It is one of the most aggressive freshwater invasive species in the world and one of the most important molluscan pests in the United States (Sewell 2005). It competes with native species and alters benthic substrates. However, the principal adverse impact of the Asian clam in the United States is biofouling, in which living clams and the shells of dead clams clog and reduce water flow through the intakes and pipes of power plants and other users of raw water, including industrial and drinking water systems and irrigation systems. In power plants, it can clog heat exchangers, raw service water pipes, and firefighting equipment (Foster et al. 2007).

Another bivalve mollusk that potentially could occur in waterbodies of the study area in the future, possibly within the period of construction and/or operation of the proposed facility, is the zebra mussel (*Dreissena polymorpha*). The zebra mussel is a non-native, invasive species that recently has been found in Texas in Lake Texoma (on the Texas-Oklahoma border) and Lake

Lavon (northeast of Dallas and south of Lake Texoma). The zebra mussel has been spreading from the Great Lakes region and is likely to eventually spread throughout much of Texas, possibly including the waterbodies of the study area. It causes problems similar to those discussed for the Asian clam, particularly biofouling (TPWD 2010j).

Another aquatic animal that is a nuisance species, though it is native to Texas, is the estuarine mud crab (*Rhithropanopeus harrisii*). This crab is a common resident of estuaries in Texas and Florida, and it has been introduced into estuaries throughout the world. It is known to migrate upstream in estuaries, and it can tolerate fresh water. It was thought not to be able to reproduce at extremely low salinities, but there is strong evidence that this crab has established reproducing populations in eight freshwater reservoirs in Texas, including Lake Granbury, SCR, Lake Whitney, and PKL. The route by which the estuarine mud crab was introduced to these reservoirs is uncertain (Keith 2005). It is suspected to have involved fish stocking activities, using fish from a coastal hatchery where the crab occurs naturally, or accidental releases by anglers or boaters, such as from bait buckets. The crabs have caused biofouling problems in water intakes at lakeshore homes and have been found on the intake screens for CPNPP Units 1 and 2, and there is some evidence that they may be altering the benthic community by replacing native crayfish (Keith 2005, Perry 2006).

Federally and State-Listed Aquatic Species

This section describes the Federally and Texas State-listed threatened and endangered aquatic species potentially inhabiting aquatic or wetland habitats in the vicinity of the site and the proposed new transmission line ROWs. Table 2-18 presents the aquatic species that are Federally and/or State-listed as threatened or endangered, or that are designated as State species of concern, in counties within which CPNPP Units 3 and 4 (Hood and Somervell Counties) and the proposed new transmission line ROWs (Somervell and Bosque Counties) would be located. Also included are designated species for counties upstream of Lake Granbury that could be affected by hydrological changes due to alterations in water management practices such counties include: Palo Pinto County, in which PKL is predominantly located, and Parker County, through which the Brazos River flows between PKL and Lake Granbury.

As shown in Table 2-18, there are no Federally listed aquatic species recorded as occurring in the three counties in which CPNPP Units 3 and 4 (Hood and Somervell Counties) and the proposed new transmission line ROWs (Somervell and Bosque Counties) would be located, or the two upstream counties that could be affected by changes in hydrology. However, there are two aquatic species potentially occurring in Hood, Somervell, Palo Pinto, and Parker Counties that are designated by USFWS as Federal candidates for listing: the sharpnose shiner (*Notropis oxyrhynchus*) and the smalleye shiner (*N. buccula*). Candidate species are under consideration for listing but are not currently legally protected under the Endangered Species Act. These Federally designated candidate species potentially occurring in the vicinity of the proposed CPNPP Units 3 and 4 are described below.

Table 2-18. Federally and State-Listed Aquatic Species Occurring in the Vicinity of Proposed CPNPP Units 3 and 4 and Proposed New 345-kV Transmission Line ROWs

Scientific Name	Common Name	Federal Status[(a)]	State Status[(b)]	Counties[(c)]
Fishes				
Notropis oxyrhynchus	Sharpnose shiner	FC	SSC	Hood, Somervell, Palo Pinto, Parker
Notropis buccula	Smalleye shiner	FC	SSC	Hood, Somervell, Palo Pinto, Parker
Micropterus treculii	Guadalupe bass		SSC	Bosque, Palo Pinto
Mussels				
Tritogonia verrucosa	Pistolgrip		SSC	Hood, Somervell, Bosque, Palo Pinto, Parker
Arcidens confragosus	Rock pocketbook		SSC	Hood, Somervell, Bosque, Palo Pinto, Parker
Truncilla macrodon	Texas fawnsfoot		ST	Hood, Somervell, Bosque, Palo Pinto, Parker
Quadrula mitchelli	False spike		ST	Bosque
Quadrula houstonensis	Smooth pimpleback		ST	Bosque
Reptiles				
Nerodia harteri harteri	Brazos water snake		ST	Hood, Somervell, Bosque, Palo Pinto, Parker

(a) Federal status definitions: FC = Federal candidate for listing.
(b) State status definitions: ST = State-listed – threatened; SSC = State species of concern.
(c) Counties listed are those in which components of the proposed action would be located and where TPWD has identified the potential for occurrence of the species based on evidence such as recorded occurrences, historic ranges, field guides, staff expertise, and scientific publications. Sources: TPWD 2010c, 2010d, 2010e, 2010f, and 2010g.

The Brazos water snake (*Nerodia harteri harteri*) and three species of freshwater mussels are the only State-listed aquatic species with potential or recorded occurrences in one or more of the counties that may be affected by the proposed CPNPP Units 3 and 4 facilities (Hood and Somervell Counties), the two proposed new transmission line ROWs (Hood, Somervell, and Bosque Counties), or upstream changes in hydrology (Palo Pinto and Parker Counties). All four species are State-listed as threatened. The three mussel species are the Texas fawnsfoot (*Truncilla macrodon*), false spike mussel (*Quadrula mitchelli*), and smooth pimpleback (*Q. houstonensis*) (TPWD 2010c, 2010d, 2010e, 2010f, and 2010g). Species that do not have a legal listing status in Texas may be designated as State species of concern. Species of concern are priority species in greatest need of conservation as determined by the Texas

Wildlife Action Plan (TPWD 2005). Occurrences of three species of concern have been reported from two or more of these three counties: the Guadalupe bass (*Micropterus treculii*) and two mussels, the pistolgrip (*Tritogonia verrucosa*) and rock pocketbook (*Arcidens confragosus*) (TPWD 2010c, 2010d, 2010e, 2010f, and 2010g). Species that are State-listed or are designated as State species of concern and have the potential to occur in the vicinity of the proposed CPNPP Units 3 and 4 or the proposed new transmission line ROWs or to be affected by related changes in upstream hydrology are described below.

Sharpnose Shiner

The sharpnose shiner is designated by USFWS as a candidate species and is considered a species of concern (high priority) by the State of Texas in Somervell, Hood, and Bosque Counties. This slender, silvery minnow is endemic to the Brazos River basin in Texas, where it prefers the shallow water habitat of broad, open, sandy channels with moderate current (USFWS 2008a). It is suspected to forage primarily among the sediment, based on the large quantities of sand/silt that it ingests, but it also may consume organisms drifting in the water column. Aquatic and terrestrial invertebrates compose the majority of the diet (approximately 70 percent), which also includes plant material, detritus, and sand (USFWS 2008a). Little is known about the life history of the sharpnose shiner, but spawning likely occurs from mid May through September in open-water areas. Durham (2007) reported that the reproductive strategy of this species likely was to broadcast-spawn multiple batches of semibuoyant, nonadhesive eggs in areas of open substrate.

Historically, this strictly riverine species occurred throughout the Brazos River basin, including several major drainages within the watershed. Recent studies indicate that sharpnose shiner populations in the upper Brazos River drainage (upstream of PKL) remain stable, while in the middle and lower Brazos River drainage the species may exist only in remnant areas of suitable habitat but is likely extirpated (USFWS 2008a). Within the last decade, two independent sampling studies that focused on middle and lower reaches of the Brazos River were conducted, and both failed to find any sharpnose shiners (USFWS 2008a). The data suggest that the range of this species may have been reduced by as much as 70 percent relative to its historical range. This reduction in range and distribution likely is attributable to anthropogenic factors such as reservoir construction, sedimentation, municipal discharges, and agricultural activities within the basin (USFWS 2008a).

The addition of impoundments within the middle and lower Brazos River basin has altered historical habitat in the basin and is thought to be a primary contributor to range reduction for this species. The construction of reservoirs can alter thermal, physical, and morphological characteristics of existing habitats to such an extent that they are no longer suitable for the shiner, as evidenced by the near or complete extirpation of this species downstream of the three major reservoirs on the main stem of the Brazos River (PKL, Lake Granbury, and Lake Whitney). Small areas of suitable habitat likely still exist and possibly could contain remnant sharpnose shiner populations, but continued effects from existing reservoirs and possible future water management plans indicate that recovery of this species in the middle to lower Brazos River is highly unlikely (USFWS 2008a). Based on its habitat requirements, the sharpnose shiner would not occur in reservoirs such as Lake Granbury, SCR, or PKL. Based on its current distribution within the Brazos River drainage, it is unlikely to occur in the river downstream of Lake Granbury, downstream of PKL, in Squaw Creek, or in other streams in the vicinity of the proposed facilities.

Smalleye Shiner

The smalleye shiner was first designated as a Federal candidate for listing by USFWS in 2002. In addition, this fish is a State-designated species of concern (high priority) in the Hood and Somervell Counties where the proposed CPNPP Units 3 and 4 would be located. The smalleye shiner is a small, straw-colored minnow that is morphologically similar to the sharpnose shiner and is also endemic to the Brazos River drainage. Habitat requirements of this species are almost identical to those of the sharpnose shiner, and the smalleye shiner is tolerant of high salinity, high temperatures, and low dissolved oxygen concentrations (Ostrand and Wilde 2001). Within their preferred habitat, they seek out the center of channels with turbid waters and shifting sand, often avoiding the shallow depths and slow velocities of stream edges. Their diet consists of aquatic and terrestrial insects (38 percent of diet), detritus, plant material, and sand/silt, an indication that they forage in the substrate (USFWS 2008b).

The smalleye shiner is thought to have a relatively short life span, with most living to 1 year and some surviving up to 2 years of age (Durham 2007). Its reproductive strategy is similar to that of the sharpnose shiner. The smalleye shiner releases semi-buoyant eggs in areas of open substrate. It likely spawns in periodic batch-spawn events in open water from April through September, but spawning may occur continuously from April to August (Wilde and Durham 2007).

The smalleye shiner originally was present throughout the Brazos River system, including the lower reaches as far south as Hempstead, Texas (northwest of Houston). However, this species has been completely extirpated from the middle Brazos region and reduced to relict populations within the lower portion of the river (USFWS 2008b). Smalleye shiners have not been collected from these areas of the Brazos River since 1986, indicating their historical range has been reduced by approximately 54 percent. The Texas Natural Diversity Database (TPWD 2009i) indicates that the only reported sighting of a smalleye shiner within 10 mi of the proposed CPNPP Units 3 and 4 site occurred in 1953. Population declines downstream of PKL are attributable to factors that include river impoundments, sand and gravel mining, water diversions, irrigation, agricultural activities, and the spread of the invasive, exotic plant saltcedar. Invasion of saltcedar upstream of PKL may adversely affect native fish assemblages by reducing flood water velocities, resulting in increased sediment deposition and narrower channels (Blackburn et al. 1982).

As described for the sharpnose shiner, the major reservoirs of the Brazos River have altered water quality parameters substantially enough to affect downstream habitat. Upstream of PKL, smalleye shiner populations in the upper reaches of the Brazos drainage appear to be stable or increasing (Wilde and Durham 2007). Based on its habitat requirements, the smalleye shiner would not occur in reservoirs such as Lake Granbury, SCR, or PKL. Based on its current distribution within the Brazos River drainage, it is unlikely to occur in the river downstream of Lake Granbury, downstream of PKL, in Squaw Creek, or in other streams in the vicinity of the proposed facilities.

Brazos Water Snake

The Brazos water snake (also referred to as Harter's water snake) is a State-listed threatened species in Texas, and its status is currently under review by FWS for possible Federal listing (McBride 2009). The Brazos water snake, a member of the family Colubridae, is a medium-sized, brown to olive-colored, non-venomous snake endemic to the Brazos River system in north-central Texas (Ernst and Ernst 2003). In 1961, an allopatric population from the Concho and Colorado rivers in central Texas was described, thereby dividing the species into two subspecies: *Nerodia harteri harter* (Brazos water snake) from the upper Brazos River drainage, and *N. h. paucimaculata* (Concho water snake) from the upper Concho-Colorado River drainage (McBride 2009; Scott et al. 1989). The species inhabits a limited portion of stream corridor and reservoir shoreline within the upper reaches of two river drainages, giving it one of the most restricted geographic ranges of any North American snake species (McBride 2009). Researchers found that the range of the *N. h. harteri* subspecies encompassed approximately 700 km of the upper Brazos River drainage. Within this range, the snake was found only to inhabit approximately 186 mi of river corridor and portions of Possum Kingdom Lake and Lake Granbury (Scott et al. 1989). The patchy distribution of the *N. h. harteri* subspecies was found to be potentially linked to the availability of suitable juvenile habitat (McBride 2009). This mostly aquatic species typically inhabits open, vegetation-free areas near the water's edge within rocky, fast-flowing streams (Werler and Dixon 2000) or along the shorelines of reservoirs

(Ernst and Ernst 2003). While adults are often found in riffles, pools, and lakes, juveniles use rocky shallows for foraging and flat rocks in unshaded areas of the shore for hiding (Scott et al. 1989). Adults forage primarily between dawn and dusk and feed mostly on small fishes such as minnows (Tennant 1984). Adults utilize a much wider range of habitats than juveniles; for example, as adults also live in deeper waters and bask in the sun on tree branches near the shore (Scott et al. 1989). Their distribution is believed to be limited by the distance they can travel from suitable juvenile habitat and their need for deeper, more secure rocky cover (McBride 2009). All *N. h harteri* observed during the 1989 survey were in water or on land within 3 m of the shoreline and typically in about 1-m-deep water; juveniles were typically found under small, flat rocks (Scott et al. 1989). This snake bears live young, as do other species of the genus *Nerodia*, and gives birth to approximately 7 to 23 young between September and October (NatureServe 2009). Juveniles range from 323 to 846 mm in total length and from 7.5 to 200 g in total weight, with averages of 431 mm and 31.2 g, respectively (McBride 2009).

The State-threatened conservation status of this species is attributed to its limited range and specific habitat requirements (McAllister and Bursey 2008). Threats to the species' range and distribution include barriers, such as dams, which can inundate streams, thereby reducing potential riverine habitat. However, the standing waterbodies that result from such barriers may also provide suitable habitat for the Brazos water snake. Although the Brazos water snake has historically occurred in Somervell, Hood, and Bosque Counties, review of available records in the Texas Natural Diversity Database (TPWD 2009i) indicates that there have been no reported observations of this species within 10 mi of the CPNPP site since 1989. According to the database maintained by the TPWD, three Brazos water snakes were sighted within 10 mi of the CPNPP site between 1984 and 1989. A study by McAllister and Bursey (2008) reported that seven individuals of this species (juveniles and adults) were collected in Somervell County in July 1987 and between May and July 1988. McBride (2009) indicated that the range of the *N.h. harteri* subspecies remains intact; however, the population density has declined significantly, and the subspecies is now rare within its range.

Mussels

Three species of freshwater mussels that are State-listed as threatened are designated by TPWD as potentially occurring or having been recorded in at least one of the three counties in which proposed facilities would be located: the Texas fawnsfoot in Hood, Somervell, and Bosque Counties; and the false spike and smooth pimpleback in Bosque County (TPWD 2010c, 2010d, and 2010g). The Texas fawnsfoot also has been recorded in Palo Pinto and Parker Counties (TPWD 2010e, 2010f). The habitat requirements of the Texas fawnsfoot are not well known – it appears to occur in rivers and larger streams with moderate flows, to be intolerant of impoundments, and to utilize substrates that may include gravel, sand, or sandy mud. The false spike, which possibly has been extirpated in Texas, probably occurred in medium to large rivers (including the Brazos) and utilized substrates ranging from mud to mixtures of sand, gravel, and cobble. It has not been found to persist in the Brazos River and is unlikely to be present. The smooth pimpleback occurs in rivers and streams of moderate to small size and moderate-sized reservoirs; it prefers substrates of mixed mud, sand, and fine gravel; it tolerates moderate to very slow flows; and it appears not to tolerate dramatic fluctuations in water levels or substrates of scoured bedrock or shifting sand (TPWD 2010c). In 2006, the fawnsfoot was observed in a range of areas with low to moderate levels of disturbance along shoreline habitats within Sandy Beach Park/Pecan Plantation of the Brazos River, but TPWD 2007 surveys for the fawnsfoot below Lake Granbury yielded no detected individuals (TPWD 2011).

Two species of freshwater mussels, the pistolgrip and rock pocketbook, are State species of concern designated by TPWD as potentially occurring or having been recorded in all three counties in which proposed facilities would be located and in the two upstream counties. The pistolgrip inhabits stable substrates of rock, hard mud, silt, or soft bottoms in medium to large rivers. The rock pocketbook inhabits mud, sand, or gravel substrates within medium to large rivers, usually in standing or slow-moving waters, but it also may occur in moderate currents and some reservoirs (TPWD 2010d). In 1995, evidence of the pimpleback was detected by TPWD in McClennan County below the sewage treatment plant along the Brazos River. TPWD surveys completed in 2006 and 2007 yielded the detection of one organism in Lake Waco (McClennan County) (TPWD 2006; 2007 as provided by TPWD 2011).

The Brazos River starting at PKL dam extending to Tin Top Road has been designated as a Texas Mussel Sanctuary (TPWD 2011). However, the Texas Natural Diversity Database includes no reported observations of any of these mussels within 10 mi of the CPNPP site or the proposed new transmission line ROWs (TPWD 2009i). Although habitats supportive of all five species potentially could be present in the Brazos River between Lake Granbury and Lake Whitney, these mussels are not known to occur in this river segment and were not found in recent biological surveys at a location downstream of the DeCordova Bend Dam (Bio-West 2008a). Although the smooth pimpleback and rock pocketbook may occur in reservoirs, they have not been reported in recent surveys of invertebrate organisms in Lake Granbury and SCR. WBR was recently built on a very small stream that drains to the Paluxy River and would not have provided suitable habitat for these mussels. Although the rock pocketbook is capable of inhabiting reservoirs, it would not be expected to have occurred in Wheeler Branch prior to the building of the dam or to have colonized the reservoir.

The Brazos River upstream of Lake Granbury and below PKL potentially could provide habitat suitable for the pistolgrip, rock pocketbook, and Texas fawnsfoot. PKL potentially could provide habitat suitable for the rock pocketbook.

Guadalupe Bass

The Guadalupe bass is a State species of concern that occurs only in Texas and is the official state fish. It reaches a weight of approximately 4 pounds and utilizes habitats with flowing water, preferring downstream segments of small streams, especially riffles or the heads of pools where the water is shallow and swift. The range of the Guadalupe bass is limited to the northern and eastern parts of the Edwards Plateau region of south-central Texas, including portions of the Brazos River drainage well downstream of Lake Whitney, such as the Lampasas, Leon, and Little Rivers (Lee et al. 1980, TPWD 2009d). Thus, the Guadalupe bass does not occur in the Brazos River drainage in Hood or Somervell Counties, and review of available records in the Texas Natural Diversity Database indicates that its last reported observation within 10 mi of the proposed new CPNPP Units 3 and 4 transmission line ROWs in Bosque County was in 1979 (TPWD 2009i).

2.4.2.5 Aquatic Monitoring

Preapplication investigations were performed in 2007 and 2008 to characterize the aquatic communities of Lake Granbury and SCR. The results of these field studies were utilized in the descriptions of these communities provided above. No additional preoperational ecological monitoring is planned. The TPWD has been monitoring the fish communities of Lake Granbury since 1998 and PKL since 1999 through periodic surveys conducted in conjunction with its Statewide Freshwater Fisheries Monitoring and Management Program, which is supported by the Federal Aid in Sport Fish Restoration Act. Under this program, Lake Granbury and other large public reservoirs are surveyed every 4 years, and the results are reported. The most recent TPWD survey of Lake Granbury was performed in 2005–2006 (Baird and Tibbs 2006), and the most recent TPWD survey of PKL was in 2006–2007. If funding is maintained, this monitoring program may continue into the period of construction and operation of the proposed CPNPP Units 3 and 4.

Specific operational monitoring requirements have not yet been established for CPNPP Units 3 and 4, but they are expected to be similar to and/or modifications of existing monitoring programs for Units 1 and 2. Thus, monitoring in conjunction with the operation of Units 3 and 4 with respect to aquatic resources is expected to include monitoring of surface water relative to water quality standards and TPDES permit requirements, including thermal requirements. Monitoring of fish and other components of the ecological communities of Lake Granbury, SCR, PKL, and the Brazos River also may be required by State regulatory agencies (Luminant 2009a).

2.5 Socioeconomics

This section describes the socioeconomic baseline for the proposed Units 3 and 4 to be built and operated by Luminant at the existing CPNPP site. The scope of the review of demographic and community characteristics is guided by the magnitude and nature of the expected impacts of the building and operation of the proposed project.

The review team reviewed the ER prepared by Luminant and verified the data sources used in its preparation by examining cited references (Luminant 2009a). The review team requested clarifications and additional information from Luminant where needed to verify data in the ER. Unless otherwise specified in the following sections, the review team used verified data from Luminant's ER and responses to requests for additional information. Where the review team used different analytical methods or additional data or information for its own analysis, the following sections include explanatory discussions and citations for additional sources.

The discussion of socioeconomic impacts considers the area within a 50-mi radius of the proposed site for Units 3 and 4 (the region), with a focus on Somervell and Hood Counties, Texas. The discussion emphasizes the socioeconomic characteristics of Somervell and Hood Counties because

- they are the two counties in which the CPNPP site is located;
- based on the relatively shorter commutes and the availability of other amenities in Somervell and Hood Counties' population centers, the review team expects that most of the in-migrating construction and operations workers would choose to live in these two counties (currently over two-thirds of the current CPNPP workforce resides in Somervell or Hood Counties);
- the review team expects that the project's locally available construction and operations work forces would be primarily drawn from these two counties; and
- Somervell and Hood Counties would receive almost all of the social and economic impacts from building and operations activities.

However, almost 30 percent of the current CPNPP workers reside in four other Texas counties—Bosque, Erath, Johnson, and Tarrant Counties. While the review team expects that each of these counties would receive negligible impacts from building and operations activities at the proposed site, this EIS also includes information about them. Therefore, the six counties of Somervell, Hood, Bosque, Erath, Johnson, and Tarrant Counties make up this Economic Impact Area (EIA). Finally, the discussion includes some data for the region. Table 2-19 lists the 19 counties within the 50-mi CPNPP region; all of the counties are in Texas.

Table 2-19. Counties Entirely or Partially Located Within the 50-mi CPNPP Region

Bosque	Ellis	Jack	Somervell
Comanche	Erath	Johnson	Stephens
Coryell	Hamilton	McLennan	Tarrant
Dallas	Hill	Palo Pinto	Wise
Eastland	Hood	Parker	

Source: Luminant 2009a.

2.5.1 Demographics

For the purposes of this analysis, the review team divided the total population within the CPNPP region into three major groups: residents, who live permanently in the area; transients, who may temporarily live in or visit the area but have permanent residence elsewhere; and migrant workers, who travel into the area to work and then leave after their job is done. The U.S. Census Bureau (USCB) does not fully characterize transient and migrant populations, but focuses on data about resident populations.

The data used in this section are from the USCB and the Texas State Data Center (TSDC). The most recent data and information are used where possible, with 2000 Census of Population data used in some cases to allow comparisons among multiple jurisdictions.

2.5.1.1 Resident Population

In 2007, the resident population in the region was 1.5 million. Table 2-20 provides population totals for the EIA and the State of Texas from 1970 through 2000. The table also provides population projections for these jurisdictions through 2040, based on estimates developed by the TSDC (TSDC 2009).

As indicated in Table 2-20, the EIA and the State of Texas experienced considerable population growth between 1970 and 2000, and are projected to continue growing, although at a slower rate, between 2000 and 2040. The two counties with the most rapid population growth between 1970 and 2000, Hood and Johnson, both grew faster than the State of Texas and are projected to continue to do so through 2040. Somervell and Tarrant Counties experienced more rapid growth than the State of Texas between 1970 and 2000, but are not projected to do so through 2040. Erath and Bosque Counties have experienced slower growth than the State of Texas since 1970, and are projected to continue to do so through 2040.

Table 2-20. Population and Percent Population Change in the EIA and the State of Texas (1970–2040)

Year	County												State of Texas	
	Somervell		Hood		Bosque		Erath		Johnson		Tarrant			
	Pop.	% Change	Pop.	% Change	Pop.	% Change	Pop.	% Change	Pop.	% Change	Pop.	% Change	Pop.	% Change
1970	2,793	–	6368	–	10,966	–	18,141	–	45,769	–	716,317	–	11,196,730	–
1980	4,154	48.7	17,714	178.2	13,401	22.2	22,560	24.4	67,649	47.8	860,880	20.3	14,229,191	27.1
1990	5,360	29.0	28,981	63.6	15,125	12.9	27,991	24.1	97,165	43.6	1,170,103	35.9	16,986,510	19.4
2000	6,809	27.0	41,100	41.8	17,204	13.7	33,001	17.9	126,811	30.5	1,446,219	23.6	20,851,820	22.8
2010 (est.)	7,693	13.0	48,396	17.8	18,609	8.2	38,410	16.4	152,115	20.0	1,662,201	14.9	24,330,646	16.7
2020 (est.)	8,659	12.6	56,847	17.5	20,444	9.9	42,617	11.0	181,951	19.6	1,895,533	14.0	28,005,740	15.1
2030 (est.)	9,429	8.9	65,089	14.5	22,025	7.7	46,341	8.7	213,911	17.6	2,152,155	13.5	31,830,575	13.7
2040 (est.)	10,032	6.4	73,429	12.8	23,353	6.0	50,032	8.0	249,889	16.8	2,437,327	13.3	35,761,165	12.3

Sources: Luminant 2009a; USCB 1970; USCB 1980; USCB 1990; TSDC 2009.

The CPNPP site is located in Somervell and Hood Counties. Fort Worth, Texas, is the largest city within 50 mi, with a 2007 estimated population of 681,818 (USCB 2009c). Smaller cities within the region include North Richland Hills (2007 population of 64,408), Mansfield (44,061), Haltom City (40,111), Burleson (33,359), Cleburne (29,552), Watauga (23,873), Weatherford (25,749), and Benbrook (22,691). Several cities have 2007 estimated populations between 10,000 and 20,000. These include Azle, Forest Hill, Mineral Wells, Saginaw, Stephenville, and White Settlement. Many other small towns, cities, and urban areas with populations of less than 10,000 are distributed within the 50-mi region. The towns closest to the CPNPP site are Glen Rose (2007 population of 2771) in Somervell County and Granbury (8029) in Hood County (USCB 2009c).

2.5.1.2 Transient Population

Transient populations include people who work in or visit large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, recreational areas, or special events where there may be seasonal and workday variations in population. The largest transient populations within the region include people attending special events, visitors to State parks, and visitors to major tourist attractions (e.g., museums, aquariums, theme parks, retail outlet centers). Figure 2-17 shows the locations of contributors to transient populations in the region.

The total annual transient population within the region was 10.5 million in 2007. For an average day in 2007, the transient population for the region was 352,219. Given that the resident population for the region in 2007 was 1.5 million, the total nonmigrant population within the region (i.e., resident plus transient) was 1.85 million people.

2.5.1.3 Migrant Labor

The USCB defines a migrant laborer as someone who works seasonally or temporarily and moves one or more times to perform seasonal or temporary work. During scheduled refueling outages at CPNPP Units 1 and 2, there is an influx of workers to the area who are hired by Luminant to carry out fuel reloading activities, equipment maintenance, and other projects associated with the outage. Luminant employs approximately 800 to 1200 workers for approximately 24 days during each refueling outage, which occurs every 18 months for each existing unit. Even if 1200 workers are assumed to in-migrate into the EIA with two additional family members [the average number of persons per household in Texas in 2000 was 2.74 (USCB 2009d)], the total population increase (3600 people) would represent less than 0.2 percent of the EIA's estimated 2010 resident population of 1.9 million. For Hood and Somervell Counties, where the review team expects 66.6 percent of the in-migrating workers would locate, the two additional family member scenario would result in an increase of about 1.7 percent (814 outage workers and their families) in Hood County, but a 20.6 percent increase (about 1584 outage workers and their families) in Somervell County.

Because of the seasonal fluctuation in labor requirements, the agricultural sector can be another source of migrant workers. The most recent source for data on agricultural migrant workers is the 2002 Census of Agriculture, which provides the number of farms in the region that employ migrant labor (173 farms) but only provides data on the number of workers "working less than 150 days" per year (10,860 workers). Assuming the upper bound (i.e., that all of the 10,806 workers who work less than 150 days are migrant workers), the population of migrant agricultural workers is still negligible compared with the resident population of the region. Even if 10,860 workers are assumed to in-migrate with two additional family members, the total population increase (32,418 people) would represent only 2.2 percent of the region's 2007 resident population of 1.5 million.

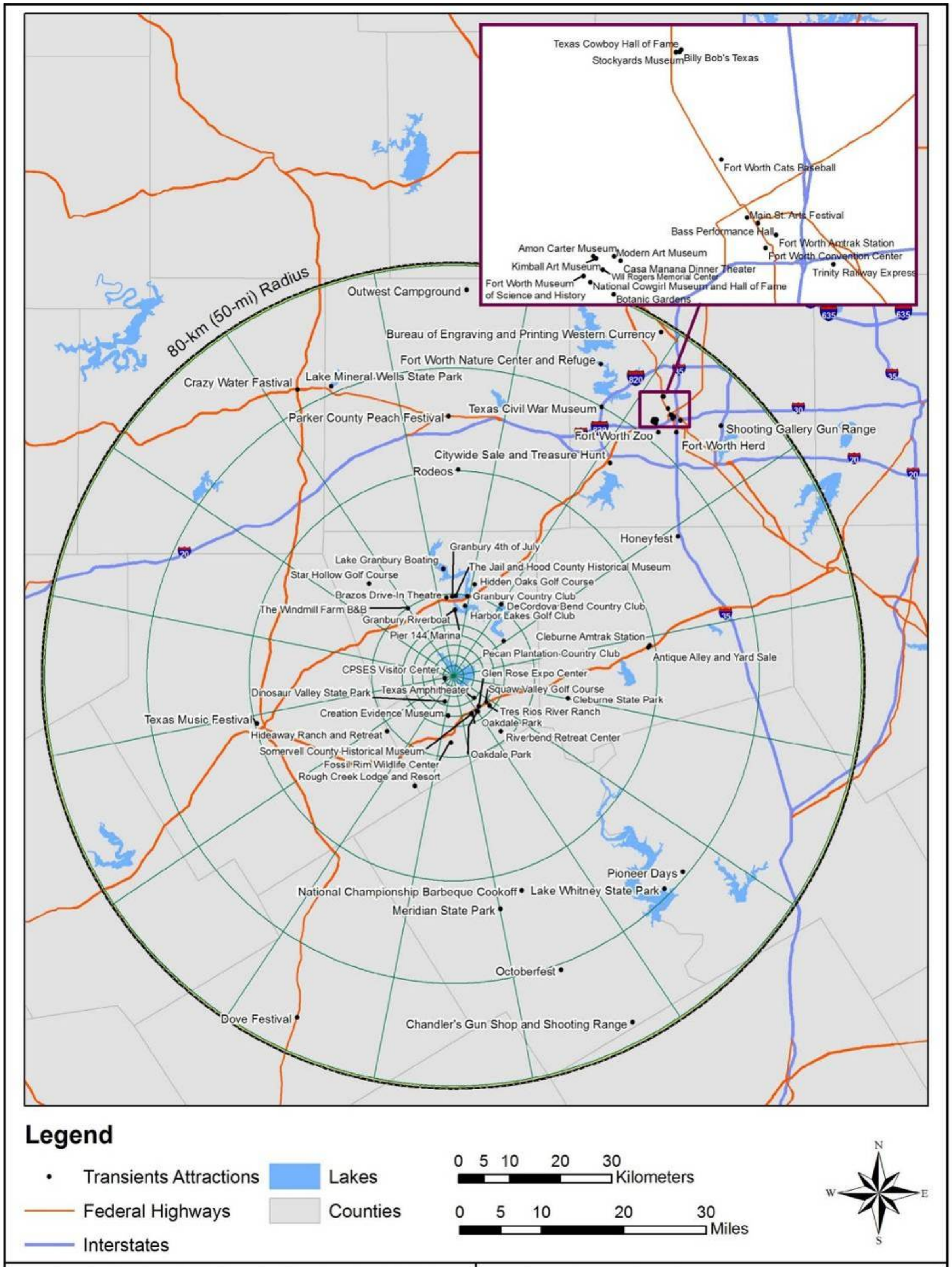


Figure 2-17. Locations of the Contributors to Transient Populations in the Region (Luminant 2009a)

2.5.2 Community Characteristics

This section consists of seven subsections that characterize the communities that may be affected by building and operating CPNPP Units 3 and 4. The characteristics evaluated include the economy, tax-based revenue, transportation, aesthetics and recreation, housing, public services (water and wastewater, solid waste, police, fire, and medical services, and social services), and education.

2.5.2.1 Economy

This section provides information on the labor force, employment, and income within the EIA. Labor force and employment data include labor force size, total employment and unemployment, and employment by major industry type. Income data are provided at the per capita level and as the total within the EIA.

The local economic centers near CPNPP are the towns of Glen Rose and Granbury. However, the largest economic center within the CPNPP region is the city of Fort Worth in Tarrant County. Table 2-21 details labor force size, employment and unemployment levels, and unemployment rates for the EIA and the state of Texas in 2008.

Table 2-21. Annual Average Labor Force, Employment, and Unemployment in the EIA and the State of Texas (2008)

	Labor Force	Employed	Unemployed	Unemployment Rate
Hood County	25,273	24,200	1073	4.2
Bosque County	8349	7960	389	4.7
Erath County	18,513	17,802	711	3.8
Johnson County	72,968	69,562	3406	4.7
Tarrant County	884,611	841,316	43,295	4.9
State of Texas	11,701,584	11,126,436	575,148	4.9

Sources: BLS 2009a; BLS 2009b.

The Barnett Shale is a fertile area of natural gas production in northern Texas. In 2007, the Barnett Shale contributed $5 billion to the 14 counties atop the region, including Hood, Erath, Johnson, and Tarrant, among others. An estimated 55,000 permanent jobs have been created by Barnett Shale exploration (Business Wire 2007). A study commissioned by the Fort Worth Chamber of Commerce estimates that the Barnett Shale would be responsible for an average of 108,000 jobs and $10.4 billion in output each year through 2015. An estimated $3 billion in retail sales are generated per year due to the Barnett Shale (Business Wire 2007). In 2006, revenue to local governments including schools was approximately $227.7 million. According to the study, the economic impact of the Barnett Shale expanded by 50 percent from 2006 to 2007, with peak productivity forecast in 2014 or 2015 (Business Wire 2007).

Employment associated with the Barnett Shale has contributed to the relatively low unemployment numbers in the region. Unemployment rates of 4.0 percent or below are considered full employment by the Texas Workforce Commission, and annual average unemployment rates in the region were below 5.0 percent in 2008 (Table 2-21). Competition for workers in the region, especially those with technical skills, has reduced the availability of workers for projects such as CPNPP Units 3 and 4 (Luminant 2009a).

Table 2-22 provides data on total non-farm employment by industry type in the EIA in 2007. In Somervell County, in which CPNPP Units 1 and 2 are located and in which Units 3 and 4 would be located, non-farm employment in 2007 was highest in local government (12.7 percent), construction (8.7 percent), and retail trade (7.5 percent) (Table 2-22). These data are somewhat misleading, however, because the largest single employer in Somervell County is Luminant, with 977 employees at the CPNPP site alone. These Luminant employees are included as "Not Shown" in the "Utilities" category in Table 2-22.

Table 2-23 shows the current pattern of residence for the operations workers at CPNPP Units 1 and 2. Most of the workers live in the nearby communities of Granbury (41.0 percent) and Glen Rose (19.9 percent), but many live in more distant cities and towns such as Cleburne (10.2 percent) and Fort Worth (6.1 percent). Based on this distribution of Units 1 and 2 workers, the review team expects that most of the construction and operations workers at Units 3 and 4 would live in Hood and Somervell Counties.

In Hood County, in which part of the CPNPP site is located, the non-farm sectors with the largest employment in 2007 were retail trade (14.5 percent), local government (10.6 percent), and construction (10.3 percent) (Table 2-22). The largest single employer in Hood County is Granbury Independent School District (ISD) with 1230 employees. Table 2-22 also provides data on non-farm sector employment for the four other counties in the EIA.

Table 2-24 provides data on total personal and per capita income for the EIA and the State of Texas in 2007. Total personal income in the EIA ranged from a high of almost $65.9 billion in Tarrant County to a low of $245.1 million in Somervell County. Per capita income in the EIA ranged from a high of $38,538 in Tarrant County to a low of $27,274 in Bosque County. In the EIA, only one county (Tarrant) had a higher per capita income in 2007 than the State of Texas ($37,083).

Table 2-22. Total Non-Farm Employment by Industry Type in the EIA (2007)

Industry	County											
	Somervell		Hood		Bosque		Erath		Johnson		Tarrant	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Forestry, fishing, related activities, and other	NS[1]	–	87	0.5	88	1.0	669	2.9	NS	–	687	0.1
Mining	78	1.5	654	3.6	80	1.0	205	0.9	1758	2.7	12,749	1.2
Utilities	NS	–	126	0.7	63	0.8	78	0.3	195	0.3	1554	0.2
Construction	448	8.7	1883	10.3	735	8.8	1586	6.8	7107	10.9	67,404	6.6
Manufacturing	92	1.8	624	3.4	560	6.7	1493	6.4	6327	9.7	93,225	9.1
Wholesale trade	NS	–	368	2.0	262	3.2	692	3.0	2153	3.3	45,747	4.5
Retail trade	382	7.5	2659	14.5	816	9.8	2391	10.3	8142	12.5	117,035	11.4
Transportation and warehousing	317	6.2	279	1.5	149	1.8	588	2.5	3565	5.5	68,048	6.6
Information	23	0.4	224	1.2	57	0.7	149	0.6	710	1.1	18,966	1.8
Finance and insurance	131	2.6	769	4.2	302	3.6	663	2.9	1991	3.1	52,971	5.2
Real estate and rental and leasing	234	4.6	892	4.9	358	4.3	725	3.1	2931	4.5	43,474	4.2
Professional, scientific, and technical services	197	3.8	763	4.2	235	2.8	755	3.2	2464	3.8	58,534	5.7
Management of companies and enterprises	0	0.0	NS	–	NS	–	NS	–	316	0.5	5,507	0.5
Administrative and waste services	337	6.6	NS	–	NS	–	NS	–	3628	5.6	82,467	8.0
Educational services	13	0.3	144	0.8	141	1.7	105	0.5	845	1.3	17,192	1.7
Health care and social assistance	NS	–	1459	7.9	503	6.0	1829	7.9	4556	7.0	84,523	8.2

Table 2-22. (contd)

Industry	County											
	Somervell		Hood		Bosque		Erath		Johnson		Tarrant	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Arts, entertainment, and recreation	90	1.8	517	2.8	78	0.9	382	1.6	NS	–	19,747	1.9
Accommodation and food services	313	6.1	1529	8.3	277	3.3	1940	8.4	3384	5.2	74,172	7.2
Other services, except public administration	265	5.2	1377	7.5	564	6.8	1639	7.1	4221	6.5	58,950	5.7
Federal government, civilian	17	0.3	111	0.6	76	0.9	78	0.3	265	0.4	15,086	1.5
Federal government, military	17	0.3	110	0.6	40	0.5	80	0.3	336	0.5	4961	0.5
State government	25	0.5	58	0.3	47	0.6	2044	8.8	201	0.3	9595	0.9
Local government	652	12.7	1947	10.6	1078	13.0	1431	6.2	6382	9.8	73,649	7.2
Total	5124		18,357		8308		23,232		65,235		1,027,657	

Sources: Luminant 2009a; BEA 2009.

Table 2-23. Place of Residence for CPNPP Units 1 and 2 Workers

County	Number of Workers	Percent of Total Workers	City/Town	Number of Workers	Percent of Total Workers
Somervell County	221	22.6	Glen Rose	194	19.9
			Rainbow	14	1.4
			Nemo	13	1.4
Hood County	430	44.0	Granbury	401	41.0
			Tolar	29	3.0
Bosque County	43	4.4	Walnut Springs	27	2.8
			Meridian	11	1.2
			Iredell	5	0.5
Erath County	47	4.8	Stephenville	42	4.3
			Bluff Dale	5	0.5
Johnson County	108	11.1	Cleburn	100	10.2
			Burleson	8	0.8
Tarrant County	90	9.2	Fort Worth	60	6.1
			Benbrook	20	2.0
			Arlington	5	0.5
			Crowley	5	0.5
Hamilton County	25	2.6	Hico	25	2.6
Parker County	13	1.3	Weatherford	13	1.3
Total	977	100.0		977	100.0

Source: Luminant 2009a.

Table 2-24. Total Personal and per Capita Income in the EIA and the State of Texas (2007)

	Total personal Income ($1,000)	Per Capita Income ($)
Somervell County	245,109	31,676
Hood County	1,772,377	36,142
Bosque County	486,096	27,274
Erath County	1,008,206	28,331
Johnson County	4,383,404	29,347
Tarrant County	65,870,354	38,538
State of Texas	884,190,552	37,083

Source: BEA 2009.

2.5.2.2 Taxes

The State of Texas has no personal or corporate income taxes. There is a corporate margin tax, under which a company owes 1.0 percent of gross receipts less compensation or the costs of goods sold. The rate is reduced to 0.5 percent for retailers and wholesalers, while sole proprietorships, general partnerships, and businesses with total revenues of under $300,000 are exempt.

Sales and use tax is imposed on all retail sales, leases and rentals of goods, and taxable services in the State of Texas. The State's tax rate is 6.25 percent. Local governments can add an additional 0.25 to 2.0 percent, with the State tax rate plus local tax rate not to exceed 8.25 percent. Bosque, Erath, and Hood Counties impose a sales and use tax of 0.5 percent. Johnson, Somervell, and Tarrant Counties do not charge a sales and use tax. The cities of Granbury, Cleburne, Stephenville, and Tolar tax at a rate of 1.5 percent, while Glen Rose has a sales and use tax of 2.0 percent. The City of Fort Worth has a tax rate of 1.0 percent, while the Fort Worth Metropolitan Transit Authority and the Fort Worth Crime Control Special Purpose District each charge a 0.5 percent tax.

Texas has no State property tax. Property taxes are levied by counties, cities, school districts, and special districts (junior colleges, hospitals, road districts, and others). As indicated in Table 2-25, Somervell County collected more than $8.4 million in property taxes in 2007, while Hood County collected over $14.4 million.

In Texas, schools are funded solely through local property taxes. The largest school districts in Somervell and Hood Counties collected significantly more in property taxes in 2007 than did the other counties: Glen Rose ISD collected over $24.8 million while Granbury ISD collected over $40.6 million (Table 2-25). Texas school districts are designated either "property rich" (Chapter 41) or "property poor" (Chapter 42) based on a wealth benchmark, calculated as the district's total assessed property valuation divided by the total number of students. Those districts with a total wealth per student above the State benchmark are considered Chapter 41 and those below the benchmark are considered Chapter 42. Chapter 41 districts are required to send a portion of their local property tax revenue to the State for redistribution to Chapter 42 districts. Both the Glen Rose and Granbury ISDs are Chapter 41 districts (see Section 2.5.2.7).

Currently, Luminant pays ad valorem taxes on CPNPP Units 1 and 2 to Somervell and Hood Counties and to smaller jurisdictions within those counties. Table 2-26 shows the amount of ad valorem taxes paid to each jurisdiction for 2006. The ad valorem taxes are paid in two categories, personal property and real property. The taxed amounts were phased in through the years of development, with the total market value assessed on January 1 of 1990 and 1993, the years the units became operational. CPNPP Units 3 and 4 are expected to pay ad valorem taxes at the same rate and to the same jurisdictions as Units 1 and 2. However, the tax rates for CPNPP Units 3 and 4 have not been finalized.

Based on the data in Tables 2-26 and 2-27, the ad valorem taxes paid to Somervell County and Glen Rose ISD in 2006 were nearly comparable to the amounts those jurisdictions received from property taxes. In contrast, the amount of ad valorem taxes paid to Hood County and Granbury ISD in 2006 were only a fraction of the amounts those jurisdictions received from property taxes.

Table 2-25. Property Tax Rates and Revenues in Somervell and Hood Counties (2007)

	Total Tax Rate ($)	Total Levy ($)
Somervell County	0.313	8,483,358
Glen Rose	0.4669	606,652
Somervell County Water District	0.1266	3,431,275
Glen Rose ISD[(a)]	0.8784	24,839,584
Hood County	0.367	14,412,633
Granbury	0.415	3,621,038
Lipan	0.4	51,267
Tolar	0.46	82,081
Acton Municipal Utility District	0.1025	27,866
Granbury ISD	1.1712	40,667,901
Lipan ISD	1.2343	1,146,053
Tolar ISD	1.2493	1,764,950

(a) Independent school district.

Source: Luminant 2009a.

Table 2-26. Ad Valorem Taxes Paid by CPNPP Units 1 and 2 (2006)

	Net Taxes ($)
Somervell County	5,124,604
Glen Rose	35
Somervell County Water District	1,882,099
Glen Rose ISD	17,355,171
Hood County	8595
Tolar	37
Granbury ISD	18,734
Tolar ISD	15,073
Hood County Library District	255

Source: Luminant 2009a.

2.5.2.3 Transportation

The region is accessible by a transportation network of FM roads, Federal and State highways, rail, and a public airport. Due to the predominantly rural setting and the small sizes of the cities and towns near the CPNPP site, most traffic is by personal vehicle or tractor/trailer transport. Thus, this description of the existing transportation network focuses primarily on roads in Somervell and Hood Counties near the CPNPP site.

Figure 2-18 illustrates the road and highway system in Somervell and Hood Counties. U.S. Highway 67 (US 67) is located south of the CPNPP site and runs from northeast to southwest through the town of Glen Rose. In Hood County, US 377 is a four-lane divided highway that runs northeast to southwest through Granbury. Texas State Highway 144 (SH 144) passes to the east of the CPNPP site and connects US 67 to US 377.

Table 2-27. Housing Data for the EIA (2000 or 2007)[(a)]

	Total Housing Units	Occupied	Owner Occupied	Renter Occupied	Vacant Units	Vacancy Rate (%)
Somervell County	2750	2438	1825	613	312	11.3
Hood County	20,340	17,460	13,404	4056	2880	14.2
Bosque County	8644	6726	5225	1501	1918	22.2
Erath County	15,223	12,750	7703	5047	2473	16.2
Johnson County	51,628	46,920	36,150	10,770	4708	9.1
Tarrant County	657,259	591,745	375,675	216,070	65,514	10.0

(a) Data are for 2007 except for 2000 data used for Somervell and Bosque Counties.

Sources: USCB 2007; USCB 2009b.

Numerous FM roads traverse both counties, providing rural access to the larger populated areas. FM 56, located just west of the CPNPP site, is a two-lane highway that runs from north to south, connecting US 377 at Tolar to US 67 at Glen Rose. FM 56 provides the only road access to the CPNPP site. For CPNPP workers who live in Somervell County, FM 56 north from Glen Rose provides access to the CPNPP site. For CPNPP workers who live in Hood County, FM 56 south from Tolar or FM 51 (a two-lane highway southwest from Granbury) to FM 56, provides access to the CPNPP site.

The roadways in Somervell and Hood Counties are best described as primarily rural, with some urban roadways in and near the major population centers of each county. Data on vehicle volume on these roads are obtained from estimated Annual Average Daily Traffic (AADT) counts from the Texas Department of Transportation (TxDOT). These bidirectional traffic counts from TxDOT were last revised in 2007.

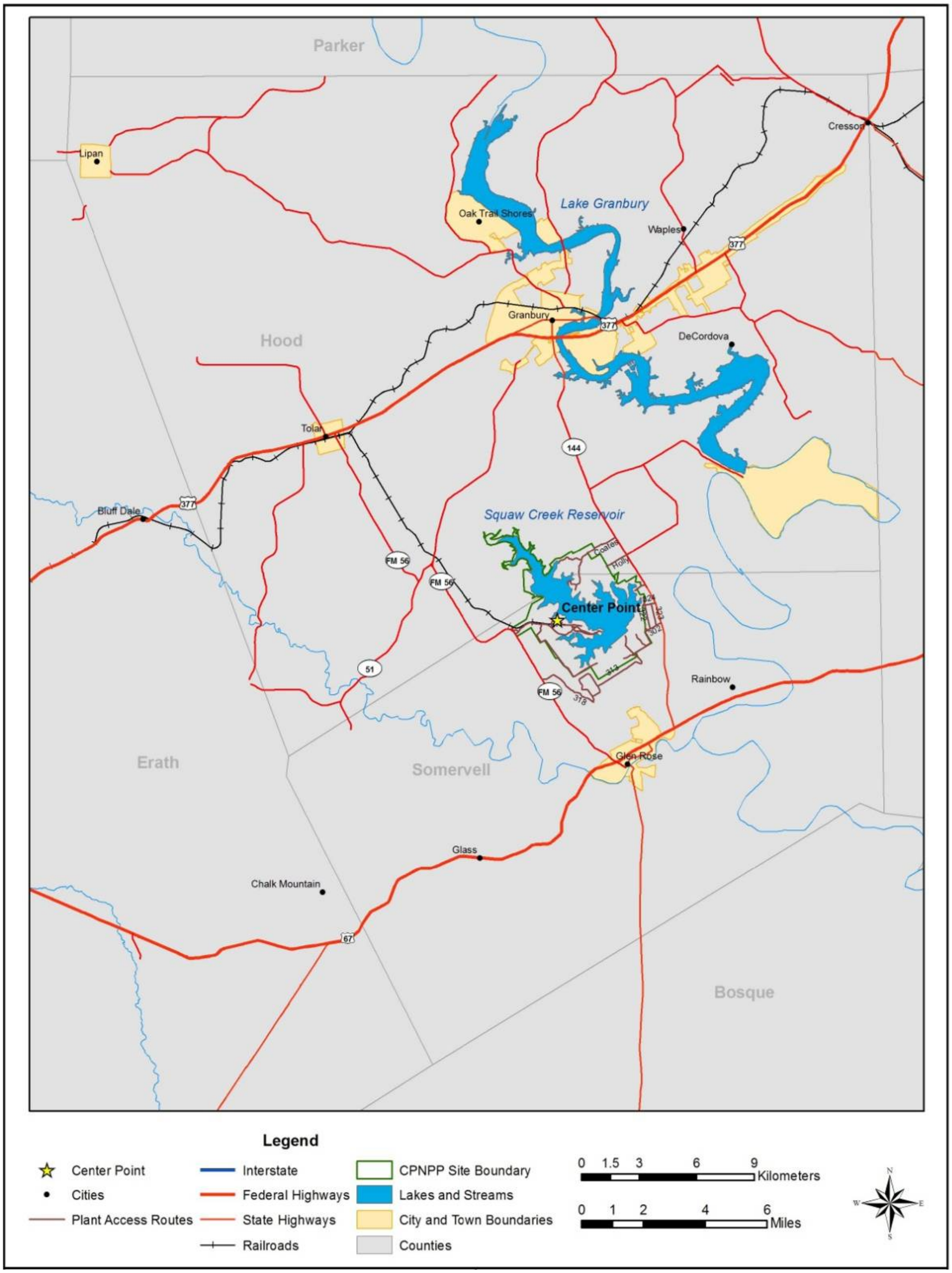


Figure 2-18. Road and Highway System in Somervell and Hood Counties (Luminant 2009a)

According to TxDOT data for 2007, FM 56 has an AADT count of 3500 vehicles just south of the CPNPP entrance between mile markers 310 and 312. The AADT count on FM 56 southbound from FM 51 is 8500 vehicles between mile markers 304 and 306. Heading north on FM 56 from Glen Rose, the AADT count is 5000 vehicles just north of the city between mile markers 314 and 316. Travelling south from Granbury, FM 51 has an AADT count of 6000 vehicles just south of US 377, between mile markers 320 and 322. This decreases to 3300 vehicles just before FM 56, between mile markers 328 and 330. Traveling south on FM 56 from Tolar, the AADT count is 4400 vehicles between mile markers 298 and 300, increasing to 4700 vehicles just before FM 51, between mile markers 302 and 304.

Luminant has provided no information about the specific capacities of roads in Somervell and Hood Counties in the vicinity of CPNPP. However, Luminant reports that FM 51 and FM 56 have a Level of Service of "A," meaning that there are no traffic delays.

Based on a traffic study conducted in 1987 during development of CPNPP Units 1 and 2 (DeShazo, Starek and Tang, Inc. 1987), TxDOT made some improvements in traffic signals, lane width, turn lanes, and signage near the CPNPP site to handle the large volume of traffic. These improvements included adding the following:

- a 12-ft-wide, 360-ft-long right turn lane into the site from northbound FM 56;
- a 12-ft-wide, 750-ft-long acceleration lane from the site onto northbound FM 56; and
- a 12-ft-wide, 430-ft-long left turn lane into the site from southbound FM 56.

According to local officials, the roads in Somervell and Hood Counties are in good condition and are well maintained. In particular, US 67, FM 56, and SH 144 are in good condition, and there are no plans to make improvements on those roads in the next few years (Luminant 2009a). In Hood County, TxDOT has approved a contract to add a hot mix overlay to the road surface and shoulders of US 377. This overlay would not add any length to the road system, but it would provide a new surface on the existing road. TxDOT is also planning two improvement projects for US 377, but neither project has received funding. The first project would affect US 377 west of Granbury through Tolar to the Erath County line. This section of US 377 is currently a two-lane highway, but TxDOT plans to widen it to a four-lane divided highway. The second project would involve US 377 east of Granbury from SH 144 to FM 167. This section of US 377 is currently a five-lane highway (four lanes with a turn lane in between), but TxDOT plans to expand it to a six-lane highway (four lanes with two designated turn lanes) (Luminant 2009a).

Figure 2-18 shows the railways in the immediate vicinity of the CPNPP site. The Ft. Worth Western Railroad Company owns and operates the railroad line that runs through Tolar approximately 10 mi northwest of the CPNPP site. An average of two trains use this railway each day, with four to five cars of hazardous materials from various sources transported each month. The spur line that provides rail access to the CPNPP site connects with this main line in Tolar.

There are three private airports and one public airport within three mi of the CPNPP site, and five more private airports and one private heliport within 10 mi of CPNPP. The closest airport is Parker Airport, located 3.5 mi north of the site. Parker is home to one single-engine airplane and has a 200-ft turf runway and a 610-ft turf runway. The closest public airport is Granbury Municipal Airport, located approximately 10 mi north. Granbury Municipal Airport has one 3603-ft asphalt runway and is home to 54 single-engine aircraft, three multi-engine aircraft, and two helicopters. Granbury Municipal Airport averages 33 aircraft operations a day. There are plans to begin construction on a new 5300-ft runway.

2.5.2.4 Aesthetics and Recreation

The CPNPP site is located in north central Texas in the Grand Prairie and North-Central Plains physiographic regions. The Grand Prairie region ranges in elevation from 450 to 1250 ft and is characterized by low hills. The western portion of the Grand Prairie region includes the Western Cross Timbers, a forested area of predominately post oaks. The North-Central Plains region ranges from 900 to 3000 ft in elevation and is characterized by low north-south ridges. The land around the CPNPP site is primarily rural, consisting of grasslands, deciduous and evergreen forests, and some agricultural cropland.

The reactor domes at CPNPP Units 1 and 2 are visible for several mi in most directions, including views from Dinosaur Valley State Park (3.3 mi to the southwest) and Oakdale Park (5.2 mi to the southeast). In response to local residents' complaints about not being able to see the stars at night, Luminant installed low-sodium lighting on CPNPP Units 1 and 2 to reduce light pollution. Luminant would install the same type of low-sodium lights on Units 3 and 4 (Luminant 2009a).

The region is well situated geographically for outdoor activities. Lake Granbury hosts numerous water sports activities throughout the year, including boating, swimming, and fishing. Other large parks and outdoor attractions within the region include Cleburne State Park, Dinosaur Valley State Park, the Fort Worth Nature Reserve, Fossil Rim Wildlife Center, Lake Mineral Wells State Park, Lake Whitney State Park, and Meridian State Park. A new recreational site is planned for WBR, about 1 mi south of the CPNPP, including a boat launch, fishing pier, swim area, and biking or walking trails.

The nearest State park to the CPNPP site is Dinosaur Valley State Park. The Glen Lake Camp and Retreat Center is located 5.3 mi southeast of the CPNPP site and hosts various retreats, summer camps, and events. Oakdale Park and Tres Rios Park, which are located 5.7 mi southeast of CPNPP, both host outdoor events throughout the year and provide camping facilities. The Texas Amphitheatre, located 3.7 mi east of CPNPP, hosts outdoor events. Additional parks and venues in the area surrounding CPNPP include Squaw Creek Golf Course 5.0 mi to the southeast, Pecan Plantation Country Club 7.5 mi to the northeast, and Nutcracker Golf Club 8.2 mi to the northeast.

Outdoor activities in the area include backpacking, climbing, camping, and hunting. Several of the State parks within the region provide numerous facilities and recreational opportunities, including camping facilities, beach complexes, boating access, and hiking trails.

2.5.2.5 Housing

As discussed in Section 2.5.2.1, most of the current CPNPP employees (over 66 percent) live in Hood and Somervell Counties, and over 96 percent live in the EIA. Most of the construction workers and almost all of the operations workers for Units 3 and 4 are expected to follow a similar residential pattern. Thus, this section describes housing in the EIA.

Table 2-27 provides data from the USCB on the total number of housing units, types of occupancies, and vacancies in the EIA. In some cases, the data in Table 2-27 are from the 2000 U.S. Census (the latest housing data available from the USCB for Somervell and Bosque Counties); in others the data are from the 2007 American Community Survey (USCB 2007).

As indicated in Table 2-27, Tarrant and Johnson Counties had the most total housing units and the lowest vacancy rates in the EIA in 2007. Near the CPNPP site, most of the residents are clustered in residential neighborhoods in Glen Rose and Granbury. Outside of these city limits, residents generally live in scattered, single-family homes or mobile homes. Table 2-28 provides

2000 USCB data on housing in the communities closest to the CPNPP: Glen Rose, Granbury, Pecan Plantation Census Designated Place (CDP), and Tolar.

Table 2-28. Housing Data for Glen Rose, Granbury, Pecan Plantation CDP,[(a)] and Tolar (2000)

	Total Housing Units	Occupied	Owner Occupied	Renter Occupied	Vacant Units	Vacancy Rate (%)
Glen Rose	903	801	474	327	102	11.3
Granbury	2727	2391	1321	1070	336	12.3
Pecan Plantation CDP[(a)]	1568	1475	1410	65	93	5.9
Tolar	217	186	140	46	31	14.3
Total	5415	4853	3345	1508	562	10.4

(a) Census designated place.

Source: USCB 2009a.

The four jurisdictions listed in Table 2-28 had a total of 562 vacant units and a vacancy rate of 10.4 percent in 2000. Combined, the two cities in which most of the current CPNPP workers reside, Glen Rose and Granbury, had 438 vacant units and a vacancy rate of 12.1 percent.

Temporary housing is available at one of the many local hotels and motels in the Glen Rose and Granbury areas. In 2009, Glen Rose had eight hotels with 471 rooms, and Granbury had 746 hotel or motel rooms (with construction of another hotel planned, which would add 88 more rooms). With the exception of one hotel, all the hotels in the area accept long-term occupants and are frequented by the outage workers from CPNPP Units 1 and 2. Hotel rooms are available on a first-come, first-served basis, and only two hotels reserve spaces for recreational users. Thus, during outages, CPNPP outage workers and transients compete for temporary housing, and this competition is expected to increase when the construction workers for Units 3 and 4 enter the area.

There are also several hotels and motels in the surrounding communities. Stephenville and Cleburne are both located approximately 30 minutes from the CPNPP site. Cleburne had 260 rooms available in 2008, while Stephenville had 363 rooms available in 2004. The proximity of these cities to the CPNPP site makes it likely that workers seeking temporary housing would travel to those hotels for lodging.

There are also temporary housing opportunities at local campgrounds and recreational vehicle (RV) parks. There are six RV parks located in Glen Rose and Rainbow in Somervell County: B Street RV Park, Cedar Ridge Cabins and RV Park, Dinosaur Valley State Park, Jurassic RV Park, Oakdale Park, and Tres Rios River Ranch. These six RV parks have a total of 428 RV spots. Outage workers stay at the RV parks during outages at CPNPP Units 1 and 2. Of these parks, only Jurassic RV Park intends to expand by adding 30 additional spots if it becomes consistently full.

There are five RV parks located in Granbury in Hood County: 377 Market Place RV Park, Countryside RV Park, Midway Pines RV Park, The Cove Marina and RV Park (formerly Pier 144 RV Park), and Thorp Spring RV Park. Combined, these parks have a total of 191 RV spots. CPNPP outage workers stay at all of the parks except for 377 Market Place RV Park. Midway Pines RV Park even takes reservations solely for outage workers, and intends to add 24 RV spots to its facility with plans to add another 60 spots in the next 3 to 4 years. Several additional RV parks are located in the nearby communities of Stephenville, Cleburne, Joshua, and Alvarado. All of these temporary housing opportunities are also shared by visitors to the area.

There are seven RV parks located in and around Stephenville, and four RV parks in Cleburne and surrounding areas. Doc's City RV Park offers 65 spots and has received outage workers in the past. The Ranch Oaks Mobile Home Park in Cleburne also has 65 spots that are solely for long-term rent.

2.5.2.6 Public Services

The following subsections contain information about the public services provided to residents of the EIA but focus primarily on Somervell and Hood Counties. The public services discussed are water and wastewater; solid waste; police, fire, and medical services; and social services. Educational services are discussed in Section 2.5.2.7.

Water and Wastewater

In Somervell and Hood Counties, there are various ways for residents to obtain water and wastewater services. Depending on the geographic location, residents of the two counties can get water from a municipality or from private wells.

The SCWD operates the only water treatment plant in Somervell County. Drinking water for the City of Glen Rose and other county residences comes directly from the Trinity aquifer. The existing system has a maximum capacity of 1.426 MGD and an average daily consumption of 488,000 gpd. The City of Glen Rose also has a water distribution system that provides service to 1294 service connections. Residents outside of these water systems are on different systems.

In 2008, TCEQ designated five counties including Somervell and Bosque Counties as the Central Texas Trinity Aquifer Priority Groundwater Management Area (PGMA). A PGMA is an area that is experiencing, or is expected to experience, critical groundwater problems including shortage of surface water or groundwater within 25 years. In an effort to decrease Somervell County's dependency on groundwater, the SCWD recently created WBR, located north of Glen Rose. The reservoir was completed in 2008, and construction on the water treatment and distribution system is expected to begin in 2010. The reservoir has a capacity of 1.3 billion gal and is expected to provide access to an estimated 1.8 MGD of water to the City of Glen Rose and other county users.

The City of Glen Rose has the largest wastewater treatment plant in Somervell County. At maximum capacity, the plant can handle 600,000 gpd but only operates at 320,000 gpd. For the rest of Somervell County, wastewater is treated onsite in privately owned septic systems.

In Hood County, the Lake Granbury SWATS is run by the BRA and can supply water to the City of Granbury and the Acton Municipal Utility District (AMUD), as well as other entities in neighboring Johnson County. The SWATS facility has a water treatment capacity of 10.5 MGD with a current usage of 6.1 MGD. The City of Granbury obtains water from wells and also operates a drinking water treatment facility that draws water from Lake Granbury and the Trinity aquifer. The system has a capacity of 500,000 gpd and currently serves approximately 43,000 connections. Plans are in place for a new 1.5 MGD water treatment plant north of Granbury to serve the growing population. The new plant would be capable of being expanded up to 7.5 MGD and would allow the City of Granbury to discontinue purchasing water from the Lake Granbury SWATS facility. Portions of Hood County around Lake Granbury and the Brazos River receive water from AMUD, including a number of subdivisions and undeveloped agricultural land. The AMUD treatment plant has a maximum capacity of 4.13 MGD and is currently operating at 1.9 MGD. The City of Tolar receives its water from wells and has a maximum capacity of 280,000 gpd with current use at 75,000 gpd. Residents outside of these water systems are on different systems.

In 2009, the TCEQ designated 13 counties including Hood, Johnson, and Tarrant Counties as the North-Central Texas and Woodbine Aquifers PGMA. The TCEQ further recommended that eight of those counties including Johnson County form a GCD. This shortage is most likely to affect the City of Tolar, as its municipal water is drawn solely from wells.

Wastewater processing in Hood County occurs at a facility in Granbury with a 2.0-MGD capacity that typically operates at approximately 1.0 MGD. The Tolar Wastewater Treatment Plant has a capacity of 100,000 gpd and is currently operating at 70 percent capacity. Plans for expansion of the plant are expected to be made within the next few years.

In Bosque County, the City of Walnut Springs receives its drinking water from two wells with an average use of 6000 gpd. No capacity numbers are available for the drinking water treatment plant; however, the city currently has 315 connections and could increase to 2000 connections with the existing groundwater supply. The wastewater treatment plant has a current usage of 63,000 gpd and an approximate maximum capacity of 120,000 gpd.

In Erath County, the City of Stephenville has a water treatment plant with a maximum capacity of 5.5 MGD. The plant provides water to 5512 connections, and the average daily consumption is 2.3 MGD. The wastewater treatment plant has a capacity of 9.0 MGD and a current utilization of 1.4 MGD.

In Johnson County, the City of Cleburne receives its drinking water from Lake Pat Cleburne, Lake Aquilla, and groundwater. However, groundwater supplies are diminishing, so plans are in place to make use of unused water rights to Lake Whitney, with initial capacity of 2.1 MGD in 2013. The existing water treatment plant has a capacity of 15 MGD, with plans to expand to 20 MGD by 2011 in response to increased population and industrial demand. Average daily consumption is 7.3 MGD with peak demand of 11.3 MGD, usually occurring in August. The City of Cleburne has two wastewater treatment plants with a combined total capacity of 7.5 MGD. The average daily usage is 6.6 MGD. There are plans to increase the plants' capacity using new technology in the next few years, with a plant expansion 4 to 5 years later as demand dictates.

In Tarrant County, the City of Fort Worth receives its drinking water from six sources: Benbrook Lake, Cedar Creek Lake, Lake Bridgeport, Eagle Mountain Lake, Richard-Chambers Reservoir, and Lake Worth. Lake Worth is owned by the City of Fort Worth and Benbrook Lake is owned by the Army Corps of Engineers. The other four lakes are owned by the Tarrant Regional Water District. The City of Fort Worth has four water treatment plants. The North and South Holly Water Treatment Plants have a combined capacity of 180 MGD, the Rolling Hills plant has a capacity of 200 MGD, and the Eagle Mountain plant has a capacity of 105 MGD, for a total capacity of 485 MGD. The average daily consumption is 164.8 MGD with a peak of 335.2 MGD. Fort Worth has one wastewater treatment plant, the Village Creek Wastewater Treatment Plant. The plant has a capacity of 166 MGD with an average flow of 108.5 MGD.

Solid Waste

There are no active landfills in Somervell or Hood Counties. Solid waste in Somervell County is gathered at the IESI, Inc., Somervell County Transfer Station, and waste in Hood County is gathered at the IESI Granbury Transfer Station. In 2005, the IESI Somervell County Transfer Station handled 14,284 tons of waste, and the IESI Granbury Transfer Station handled 16,153 tons. Waste from these two stations is transported to the IEASI Weatherford Landfill in Parker County. The Weatherford Landfill is a Type 1 landfill and received 194,125 tons of waste in 2005 with an estimated 1,100,000 tons of space remaining.

Police, Fire, and Medical Services

Police protection in Somervell County is provided mainly by the Somervell County Sheriff's Department, which employed 19 sworn officers in 2004. In addition, the City of Glen Rose has a police chief.

Police protection in Hood County is provided mainly by the Hood County Sheriff's Department, which employed 37 sworn officers and 78 civilians in 2006. There are also two other police departments in Hood County: the Granbury Police Department and the Tolar Police Department. The Granbury Police Department has 30 officers, while the Tolar Police Department employs one. The Granbury Police Department plans to augment its force with 30 to 35 citizen volunteers who are trained at the Citizen Police Academy in Granbury to aid the officers in disaster and emergency response, including response to situations at CPNPP.

Somervell County has a single fire department, the Somervell County Volunteer Fire, Rescue, and Emergency Management Services. The department is served by 40 people: 34 volunteers and 6 paid employees. The department has three engines, two tankers, one ladder truck, six brush trucks, one rescue vehicle, one command vehicle, and three ambulances. The department responds in the event of an emergency at CPNPP.

There are a total of nine fire departments with 250 volunteers in Hood County. Each fire department is assigned one of nine response areas in the county but responds to larger emergencies anywhere in or even outside of the county. Each station has at least one 2000-gal pumper truck. The City of Granbury is served by the Granbury Volunteer Fire Department (VFD). The department has 60 volunteers and operates out of two stations. The fire department owns four pumper trucks, one aerial ladder truck, one tanker, three brush trucks, and two rescue trucks. Granbury VFD, Tolar VFD, Indian Harbor VFD, and DeCordova/Acton VFD have a mutual aid agreement with CPNPP to respond to fires. Each department contributes one engine and a squad of approximately 10 people.

Somervell County contains one hospital, Glen Rose Medical Center, which also has an associated nursing home. The hospital has 16 beds and the nursing home has 118 beds. Combined, the two facilities employ 280 people. The daily load at the hospital is seven beds. During an emergency, the 16 beds could be augmented with 7-10 additional beds.

Hood County also contains one hospital, Lake Granbury Medical Center in Granbury. The Center has 59 beds with 36 doctors on active duty. The daily load is 16 beds and the maximum capacity is 59 beds.

Social Services

Social services in the State of Texas are overseen by the Texas Department of Family and Protective Services (DFPS), which has an office in Granbury. The DFPS provides services such as child and adult protective services, child care licensing, and assistance to adult or elderly disabled. The agency also manages community-based programs targeting the prevention of abuse, neglect, delinquency, and exploitation of children, disabled adults, or the elderly. Other social services in the project area are provided by local non-governmental organizations and religious groups.

2.5.2.7 Education

There are two school districts within Somervell County: Brazos River Charter School and Glen Rose ISD. Brazos River Charter School has one school that provides education for grades 9-12, and had a total enrollment of 135 students in the 2006–2007 school year. Glen Rose ISD has four schools which provide PK-12 education. Glen Rose ISD has a maximum capacity of

2862 students, with 1657 students enrolled for the 2007–2008 school year. According to Texas House Bill 72, elementary school classes are required to have a student-teacher ratio of 22:1. Brazos River Charter School has a student-teacher ratio of 15.9 while Glen Rose ISD has a student-teacher ratio of 11.6.

There are three school districts within Hood County: Granbury ISD, Lipan ISD, and Tolar ISD, each of which provides K–12 education. Granbury ISD has twelve schools with a total maximum capacity of 8665 students. Granbury ISD had a total enrollment of 6882 in 2007–2008. Lipan ISD has one school with a total enrollment of 590 in 2006–2007. Tolar ISD has two schools with a total enrollment of 595 in 2006–2007. Granbury ISD has a student-teacher ratio of 14.2 while Lipan ISD and Tolar ISD have student-teacher ratios of 11.2 and 13.1, respectively.

Both Glen Rose ISD and Granbury ISD are categorized as "Chapter 41" school districts (see Section 2.5.2.2), which means they are subject to the redistribution of funds to poorer school districts under State law. The law stipulates that any funds in excess of the state-mandated per student limit be recaptured from wealthier school districts and distributed to poorer school districts. The amounts recaptured are based on the wealth per weighted student in average attendance. Estimates show that Glen Rose ISD's recapture cost for the 2007–2008 year was $6,976,397. Granbury ISD did not have any recapture cost for the 2007–2008 school year.

2.6 Environmental Justice

Environmental justice requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies, and activities on minority and low-income populations (59 FR 7629)[b].Environmental Justice was established by Executive Order (EO) 12898. The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although the Commission is not required to comply with EO 12898, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040).

This section describes the existing demographic and geographic characteristics of the proposed site and its surrounding communities. It offers a general description of minority and low-income populations within the 50-mi region surrounding the site. The characterization in this section forms the analytical baseline from which the determination of potential environmental justice effects would be made. The characterization of populations of interest includes an assessment of "populations of particular interest or unusual circumstances," such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the CPNPP site using data from the 2000 Census to identify minority

(b) The U.S. Census Bureau defines minority categories: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity; "other" may be considered a separate minority category. Low-income refers to individuals living in households meeting the official poverty measure. To see the U.S. Census Bureau definitions and values for 2000, visit the U.S. Census website at http://ask.census.gov/.

and low-income populations. The review team examined each Census block group[c] that is fully or partially included in the region to determine for each minority and low-income population group whether

- the population of interest exceeds 50 percent of the total population for the block group, or;
- the percentage of the population of interest is 20 percent (or more) greater than the same population's percentage in the block group's state.

The identification of Census block groups that meet either of the above criteria is not, in and of itself, sufficient for the review team to conclude that disproportionately high and adverse impacts would occur. Likewise, the lack of Census block groups meeting either of the above criteria cannot be construed as evidence of no disproportionately high and adverse impacts. To reach an environmental justice conclusion, the review team must investigate all populations in greater detail to determine if there are potentially significant environmental impacts that may have disproportionately high and adverse effects on minority or low-income communities. To determine whether disproportionately high and adverse effects may occur, the review team considers the following:

Health Considerations

1. Are the radiological or other health effects significant or above generally accepted norms?
2. Is the risk or rate of hazard significant and appreciably in excess of the general population?
3. Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards?

Environmental Considerations

4. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
5. Are there any significant adverse impacts on a group that appreciably exceed or [are] likely to appreciably exceed those of the general population?
6. Do the environmental effects occur in groups affected by cumulative or multiple adverse exposure from environmental hazard? (NRC 2007a)

If this investigation in greater detail does not yield any potentially disproportionately high and adverse impacts on populations of interest, the review team may conclude that there are no disproportionately high and adverse effects. If, however, the review team finds any potential for disproportionately high and adverse impacts, the review team would fully characterize the nature and extent of those impacts and consider possible mitigation measures that would be used to lessen those impacts.

Minority and Low-Income Populations

The review team included all the Census blocks that are located either fully or partially within the region to identify minority and low-income populations. The review team used the State of Texas as the geographic area for defining the threshold criteria discussed as items 1 and 2 above, and averaged the statewide Census data to derive the specific threshold criteria for

(c) The U.S. Census Bureau defines a Census block group as a "subdivision of a census tract (or, prior to 2000, a block numbering area)" and as the "smallest geographic unit for which the Census Bureau tabulates sample data. A block group consists of all the blocks within a census tract with the same beginning number." To see more definitions of terms used in the Census, visit the U.S. Census website at http://factfinder.census.gov/home/en/epss/glossary_b.html.

minority and low-income populations. The review team then compared the calculated percentages of minority and low-income residents derived from Census block data with the specific criteria to identify Census blocks that contain a minority or low-income population.

In addition to the minority definitions stated above, the review team also considered Hispanic ethnicity in identifying minority populations. According to the USCB, Hispanic ethnicity is not a race; therefore, a Hispanic individual can be counted in any of the race categories as well as the Hispanic ethnicity category.

Figure 2-19 shows the Census block groups with minority populations, as defined above, within the region. There are a total of 37,212 Census blocks in the region, of which 10.5 percent had an "Aggregate Minority" (i.e., all minority groups combined) population that exceeded one of the above criteria, and 20.5 percent had an "Aggregate Minority plus Hispanic" population that exceeded one of the above criteria. The closest Census block group to the CPNPP site borders the CPNPP property to the south.

Figure 2-20 shows the Census block groups with low-income populations, as defined above, within the 50-mi CPNPP region. Less than one percent of the 37,212 Census blocks in the region had a low-income population that exceeded one of the above criteria. The closest Census block to the site with a low-income population as defined above is more than 35 mi away to the southwest, in Dublin, Texas.

Table 2-29 lists the results of the review team's analysis for total minority and low-income individuals as a percentage of the total population within the region. The review team added data from the 2000 Census for the State of Texas for purposes of comparison.

As indicated in Table 2-29, the percentage of minority individuals in the region (25.5 percent Aggregate Minority) was slightly lower than the percentage of minority individuals for the State of Texas (29.1 percent Aggregate Minority). Further, the percentage of Hispanic ethnicity (18.8 percent) and Aggregate Minority plus Hispanic (44.3 percent) in the region was much lower than the percentage of Hispanic ethnicity (32.0) and Aggregate Minority plus Hispanic (61.1 percent) for the State of Texas. Also, the percentage of households below the poverty level in the region (11.4 percent) was lower than the percentage statewide (14.0 percent).

The closest census block group cluster that contains a minority population of interest shares a boundary with the CPNPP site to the south and west. Two small Census block group clusters lie about 6 mi from the CPNPP. At much greater distances (more than 10 mi from the site) clusters of Census block groups can be found scattered throughout the southwest and the northeast of the site, with the largest concentrations of minority populations of interest near Fort Worth. Of these Census blocks, about 1.3 percent had an Aggregate Minority population that exceeded one of the above criteria, and about 5.1 percent had an Aggregate Minority plus Hispanic population that exceeded one of the above criteria. The closest Census block group cluster with a low-income population of interest lies between 30 and 35 mi of the CPNPP to the southwest, near Dublin in Erath County.

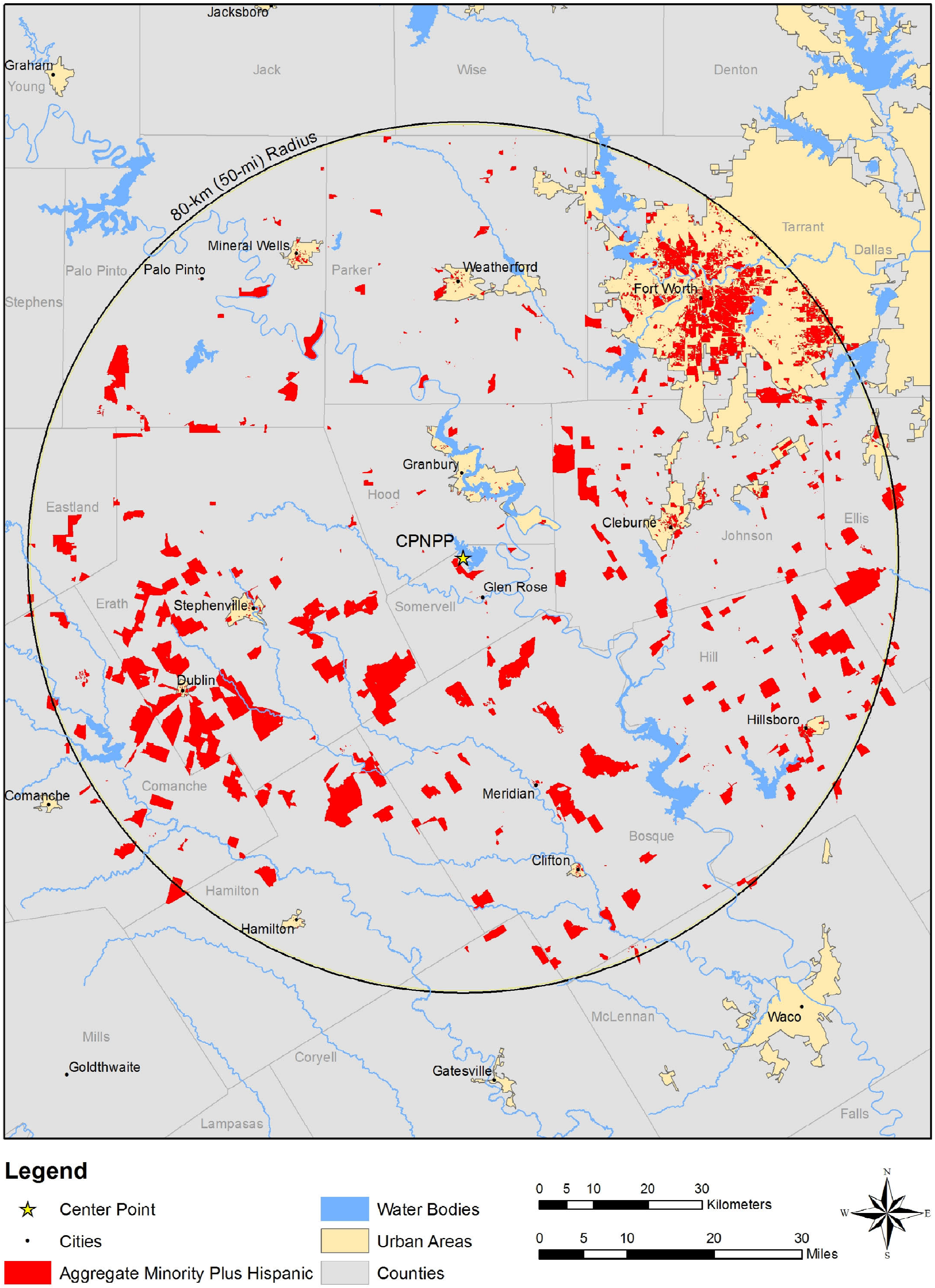


Figure 2-19. Census Block Groups with Minority Populations Within a 50-mi Radius of CPNPP Units 3 and 4 (Luminant 2009a)

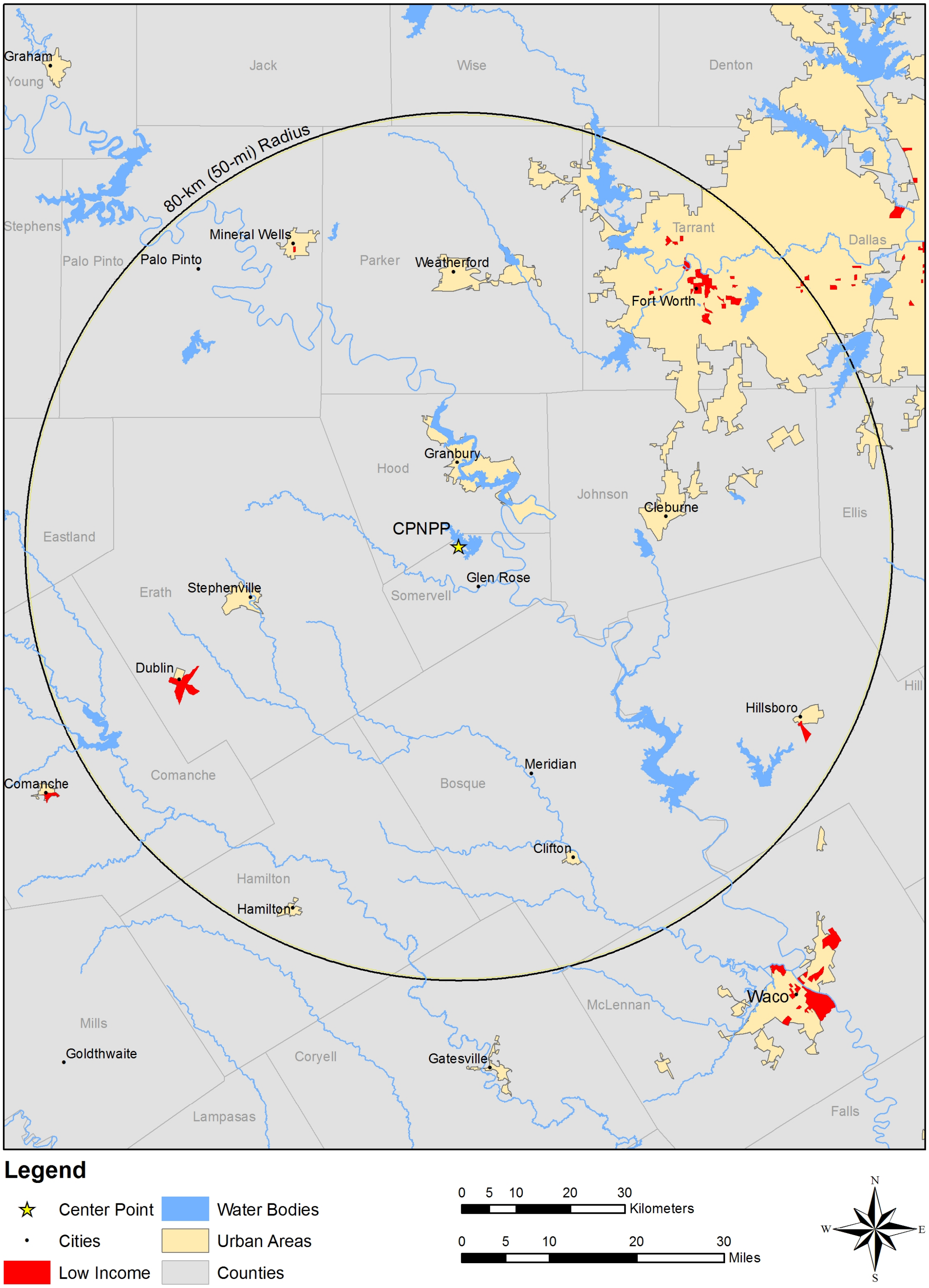


Figure 2-20. Census Block Groups with Low-Income Populations Within a 50-mi Radius of CPNPP Units 3 and 4 (Luminant 2009a)

Table 2-29. Minority and Low-Income Population as a Percent of Total Population Within 50-mi of CPNPP and for the State of Texas (2000)

Category	Percent of the Total Population Within 50 mi of CPNPP	Percent of the Total Population Within the State of Texas
American Indian or Alaskan Native	0.6	0.6
Asian	2.6	2.7
Native Hawaiian or other Pacific Islander	0.1	0.1
Black	11.4	11.5
Persons reporting some other race	8.5	11.7
Persons reporting two or more races	2.3	2.5
Aggregate minority	25.5	29.1
Hispanic ethnicity	18.8	32.0
Aggregate minority plus Hispanic	44.3	61.1
Low-income population	11.4	14.0

Sources: Luminant 2009a, USCB 2009d.

2.6.2 Scoping and Outreach

NRC staff issued advance notice of public EIS scoping meetings in accordance with Commission guidance (NRC 2003) and conducted public scoping meetings in Glen Rose, Texas, on January 6, 2009. Also, on February 24, 2009, NRC staff met with local government officials from Somervell and Hood Counties and with representatives of organizations that serve minority and low-income communities. One purpose of the February 24, 2009, meeting was to identify and assess the potential for disproportionately high and adverse effects on minority and low-income populations. Through these meetings, the review team did not identify any additional groups of minority or low-income populations or any additional issues that Luminant had not already identified in its ER.

2.6.3 Subsistence and Communities with Unique Characteristics

For each of the identified minority and low-income populations, it is necessary to determine if any of those populations appear to have a unique characteristic at the population level that would cause an impact to be disproportionately high and adverse. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, close proximity to the plant, or subsistence activities, but such unique characteristics need to be demonstrably present in the population and relevant to the potential effects of the plant. If the impacts from the proposed action would appear to affect an identified minority or low-income population more than the general population because of one of these or other unique characteristics, then a determination is made whether the impact is disproportionately high and adverse when compared to the general population. Through its review of the Applicant's ER, its own outreach and research, and through scoping comments, the review team did not identify any communities with unique characteristics that would require further consideration.

Regarding subsistence populations, the review team did not identify any unusual resource dependencies or practices, or other circumstances that could result in disproportionately high and adverse impacts to minority or low-income populations. Specifically, based on the U.S. Census data discussed above, there are no low-income populations near the CPNPP site, where potential plant-related impacts would be expected to be most significant. Moreover, the low-income populations identified in the region are located principally within urban areas southwest of Fort Worth, where subsistence type dependence on natural resources (e.g., fish, game, agricultural products, and natural water sources) is less likely.

2.6.4 Migrant Populations

Section 2.5.1.3 discusses the two largest migrant populations within the region: migrant workers associated with outages at CPNPP Units 1 and 2 and with agricultural activities in the region. Based on the discussion in Section 2.5.1.3, it does not appear that either of these groups meets the criteria for minority or low-income populations as defined above.

2.6.5 Environmental Justice Summary

As discussed above, the review team found that 10.5 percent of the Census blocks in the 50-mi CPNPP region had an Aggregate Minority population that exceeded one of the criteria established for environmental justice analyses, and that 20.5 percent had an Aggregate Minority plus Hispanic population that exceeded one of the criteria. The review team found that less than one percent of the Census blocks in the region had a low-income population that exceeded one of the criteria. Based primarily on the presence of minority populations, the review team performed analyses in greater detail before making a final environmental justice determination. These analyses can be found in Chapter 4 of this EIS for project development, and in Chapter 5 for project operations.

2.7 Historic and Cultural Resources

In accordance with 36 Code of Federal Regulations (CFR) 800.8(c), the NRC staff is using the National Environmental Policy Act (NEPA) process (NEPA 1969) to comply with the obligations imposed under Section 106 of the National Historic Preservation Act of 1966, as amended, (NHPA 1996). The NRC has determined that the Area of Potential Effect (APE) for the COL review is the area at the proposed CPNPP Units 3 and 4 site and the immediate environs that may be impacted by land-disturbing activities associated with building and operating the proposed CPNPP Units 3 and 4. The USACE also considers the transmission line corridors to be within the APE for its permit review.

This section discusses the historic and cultural background in the CPNPP site region. It also details the efforts that have been taken to identify cultural resources in the APE and the resources that were identified. A description of the consultation efforts accomplished to date is also provided. The assessments of effects from the proposed construction and operation are found in Sections 4.6 and 5.6, respectively.

2.7.1 Cultural Background

The area in and around the CPNPP site has a diverse cultural history and a substantial record of prehistoric and historic resources (Skinner and Humphries 1973). The Brazos River system flows through the area and has influenced settlement patterns throughout prehistoric and historic times. The following section presents a brief summary of the region's cultural background and a description of known historic and archaeological resources at the CPNPP site and its immediate vicinity. The information presented was collected from area repositories, the Texas State Historic Preservation Office (SHPO), and the Applicant's ER (Luminant 2009a).

2.7.1.1 Prehistoric Overview

Paleoindian Period (9200 to 6000 BC)

Paleoindian people in Texas ranged over large areas of land traveling in small bands. Early Paleoindian groups are thought to have lived in small central base camps for varying periods throughout the year. Over the course of the Paleoindian era, occupation of fixed base camps gave way to a mobile foraging lifeway, with bands frequently moving their camps as they exhausted the food supply in their immediate area (Hester and Turner 1997). Most Paleoindian sites that have been excavated in Texas to date are located in the Panhandle Region, northeast of the CPNPP site, and very few Paleoindian finds have been recorded in the Brazos River drainage (Hester and Turner 1997).

Archaic Period (6000 BC to AD 700)

The Early Archaic period in Texas saw a small increase in population; however, Early Archaic people did not stray greatly from Paleoindian lifeways, continuing to travel in small groups or "bands" hunting wild game and collecting seasonal and perennial edible flora. The climate in north central Texas became increasingly arid during the Middle Archaic, causing food resources to become scarcer. As a result, Middle Archaic people became more resourceful, processing plants and burning rock middens to extract edible foods from previously unusable sources (Black et al. 1997). During the Late Archaic, an increasingly moist climate, similar to today's climate, led to a greater abundance of food resources and to a continued increase in population. Greater technological diversity is also evident in the many new projectile point forms that appeared during this period.

Late Prehistoric Period (AD 700–1500)

The Late Prehistoric Period in north central Texas is defined by major technological and subsistence developments such as the bow and arrow, pottery, and agriculture. The transition from use of the atlatl and dart for hunting to the bow and arrow was a very important development during this period. Pottery in north central Texas, referred to as Henrietta Complex pottery, consisted mostly of plain shell-tempered jars and bowls (Perttula 2004). Some specimens have been recovered that resemble cups or mugs and have been indented with corn. Though there is evidence for the introduction of agriculture during the Late Prehistoric Period, general subsistence remained geared to broad-based hunter-gatherer strategies (Hester and Turner 1997).

2.7.1.2 Historic Overview

The CPNPP site is located in Somervell County, part of Texas's historically important Brazos River Area. Somervell County was created from portions of Hood and Johnson Counties in 1875 (Nunn 1975). The area was first settled in 1840s by Charles Barnard, and the small settlement that bore his name, Barnard's Mill, was granted a post office in 1859. Barnard's Mill was incorporated as Glen Rose in 1872 and currently serves as the Somervell County seat (Nunn 1975). The CPNPP site saw only sparse occupation by settlers during the historic period. Ranchers ran cattle along Squaw Creek and the Brazos River, ranging into portions of the project area. The small community of Hopewell existed in the southeast portion of the CPNPP site and was occupied from the late nineteenth century through the middle of the twentieth century (Skinner and Humphries 1973). Remnants of the community, including foundations of the Hopewell School and other buildings, and a small cemetery are still evident. The population of Somervell County was 3931 in 1910, and more than 600 farms were in operation across the county (Elam 1997). By the middle part of the twentieth century, farming had declined dramatically, and the county began to shift to an industrial and commercial economy. The construction and operation of CPNPP in the mid-1970s led to rapid population growth and financial change. By the mid-1980s the county had nearly $2 billion of taxable property on the books, and the 2000 Census recorded a population of 6809 (Elam 1997).

2.7.2 Historic and Cultural Resources at the Site

To identify the historic and cultural resources at the CPNPP COL site and associated power lines, the following information was used:

CPNPP COL ER (Luminant 2009a) – Luminant's contractor Enercon subcontracted with Briscoe Consulting Services, a cultural resource contractor to identify and evaluate cultural -resource sites in the area.

The Historic and Prehistoric Archaeological Resources of the SCR–this report was submitted to Texas Utilities Services Inc. in 1973, by the Southern Methodist University Department of Anthropology, in advance of construction of the plant and reservoir.

NRC Audit – NRC staff conferred with the Texas Historical Commission and also conducted an on-the-ground visit of the COL site.

To comply with NRC guidance, National Register-eligible archaeological sites, structures, buildings and districts located within 10 mi of the proposed CPNPP Units 3 and 4 site were identified in the ER (Luminant 2009a). In its ER, Luminant identified 51 sites listed on or considered eligible for inclusion on the *National Register of Historic Places* within 10 mi of the COL site.

Luminant contracted with Enercon to identify and evaluate any cultural resources located within the proposed construction areas at the plant. Enercon conducted a Phase 1a cultural resources investigation of the CPNPP project to identify previously recorded archaeological resources and architectural resources and to identify areas with archaeological potential that would require further investigation (Luminant 2009a). Additionally, on behalf of Luminant, Enercon conducted a Phase 1a and 1b survey of proposed water transmission pipelines in August 2007 and February 2008. This survey included investigation of four alternative water transmission pipeline routes on the CPNPP property.

The Phase 1a investigation of the CPNPP site resulted in the identification of 28 archaeological sites and four historic cemeteries on or within a one mi radius of CPNPP, recorded during previous surveys. Of these 28 sites, 23 were either inundated by the waters of the SCR or destroyed by construction activity. One site that is eligible for the *National Register*, 41SV30 (recorded during Southern Methodist University's 1972 survey), was revisited by Enercon in 2007. The site had been extensively excavated by Southern Methodist University archaeologists in 1972, and Enercon found that it no longer retains its archaeological integrity (Luminant 2009a); NRC staff agrees with this assessment.

The Phase 1a and 1b cultural resources investigations of the proposed water lines were completed by Enercon in June 2008. This investigation resulted in the identification of six archaeological sites, two of which are associated with the historic-period. All of these sites are either partially or extensively disturbed by electric transmission line and water transmission line construction activity and none is considered eligible for listing in the *National Register of Historic Places.*

Luminant consulted with the Texas Historical Commission. In a letter dated February 21, 2007, the commission responded with a stamped copy of Enercon's letter, noting that no historic properties would be affected.

2.7.3 Consultation

In December of 2008 the NRC initiated consultation on the proposed action by writing the Texas SHPO and the Advisory Council on Historic Preservation. Also in December of 2008, the NRC initiated communications with 17 tribes (see Appendix F for complete listing). In the letters, the NRC provided information about the proposed action, indicated that review under NHPA would be integrated with the NEPA process in accordance with 36 CFR 800.8, invited participation in the identification and possible decisions concerning historic properties, and invited participation in the scoping process.

The regional American Indian Tribes that were invited to participate and the NRC independent evaluation of information sources have not identified traditional cultural properties in the vicinity of the proposed construction area of the plant.

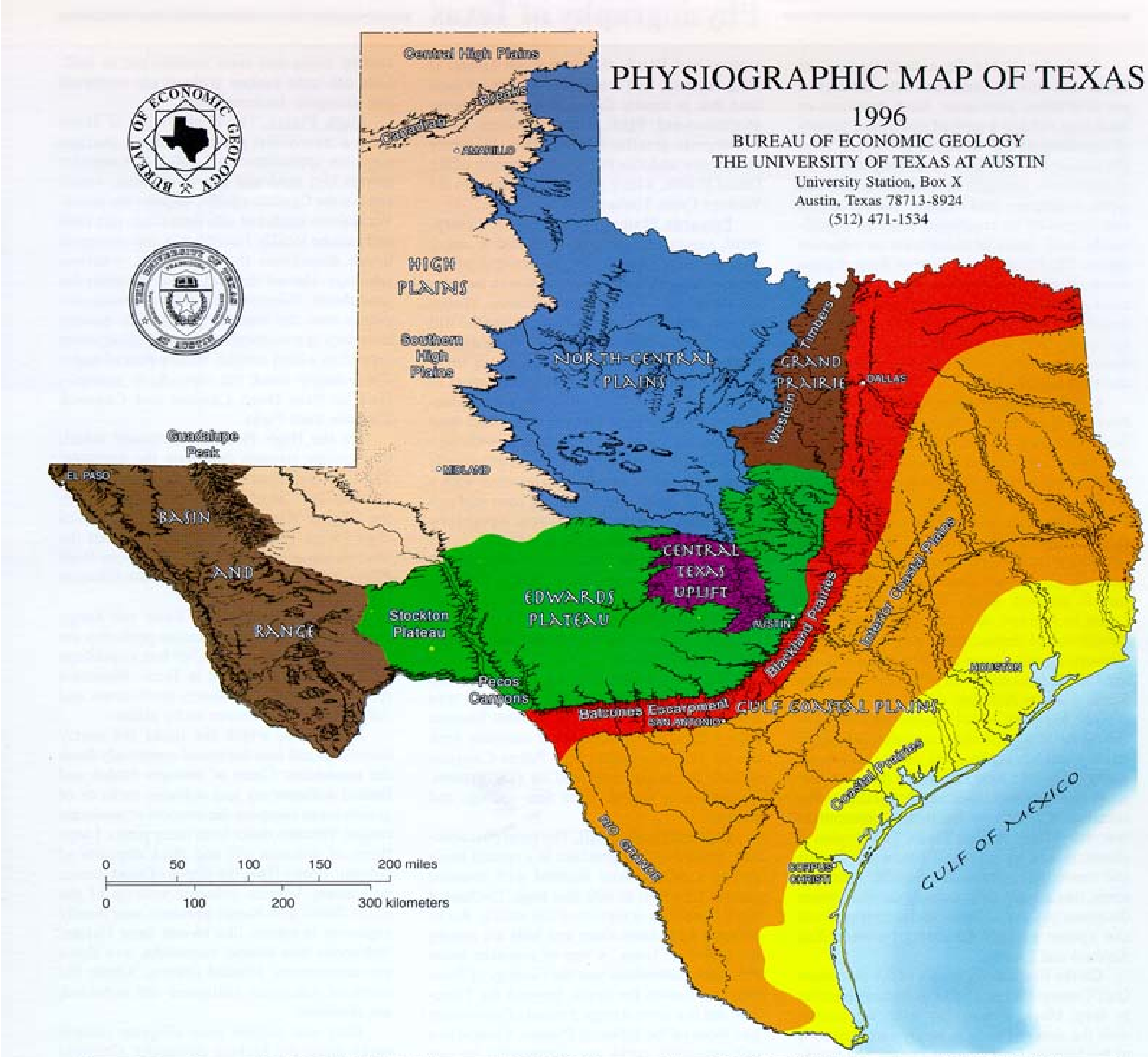
On January 6, 2008, NRC conducted two public scoping meetings in Glen Rose, Texas. No comments or concerns regarding historic and cultural resources were made at these public scoping meetings.

2.8 Geology

The geology and associated seismological and geotechnical conditions at the proposed CPNPP Units 3 and 4 site are described in Section 2.5 of the FSAR, which is part of the COL application (Luminant 2009b). Both the FSAR and the ER were informed by the geologic characterization conducted for the existing CNPP Units 1 and 2 and the results of subsurface investigations performed recently to support the COL application. The NRC staff's description of the site and vicinity geological features and the detailed analyses and evaluation of geological, seismological, and geotechnical data, as required for an assessment of the site-safety issues related to the proposed CNPP Units 3 and 4 site, are included in the staff's Safety Evaluation Report. The site is in the Grand Prairie physiographic province (Figure 2-21) (according to the Texas Bureau of Economic Geology). The Grand Prairie province is underlain by relatively flat-lying Lower Cretaceous limestones and shales with intervening sandstone units that mark transgressive events. The limestone–shale sequences are variably resistant to erosion, with the harder, more resistant limestone units forming steeper slopes than the less resistant shale units. This results in a "stairstep" topographic expression that is characteristic of the region.

Surface elevations in the CPNPP site area range from about 580 ft MSL southeast of the site in the Brazos River Valley to 1224 ft MSL at the top of Comanche Peak, north of the CPNPP site. Local elevation differences result from stream incision and the differential weathering resistance of site area rocks. Surface elevations of the CPNPP site range from 870 ft MSL on the drainage divide between Squaw Creek and Panther Branch down to the 775 ft MSL pool level of SCR.

Figure 2-22 shows the stratigraphic column that represents the geology beneath the CPNPP site. Bedrock stratigraphic units exposed in the site area are sedimentary rocks of Lower Cretaceous age. The oldest unit in the Lower Cretaceous sequence is the Twin Mountains Formation which is principally sandstone, but with shale, limestone, claystone, and siltstone inclusions. The oldest unit exposed in the site area is the Glen Rose Formation, which is immediately above the Twin Mountains Formation and is present under the site. In the site area the Glen Rose Formation consists of carbonates that are interbedded with mudstones and shale. The Paluxy Formation, which is stratigraphically above the Glen Rose, is found only at higher elevations associated with drainage divides. It consists of loosely consolidated to unconsolidated sandstone. Stratigraphically above the Paluxy Formation is the Fredericksburg Group, which includes the Walnut, Comanche Peak, and Edwards Formations.



PROVINCE	MAX. ELEV. (ft)	MIN. ELEV. (ft)	TOPOGRAPHY	GEOLOGIC STRUCTURE	BEDROCK TYPES
Gulf Coastal Plains					
Coastal Prairies	300	0	Nearly flat prairie, <1 ft/mi to Gulf	Nearly flat strata	Deltaic sands and muds
Interior Coastal Plains	800	300	Parallel ridges (questas) and valleys	Beds tilted toward Gulf	Unconsolidated sands and muds
Blackland Prairies	1000	450	Low rolling terrain	Beds tilted south and east	Chalks and marls
Grand Prairie	1250	450	Low stairstep hills west; plains east	Strata dip east	Calcareous east; sandy west
Edwards Plateau					
Principal	3000	450	Flat upper surface with box canyons	Beds dip south; normal faulted	Limestones and dolomites
Pecos Canyons	2000	1200	Steep-walled canyons		Limestones and dolomites
Stockton Plateau	4200	1700	Mesa-formed terrain; highs to west	Unfaulted, near-horizontal beds	Carbonates and alluvial sediments
Central Texas Uplift	2000	800	Knobby plain; surrounded by questas	Centripetal dips, strongly faulted	Granites; metamorphics; sediments
North-Central Plains	3000	900	Low north-south ridges (questas)	West dip; minor faults	Limestones; sandstones; shales
High Plains					
Central	4750	2900	Flat prairies slope east and south	Slight dips east and south	Eolian silts and fine sands
Canadian Breaks	3800	2350	Highly dissected; local solution valleys		
Southern	3800	2200	Flat; many playas; local dune fields		
Basin and Range	8750	1700	North-south mountains and basins	Some complex folding and faulting	Igneous; metamorphics; sediments

Figure 2-21. Physiographic Map of Texas. The CPNPP Site Is Located in the Grand Prairie Physiographic Province (Texas Bureau of Economic Geology 1996)

Geologic Period	Series	Geologic Unit		Depositional Setting
Quaternary	N/A	Quaternary Alluvium		Fluvial deposition and terrace deposits
Early Cretaceous	COMANCHEAN	Fredericksburg Group	Edwards Formation	Passive margin onlap from transgressing Gulf of Mexico
			Comanche Peak Formation	
			Walnut Formation	
		Trinity Group	Paluxy Formation	
			Glen Rose Formation	
			Twin Mountains Formation	
Pennsylvanian	MISSOURI	Strawn Group	Mineral Wells Formation	Filling of Fort Worth Basin with decreased subsidence
	DES MOINES		Brazos River Formation	
			Mingus Formation	
			Grindstone Creek Formation	
			Lazy Bend Formation	
	ATOKA	Atoka Group	Atoka Sand	Foredeep basin subsidence followed by synorogenic clastic facies
			Smithwick	
			Big Saline	
	MORROWAN	Marble Falls Limestone		
Mississippian	CHESTERIAN - MERAMECIAN			
		Barnett Shale		
	OSAGEAN			
		Chappel Limestone		
Late Cambrian to Ordovician	CANADIAN	Viola and Simpson Formations		Laurentian Shelf
		Ellenburger Group	Honeycut Formation	
			Gorman Formation	
			Tanyard Formation	
		Wilberns Formation	San Saba	
			Point Peak	
			Morgan Creek Limestone	
			Welge Sandstone	
		Riley Formation	Lion Mountain Sandstone	
			Cap Mountain Limestone	
			Hickory Sandstone	
Precambrian	Undifferentiated Grenville crystalline Basement			Precambrian North American craton

Legend:

= Unconformity

Figure 2-22. Bedrock Stratigraphic Column for the CPNPP Site Area (Adapted from Luminant 2009b)

Quaternary alluvial deposits overlie bedrock in drainages, primarily the Brazos River valley in the southeastern portion of the site area, the Paluxy River valley in the southwestern portion of the area, and Squaw Creek. Figure 2-23 is a geologic map of the region within 25 mi of the CPNPP site.

The existing terrain at the proposed site for CPNPP Units 3 and 4 site has relatively gentle slopes, with the exception of a steeper slope that descends to SCR along the north margin of the site. Prevalent site soil types are loams and clay loams formed over limestone or sandstone bedrock; sandy loam soils formed on alluvium are present on the southwestern portion of the proposed BDTF site (Enercon 2009). There is no evidence of active karst conditions or related subsidence in the site area.

The only active mining in the site area is surface strip mining for aggregate, focusing on the Paluxy Formation for gravel and the Glen Rose Formation for dimension stone. The FSAR identified three aggregate mining and processing operations within about 4 mi of the CPNPP site (Luminant 2009b, Section 2.5.1.2.5.10).

The site is in a region where oil and natural gas have been produced for several decades from underlying Paleozoic rocks (Pollastro et al. 2007). Currently most production activity is extraction of natural gas from the Mississippian-age Barnett Shale using hydraulic fracturing and fluid injection to enhance recovery. Figure 2-24 shows the locations of active gas wells in the vicinity of the CPNPP site with their production volumes. In addition to the active production wells shown on the map, there are numerous abandoned production wells in the area, as well as both active and abandoned injection wells (Luminant 2009b, Section 2.5.1.2.5.10.1).

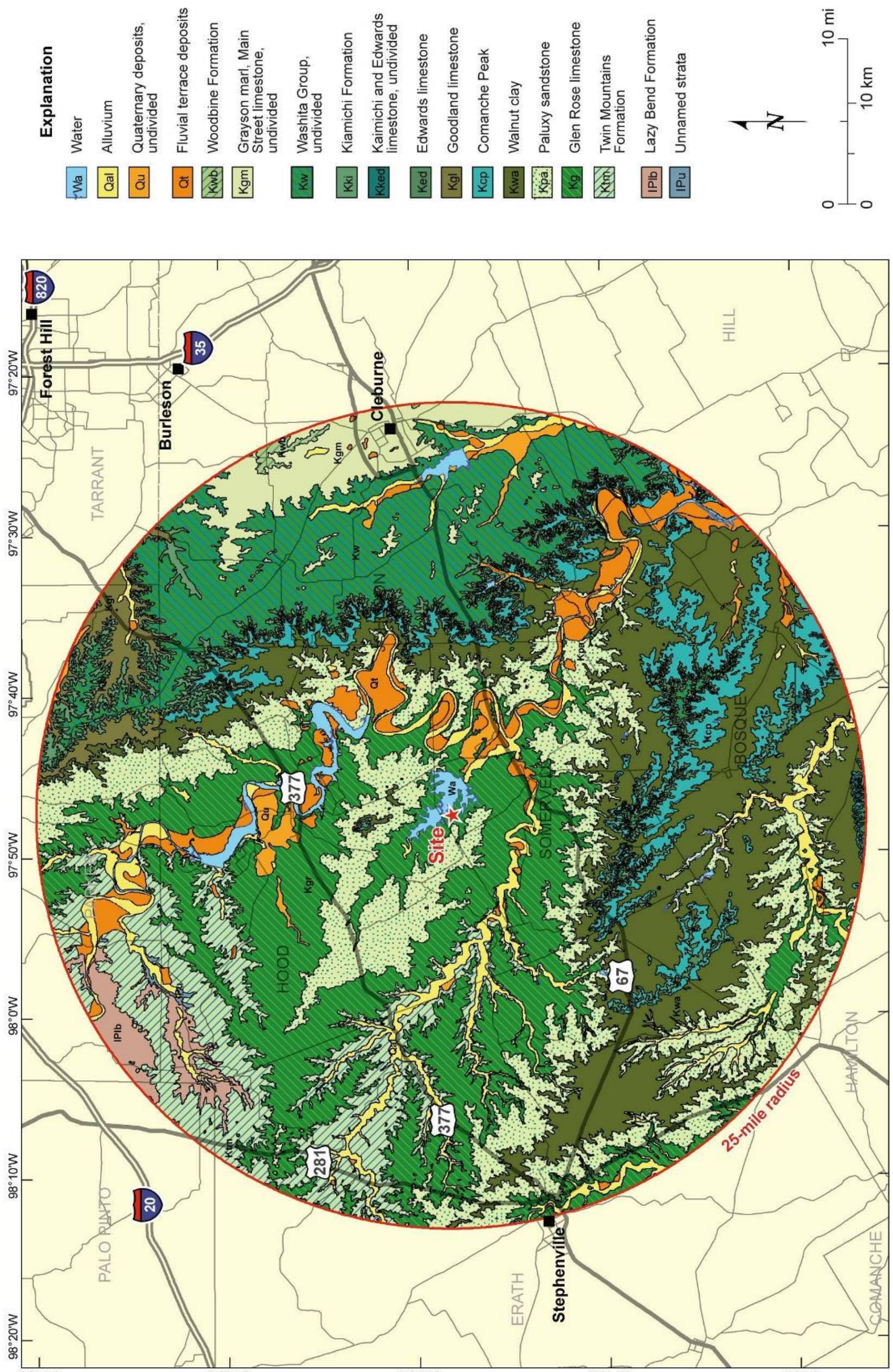
2.9 Meteorology and Air Quality

The following subsections describe the climate and air quality of the CPNPP site. Section 2.9.1 describes the climate of the region and area in the immediate vicinity of the site. Section 2.9.2 describes the air quality of the region. Section 2.9.3 describes the atmospheric dispersion characteristics of the site, and Section 2.9.4 describes the meteorological monitoring program at the site.

2.9.1 Climate

The CPNPP site is located in Somervell County, in the north-central part of Texas. Due to its large size and topographic variability, the State of Texas exhibits a wide variety of climatic types. The Texas High Plains, comprising the Panhandle and portions of west Texas, is characterized by a Continental Steppe climate, which is semi-arid with a large range in daily temperature extremes and low relative humidity. A Mountain climate predominates in portions of west Texas, and is characterized by cool temperatures and topographically influenced precipitation patterns. Most of the State has a Modified Marine climate that is subtropical, and predominantly influenced by the onshore flow of tropical moisture from the Gulf of Mexico (TDWR 1983). Within the Modified Marine climate area, the annual average precipitation increases from west to east. West Texas is arid, with an annual rainfall of 10 in. per year, while east Texas receives up to 55 in. of precipitation per year (TWDB 2007a).

Weather data are collected at a meteorological station located at the CPNPP site, and at several stations in the region near CPNPP. These stations have measured and reported a variety of meteorological parameters through different time periods, and therefore, not all of the data are directly comparable to each other. The onsite monitoring station was initially installed and operated from 1972 to 1976 to collect preoperational baseline data. The system was again



Sources: Adapted from Geologic Atlas of Texas (USGS, 2005)

Projection: NAD83 State Plane, Texas North Central (feet)

Figure 2-23. Geologic Map of the Region Within 25 mi of the CPNPP Site (Luminant 2009b)

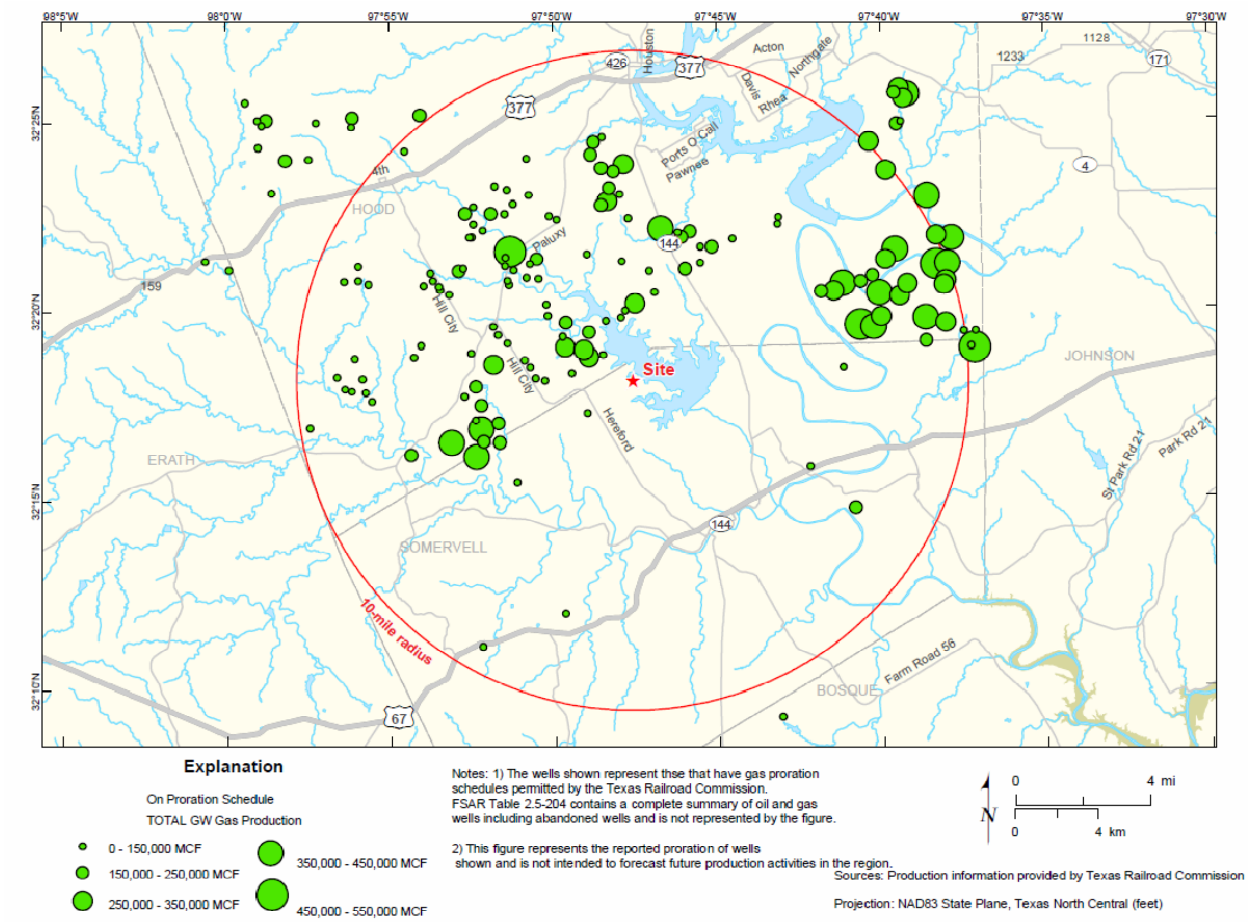


Figure 2-24. Active Gas Wells in the Vicinity of the CPNPP Site and Production Volumes (Luminant 2009b)

made operational in 1990, concurrent with start-up of CPNPP Unit 1, and has operated continually from 1990 to the present. The onsite monitoring system includes measurements for wind speed, wind direction, temperature, and precipitation (Luminant 2009b). For short-term climatic records, use of the onsite station data is preferable because of the proximity to the site, and the measurement of all of the necessary parameters. A more detailed description of the monitoring system is presented in Section 2.9.4.

The closest offsite monitoring station is in Glen Rose, located 8.3 km (5.2 mi) to the south of the CPNPP site. Data available from the Glen Rose station includes daily temperature and precipitation. However, wind data are not available, and monitoring at this station ceased in 2000. Additional stations in the region include Cleburne (39.2 km east), Stephenville (37.9 km southwest), Dublin (57.1 km southwest), Mineral Wells (63.2 km northwest), Weatherford (49.6 km north), Benbrook (52.2 km northeast), Love Field (104.2 km northeast), and Dallas–Ft. Worth Airport (DFW) (81.9 km northeast). The longest duration of measurements from these stations is at Dublin and Weatherford, both from 1896. The parameters measured at these two stations are temperature and precipitation only, with no wind measurements. The datasets from the stations at Mineral Wells and DFW Airport are the most complete. The Minerals Wells station includes temperature, precipitation, and humidity measurements dating back to 1949, and wind data since 2001. The DFW Airport has reported temperature, precipitation, and wind data since 1974, and humidity data since 1997 (NCDC 2009).

The datasets from Mineral Wells and DFW Airport are appropriate for longer-term climatic information because they are still close enough to be generally representative of the region, have had numerous parameters (including wind) measured, and include data back to 1949. The CPNPP site is located within the Subtropical/Subhumid subregion of Texas, which is characterized as having hot summers and dry winters (TDWR 1983). Summers typically have more than 90 days in which the temperature exceeds 90ºF, with temperatures commonly exceeding 100ºF. Winter temperatures drop below 32ºF about 30 days per year, but these events typically last only a few days (TDWR 1983). The wettest season is spring, during which frequent and violent thunderstorms may occur. The long-term average annual rainfall is approximately 30 in. per year, as reported at the Weatherford station (NCDC 2009).

Due to its proximity to the Gulf of Mexico and the High Plains, the area is prone to severe weather events that may include high rainfall events (associated with the remnants of hurricanes), droughts, and tornadoes.

On a larger and longer-term scale, climate change is a subject of National and international interest. The recent compilation of the state of knowledge in this area by the U.S. Global Change Research Program (GCRP), a Federal Advisory Committee (Karl et al. 2009) has been considered in preparation of this EIS. The projected change in temperature from ‘present day’ (1993-2008) over the period encompassing the licensing action (i.e., to the period of 2040 to 2059 in the GCRP report) in the vicinity of the CPNPP site is an increase of between 3 to 5°F. While the GCRP has not incrementally forecasted the change in precipitation by decade to align with the licensing action, the projected change in precipitation from the ‘recent past’ (1961 to 1979) to the period 2080 to 2099 was presented; the GCRP report forecasts a decrease of between 5 to 15 percent (Karl et al. 2009).

Based on the assessments of the GCRP and the National Academy of Sciences’ National Research Council, the EPA determined that potential changes in climate caused by greenhouse gas (GHG) emissions endanger public health and welfare (74 FR 66496). The EPA indicated that, while ambient concentrations of GHGs do not cause direct adverse health effects (such as respiratory or toxic effects), public health risks and impacts can result indirectly from changes in climate. As a result of the determination by the EPA and the recognition that mitigative actions are necessary to reduce impacts, the review team concludes that the effect of GHG on climate and the environment is already noticeable, but not yet destabilizing. In CLI-09-21, the Commission provided guidance to the NRC staff to consider carbon dioxide and other GHG emissions in its NEPA reviews and directed that it should encompass emissions from constructing and operating a facility as well as from the fuel cycle (NRC 2009). The review team characterized the affected environment and the potential GHG emissions of the proposed action and alternatives in this EIS. Consideration of GHG emissions was treated as an element of the existing air quality assessment that is essential in a NEPA analysis. In addition, where it was important to do so, the review team considered the effects of the changing environment during the period of the proposed action on other resource assessments.

2.9.1.1 Wind

A comparison of the wind data from the stations at CPNPP (10 m measurement), DFW Airport, and Mineral Wells shows regional consistency in average wind speed and direction. The prevailing surface wind direction at all three stations is from the south and southeast, with a secondary wind direction maximum from the north-northwest occurring in winter, associated with southern movement of polar air masses. The average annual wind speeds at the three stations are 10.3 mph at DFW Airport, 9.0 mph at Mineral Wells, and 9.8 mph at CPNPP (NCDC 2009; Luminant 2009a).

The topography of the region near CPNPP is relatively flat, with elevations ranging from 600 to 1000 ft MSL within 5 mi of the site. Therefore, terrain variation would not be expected to have a significant influence on wind direction due to channeling or cold air drainage. The only local topographic feature that may have the potential to influence wind direction is Squaw Creek, but the maintenance of this creek as a reservoir effectively flattens the topography and eliminates any topographical variation that may have previously affected wind direction. Comparisons of the onsite wind direction data with that from the local stations, as well as comparison of the 10 m and 60 m data at CPNPP, indicate that channeling and cold air drainage along Squaw Creek do not occur (Luminant 2009a).

The CPNPP monitoring station measures wind speed and direction at heights of 10 m and 60 m. Predominant wind directions are the same at both heights. At the 10 m height, the wind direction is from the southeast, south-southeast, south, and south-southwest 51 percent of the time. At the 60 m height, the wind direction is from the same direction 52 percent of the time. The average annual wind speed at the 60 m height is 12.6 mph. This is slightly higher than the average wind speed at the 10 m height, which would be expected due to the reduction of wind speeds by surface effects near the ground surface (Luminant 2009a).

2.9.1.2 Temperature

The CPNPP site is located within the Subtropical/Subhumid subregion of Texas, which is characterized as having hot summers (TDWR 1983). Summers typically have more than 90 days in which temperatures reach 90ºF, and temperatures exceeding 100ºF are common. The monthly average temperature is approximately 85ºF in July and August, and 45ºF in January. A comparison of the temperature data for all of the local stations shows that the highest average temperatures are exhibited at the Love Field and DFW Airport stations, which are the two northernmost stations in the area, while the lowest average temperatures are found at the Dublin and Stephenville stations to the south. This is likely to be due to the urban heat island effect, in which temperatures in urbanized areas tend to be higher due to the replacement of vegetated areas with asphalt and concrete-covered areas. Because CPNPP is located in a rural area, the temperature measurements at Dublin and Stephenville are likely to be more representative of those present at the site.

2.9.1.3 Atmospheric Moisture

Common methods of measuring and presenting information on atmospheric moisture include humidity, precipitation, and fog. At the CPNPP onsite monitoring station, only precipitation rates are routinely and continuously measured. Information on humidity and fog is available from measurements at the DFW Airport and Mineral Wells stations. Atmospheric moisture, as measured by precipitation, increases systematically from west to east across the State of Texas. West Texas receives less than 10 in. of rain per year, and east Texas receives more than 55 in. per year. The CPNPP site is located in the center of the state, in the Subtropical/Subhumid subregion. Average annual precipitation at the onsite monitoring tower in the years 2001, 2003, and 2006 was approximately 30 in. per year, a value that is similar to longer term averages from the stations at Dublin and Weatherford (NCDC 2009). The highest monthly average at the CPNPP station during the years 2001, 2003, and 2006 was during March, but this is likely to be an anomaly due to the limited reporting period. Longer term data from the Weatherford and Dublin stations show that highest annual average rates are in May (approximately 4 in.), and the lowest annual average rates are in January and December (1.5 in.) (NCDC 2009).

Relative humidity and dew point measurements are available from the DFW Airport and Minerals Wells stations. The average annual relative humidity is 65 percent and 69 percent at

DFW Airport and Mineral Wells, respectively (NCDC 2009). Luminant collected onsite humidity measurements during June through September of 2008 to establish the applicability of these offsite data to the CPNNP site,. The correlation of these onsite measurements with the data from DFW Airport and Mineral Wells indicated that the onsite humidity conditions could be adequately represented by use of the data from Mineral Wells (Luminant 2009a). Average dew point temperatures in the region range from 32ºF in January to 67ºF in July, based on measurements at Weatherford from 1949 to 2006 (NCDC 2009).

The region experiences occasional snow or sleet events from December to March. The average annual snowfall amount, based on measurements at DFW Airport, Love Field, Mineral Wells, and Glen Rose is 2.5 in. (NCDC 2009).

A record of fog events is not collected at the onsite CPNPP station. Fog records from DFW Airport and Mineral Wells demonstrate the high variability of fog based on location. At DFW Airport, the annual average hours of fog from 1997 to 2006 are 16.2 hr/yr (NCDC 2009). At Mineral Wells, from 2001 to 2006, the annual average was 46.7 hr (NCDC 2009). At both locations, almost all fog events occurred during the months from October to March.

2.9.1.4 Severe Weather

The CPNPP site is located near the High Plains, an area noted for severe thunderstorm and tornado activity, and is also near the Gulf of Mexico, an area of hurricane activity. The effects of severe thunderstorms may include high winds, lightning strikes, hail, and tornadoes. Due to its inland location, any Gulf of Mexico hurricanes approaching the site have generally been downgraded to tropical depressions by the time they reach the area. Therefore, effects of hurricanes are generally related to high rainfall and localized flooding. The site is not expected to be subjected to frequent snow or ice storms.

Thunderstorms occur within the five-county area surrounding the site on an average of about 9 days per year (NOAA 2009). Of these, most occur during the months of April, May, and June, with very few occurrences in December through February (NOAA 2009). Thunderstorms in this area can be associated with high wind and hail events. Over the period from 1950 to 2006, there was an annual average of 12.8 incidences of large (greater than 0.75 in. in diameter) hail in the five-county area surrounding the site (NOAA 2009).

During the same period (1950 to 2006), an annual average of 3 tornadoes was reported in the five-county area surrounding the site (NOAA 2009). The most common time of year for tornadoes is the spring. The tornado strike probability at the CPNPP site is estimated using the methodology provided in NUREG/CR-4461, Revision 2 (NRC 2007c). This document has developed the expected maximum tornado wind speed and upper limit (95 percent) of the expected tornado wind speed as a function of the probability of occurrence for the 2-degree longitude and latitude box that includes the CPNPP site. The corresponding tornado wind speeds are listed in Table 2-30.

Table 2-30. Expected Maximum Tornado Wind Speeds and Upper Limits

Probability	Expected Maximum Tornado Wind Speed, mph	Upper Limit (95 percent) of the Expected Tornado Wind Speed, mph
10^{-5}	141	146
10^{-6}	178	184
10^{-7}	211	217

Source: NRC 2007c.

From 1899 to 2007, a total of 42 tropical storms and hurricanes affected the Texas Gulf Coast (NOAA 1999; NOAA 2009). In general, these storms lose wind strength as they move inland, but can still bring heavy rains and flooding to the CPNPP area.

2.9.1.5 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between the surface (10-m level) and the level of a potential release point. The temperature difference between the two elevations reflects a density difference that may indicate that the air mass is stable, neutral, or unstable. A temperature decrease with height indicates that the vertical density structure is unstable, resulting in higher levels of atmospheric dispersion. Temperature increase with height indicates a stable density structure, and therefore limited dispersive capability.

The procedures to be used to measure the temperature difference are provided in NRC's Regulatory Guide 1.23, Revision 1 (NRC 2007b), in which the potential release point level is assumed to be 60 m. The resulting temperature difference is used to define the Pasquill Stability Category, which becomes an input parameter into atmospheric dispersion calculations as part of the prediction of potential accident consequences. The results of the atmospheric dispersion calculations are presented in Section 2.9.3, and these calculations are used in the evaluation of potential accident consequences in Section 5.10.

At CPNPP, atmospheric stability is determined using the temperature measurements at the 10- and 60-m levels at the onsite meteorological tower. Overall, the Pasquill Stability Class is neutral (Class D) or stable to extremely stable (Classes E, F, and G) 78.1 percent of the time. Neutral or stable classifications are most common in the fall and winter, with the greatest instability occurring during the months of May through August (Luminant 2009a).

2.9.2 Air Quality

The discussion on air quality includes the six common "criteria pollutants" for which the EPA has set national ambient air quality standards (ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead). The air quality discussion also covers heat-trapping "greenhouse gases" (primarily carbon dioxide) which have been the principal factor causing climate change over the last 50 years (Karl et al. 2009).

The CPNPP site is located in Somervell County, which is in the Metropolitan Dallas-Fort Worth Intrastate Air Quality Control Region (40 CFR 81.39). Air quality in Somervell County is regulated by TCEQ Region 4, DFW region. Somervell County, the location of CPNPP, is designated as unclassifiable/attainment for all criteria pollutants (40 CFR 81.344; TCEQ 2009c). Although there are no monitoring stations operated within the county, TCEQ monitors a station in Granbury, in Hood County, less than 10 mi from the CPNPP site, and the results from this site are considered to be applicable to Somervell County. In 2008, there were nine days on which the EPA's Eight-Hour Ozone Standard of 0.075 parts per million (ppm) was exceeded for at least one 1-hour measurement period at the Granbury monitoring site. However, the Eight-Hour average standard was not exceeded at any point during 2008 (TCEQ 2009b).

In the area near Somervell County, a nine-county area to the northeast is a nonattainment area for EPA's 8-hr ozone standard (TCEQ 2009c). This area includes Johnson County, which borders Somervell County to the east, and the other counties within the Dallas and Fort Worth metropolitan area. In this area, the EPA's Eight-Hour Ozone Standard was exceeded on 12 days during 2008 (TCEQ 2009a). The prevailing wind direction in the region is from the south and southeast (from the CPNPP area towards the Dallas-Fort Worth area), and this pattern is even more prevalent in the summer months when air quality standards are exceeded.

CPNPP currently has a TCEQ air permit, Number 19225, to manage air quality associated with the operation of CPNPP Units 1 and 2. The sources of the emissions, and their associated emissions and operations limits as defined in the permit, are presented in Table 2-31. The permit, renewed in 2004 for a ten-year period, specifies emissions limits for volatile organic carbons (VOCs), total oxides of nitrogen (NO_x), sulfur dioxide (SO_2), particulate matter (PM), and carbon monoxide (CO) (TCEQ 2004).

Table 2-31. Emissions and Operations Limits Associated with CPNNP Units 1 and 2

Source	VOC	NO_X	SO_2	PM	CO	Hours/Year
Auxiliary Boiler	<1.0	3.7	12.8	2.1	3.7	500
Emergency Generator #1	<1.0	20.9	2.8	<1.0	1.8	600 (combined for generators 1 through 4)
Emergency Generator #2	<1.0	20.9	2.8	<1.0	1.8	600 (combined for generators 1 through 4)
Emergency Generator #3	<1.0	20.9	2.8	<1.0	1.8	600 (combined for generators 1 through 4)
Emergency Generator #4	<1.0	20.9	2.8	<1.0	1.8	600 (combined for generators 1 through 4)
Emergency Generator #5	<1.0	1.2	<1.0	<1.0	<1.0	250
Emergency Generator #6	<1.0	<1.0	<1.0	<1.0	<1.0	250
Diesel Fire Pump No.1	<1.0	1.0	<1.0	<1.0	<1.0	200 (combined for both fire pumps)
Diesel Fire Pump No.2	<1.0	1.0	<1.0	<1.0	<1.0	200 (combined for both fire pumps)
Total	<9.0	90.5	24.0	2.1	10.9	-

Source: TCEQ 2004.

Carbon dioxide has been building up in the Earth's atmosphere since the beginning of the industrial era in the mid-1700s, primarily due to the burning of fossil fuels (coal, oil, and natural gas) and the clearing of forests. Human activities have also increased the emissions of other GHG such as methane, nitrous oxide, and halocarbons. These emissions are increasing the optical thickness of heat-trapping gases in the Earth's atmosphere, causing global surface temperatures to rise (Karl et al. 2009).

2.9.3 Atmospheric Dispersion

Atmospheric dispersion factors are used to evaluate the potential consequences resulting from accidental and routine radiological releases from the CPNPP site. For accidental releases, atmospheric relative air concentration values (χ/Q values) are used to estimate the dispersion of released effluents that will occur through atmospheric transport and atmospheric diffusion processes. Guidance for the calculation of atmospheric dispersion factors is presented in NRC's Regulatory Guide 1.145 (NRC 1983). The atmospheric dispersion calculations are presented in Section 2.9.3.1, and the results are used to estimate the consequences of potential accidents in Section 5.10. For the evaluation of routine releases of gaseous effluents, χ/Q values and atmospheric relative deposition (D/Q) values are used to estimate the dispersion of released effluents and the rates of deposition and radioactive decay of released gaseous effluents. Guidance for the calculation of χ/Q and D/Q values associated with routine releases is presented in NRC's Regulatory Guide 1.111 (NRC 1977). The results of the routine release calculations are presented in Section 2.9.3.2, and the results are used to estimate the consequences of routine releases of gaseous effluents in Section 5.9.

The meteorological data used in the dispersion and deposition calculations include wind speed, wind direction, and atmospheric stability. The data are to be collected and presented as hourly averages, as defined in NRC's Regulatory Guide 1.23 (NRC 2007b). For CPNPP, the data used in the calculations are the data collected from the onsite meteorological station for the years 2001 through 2004, and 2006 (five total years of data). According to the ER, data recovery for the year 2005 was below 90 percent, and therefore data from 2005 were not used (Luminant 2009a). The data used included wind speed and direction at the height of 10 m and atmospheric stability class based on temperature differential measurements at the 10- and 60-m heights at the onsite meteorological station.

To confirm the applicability of the data, the review team viewed the meteorological station and instrumentation, reviewed the available data from the station and compared data from the station with data from other, nearby stations. In addition, the review team compared the data from the 5-year period (2001 to 2004, and 2006) with that from other years to verify that it results in representative or conservative calculations.

Based on these comparisons, the review team concludes that the data from the onsite meteorological tower represent the affected environmental conditions as required by 10 CFR 100.20 and that the data are representative of longer-term meteorological conditions in the region. Therefore, the data provide an acceptable basis for estimating atmospheric dispersion for the evaluation of routine and accidental releases required by 10 CFR 50.34 and 10 CFR Part 50, Appendix I.

2.9.3.1 Short-Term Atmospheric Dispersion Estimates for Accident Releases

The purpose of the calculation of short-term atmospheric relative concentration values is to estimate the dispersion that would occur in association with an accidental release of gaseous effluent. As directed in Regulatory Guide 1.145 (NRC 1983), calculations were performed to estimate the dispersion occurring at the EAB over a 2-hr time period. In addition, calculations were performed to estimate the dispersion occurring at the outer boundary of the Low Population Zone (LPZ) at time intervals of 0 to 8 hr, 8 to 24 hr, 1 to 4 days (24 to 96 hr), and 4 to 30 days (96 to 720 hr) following an accident, as defined in Section 2.3.4 of Regulatory Guide 1.70 (NRC 1978). The calculation was performed by developing hourly cumulative frequency distributions of the relative concentration (χ/Q) value at each location of interest. The χ/Q reported and used in the evaluation of consequences of a release is that which is exceeded 50 percent of the time during the time period evaluated (the median value).

Additional site-specific input parameters required for the dispersion calculations include the release height, cross-sectional area of the reactor building, and distances to the EAB and LPZ boundary. For the calculations associated with accidental releases, the release height was assumed to be at ground level. The cross-sectional area of the containment building is 2500 m^2, and the height of the building is 69.9 m. The distance from the release boundary to the EAB is 600 m, and the distance to the LPZ boundary is 3219 m.

Using the meteorological data discussed in Section 2.9.3, and the input parameters presented above, the Applicant used the PAVAN computer code to calculate the atmospheric dispersion estimates. The PAVAN computer code calculates χ/Q values using the equations and assumption provided in Section 1.3.1 of Regulatory Guide 1.145 (NRC 1983). The review team reviewed the calculations presented in the ER (Luminant 2009a), evaluated the applicability of the input parameters and reasonableness of the results, and performed independent calculations to confirm the calculations performed by the Applicant. The results of the calculations are provided in Table 2-32. The results are used in Section 5.10 to calculate potential exposures associated with accidental releases of gaseous effluents.

Table 2-32. CPNPP Short-Term Atmospheric Dispersion Estimates for Accident Releases

50% Probability Level χ/Q Values (sec/m^3)					
	0-2 hr	**0-8 hr**	**8-24 hr**	**24-96 hr**	**96-720 hr**
EAB	5.75E–05				
LPZ		3.32E–06	2.75E–06	1.83E–06	1.01E–06

2.9.3.2 Long-Term Atmospheric Dispersion and Deposition Estimates for Routine Releases

The purpose of the calculation of long-term atmospheric relative concentration values is to estimate the dispersion and deposition associated with routine releases of gaseous effluents. The estimates are expressed as annual average normalized χ/Q values, and as annual normalized total D/Q computed at selected downwind locations. These estimates are developed by considering the release characteristics, meteorological conditions, and the downwind travel distance.

To develop estimates of the long-term dose to the population in the region surrounding the site, the Applicant used the XOQDOQ computer program (NRC 1982). The estimates were calculated at the points of maximum potential concentration outside of the site boundary, at points of maximum individual exposure, and at points within a radial grid of sixteen 22.5-degree sectors extending to a distance of 80 km from the site. The calculations included consideration of the effects of radioactive decay and dry deposition.

The meteorological data used as input into the XOQDOQ program were taken from a table of joint frequency distribution of wind direction and wind speed by atmospheric stability class. The data were obtained from the onsite meteorological station during the period from 2001 to 2004, and 2006. The assumed release point was located at the center of the containment, with the release assumed to be at ground level in accordance with Regulatory Guide 1.111 (NRC 1977b). The cross-sectional area of the reactor building, and distances to the EAB and LPZ boundary were the same as those used for the short-term exposure dispersion calculations.

Radioactive decay and deposition were incorporated into the calculations for radiological impact evaluations. The evaluation used an overall half-life of 2.26 days for short-lived noble gases, and a half-life of 8 days for iodines released to the atmosphere. Wet deposition is assumed not to be important, and the dry deposition rate of noble gases is expected to be negligible so that depletion is not an important factor.

Using the meteorological data discussed in Section 2.9.3, and the input parameters presented above, the Applicant used the XOQDOQ computer program (NRC 1982) to develop relative χ/Q and relative D/Q estimates. The XOQDOQ program performs the calculations using methods and assumptions required in Regulatory Guide 1.111 (NRC 1977). The results were developed with and without the consideration of dry deposition, and as depleted and undepleted values. The review team reviewed the calculations presented in the ER (Luminant 2009a), evaluated the applicability of the input parameters and reasonableness of the results, and performed independent calculations, which confirmed the calculations performed by the Applicant. The results are used in Section 5.9.2.2 to calculate doses from potential exposures to ionizing radiation associated with routine releases of gaseous effluents.

2.9.4 Meteorological Monitoring

The source of most of the meteorological data used to support the CPNPP Unit 3 and 4 COL evaluation is the onsite meteorological monitoring station that is used to support operation of CPNPP Units 1 and 2. The onsite station operated from 1972 to 1976 to collect data to support the preoperational phase for Units 1 and 2. The system was then reestablished prior to fuel load for Unit 1 and has operated continually from 1990 to the present (Luminant 2009b).

The meteorological station consists of a primary meteorological tower, a backup tower, and associated computer systems for operation, data collection, and data analysis. The primary tower has instruments, located on booms, at heights of 10 and 60 m. The following data are collected: wind speed at 10 and 60 m; wind direction at 10 and 60 m; ambient temperature at 10 m; temperature difference between 10 and 60 m; sigma theta (standard deviation of the wind vane position, a measure of turbulence) at 10 m; and precipitation near ground level (Luminant 2009d). The primary tower is located east of the reactor complex, and will continue to be used during the construction and operation of Units 3 and 4. The length and orientation of the booms and alignment of aspirator motors and shields are designed to comply with meteorological monitoring requirements of Regulatory Guide 1.23 (NRC 2007b).

The backup tower is located approximately 25 m from the primary tower. Backup measurements are made at a height of 10 m and include wind speed, wind direction, ambient temperature, and sigma theta.

Humidity measurements are not currently made at the onsite station. Luminant collected onsite humidity measurements during June through September of 2008 for the purpose of establishing a correlation between onsite humidity measurements and humidity measurements from DFW Airport and Mineral Wells. Based on this correlation, Luminant relied upon the data from Mineral Wells as the data of record to support calculations associated with cooling tower plume analyses (Luminant 2009a).

2.10 Nonradiological Health

This section describes aspects of the environment at the CPNPP site and within the vicinity of the site associated with nonradiological human health impacts. The section provides the baseline for evaluation of impacts to human health from building and operation of the proposed Units 3 and 4. Building activities have the potential to affect public and occupational health, create impacts from noise, and impact health of the public and workers from transportation of construction materials and personnel to the building site. Operation of the proposed Units 3 and 4 has the potential to impact the public and workers at the CPNPP site from operation of the cooling system, noise generated by operations, electromagnetic fields (EMFs) generated by transmission systems, and transportation of operations and outage workers to and from the site.

2.10.1 Public and Occupational Health

This section describes public and occupational health at the CPNPP site and vicinity associated with air quality, occupational injuries and etiological agents (i.e., disease causing microorganisms).

2.10.1.1 Air Quality

Public and occupational health can be impacted by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 1996). Air quality near the CPNPP site is discussed in Section 2.9.2. Fugitive dust and other particulate matter (PM) (including PM_{10} and $PM_{2.5}$) can be released into the atmosphere during any site excavations and grading. Most of these activities that generate fugitive dust are short in duration, over a small area, and can be controlled using watering, application of soil adhesives, seeding, and other best management practices.

Exhaust emissions during normal plant operations associated with on-site vehicles and equipment as well as from commuter traffic can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire pump engines), and other nonradiological emission-generating sources (e.g., storage tanks) or activities at the existing CPNPP are not expected to be a significant source of criteria pollutant emissions. Diesel generators and supporting equipment are in place for emergency-use only but are started regularly to test that the systems are operational. Emissions from nonradiological air pollution sources are permitted by TCEQ.

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation and modifications are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. The U.S. Bureau of Labor Statistics provides reports that account for occupational injuries and illnesses as total recordable cases, which includes those cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The State of Texas also tracks the annual incidence rates of injuries and illnesses for electric power generation, transmission and distribution workers. These records of statistics are used to estimate the likely number of occupational injuries and illnesses for operation of Units 1 and 2 and predict the likely number of cases for the proposed new units.

The combined safety records for all Luminant's facilities reached 17 years without an Occupational Safety and Health Administration (OSHA) recorded injury and 113 years without a lost-time accident. In the first half of 2009, CPNPP reached 2 million safe work hours without a lost time injury (Business Wire 2009).

2.10.1.3 Etiological Agents

Etiologic agents consist of all microorganisms that can cause infectious disease in humans. One class of etiologic agents is thermophilic; these microorganisms thrive in hot water generally well above 40ºC. Thermal discharges have the potential to increase the growth of microorganisms, including *Salmonella* species, *Shigella* species, and *Pseudomonas* species, as well as thermophilic organisms, including fungi, bacteria such as *Legionella* species, and free-living amoeba such *Naegleria fowleri* and *Acanthamoeba* species. These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels.

Salmonella and *Shigella* species are mostly associated with areas of poor sanitation, but they can also be transmitted by the common house fly. Although the organisms can live for several weeks in water, they do not multiply there. *Pseudomonas* can be found in soil, humidifiers, on the skin of healthy individuals, and anywhere *Salmonella* and *Shigella* are found (NRC 1996, Appendix D). While *Pseudomonas* could be found in Lake Granbury (and other water bodies), there is no known sanitation pathway for large numbers of these organisms to enter the reservoir.

Legionnaires' disease can be very serious and can cause death in up to 5 to 30 percent of cases. One population-based study estimated that more than three-quarters of cases are currently undiagnosed or unreported (CDC 2009). The incidence rate is less than 0.3 per 100,000 persons in Texas (Neil and Berkelman 2008).

Primary amebic meningoencephalitis (PAM) is a rare but nearly always fatal disease caused by infection with *Naegleria fowleri*. In 2007, six cases of PAM in the United States were reported to the Centers for Disease Control and Prevention (CDC); all six patients died (CDC 2008a). Two of the six were in Texas. Exposure to PAM primarily occurred in untreated, warm, freshwater lakes or rivers in 15 southern tier states, including Texas.

Temperatures above 38º C have been measured near the point where the once-through cooling water from CPNPP Units 1 and 2 is discharged to a cove on the south end of SCR. Although this was a popular area for fishing when the reservoir was open, there were no reports of illness associated with thermophillic bacteria (Luminant 2010b).

A review of the outbreaks of human water-borne diseases in Texas indicates that the incidence of most of these diseases is not common. Outbreaks of Legionellosis, Salmonellosis, or Shigellosis that occurred in Texas from 1996 to 2006 were within the range of national trends in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes (CDC 1997, 1998a, 1999, 2001, 2002a, 2003, 2004a, 2005, 2006a, 2007, and 2008c). Texas does have higher incidences of infection by *Naegleria fowleri* compared to most other States in the country. Infection with *N. fowleri* causes the disease PAM, a brain infection that leads to the destruction of brain tissue and is fatal (CDC 2008a). From 1995 to 2007, there were three waterborne disease outbreaks in Texas (one each in 1998, 1999, and 2002). None of the outbreaks were from recreational exposure to untreated water, e.g., swimming or boating in a river (CDC 1998b, 2000, 2002b, 2004b, 2006b, 2008b, d). From 1972 to 2007, there have been 36 occurrences of PAM in Texas, ranging from zero to five cases per year. All of these cases were fatal, exposures occurred during the months of June through September, and four exposures occurred in lakes and one occurred in a river.

2.10.1.4 Noise

The noise around the CPNPP site is typical of a commercial operation in a mostly rural area. Operational noises mix with those from traffic, residential activities, and natural sources.

In 2007, Luminant conducted an ambient noise survey within 5 mi. of the site. The locations chosen were near the site boundary or places where people might gather, such as churches. The nearest residence to the southwest and the residences across SCR were also considered. The locations of the sampling sites are shown in Figure 2.5-20 of the ER (Luminant 2009a). While noise is diminished by distance, foliage, and geographic features, it will be attenuated much less over water.

The area noise levels during the day were found to be between 35–70 (traffic) dBA, with 36–60 dBA at night. The average equivalent sound levels ranged between 36 and 55 dBA (daytime) and 37–55 dBA (night time) (Luminant 2009a). For context, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA.

Regulations governing noise associated with the activities at the CPNPP site are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910, "Occupational Health and Safety Standards," and 40 CFR Part 204, "Noise Emission Standards for Construction Equipment." The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. Although several Texas municipalities have noise ordinances, the State of Texas does not have noise regulations covering rural areas that would be applicable to the CPNPP site.

2.10.2 Transportation

The transportation network surrounding the CPNPP site consists of FM roads, Federal and State highways, and railway, as well as a public airport. Most traffic is personal vehicle and over-the-road tractor/trailer transport. Plant workers from Hood County travel to work on FM 56 or FM 51. FM 56 provides access from Somervell County. An additional network of roads, such as US 377, are available for workers from other areas (Luminant 2009a). A railway about 9.5 mi from the site serves an average of two trains a day, while the Granbury Municipal Airport about 10 mi north of the site averages 73 aircraft operations a day (Luminant 2009a).

2.10.3 Electromagnetic Fields

Transmission lines generate both electric and magnetic fields, referred to collectively as EMF. Public and worker health can be compromised by acute exposure to electrical sources associated with the power transmission systems, including switching stations (or substations) on-site and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be extremely low frequency (ELF). In comparison, television transmitters have frequencies of 55 to 890 MHz and microwaves have frequencies of 1000 MHz and greater (NRC 1996).

The transmission corridors surrounding CPNPP are described in Section 2.2 of the ER (Luminant 2009d). Three single-circuit transmission lines are located on existing ROWs and use existing tower structures (Luminant 2009a, Figure 1.1-5).

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1996). Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases, where the current can flow from the line through the object into the ground. Capacitive charges can occur in objects that are in the electric field of a line, storing the electric charge, but insulated from the ground. A person standing on the ground can receive an electric shock from coming into contact with such an object because of the sudden discharge of the capacitative charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and adherence to the standards for transmission systems regulated by the Public Utility Commission of Texas (PUCT).

Long-term or chronic exposure to power transmission lines have been studied for a number of years. These health effects were evaluated in NUREG-1437, which concluded:

> The chronic effects of electromagnetic fields (EMFs) associated with nuclear plants and associated transmission lines are uncertain. Studies of 60-Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer-term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible (NRC 1996).

2.11 Radiological Environment or Monitoring

A REMP has been conducted around the CPNPP site since operations began in 1990. This program measures radiation and radioactive materials from all sources, including the CPNPP Units 1 and 2. The REMP includes the following pathways: direct radiation; atmospheric, aquatic and terrestrial environments; and groundwater and surface water. A preoperational environmental operating program was conducted from 1981 to 1989 (Luminant 2009a) to establish a baseline to observe fluctuations of radioactivity in the environment after operations began. After routine operation of Unit 1 started in 1990 and Unit 2 started in1993, the monitoring program continued to assess the radiological impacts to workers, the public, and the environment. The results of this monitoring are documented in an annual environmental operating report for the CPNPP site.

The NRC staff reviewed historical data from the REMP reports for the 6-year period 2003 through 2008 (TXU 2004, TXU 2005, TXU 2006, TXU 2007, Luminant 2008, Luminant 2009d). These reports show that exposures or concentrations in air, water, and vegetation are comparable to preoperational levels, with the exception of the levels of tritium in SCR. The monitoring data for the waters of the SCR show tritium concentration ranging from 11,800 to 14,300 pCi/L. The trend in SCR tritium levels indicates that SCR may have reached equilibrium with the tritium release rate of the existing CPNPP Units 1 and 2. The equilibrium value is less than Luminant's administrative action level of 30,000 pCi/L.

The *NRC*'s *Liquid Radioactive Release Lessons Learned Task Force Report* (NRC 2006) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. Groundwater is monitored at five onsite locations; the results of the groundwater monitoring are included in the annual environmental operating report. In 2007 and 2008, all radionuclides in the groundwater, including tritium, were below the detection limits (Luminant 2008 Luminant 2009c).

2.12 Related Federal Projects and Consultations

The review team reviewed the possibility that activities of other federal agencies (e.g., dam construction) might impact the issuance of COLs to Luminant for proposed Units 3 and 4. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS [10 CFR 51.10(b)(2)].

Federal lands within a 50-mi radius of the CPNPP site include the Naval Air Station Joint Reserve Base six mi west of central Fort Worth and four lakes managed by the USACE (Figure 2-9). State parks and other recreation facilities in the region are enumerated in Sections 2.5.1.2 and 2.5.2.4. There are no Native American tribal reservations within 50 mi of the CPNPP site. The NRC is required under Section 102(2)(C) of NEPA to consult with and obtain the comments of any federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. During the course of preparing this EIS, NRC consulted with the USFWS and National Marine Fisheries Service. A list of such correspondence is included in Appendix F.

2.13 References

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29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Health and Safety Standards."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

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3.0 Site Layout and Plant Description

The Comanche Peak Nuclear Power Plant (CPNPP) site is located on the border of Hood and Somervell Counties, Texas. Luminant applied to the U.S. Nuclear Regulatory Commission (NRC) for combined construction permits and operating licenses (COLs) for proposed Units 3 and 4. In addition to the COL application, Luminant may need to apply for a permit from the U.S. Army Corps of Engineers (Corps) to conduct activities that result in alteration of waters of the United States. The proposed new units would be situated wholly within the existing CPNPP site and adjacent to existing CPNPP Units 1 and 2. The site is situated approximately 40 mi southwest of Fort Worth, Texas, and 5 mi north of Glen Rose, Texas.

This chapter describes the key plant characteristics that are used to assess the environmental impacts of the proposed actions. The information is drawn from Luminant's Environmental Report (ER) (Luminant 2009a), its Final Safety Analysis Report (FSAR) (Luminant 2009b), and supplemental documentation from Luminant as referenced.

Whereas Chapter 2 of this environmental impact statement (EIS) describes the existing environment of the proposed site and its vicinity, this chapter describes the physical layout of the proposed plant. This chapter also describes the physical activities involved in building and operating the plant and associated transmission lines. The environmental impacts of building and operating the plant are discussed in Chapters 4 and 5, respectively. This chapter is divided into four sections. Section 3.1 describes the external appearance and layout of the proposed plant. Section 3.2 describes the proposed plant structures, systems and components, and it provides an overview of the reactor power conversion system and overall plant design. Section 3.3 describes the activities involved in building or installing each of the plant structures. Section 3.4 describes the operational activities of the plant systems that interface with the environment. References cited are listed in Section 3.5.

3.1 External Appearance and Plant Layout

The existing CPNPP site consists of two Westinghouse pressurized-water reactor units (i.e., CPNPP Units 1 and 2), a turbine building, a switchyard, water intake and discharge structures, and support buildings. The CPNPP site is located in Hood and Somervell Counties, approximately 5 mi north of Glen Rose, Texas. The site lies on a peninsula located next to Squaw Creek Reservoir (SCR) (see Figures 2-2 and 2-3), which serves as the source of cooling water for Units 1 and 2.

A radioactive waste disposal system, a fuel-handling system, the auxiliary structures, and other onsite facilities required for a complete nuclear power station are located on the CPNPP site. The existing site development is shown in the photograph in Figure 3-1, which also shows an artist's conception of the proposed two new reactor units. The COL site is located in a previously disturbed area approximately 0.5 mi northwest of Units 1 and 2. Units 1 and 2 would not be changed under the proposed action.

For the Unit 3 and 4 cooling systems, Luminant proposes to use wet mechanical draft cooling towers. Water for the new cooling towers would be supplied from a new intake structure on Lake Granbury through two new pipelines (see Figure 2-5). A new blowdown water treatment facility (BDTF) and evaporation pond would be constructed south of Units 1 and 2. Two new pipelines would be built for discharge of treated blowdown water to Lake Granbury.

Figure 3-1. Photograph of Existing CPNPP Units 1 and 2, with an Artist's Conception of the Proposed Units 3 and 4 on the Left-Hand Side of the Photograph (Luminant 2009a)

Up to four new transmission lines would be built. Two would be added to existing towers and two would be built on new towers in new rights-of-way (ROWs). The transmission lines are described in Section 3.2.2.3.

3.2 Proposed Plant Structures, Systems, and Components

This section describes each of the major plant structures: the reactor power system, structures that would have a significant interface with the environment during operation, and the balance of plant structures. All of these structures are relevant in the discussion of the impacts of building the proposed Units 3 and 4 in Chapter 4. Only the structures that interface with the environment are important to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power Conversion System

The proposed new CPNPP Units 3 and 4 would utilize Mitsubishi Heavy Industries (MHI) U.S. Advanced Pressurized-Water Reactor (US-APWR) units (MHI 2009). Each US-APWR unit has a reactor vessel, four steam generators (SGs), and four reactor coolant pumps. The thermal energy produced by the new reactors is carried by the primary coolant to the SGs, where it is transferred in a heat exchanger to the secondary-side cooling water to produce steam.

The steam from the SGs flows through steam turbines, creating rotational mechanical energy, which in turn rotates an electric generator to produce electricity. Secondary-side steam from the turbines is condensed and cooled by water from the new mechanical draft cooling towers. Then the secondary-side coolant is pumped by a series of feedwater pumps back to the SGs.

Figure 3-2 is a simplified flow diagram of the reactor power conversion system. A more detailed discussion using information from Luminant's ER (Luminant 2009a) is presented in the following paragraphs.

Each US-APWR unit is connected to four SGs by means of four primary hot leg pipes and four primary cold leg pipes. A reactor coolant pump is located in each of the four cold leg pipes to circulate the pressurized reactor coolant through the reactor core. As the reactor coolant flows through the reactor core, it makes contact with the fuel rods, which contain the enriched uranium dioxide fuel. As the reactor coolant passes through the reactor core, heat from the nuclear fission process is removed from the reactor. This heat is transported to the SGs by the circulating reactor coolant and passes through the tubes of the SGs to heat the feedwater from the secondary system. The reactor coolant is pumped back to the reactor by the reactor coolant pumps, where it is reheated to start the heat transfer cycle over again (Luminant 2009a).

Inside the SGs, the reactor heat from the primary system is transferred through the walls of the tubes to convert the incoming feedwater from the secondary system into steam. The steam is transported from the SGs by main steam piping to drive the high-pressure and low-pressure turbines connected to an electric generator to produce electricity. After passing through the three low-pressure turbines, the steam is condensed back to water by cooled circulating water inside titanium tubes located in the condenser. The cooled circulating water used to condense the steam is provided by a separate water circuit that includes the mechanical draft cooling towers. The heat from the condensed steam is rejected into the atmosphere at the mechanical cooling towers. The condensate is then preheated and pumped back to the SGs as feedwater to repeat the steam cycle (Luminant 2009a).

The primary reactor coolant circuit, the secondary-side coolant circuit, and the mechanical cooling towers involve three separate systems, each having its own liquid coolant. The liquid coolants are not allowed to mix or exchange between or among these three systems.

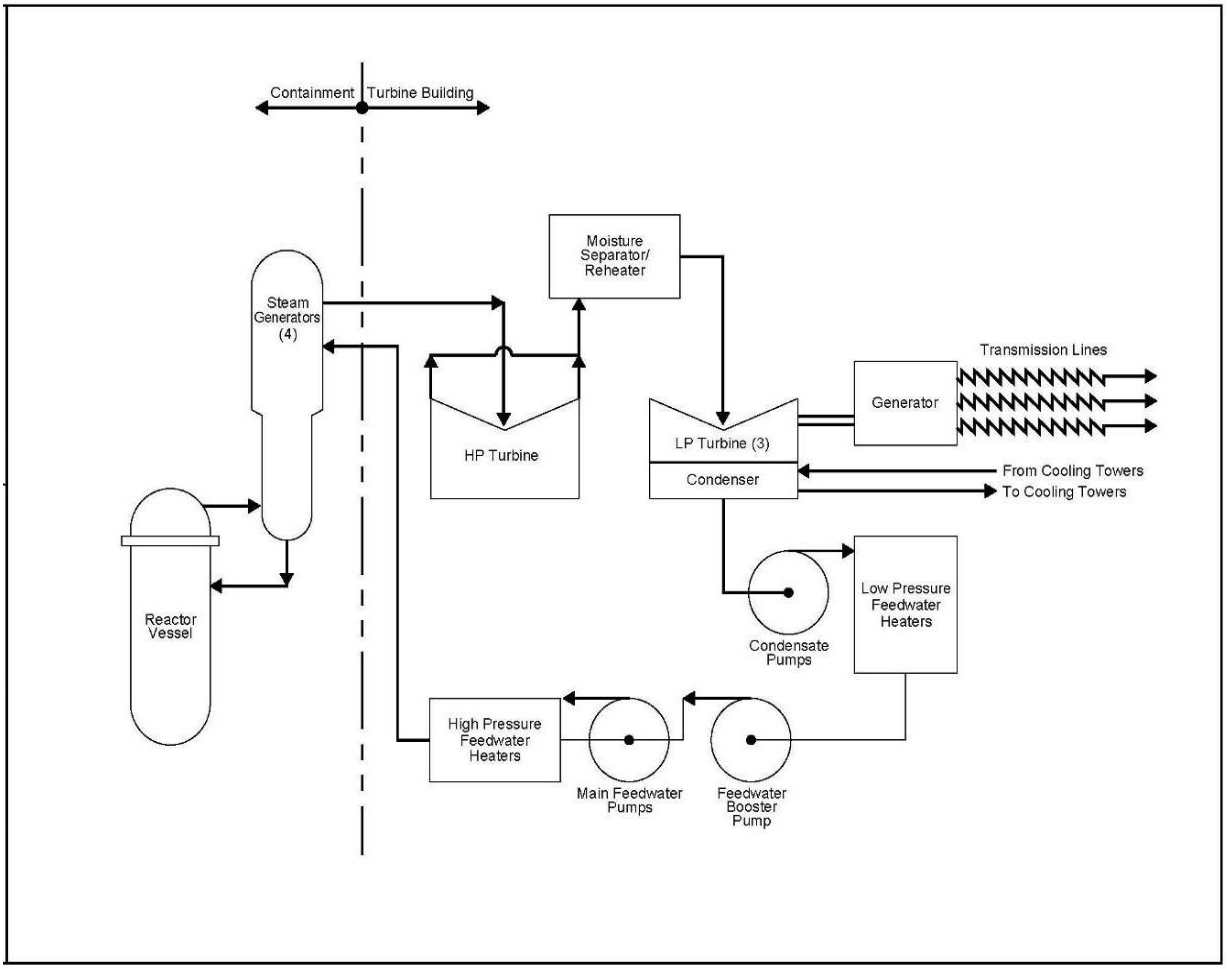

Figure 3-2. Simplified Flow Diagram for the CPNPP Reactor Power Conversion System (Luminant 2009a)

3.2.1.1 Plant Description

Each of the two proposed Units 3 and 4 would have a rated and design core thermal power level of 4451 megawatt(s) thermal (MW(t)). The rated and design net output of each electric generator is approximately 1600 megawatt(s) electrical (MW(e)).

The US-APWR units would use uranium dioxide fuel, enriched to 4.55 weight percent uranium-235. Each US-APWR unit would contain 257 fuel assemblies, each containing 264 fuel rods. The total quantity of uranium dioxide is 305,830 lb (1190 lb per fuel assembly). The reactor core design is expected to operate for 24 months between refueling, with an average burnup of 46,200 megawatt-days per metric ton uranium (MWd/MTU) and a maximum burnup of 54,200 MWd/MTU.

For the cooling system, Luminant proposes to use wet mechanical draft cooling towers. Two such cooling towers would be constructed for each of the proposed units, for a total of four new cooling towers. Water for the new cooling towers would be supplied from Lake Granbury through two new pipelines. No water from the adjacent SCR would be used to cool the new CPNPP Units 3 and 4. A new BDTF, including two large ponds, to reduce the total dissolved solids (TDS) of blowdown water would be built south of Units 1 and 2. The BDTF would produce a clean permeate stream, which would then be blended with the remaining untreated blowdown and routed to Lake Granbury via two new pipelines and underwater diffusers in the lake.

Engineered safety features of the new construction protect the public in the event of an accidental release of radioactive fission products from the reactor cooling system. The following discussion summarizes these safety features using information taken from Luminant's ER (Luminant 2009a). Additional detail is contained in the Design Control Document (DCD) for the US-APWR (MHI 2009). The engineered safety features include the following.

- Containment System. The containment vessel is a cylindrical structure with a hemispherical dome made of prestressed, post-tensioned concrete. The inside of the structure is lined with carbon steel. The structure sits upon a flat, reinforced concrete foundation slab. The containment vessel completely encloses the reactor and the reactor coolant system and is designed to minimize any leakage.
- Containment Heat Removal System. This system consists of four independent trains with four containment spray (CS)/residual heat removal (RHR) pumps and four CS/RHR heat exchangers. The CS reduces temperature and pressure in containment to acceptable levels and provides long-term containment cooling following a loss of coolant accident (LOCA). This system automatically actuates following a CS signal and draws water from the refueling water storage pit. The refueling water storage pit provides a continuous source of water for the CS/RHR pumps. The RHR removes reactor core decay heat and other residual heat from the reactor coolant. This system also transfers refueling water between the reactor cavity and the refueling water storage pit at the beginning and end of refueling operations. All pumps, motor-operated valves, and instruments have emergency power backups.
- Containment Isolation System. This system provides isolation of lines penetrating the reactor containment to preserve the integrity of the containment boundary and to prevent the release of radioactive products to the environment following a postulated accident.
- Emergency Core Cooling System. The primary function of this system is to provide emergency reactor core cooling following a LOCA. The system also mitigates accidents and ensures safe shutdown by performing emergency boration, letdown, and emergency makeup.
- Control Room Habitability System. This system maintains habitable conditions in the main control room envelope to protect the operators from airborne radioactivity, smoke, and toxic gas. The habitability system has a heating, ventilating, and air-conditioning (HVAC) system with dedicated redundant air-handling units, filters, fans, and airtight isolation dampers.
- Fission Product Removal and Control System. This system consists of the pH control system and the annulus air cleanup system. To control pH, a buffer agent is added to provide sump water pH adjustment following a LOCA. The annulus air cleanup system prevents uncontrolled release of radioactivity to the environment from the containment penetration area and the safeguards components area. These areas are maintained at negative pressure during an accident. This system is also used for containment depressurization during normal operations. The annulus air cleanup system initiates automatically on a safety injection signal.
- Emergency Feedwater System. This system is automatically initiated during a significant transient event. It provides makeup water to the steam generators to sustain their ability to remove heat from the reactor coolant system by converting it to steam. The heat so converted would be discharged to the condenser or to the atmosphere.

The turbine generator consists of the turbine, generator, moisture separator and reheaters, steam valves, and their auxiliary systems. The turbine generator system is designed to change the thermal energy of the steam flowing through the turbine into rotational mechanical energy, which rotates an electric generator to provide electrical power. The turbine generator consists of a double-flow, high-pressure turbine and three double-flow, low-pressure turbines. It is a tandem compound type, 1800 rpm machine. The design details are provided in Section 10.2 of the DCD (MHI 2009).

Each turbine generator has a rated and design net output of approximately 1600 MW(e) for each reactor thermal output of 4451 MW(t). The generator rating is 1,900,000 kVA with a power factor of 0.9. Plant electrical consumption is approximately 90 MW(e), or about 5.5 percent of generator output at rated power.

Figure 3-2 shows a simplified flow diagram of the reactor power conversion system. The significant design features and performance characteristics for the major power conversion system components are listed in Table 10.1-1 of the DCD (MHI 2009). Turbine generator and auxiliary design parameters are listed in Table 10.2-1 of the DCD (MHI 2009). The main condenser is a single-pressure, surface cooling, radial flow type unit with a total heat transfer surface area of 1.437×10^6 ft^2. The condenser-designed heat duty is 9.90×10^9 Btu/hr. The condenser is equipped with titanium tubes (Luminant 2009a).

3.2.2 Structures with a Major Environmental Interface

The review team divided the plant structures into two primary groups: those that interface with the environment and those that are internal to the reactor and associated facilities but without direct interaction with the environment. Examples of interfaces with the environment are withdrawal of water from the environment at the intake structures, release of water to the environment at the discharge structure, and release of excess heat to the atmosphere. The structures or locations with environmental interfaces are considered in the review team's assessment of the environmental impacts of facility construction and preconstruction and facility operation in Chapters 4 and 5, respectively. The power-production processes that would occur within the plant itself and that do not affect the environment are not relevant to a National Environmental Policy Act (NEPA 1969) review and are not discussed further in this EIS. However, such internal processes are considered by the NRC in the US-APWR design certification documentation and in the NRC safety review of Luminant's COL application. This section describes the structures with a significant plant-environment interface. The remaining structures are discussed in Sections 3.3.1 and Section 3.4.2, inasmuch as they may be relevant in the review team's consideration of impacts discussed in Chapters 4 and 5.

3.2.2.1 Cooling Water System

The detailed description of the cooling water systems and their anticipated modes of operation for CPNPP Units 3 and 4, as provided in this section, is taken from Luminant's ER (Luminant 2009a). Design data and performance characteristics for the cooling system components are presented in the next subsection. The parameters provided are used to evaluate the impacts to the environment from cooling system operation in Chapter 5. The principal environmental interfaces of these systems are the plant intake and discharge structures as well as the cooling towers. The basic system configuration is illustrated in Figure 3-3.

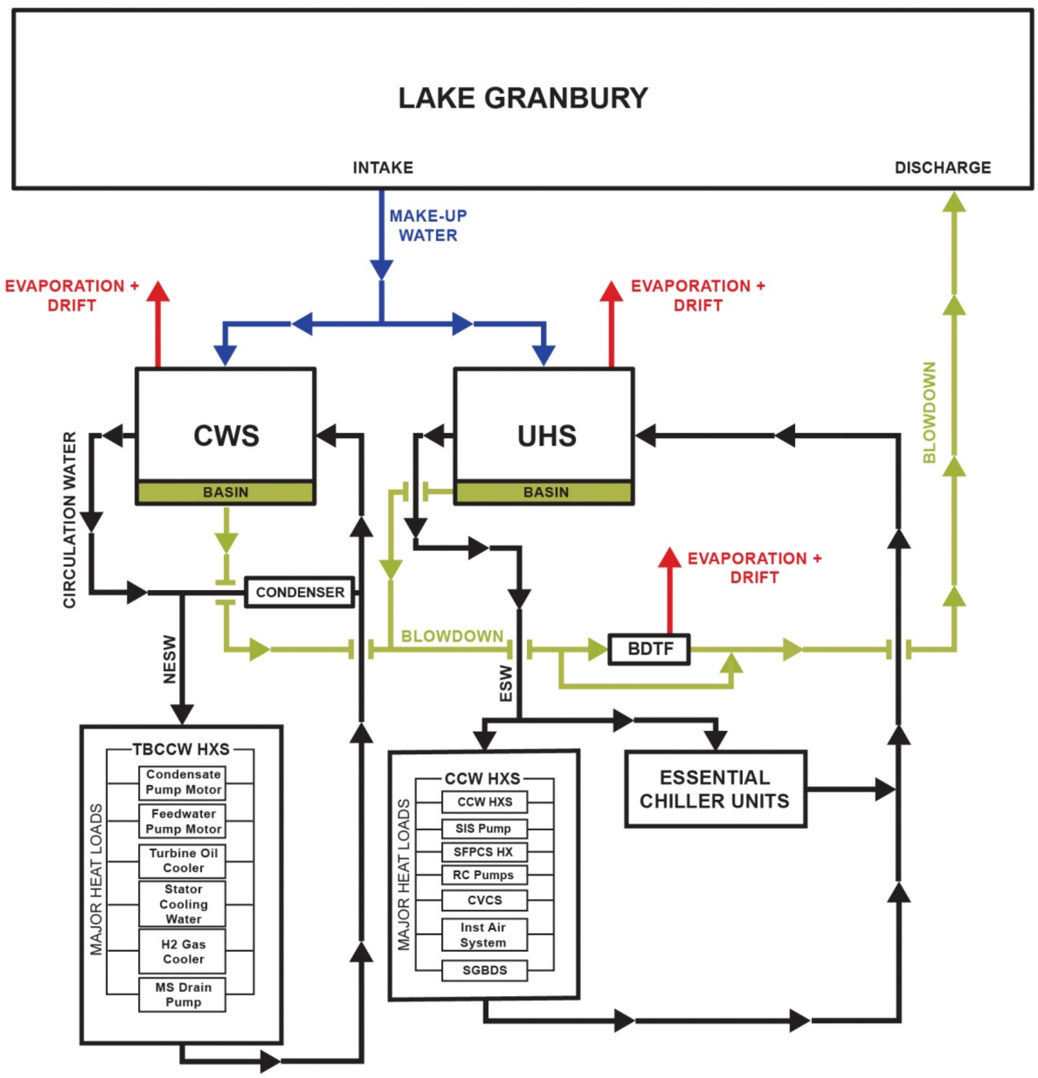

Figure 3-3. Simplified Water Use Diagram for CPNPP Units 3 and 4 (Adapted from Luminant 2010b)

Systems Description

CPNPP Units 3 and 4 are provided with three cooling systems that transfer heat to the environment during normal modes of plant operation. These systems are the essential service water system (ESWS), the non-essential service water system (NESWS), and the circulating water system (CWS). There are six anticipated plant operational modes:

- power operation,
- startup,
- hot standby,
- hot shutdown,
- cold shutdown, and
- refueling.

Heat generated during each operational mode is released to the atmosphere and to Lake Granbury from the CWS, ESWS, and NESWS. The amount of heat released to the atmosphere and Lake Granbury during each mode of operation is provided in Table 3-1.

Table 3-1. Heat Transfer to the Environment for Six Operating Modes (Data Values are in Million Btu/hr)

Modes of operation	Total Heat Transferred ESWS and CWS	Heat Dissipated to Atmosphere by ESWS	Heat Released in Liquid Discharges by ESWS[a]	Heat Dissipated to Atmosphere by CWS	Heat Released in Liquid Discharges by CWS[b]
Power Operation	10,340.	100.0	2.62	9970	267.6
Startup	659.7	144.1	3.71	498.5	13.38[c]
Hot Standby	102.62	100.0	2.62	NA	0
Safe Shutdown	390.6	390.6	0[d]	NA	0
Cooldown by CS/RHR[e]	471.5	459.1	12.4	NA	0
Refueling (Full Core Offload)	120.6	117.54	3.04	NA	0

(a) ESWS heat released in blowdown discharge is based on ESW blowdown water temperature of 95°F, and lake water temperature of 47°F.

(b) CWS heat released in blowdown discharge is based on CWS blowdown temperature of 88.5°F, and lake water temperature 47°F. Therefore, some heat would be dissipated in Lake Granbury. In addition, wastewater transferred from the BDTF to the storage pond would dissipate a fraction of the heat to the environment.

(c) The startup mode is based on 5% of rated power condition. The 5 percent heat value is prorated from the heat value of rated power operation (normal operation).

(d) ESW blowdown control valve is closed during safe shutdown.

(e) ESW cooldown by CS/RHRS operation is based on all four ESW trains operating for duration of 4 hr.

Source: Luminant 2009a

The CWS and ESWS are supplied with raw water from the intake structure on Lake Granbury to replace water which has been consumed and discharged as part of system operations. The makeup water system (MWS) supplies water to the CWS cooling towers to make up for water consumed as the result of evaporation, drift, and blowdown. The makeup water supply to the NESWS comes from the CWS. The quantities of water withdrawn, consumed, and discharged for the CWS and the ESWS are provided in Table 3-2. The chemicals to be added to the CWS and ESWS water are listed in Table 3-3.

During normal operation, the Wheeler Branch Reservoir (WBR) supplies up to 350 gpm. This water supply includes up to 50 gpm for daily potable water use for the entire site and from 0 to 300 gpm to the raw water storage tanks, which in turn supply water to the demineralized water system (DWS). The estimated monthly use of WBR water is 1.5×10^7 gal.

Table 3-2. Water Withdrawn and Discharged per Unit for Six Operating Modes

Modes of Operation	Water Source	Quantity Withdrawn gpm	Quantity Consumed (CWS) gpm	Quantity Discharged (CWS) gpm	Quantity Consumed (ESWS) gpm	Quantity Discharged (ESWS), gpm	Quantity Discharged into Lake Granbury, gpm
Power Operation	Lake Granbury	31,615	18,412	12,929	165	109	13,038
Startup	Lake Granbury	2958	1506	1057	240	155	1212
Hot Standby	Lake Granbury	1178	531	373	165	109	482
Safe Shutdown	Lake Granbury	630[(a)]	0	0	630[(a)]	0[(a)]	0[(a)]
Cold Shutdown	Lake Granbury	1283	14	10	744	515	525
Refueling (Full Core Offload)	Lake Granbury	331	5	4	195	127	131

(a) During accident conditions, including loss-of-cooling accident and loss of off-site power, blowdown control valves close automatically upon receipt of low water level signal or emergency core cooling system actuation signal. Make-up water may be available, but the design basis of the ultimate heat sink does not require make-up water.

Source: Luminant 2009a

Makeup Water System

The MWS supplies makeup water from Lake Granbury to the CWS and ESWS and consists of five 50 percent capacity pumps, two for each unit and one spare pump in standby, common for both units. The MWS supplies water to the ESWS cooling tower to make up for water consumed as the result of evaporation, drift, and blowdown.

During normal operation, Lake Granbury provides 31,341 gpm makeup to the CWS, and 274 gpm as makeup for the ESWS, for a total of 31,615 gpm per unit, plus 320 gpm to the raw water storage tanks, or a total of 63,550 gpm for both units. The estimated monthly average water need from Lake Granbury is 2.73×10^9 gal to operate both CPNPP Units 3 and 4. Normal operation is at 100 percent power operation, which is at a maximum makeup demand; therefore, the maximum is approximated to be the same as the normal need. The minimum demand is during an outage when the only flow being pulled from Lake Granbury for that unit is the ESWS makeup (331 gpm per unit). The estimated monthly minimum water demand from Lake Granbury is 1.38×10^9 gal per unit. Therefore, the minimum demand occurs when one unit is in an outage and the other is in power operation.

Table 3-3. Chemicals that Would be Added to the ESWS and CWS of CPNPP Units 3 and 4[(a)]

System	Chemicals	Amount Used (gal/yr/unit)	Frequency of Use	Concentration in Waste Stream
ESWS	Biocide (sodium hypochlorite)	12,000	Continuous	0.2 ppm residual or free chlorine
ESWS	pH/LSI/adjustment (sulfuric acid)	12,000	Continuous	<2.2 ppm H_2SO_4
ESWS	Corrosion inhibitor antiscalant (ortho-polyphosphate and phosphonate)	1200	Continuous	Permit limit
CWS	Biocide (sodium hypochlorite)	120,000	Continuous	0.2 ppm residual or free chlorine
CWS	pH/LSI/adjustment (sulfuric acid)	120,000	Continuous	<2.2 ppm H_2SO_4
CWS	Corrosion inhibitor antiscalant (ortho-polyphosphate and phosphonate)	12,000	Continuous	Permit limit
CWS	Dechlorination of blowdown (sodium bisulfite)	1200	Intermittent	Sufficient to reduce residual chlorine to <0.2 ppm

(a) The CWS supplies water to the NESWS.

(b) LSI = Langelier Saturation Index, a metric for evaluating water quality data to determine the tendency of the water to form a chemical scale.

Source: Luminant 2009a

Circulating Water System

The CWS supplies cooling water to remove heat from the main condensers under varying conditions of power plant operation and site environmental conditions. The CWS is arranged into two cooling tower basins for each unit, each with four 12.5 percent capacity, vertical, wet pit type, single-stage mixed flow circulating water pumps located in each cooling tower basin. Two CWS cooling towers provide 100 percent cooling for normal power operation. Each pump provides a flow rate of 164,715 gpm into the main condensers removing heat by transferringheat to the CWS water, and then the heated CWS water is returned to the mechanical draft cooling tower. Once in the cooling tower, the water is cooled by the counterflow principle of heat transfer to the rising air and evaporative cooling. The heat removed is rejected to the atmosphere, and the cooled water returns to the cooling tower basin. The system is provided with a blowdown capability to maintain the system performance by elimination of contaminants that build up as a result of the evaporation process. The chemical concentration factor for the CWS cooling tower is 2.4 cycles of concentration. The Texas Commission on Environmental Quality (TCEQ) specifies 93°F as the thermal water quality discharge criterion, which is the maximum temperature at which water may be discharged, in Lake Granbury (Luminant 2009a).

Non-Essential Service Water System

The NESWS provides cooling water to remove heat from the turbine component cooling water system (TCS). The heat is removed via the TCS heat exchanger and discharged to the cooling towers via the CWS.

The NESWS consists of three 50 percent capacity pumps; three 50 percent capacity TCS heat exchangers; two 100 percent capacity strainers; and associated piping, valves, instrumentation, and controls. The NESWS pumps are single-stage horizontal, centrifugal, constant speed, electric motor driven, and are located in the turbine building. Each pump is designed to provide approximately 13,500 gpm, which meets the maximum flow requirements for normal power operation (based on two pump operation); therefore, one pump can be out of service for maintenance during power operation. The temperature rise across the heat exchangers varies with each mode of operation. The NESWS is in operation during several modes of plant operation, as described in the operational modes subsection. During normal operation with a maximum heat load, the temperature rise is approximately 10°F–1°F during cold shutdown, safe shutdown, and hot standby; 0.4°F during refueling; and 8°F during plant startup.

The NESWS is arranged in such a way that any two of the three pumps can operate in conjunction with any two of three TCS heat exchangers to meet the system flow requirements. One out of two 100 percent capacity strainers is used. Each NESWS pump takes suction from a common header in the CWS piping and the discharge from the TCS heat exchangers combines into a common header.

Essential Service Water System

The ESWS provides cooling water to remove the heat from the component cooling water system (CCWS) heat exchangers and the essential chiller units. The ESWS transfers the heat from these components to the ultimate heat sink (UHS).[2]

The ESWS consists of four 50 percent capacity pumps. The ESWS is arranged into four independent trains (A, B, C, and D). Each train consists of one ESWS pump, two 100 percent strainers in the pump discharge line, one 100 percent strainer upstream of the CCWS heat exchanger, one CCWS heat exchanger, one essential chiller unit, associated piping, valves, instrumentation, and controls. Heat is dissipated via the UHS, which consists of four 50 percent wet mechanical draft cooling towers. The ESWS pumps are vertical, wet-pit, centrifugal, constant speed, electric motor driven, and are located at the essential service water intake basin. Essential service water is pumped through the strainers to the CCWS heat exchangers for heat removal. The temperature rise across the heat exchangers varies with each mode of operation. For Trains A and B during normal operation with a maximum heat load, the temperature rise is approximately 11.6°F–31.6°F during cool down, 11.0°F during refueling, 8.0°F during plant startup, and 31.6°F during safe shutdown. For Trains C and D during normal operation with a maximum heat load, the temperature rise is approximately 5.6°F–31.6°F during cool down, 6.7°F during refueling, 6.9°F during plant startup, and 31.6°F during safe shutdown. The heated essential service water returns to the UHS, where the heat is then rejected to the atmosphere.

The essential service water blowdown is diverted to Lake Granbury via the CWS blowdown pipe. This blowdown is used to control levels of solids concentration in the ESWS. As water

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[2] The UHS is comprised of a set of wet mechanical draft cooling towers located over the ESWS intake basin (also known as the cooling town basin). The cooling tower basin is also part of the UHS. The UHS provides the safety-related source of cooling for the normal essential components and removes reactor decay heat during and after an accident (Luminant 2009a)

cycles through the system, the chemicals become concentrated. The chemical concentration factor for the ESWS cooling tower, which is the number of times the water is cycled through the system to produce the chemical concentrations set forth in Table 3-3, is 2.4 cycles of concentration.

3.2.2.2 Other Permanent Plant-Environment Interfacing Structures, Systems, or Components

Blowdown Treatment Facility and Ponds

Luminant describes the BDTF as a facility to control the concentration of TDS and chlorides in the blowdown water, a stream of water that would be extracted from cooling tower water, before being returned to Lake Granbury (Luminant 2009d). Luminant's conceptual design of the BDTF is a 400-ac area consisting of reverse osmosis and ultrafiltration equipment buildings, a 47-ac storage pond and a 128-ac evaporation pond.[3] The evaporation pond would be intended to evaporate the wastewater from the BDTF to the point the salts could be disposed of at a landfill. Luminant has not described how precipitated salts and/or bittern recovered from the evaporation pond would be converted into a form that could be disposed of in a landfill. However, Luminant has stated that the salts could be passed through a filter press to reduce their moisture content (Luminant 2009c) or the wet salts could be packaged and shipped in water-tight containers to be processed at the landfill facility to meet the landfill waste treatment requirements (Luminant 2009e).

Although Luminant has not developed the following details, the BDTF would also include access roads, power lines and pipelines that are required to get people, materials and electricity to the site. The site would also have to have facilities for handling salt residues, preparing salt for shipment, as well as appropriate vehicle access. As shown in Figure 3-4, the ultrafiltration and reverse osmosis equipment would produce a product stream and two wastewater streams. The product stream would be demineralized water with low TDS and chloride concentrations that would be mixed with blowdown water from the cooling tower basins and piped to Lake Granbury. In addition to the product stream, the reverse osmosis equipment would produce a waste stream with high TDS and chloride concentration. The ultrafiltration equipment would remove particles from the blowdown water stream routed to the BDTF that might foul the reverse osmosis equipment. Part of the blowdown water stream is diverted and carries these removed particles as an additional waste stream to the storage pond. Luminant plans to combine the two waste streams in the storage pond. High-mineral-content water would be pumped from the storage pond to the evaporation pond.

Because evaporation from pond surfaces is not sufficient to evaporate the quantity of wastewater generated in the BDTF, Luminant plans to use 182 devices known as misters arrayed over the evaporation pond. Luminant based its conceptual design on Turbo-Mist evaporators sold by Slimline Manufacturing Ltd (Luminant 2010b). These evaporators consist of a powerful blower in a housing that directs a strong stream of air upward at about a 45° angle. Around the outlet of the blower housing are 30 nozzles that produce a fine spray. The blower forces the spray about 60 ft high (McIntyre 2010). The manufacturer reports that an individual evaporator produces a sound level of 95 db at 25 ft (Slimline Manufacturing 2010). Luminant plans to surround the evaporation pond with a 16-ft tall fence with fabric in order to mitigate salt drift from the misters that passes beyond the pond boundary.

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[3] Luminant has only developed a conceptual design for the BDTF (Luminat 2009e). Therefore, the design parameters for the facility could change as Luminant pursues a permit from the State of Texas for discharging blowdown water into Lake Granbury.

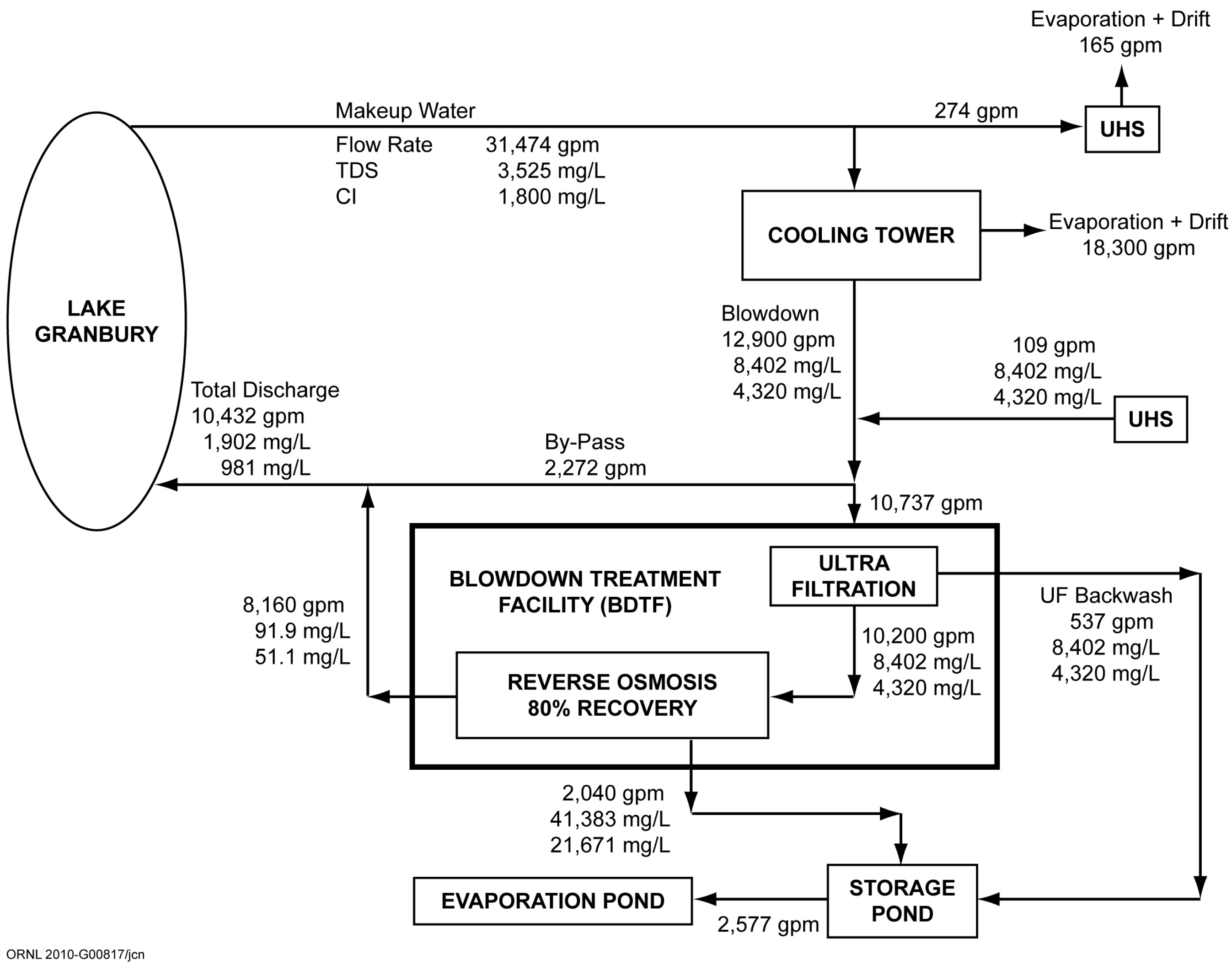

Figure 3-4. Mass Balance for Blowdown Treatment Facility (BDTF) when Lake Granbury Total Dissolved Solids (TDS) and Chloride Concentrations are High. Flow Rates are per Unit (Adapted from Luminant 2009a)

Sanitary Waste Treatment Plant

A new sanitary waste treatment plant with a 100,000 gpd capacity would be installed as part of the Unit 3 and 4 construction project. The proposed wastewater treatment system would be composed on an equalization tank, aeration chamber, clarifier, sludge digester tank with post-processing ultraviolet disinfection treatment, and associated pumps and blowers. The new system would include a filter press for sludge dewatering. Unit 1 and 2 sludge is presently dewatered using a bag filter system. The Unit 1 and 2 bag filter system would be decommissioned and replaced by the new Unit 3 and 4 filter press, which would have sufficient capacity to dewater sanitary waste sludge from all four Units. During construction of Units 3 and 4, the existing Unit 1 and 2 system would operate in parallel with the new treatment system because neither system alone would have sufficient capacity to treat the waste generated during construction. After construction of Units 3 and 4 is complete, the Unit 1 and 2 sanitary waste treatment system would be decommissioned and the combined sanitary waste would be treated in the new system.

3.2.2.3 Power Transmission System

Oncor Electric Delivery Company (Oncor) is the transmission service provider for CPNPP. Oncor Electric Delivery is a regulated electric distribution and transmission business that provides reliable electricity delivery to consumers. Oncor Electric Delivery is responsible for operating, maintaining, building, dispatching, and marketing the electric transmission system from the generator bus bars through the distribution substations. Oncor has an additional responsibility to provide a transmission system that supplies offsite power for startup and normal shutdown of nuclear reactors through the transmission switchyards.

Oncor is a member of the Electric Reliability Council of Texas (ERCOT). As the independent system operator for the region, ERCOT schedules power on an electric grid that connects 40,000 mi of transmission lines and more than 550 generation units. ERCOT manages the flow of electric power to 22 million Texas customers, representing 85 percent of the state's electric load and 75 percent of the Texas land area. ERCOT also manages financial settlement for the competitive wholesale bulk-power market and administers customer switching for 6.5 million Texans in competitive choice areas.

ERCOT is an independent not-for-profit corporation, subject to oversight by the Public Utility Commission of Texas (PUCT) and the Texas Legislature. The ERCOT region has an overall generating capacity of approximately 78,000 MW (Luminant 2009a).

Onsite Transmission System

The onsite power transmission system consists of one switchyard-transformer yard (transformer yard) for each of Units 3 and 4 at the turbine buildings and a combined switchyard (Units 3 and 4 Switching Station; U34SS) for the units where they connect to the transmission lines that leave the site. In the unit transformer yards, power from the generators is increased in voltage to 345 kV. U34SS connects and routes power from the unit transformer yards to the external transmission systems.

Luminant's construction plans have the distance between the Units 3 and 4 transformer yards and U34SS from about 0.3 to 0.66 mi (Luminant 2009a). After leaving the switchyard, transmission lines would traverse a distance of about one mi before exiting the site boundaries. These lines are described in the following subsection from U34SS to the points where they connect with the regional transmission system, not distinguishing between onsite and offsite lines.

Offsite Transmission System

Four new 345-kV circuits are planned to distribute the power that would be produced by Units 3 and 4. Two circuits would use vacant circuit positions on existing 345-kV, double-circuit lattice, steel tower structures in existing ROWs. Figure 3-5 shows a 345-kV, double-circuit tower with vacant circuit positions.

Figure 3-5. Oncor Transmission Line Towers with Vacant Circuit Positions (NRC Staff Photograph)

The first line to occupy a vacant circuit in an existing ROW is a 22.4-mi circuit utilizing a vacant circuit position on the existing 345-kV towers between U34SS and the Johnson Switch 345-kV Switching Station. The circuit would continue from Johnson Switch another 22.4 mi to the Everman 345/138-kV Switching Station. The other line to occupy a vacant circuit would be installed on the vacant position on the 41.6-mi 345-kV towers between U34SS and the Parker 345 kV Switching Station. See Figure 2-13.

Luminant reports that Oncor would build the two circuits in new ROWs. Oncor would build a new 45-mi circuit in a new ROW utilizing Oncor's standard 345-kV, double-circuit lattice, steel tower structure line between the U34SS and the Whitney 345-kV switching station. Oncor would also build a new 17-mi circuit in a new ROW utilizing Oncor's standard 345-kV, double-circuit lattice, steel tower structure line between U34SS and the DeCordova 345-kV Switching Station. There are already 345-kV and 183-kV circuits between CPNPP and DeCordova Switching Station on ROWs with a combined width of 230 ft.

The new ROW to DeCordova Switching Station would be adjacent to and parallel with the existing lines. The new ROW would be 160 ft wide, creating a combined ROW 390 ft wide. The new ROW would have standard Oncor 345-kV towers, with one of the two circuit positions filled.

The new 45-mile Whitney transmission line from the CPNPP Site to Whitney includes approximately 18-miles of new ROW that does not parallel any existing ROW. This portion of the new ROW would extend from the CPNPP site to a point near the town of Walnut Springs in Bosque County. The remainder of the route would parallel existing transmission line ROW from Walnut Springs to Whitney. The new ROW would be 160 ft wide. Where it runs adjacent to the existing ROW between Walnut Springs and Whitney, the combined ROW would be 320 ft wide. The new ROW would employ standard Oncor 345-kV towers, with one of the two circuit positions filled.

Figure 2-13 shows the current concept for the proposed connections to the existing power grid and the above discussion explains the anticipated routing for new transmission line ROWs. However, changes may be made during a routing study process that will be conducted by Oncor and reviewed by the PUCT. The PUCT considers several factors, including environmental integrity, when reviewing each application for a certificate to construct a transmission line [Texas Utilities Code (TUC) 2003]. The utility applicant must give notice of its intent to secure a certificate to neighboring municipalities and affected property owners and may be required to hold a public meeting (PUCT 2009). The utility applicant must also reasonably consider a route for the proposed transmission line that would moderate the impact on the affected community and landowners (PUCT 2003). Procedures for the route study process call for identifying areas where transmission lines are excluded or should be avoided.

3.3 Construction and Preconstruction Activities

The NRC's authority is limited to construction activities that have a "reasonable nexus to radiological health and safety or common defense and security" [72 Federal Regulations (FR) 57416], and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction [defined at Title 10 of the Code of Federal Regulations (CFR) 50.10(a)] activities for safety-related structures, systems, or components include driving of piles; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in place assembly, erection, fabrication, or testing.

Other activities related to building the plant that do not require NRC approval (but may require a permit from the Corps) may occur before, during, or after NRC-authorized construction activities. These activities are termed "preconstruction" in 10 CFR 51.45(c) and may be regulated by other local, State, Tribal, or Federal agencies. Preconstruction includes activities such as preparation of the site (e.g., site clearing and grading, erosion control and other environmental mitigation measures), erection of fences, excavation, erection of support buildings, building service facilities (e.g., roads, pipelines, transmission lines), and procurement or fabrication of components occurring at other than the final, in-place location at the site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4.

This section describes the structures and activities associated with building the proposed Units 3 and 4. This section also characterizes the major activities for the principal structures to provide the requisite background for the assessment of environmental impacts. However, it does not represent a discussion of every potential activity or a detailed engineering plan.

Table 3-4 provides general definitions and examples of construction and preconstruction activities that would be performed in building the new units. Luminant anticipates that site activities would be performed in the following sequence.

- Preconstruction planning and exploration activities would include such site activities as soil boring, sampling, and monitoring wells, or additional geophysical borings as allowed by 10 CFR 50.10(a)(1) and the removal or relocation of existing facilities at the CPNPP site.
- Site preparation activities would include installation of temporary facilities, construction support facilities, service facilities, utilities, docking and unloading facilities, excavations for facility structures and foundations, and construction of structures, systems, and components that do not constitute limited work authorization (LWA) activities as discussed in 10 CFR 50.10(a)(1).
- Subsurface preparation, placement of backfill and concrete within an excavation, and installation of foundations would be performed under the COLs.
- Construction activities would include the major power plant construction activities under the COLs.

For the purposes of analysis, Luminant assumed a construction schedule based on providing additional commercial electric generation beginning in 2017 for CPNPP Unit 3 and in 2018 for Unit 4. The description of site preparation and construction activities in this section assumes that construction on CPNPP Unit 3 would begin following the site preparation for CPNPP Units 3 and 4 and that construction of CPNPP Unit 4 would begin 12 months following commencement of CPNPP Unit 3 construction (Table 3-5).

Temporary construction facilities and laydown areas for staging of long-lead-time components would be located on site (Figure 3-6). These components would be assembled on site into modules as part of the preconstruction activities. The impacts of constructing these facilities are described in Chapter 4.

3.3.1 Site Preparation

Site preparation includes installation of temporary facilities (e.g., storage warehouses, concrete batch plant), relocation of facilities within the CPNPP site, staging equipment, module assembly, and preparation activities to support power plant construction. Figure 3-6 depicts the construction utilization plan, along with plant access roads, heavy haul roads, and other construction planning features.

In accordance with Regulatory Guide 1.165 (NRC 1997), the open excavations would be geologically mapped, and the NRC would be notified when the excavations are open for inspection.

Table 3-4. Descriptions and Examples of Building Activities for CPNPP Units 3 and 4

Activity	Description	Examples
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff.	Pumping water from excavation of base for reactor building.
Grouting	Installation of low-permeability material in the subsurface around deep excavation to minimize movement of groundwater.	Slurry wall would be installed around excavation for the reactor building.
Deep excavation	Digging an open hole in the ground. Deep excavation requires equipment with greater vertical reach than a backhoe. Deep excavation generally requires dewatering systems to keep the hole from flooding.	Excavating to support fabrication of basemat for the reactor.
Erection	Assembling of all modules into their final positions, including all connection between modules.	Using crane to assemble reactor modules.
Fabrication	Creating an engineered material from the assembly of a variety of standardized parts. Fabrication can include conforming native soils to some engineered specification (e.g., compacting soil to meet some engineered fill specification).	Preparing and pouring concrete; laying rebar for basemat.
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation.	Minor leveling of the site from its current relatively level terrain.
Hauling	Transporting material and workforce along established roadways.	Construction workers driving on new access road.
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas, and site drainage.	Paving parking area.
Shallow excavation	Digging holes or trenches to depths reachable with a backhoe. Shallow excavation may not require dewatering.	Pipelines; foundations for small buildings.
Vegetation management	Thinning, planting, trimming, and clearing vegetation.	Maintaining switchyard free of vegetation.
Filling of aquatic resources	Discharging of dredge and/or fill material into waters of the United States, including wetlands.	Placement of a culvert for a roadway.

Table 3-5. Schedule for Construction of CPNPP Units 3 and 4

Activity	Start Date	Finish Date	Duration
Unit 3			
Site preparations	4th qtr 2009	3rd qtr 2012	36 months
First concrete	4th qtr 2012		
Site construction to fuel load	4th qtr 2012	3rd qtr 2016	48 months
Fuel load to startup	4th qtr 2016	3rd qtr 2017	12 months
Commercial operation	4th qtr 2017		
Unit 4			
Site preparations	2nd qtr 2012	3rd qtr 2013	18 months
First concrete	4th qtr 2013		
Site construction to fuel load	4th qtr 2013	3rd qtr 2017	46 months
Fuel load, startup	3rd qtr 2017	2nd qtr 2018	10 months
Commercial operation	2nd qtr 2018		

Source: Luminant 2009a

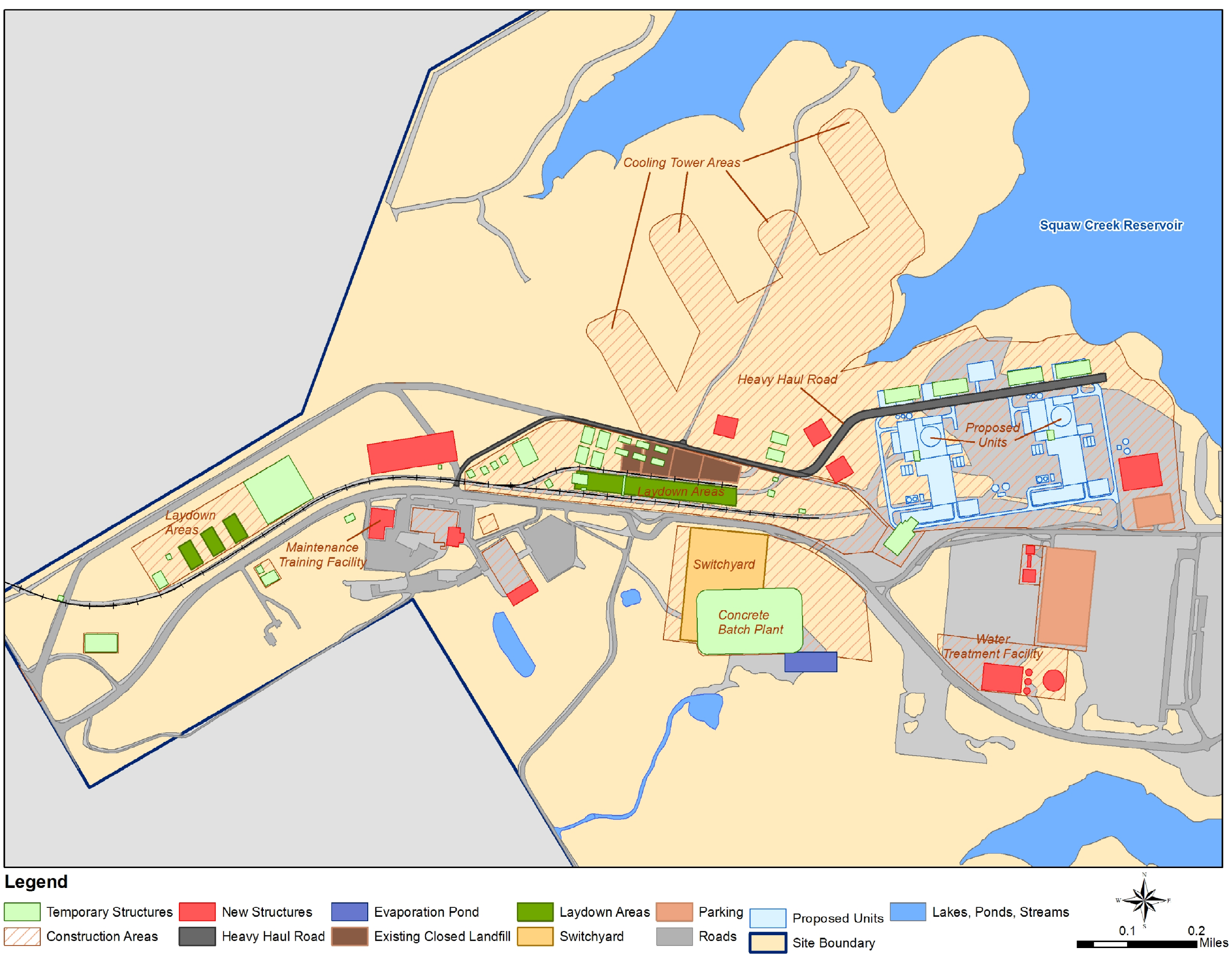

Figure 3-6. Detailed Site Plan Showing Construction Laydown Areas (Luminant 2009a)

3.3.1.1 Power Block Earthwork (Excavation)

The power block consists of an area encompassing the nuclear island and turbine building areas, which include the following buildings for each unit:

- reactor building, including the prestressed concrete containment vessel;
- power source buildings;
- power source fuel storage vaults;
- essential service water pipe tunnel;
- UHS-related structures;
- auxiliary building;
- access building; and
- turbine building.

3.3.1.2 Power Block Earthwork (Backfill)

The installation of safety-related Category 1 structural backfill material placed under safety-related structures or systems would occur as part of the site preparation activities. Backfill material would come from the concrete batch plant, qualified onsite borrow pits, or qualified offsite sources. The backfill would be installed up to the building's foundation grades in overexcavated areas and would continue around foundations upward as the buildings rise from the excavation up to plant grade.

3.3.1.3 Reactor Building Base Mat Foundation

After the subsurface preparations are completed, the next sequential work operation would be the installation of foundations. The reactor building basemat would be the first to be installed. The detailed steps include:

- installing the grounding grid;
- forming the mud-mat concrete work surface; and
- reinforcing steel and civil, electrical, mechanical/piping embedded items (basemat module) and forming, concrete placement and curing.

3.3.1.4 Blowdown Treatment Facility and Ponds

The BDTF with its storage and evaporation ponds would be constructed on 400 ac of existing site property along the blowdown return pipelines to Lake Granbury (see Figure 2-5). Luminant estimates that the evaporation pond would occupy approximately 128 ac and would be constructed to a depth of 4 ft plus 2 ft of freeboard which Luminant reports would protect from a 10-yr, 2-hr rainfall (Luminant 2009c, Luminant 2009d, Luminant 2009e). A storage pond of approximately 47 ac with a depth of 32 ft plus 2 ft of freeboard would be constructed near the evaporation ponds (Luminant 2009e). The design and construction of these ponds would be required to comply with requirements of the TCEQ, including pond liner and size requirements, operational freeboard requirements, permeability, soil compaction, and under-drain leak detection requirements. The ponds would be lined with either high density polyethylene or compacted clay. An under-drain system would be provided to collect and detect any seepage from the pond.

All 400 acres of the BDTF are anticipated to be affected by the facility construction and operation (Luminant 2010a). Excavation would be required for the construction of the ponds on the order of 1.7 million yd^3 of rock and soil for the evaporation ponds and 2.8 million yd^3 for the storage pond. Additional excavation would be required for construction of the water treatment equipment and associated pumps and pipelines.

3.3.1.5 Road and Rail Construction

During construction, access to the CPNPP site would be via Farm-to-Market Road 56 (FM 56). To the extent practical, Luminant would use the existing onsite road system and drainage systems. A new switchyard for CPNPP Units 3 and 4 would be located south of the existing access road from FM 56, and a road into the switchyard would be built. A heavy haul route would be built on site to support the transport of heavy modules and components from the existing heavy haul route. Temporary surfacing would be installed on the heavy haul route, as needed. A temporary construction parking lot would be created. Construction laydown and fabrication areas would be cleared, grubbed, graded, and graveled or paved with a road system to accommodate the site construction traffic.

The existing onsite rail line would be upgraded. The upgrades would include the installation of ballast or rail sections on the existing rail bed.

3.3.1.6 Security Construction

Security structures would include access control points, fencing, lighting, physical barriers, and guardhouses. Security features would be installed during the early part of site preparation activities.

3.3.1.7 Temporary Utilities

Temporary utilities would include aboveground and underground infrastructure for power, communications, potable water, wastewater and waste treatment facilities, fire protection, and construction gas and air systems. The temporary utilities would support the entire construction site and associated activities, including construction offices, warehouses, storage and laydown areas, fabrication and maintenance shops, the power block, the batch plant facility, measuring and testing equipment, and intake and discharge areas.

The materials brought on site for temporary utilities may include but are not limited to wood products for utility poles, concrete forms and crating; electrical cable to route temporary power; temporary piping for potable and sanitary water facilities and to the concrete batch plant; paint and spray cans for various construction and housekeeping services; plastics from containers and protective coverings. Luminant has no estimate of the quantities of these materials but estimates that an area of 5 to 10 ac may be needed for staging construction waste materials. Luminant reports that materials collected in this area will be sorted for those that can be reclaimed, either as recyclable material, reusable material or as investment recovery. The remaining material will be shipped to appropriate landfills. Luminant expects 4 to 5 truckloads of personal trash and packing wastes associated with construction to be shipped to landfills.

Luminant will not burn any waste.

3.3.1.8 Temporary Construction Facilities

Temporary construction facilities, including offices, warehouses for receiving and storage, temporary workshops, toilets, training facilities, and personnel access facilities, would be built. The site of the concrete batch plant would be prepared for aggregate unloading and storage, and the cement storage silos and concrete batch plant would be erected.

3.3.1.9 Laydown, Fabrication, Shop Area Preparation

Activities to support preparation of the laydown, fabrication, and shop areas include:

- performing a construction survey to establish local coordinates and benchmarks for horizontal and vertical control;
- grading, stabilizing, and preparing the laydown areas;
- installing construction fencing;
- installing shop and fabrication areas, including the concrete slabs for formwork laydown, module assembly, equipment parking and maintenance, fuel and lubricant storage, and rigging loft; and
- Installing concrete pads for cranes and crane assembly.

3.3.1.10 Clearing, Grubbing, and Grading

Clearing and grubbing of the site would begin with the removal of vegetation. In preparation for excavation, topsoil would be moved to a storage area for later use. The general plant area, including the switchyard and UHS areas would be brought to plant grade at an approximate elevation of 822 ft above mean sea level in preparation for foundation excavation. Existing underground utilities in the site area would be removed. The site utilization plans illustrate the areas to be cleared and graded.

Luminant estimates that about 101 ac of Ashe juniper forest and 17 ac of mixed hardwoods exist in the proposed construction area. In addition, Luminant estimates that in the area where the BDTF would be built, 313 ac of Ashe juniper and 45 ac of mixed hardwoods would be cleared. The vegetation would be disposed of by chipping/mulching to create mulch that would be spread on the construction area to minimize erosion. No vegetation would be disposed of by burning.

Luminant reports that it would use the wood chips as hydraulic mulch for erosion control per Luminant's Best Management Practice Guidance document, called "Temporary Best Management Practices" (Luminant 2010a). Hydraulic mulch uses wood fiber with or without other chemical binders in water that is applied to soil. The mixture requires 24 hours to dry after which it is effective. It may be necessary to reapply it to maintain erosion control. The wood fibers are applied at 2000 to 4000 lb/ac. Luminant reports that the mulch would be reapplied every two to six months.

For the main construction area, Luminant reports that the 118 ac of juniper and hardwoods would generate 12 million dry pounds of wood fiber. Assuming that it treats the 193-ac onsite construction disturbed areas, excluding building footprints, at a 4000-lb/ac rate two to six times per year, Luminant estimates that the shredded wood would provide mulching for 30 to 90 months. Luminant does not explain the disposition of approximately 36 million pounds of mulch that would result from chipping and shredding the 358-ac of woody vegetation on the BDTF site.

Approximately 5.3 million yd^3 of soil and rock (cut material) would be excavated during construction of CPNPP Units 3 and 4. Cut material that cannot be reused in the footprint would be retained on site in two excavated soil retention areas located in the south portion of the site. One 30-ac area is near the west property line. It can accommodate approximately 367,000 yd^3 of material. East of this area is a 149-ac site, which can accommodate up to 3.3 million yd^3 of material and includes the location of the BDTF.

Luminant reports that efforts would be taken to achieve beneficial reuse of the cut material. It is estimated that approximately 1 million yd^3 of the cut material would be available for reuse as site excavation backfill material to help achieve final grade elevation of the footprint. Approximately 3.3 million yd^3 can be beneficially reused to prepare the BDTF area for development.

Approximately 367,000 yd^3 can be beneficially reused in the expansion of the existing security training facility and gun range. In addition, suitable rock material would be used in swales and other applications. Any remaining soil that cannot be reused would be transported off site to a construction/demolition landfill or permitted landfill.

3.3.1.11 Underground Installations

Underground installations, such as non-safety-related underground fire protection, water supply piping, sanitary system, compressed air and gas piping, and electrical power and lighting duct bank would be installed and backfilled.

3.3.1.12 Unloading Facilities Installation

The existing rail line would be upgraded with adjacent construction laydown areas to support receipt of the bulk commodities. A spur into the batch plant area to support concrete materials would be built, and a heavy lift crane would be erected.

3.3.1.13 Intake/Discharge Coffer Dams and Piling Installation

Installation of a raw water intake structure for CPNPP Units 3 and 4 is planned adjacent to and northwest of the existing intake structure on Lake Granbury that currently supplies water to SCR. The new intake structure would connect to two new 42-in. pipelines, each supplying water directly to the cooling towers for Units 3 and 4 and nearby to the existing intake structure. Two additional gravity-drain 42-in. blowdown discharge pipelines (one from Unit 3 and one from Unit 4) with multiport diffusers are to be located approximately 800 ft upstream from DeCordova Bend Dam, in the vicinity of the existing discharge pipe. The distance between the intake location and the proposed discharge location on Lake Granbury is approximately 1.2 mi.

Building the intake and blowdown discharge structures is expected to require 12 to 18 months. The intake structure is expected to be approximately 80 feet long (east-west direction) and 40 feet wide (Figure 3-7). The foundation would be 3-ft diameter caissons drilled into the limestone bedrock under Lake Granbury. Steel sheet piling would establish the underwater perimeter of the intake structure. Luminant reports that neither coffer dams nor dredging would be employed (Luminant 2010a). To minimize impingement mortality and entrainment of fish and shellfish, Luminant would apply a passive screening system with the intake structure (Luminant 2009a). The system would consist of a traditional well-screen design which has spiral wound, wedge shaped wire drum modules. Each module is 6 ft long and mounted in a tee arrangement such that each tee has 12 ft of screen drum, and is 16.33 ft long, with a total screen area of 245ft^2 per tee. There are a total of four tees with a total screen area of 490 ft^2 per unit and the mesh screens are sized for a maximum through screen velocity of less than 0.5 ft/s.

The blowdown diffusers would be established along the bottom of Lake Granbury at a depth such that the discharge nozzles would be a minimum of 10 ft below the surface at low water level (Figure 3-8). The discharge pipes would be approximately 4 ft in diameter. Each 82-ft-long discharge diffuser would have eighteen 4-in diffuser nozzles aimed 30 degrees from vertical in the downstream direction. The two diffusers would be parallel and approximately 12 ft apart, center to center. Luminant has not decided whether to bury the pipe in the lake bottom or to locate it on the bottom and hold it in place with rip-rap or by strapping it to concrete supports located on the lake bottom. Burying the diffuser in the lake bottom would require excavation of trenches approximately 5 ft deep, 12 ft wide and 82 ft long for the pipes (Luminant 2010a) and the potential removal of some of the dredged material not used to refill the trenches.

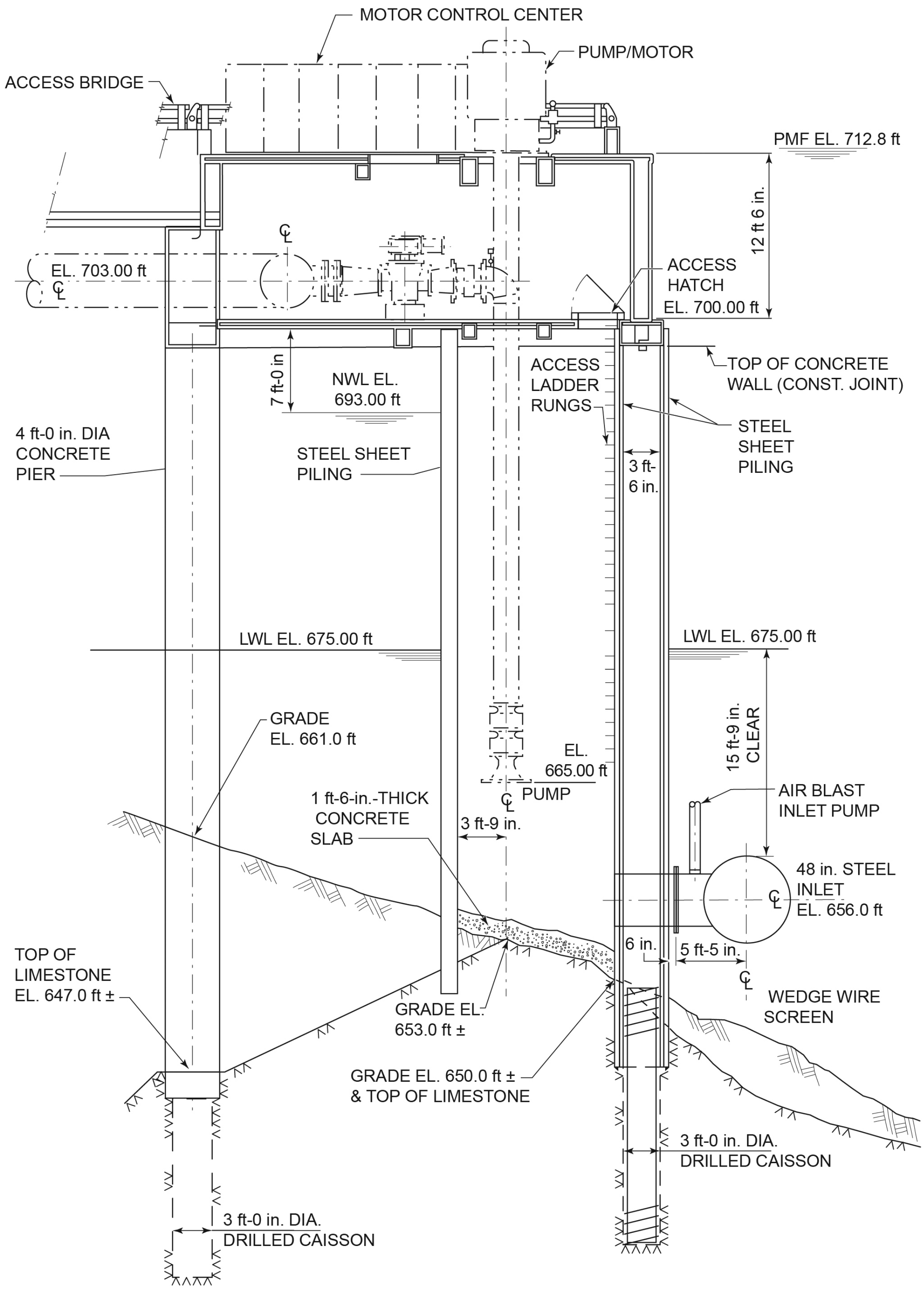

Figure 3-7. Proposed Makeup Water Intake Structure on Lake Granbury (Cross Section) (Adapted from Luminant 2010b)

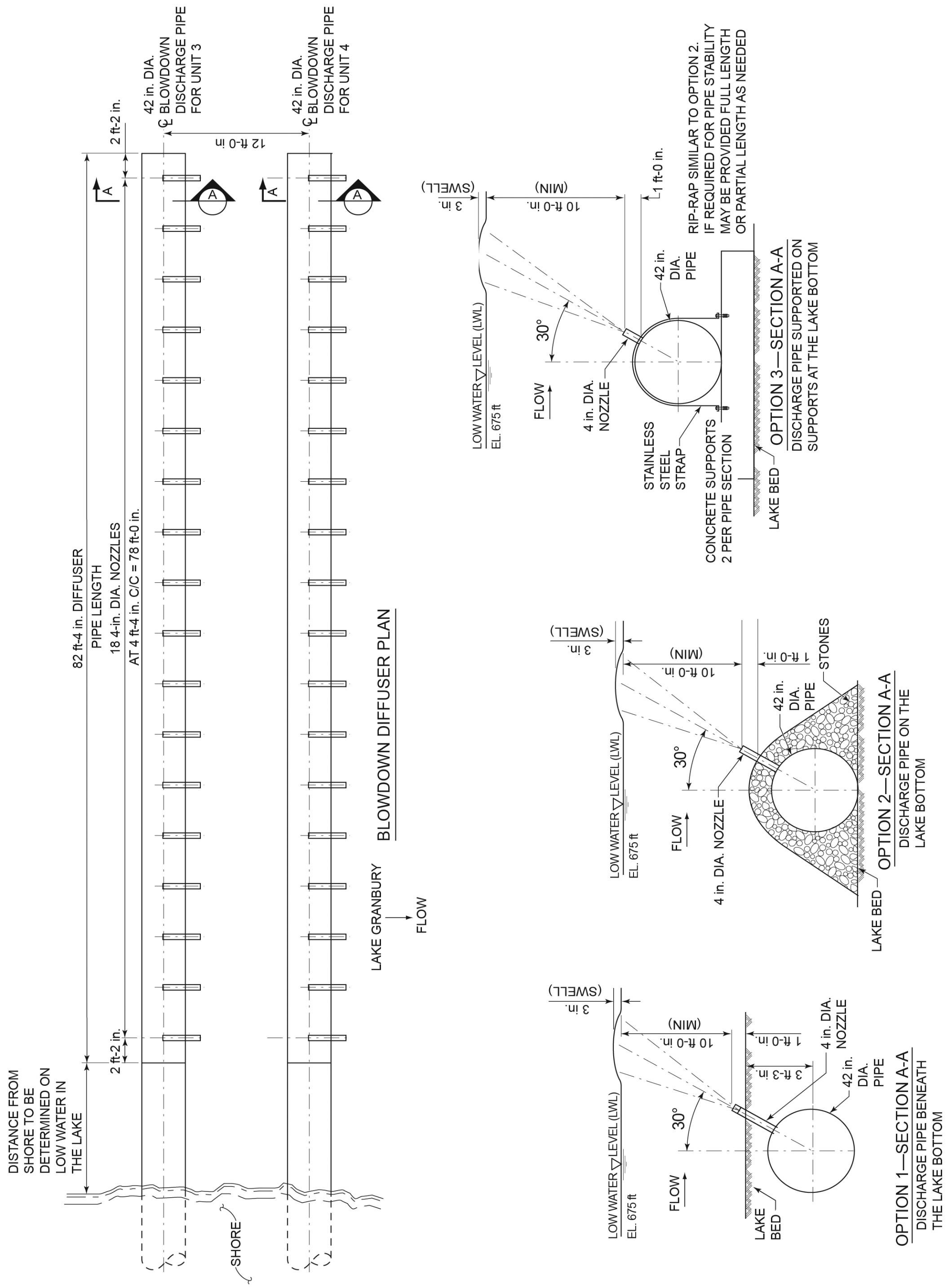

Figure 3-8. Blowdown Water System Discharge Diffuser as Proposed for Construction in Lake Granbury (Adapted from Luminant 2010b)

The four pipelines associated with the proposed Units 3 and 4 are expected to be placed in the existing 50-ft pipeline ROW. During construction, an area of up to 125 ft wide along the ROW could be disturbed. The new pipelines are expected to be parallel to the existing makeup and return water pipelines and are illustrated in Figure 2-5. The existing makeup pipelines are presently used to maintain the level in SCR. The existing return line has never been used to support operation of CPNPP Units 1 and 2 and is not expected to be used in the future. The land to be disturbed along the pipeline corridor consists mainly of grassland and scrub brush. While building the intake and discharge structures, an additional amount of land disturbance is anticipated to occur.

3.3.2 Power Block Construction

The power block consists of the reactor building, the turbine building, and more than a dozen smaller, but essential facilities.

The reactor building, which includes the reactor vessel, is an integrated steel and concrete structure with three floor elevations below plant grade and five elevations above grade in an area of approximately 304 by 210 ft. The major activities associated with the reactor building construction following the basemat foundation placement include

- erecting the reactor concrete containment vessel shell modules;
- placing walls, slabs, and reactor pedestal;
- installing the reactor vessel and pool modules; and
- setting the polar crane and the upper reactor building roof structure.

The mechanical, piping, HVAC systems, and electrical installations would begin in the lower elevations and would continue to the upper elevations.

The reactor building has the longest construction duration.

The turbine building is a concrete and steel structure with an area of approximately 167 by 321 ft. The turbine building has one floor below grade and three floor elevations above grade. The turbine building construction would begin with the pedestal basement and buried circulating water piping installation. Installation of the pedestal columns, condenser modules, and pedestal deck would follow. The building exterior to the turbine pedestal would be erected; the turbine building crane and the exterior walls and roof would then be installed. The mechanical, piping, HVAC, and electrical installations would begin in the lower elevations and would continue to the upper elevations. The turbine and generator would be assembled inside the building.

Support facilities to be constructed within the power block include

- the switchyard and installation of the main transformers,
- the administrative simulator and training facility buildings,
- the circulating water intake and discharge structures,
- circulating water cooling towers,
- safety-related tunnels,
- the UHS cooling tower,
- basin and pump houses,
- machine shop,
- sewage treatment facility,
- fire protection pump house,
- makeup water treatment building,

- various yard tanks, and
- laboratories for radiological and chemical analyses to support plant operations.

3.3.3 Transmission Lines

Luminant reports that Oncor's typical 345-kV ROW width is 160 ft, with the centerline typically in the center of the ROW (Luminant 2009a). Some ROWs are wider to accommodate additional facilities. Actual ROW widths and areas would not be known until the final ROWs are determined.

3.3.3.1 Construction of Transmission Line Corridors

Luminant reports that new transmission lines are routed in accordance with the PUCT's "policy of prudent avoidance," whereby Oncor is tasked with reasonably avoiding population centers and other locations where people gather in order to limit exposure to electromagnetic fields (EMFs) (Luminant 2009a).

The transmission line structures are self-supporting steel towers. The transmission line structures are designed to withstand standard loading conditions for the specific site. Figure 3-5 depicts a typical 345 kV Oncor transmission tower. Towers for 345 kV transmission lines are usually located at 1000 to 1100 ft intervals. The minimum ground clearance for maximum sag condition is 45 ft. The maximum operating temperatures of the line are 100°C and 120°C under emergency conditions. The tangent tower is designed for a 1200-ft wind span and a 1400-ft weight span at a 0-degree angle. Wind span is determined by the wind loading on half of the span leading into a tower plus the wind loading on half of the span leading away from a tower. Weight span is determined by the total weight loading of wire measured between the low points of the spans entering and leaving the tower.

The lines would be designed to meet or exceed the requirements of the National Electrical Safety Code and the American National Standards Institute. The 345-kV line would be designed to keep the electric field at the conductor surface significantly below corona inception (Luminant 2009a).

3.3.3.2 Clearing of Corridors

Luminant reports that clearing of new corridors would be performed in accordance with *Oncor Transmission Engineering Standard 720-003* (Oncor 2007). This standard specifies that the construction of access roads shall be minimized and that necessary access roads shall be constructed in a manner which prevents damage or erosion to the ROW and adjacent property. The standard authorizes Oncor's authorized representative to supervise and approve most aspects of the corridor work. No grading, dumping of excess dirt, clearing, or tree trimming is allowed unless permission has been obtained from the property owner(s) by Oncor or its contractor.

The standard describes full-cut clearing and selective-cut clearing, but does not indicate when or where each would be used or how the decision to use one or the other would be made. For full-cut clearing, all trees, brush and undergrowth within the ROW shall be cut level with the ground. No stump is allowed to exceed 2 in. above the ground. Trees in a fence line over 4 in. in diameter are to be cut to the top of the fence. Trees that overhang the ROW are to be trimmed to eliminate the overhanging limbs.

For selective-cut clearing, two areas are defined, the primary cleared area and the variable cleared area. The variable cleared area extends 50 ft on either side of the primary cleared area. The allowable vegetation height in the variable cleared area ranges from 10 ft at the edge of the primary cleared area to about 40 ft at 50 ft from the primary cleared area. However, the contractor is to remove any tree that would exceed the allowable height at maturity. In the primary cleared area, all trees, brush or undergrowth which exceeds 10 ft in height is to be cut, and any other vegetation which would conflict with construction or maintenance of the transmission line is to be removed. For a 345-kV steel tower line, the primary cleared area is 75 ft wide. Oncor's clearing contractors are required to treat all stumps with herbicide to prevent re-sprouting and regrowth. Additionally, Oncor requires that their clearing contractors assure strict compliance with Federal, State, and local regulations for the acquisition, storage, use, and disposal of herbicides.

Oncor retains authority to decide how cut vegetation would be disposed of. Where burning is used, Oncor and its contractors would comply with all applicable laws and regulations. Burying timber or brush is forbidden without permission from Oncor. The standard describes method by which cut vegetation may be disposed of piling it in the ROW (Oncor 2007, Luminant 2009a).

3.3.3.3 Construction and Erection of Towers and Lines

Transmission line towers are spaced 1000 to 1100 ft apart so most of the ground disturbance is associated with building the towers and building the access roads to reach the tower locations.

Luminant reports that the installation of electrical conductor wires would be performed using the tension method, as described in Institute of Electrical and Electronics Engineers (IEEE) Standard 524 (Luminant 2009a). The tension method of stringing transmission lines involves threading a light pilot pulling line through the travelers. The pilot line pulls a heavy pulling line through the travelers. Then, the pulling line is used to pull the conductor through the travelers. Once in place, the conductors are tensioned and fixed in place. IEEE Standard 524 notes that the "tension method of stringing is applicable where it is desired to keep the conductor off the ground to minimize surface damage or in areas where frequent crossings are encountered. The amount of ROW travel by heavy equipment is also reduced" (IEEE 2003).

On average, one mile of 345kV transmission requires 3 days with a crew of 70 and approximately 20 truckloads of material. Construction disturbance varies from less than 1 ac/mi to as much as 10 ac/mi. Typically, 70 percent of vegetation is reestablished after construction. At a 70-percent revegetation rate, between 0.5 and 7 ac would be restored after construction.

3.3.4 Construction Workforce

The construction workforce would consist of field craft labor and field supervisor labor. Table 3-6 provides estimates of the percentage of the total workforce for craft and field supervisor labor makeup that is anticipated during the construction of Units 3 and 4. Approximately 70 percent of the total workforce is expected to come from outside the 50-mi region. Field supervisor personnel are expected to come primarily from outside the 50-mi region.

The construction of CPNPP Units 3 and 4 would incorporate a number of large prefabricated modules. Modularization shifts some of the work to other locations that are outside the 50-mi region and thus supports smaller numbers for the onsite construction workforce and duration. The estimated construction onsite workforce present assumes a high degree of offsite fabrication.

The schedule assumes approximately 36 months for site preparation, 51 months from COL issuance to CPNPP Unit 3 fuel load, and 12 months for startup. Commercial operation of CPNPP Unit 4 is scheduled to begin 8 months after that of CPNPP Unit 3. Based on this schedule, the peak onsite construction workforce for CPNPP Units 3 and 4 is approximately 4300 people. Table 3-7 summarizes the onsite construction workforce by year of the project.

Table 3-6. Total Workforce by Craft for Construction of CPNPP Units 3 and 4

Laborers	Percentage of total workforce for US-APWR construction[(a)]
Asbestos	2.7
Boilermakers	0.5
Carpenters	14.4
Cement masons	1.3
Electricians	10.6
Ironworker	19.2
Laborers	16.4
Millwrights	4.3
Operating engineers	7.7
Painters	0.9
Pipefitters	12.8
Roofers	0.3
Sheet metal workers	2.0
Steamfitters	4.3
Teamsters	2.9
TOTAL	100.0

(a) The total man-hours were converted to man-years by assuming a 50-hr work week and 52 weeks per year. The total man-years were used to derive the percentages.

Note: Additional non-manual labor equivalent to 12.6 of the construction labor noted above will also be required.

Source: Luminant 2009a

Table 3-7. Expected Numbers of Onsite Workers by Year for Construction of CPNPP Units 3 and 4[(a)]

Year	Total Workers
2008	22
2009	60
2010	195
2011	713
2012	1054
2013	2636
2014	5201
2015	4117
2016	1055
2017	494
2018	464
2019	412

(a) Does not include existing operations workers or outage workers at CPNPP Units 1 and 2.

Source: Luminant 2009a

3.3.5 Summary of Resource Commitments during Construction and Preconstruction

Table 3-8 provides a list of the significant resource commitments of construction and preconstruction. The values in this table combined with the affected environment described in Chapter 2 provide the basis for the impacts assessed in Chapter 4. These values were stated in Luminant's ER (Luminant 2009a), and the review team determined that the values are reasonable.

Table 3-8. Summary of Resource Commitments Associated with Building CPNPP Units 3 and 4

Resource Area	Value	Description
All Resource Areas	7.25 years	Duration of preconstruction and construction activities (i.e., site preparation until time of fuel loading) for two proposed units
Land Use, Terrestrial Ecology, Cultural and Historic Resources (Site and Vicinity)	675 ac	Disturbed area footprint: • 123 ac for Units 3 and 4 • 152 ac for cooling towers • 400 ac for Blowdown Treatment Facility
Aquatic Ecology Structures	0.12 ac	Disturbed area footprint for intake and discharge in Lake Granbury: • 0.07 ac for intake structure • 0.05 ac total for discharge structures
Hydrology/Surface Water	200,560 gpd	Includes process water, potable water, and sanitary usage. Water would be provided by Somervell County Water District from surface water sources including the Wheeler Branch Reservoir
Socioeconomics, Transportation, Air Quality	4953 workers	Peak construction workforce, in late 2014
	Up to an additional 1200 workers on site for Units 1 and 2	
Terrestrial Ecology, Nonradiological Health, Socioeconomics	93-108 dBA	Peak noise level on site
	60 dBA	Estimated noise level at exclusion area boundary

Source: Luminant 2009a and Luminant 2010a

3.4 Operational Activities

The operational activities considered in the review team's environmental review are those associated with structures that interface with the environment. Examples of operational activities are withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Safety activities within the plant are discussed by the applicant in the FSAR portion of its application (Luminant 2009b) and are reviewed by the NRC in its safety evaluation report (in progress).

The following sections describe the operational activities, including the cooling system and its operational modes (Section 3.4.1), the plant-environmental interfaces of importance during operations (Section 3.4.2), the radioactive and nonradioactive waste management systems (Sections 3.4.4 and 3.4.5), and a summary of the values of parameters likely to be experienced during operations (Section 3.4.6).

3.4.1 Description of Operational Modes

The operational modes for proposed Units 3 and 4 considered in the assessment of operational impacts on the environment (Chapter 5 of this EIS) are normal operating conditions and emergency shutdown conditions. These are the nominal conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are alternative modes to normal plant operation during which water intake, cooling tower evaporation water discharge, and radioactive releases may change from nominal conditions. The primary plant cooling shifts from the CWS to the ESWS during these alternate modes.

3.4.2 Plant-Environment Interfaces during Operation

When in operation, CPNPP Units 3 and 4 would produce electrical energy from nuclear fuel using a steam turbine system as described in Section 3.2.1. Waste heat is a by-product of normal power generation at a nuclear power plant. The excess heat that remains in the closed-loop steam system after it passes through the turbines would be transferred to the atmosphere using evaporative and conductive cooling in a set of wet mechanical-draft cooling towers (as described below). Water for the new cooling towers would be obtained from a new intake structure to be built at Lake Granbury, and the water would be carried to the CPNPP site by new pipelines. Additional details are provided in Section 3.4.2.1.

In addition to evaporative losses, a fraction of cooling water (0.0005 percent of CWS flow) would also be lost in the form of droplets (drift) from the cooling tower. The water that does not evaporate or drift from each tower would be routed back to the cooling tower's basin. Evaporation of water from the cooling water system in the cooling tower increases the concentration of TDS in that water collected in the cooling tower basin. To control the concentration of dissolved solids in the cooling tower water, a stream of water would be extracted and replaced with water from Lake Granbury; the water extracted from cooling tower water, called "blowdown," is anticipated to have a TDS concentration between about 2000 and 8500 mg/L.

Luminant estimates that under conditions of very high Lake Granbury TDS concentrations, 3525 mg/l, about 83 percent of the blowdown would be diverted to the BDTF; the remainder of the blowdown would be combined with demineralized water produced by the BDTF and discharged to Lake Granbury. Cooling water system blowdown is the only wastewater that would be treated by the BDTF.

Luminant expects the ultrafiltration and reverse osmosis equipment to generate about 5200 gpm of wastewater to be evaporated (for both units combined). Using the manufacturer guidance on evaporator performance and the local 10-yr average pan evaporation rate, Luminant concluded that 182 misters (evaporators) within the bounds of the 128-ac evaporation pond would be sufficient to reduce the wastewater to a dry salt that could be shipped to a landfill for disposal.

In addition to the salts from the BDTF, the operation of CPNPP Units 3 and 4 would generate both radiological and nonradiological wastes of a solid, liquid, or gaseous nature. These wastes and the systems by which they would be managed are described in Sections 3.4.4 and 3.4.5.

CPNPP Units 3 and 4 would be connected to the existing electrical power grid at a new substation to be built at the CPNPP site. Both existing and new transmission lines would be used to distribute this power from the CPNPP site to customers as described in Section 3.2.2.3.

3.4.2.1 Plant Water Use and Treatment

Water for the operation of CPNPP Units 3 and 4 would originate from two sources: Lake Granbury and the WBR. During plant operation, raw water for cooling water and other in-plant uses in CPNPP Units 3 and 4 would be withdrawn from Lake Granbury at a withdrawal rate of up to 63,550 gpm (equivalent to 91.5 mgd). Annual withdrawals from Lake Granbury would total about 100,500 ac-ft/yr. Up to 350 gpm of water in a new pipeline (Luminant 2010a) from WBR (up to a maximum authorized withdrawal of 565 ac-ft/yr) would be acquired from the WBR through the Somervell County Water District for specific uses.

Proposed CPNPP Units 3 and 4 would utilize Lake Granbury as the source of their cooling water, so future withdrawals for that purpose would be in addition to the ongoing withdrawals of makeup water for Units 1 and 2. Treated blowdown from the cooling towers would be discharged back into Lake Granbury, and it is estimated that the consumptive water use from the operation of Units 3 and 4 would be approximately 62,700 ac-ft/yr (Luminant 2009a). During operation of all four reactors, Luminant would withdraw a total volume of approximately 137,800 ac-ft/yr from Lake Granbury, while approximately 42,100 ac-ft/yr would be returned to the lake (Luminant 2009a), a net loss of 96,800 ac-ft/yr. (Approximately 34,100 ac-ft/yr of Lake Granbury water is consumed maintaining SCR in support of Units 1 and 2.)

Most of the water withdrawn from Lake Granbury would be used as makeup water for the CSWs. An additional volume averaging 548 gpm for two units combined would be used for makeup water for the ESWSs. Water for use in the circulating water and ESWSs would be treated through the addition of chemicals, including chlorine, biocide, algaecide, pH adjuster, corrosion inhibitor, and silt dispersant. The chemicals that would be added to the ESWS and the CSW, the amounts used annually, frequency of use, and the resulting concentrations in the waste streams are discussed in Section 3.2.2.1.

For the 350 gpm of WBR water from the Somervell County Water District, up to 50 gpm would be used for daily potable water use for the entire CPNPP site. From 0 to 350 gpm of WBR water would go to the raw water storage tanks which is the supply source to the DWS (Luminant 2010a). All of the water from the WBR is treated at an off-site location to applicable drinking water quality standards (40 CFR Part 141) and would not require additional treatment prior to use.

The fire protection system would be initially supplied with water from WBR. During subsequent operations, raw water for DWSs and fire protection could be obtained from either or both WBR or Lake Granbury. Raw water requirements for these purposes would total about 1100 gpm, including up to 250 gpm to supply the fire protection systems. WBR water would be used in fire protection or sent to demineralization systems without pretreatment. Before being used for those purposes, however, Lake Granbury water would be

- treated with biocide to remove algae, slime, and bacteria,
- filtered to remove suspended matter
- treated with sodium hypochlorite to eliminate additional biological impurities,
- treated with bisulfite and antiscalant to protect reverse osmosis units from residual chlorine and scaling, and
- treated with two stages of reverse osmosis to remove dissolved solids.

Water for uses requiring demineralized water would be treated in mixed bed demineralizers to remove remaining dissolved substances.

Cooling water blowdown would contain elevated concentrations of TDS and chloride, and would be produced at an average rate of about 26,000 gpm. In order to meet anticipated discharge limits, Luminant has proposed the BDTF (Section 3.2.2.2) to control the quality of blowdown water discharged to Lake Granbury. A portion of this blowdown (approximately 21,500 gpm) would be sent to the BDTF, where treatment would separate it into two fractions: (1) a concentrated brine containing much of the dissolved salt load and (2) a demineralized fraction with a TDS concentration of about 110 mg/L. The brine (about 5200 gpm) would be discharged to the evaporation pond for evaporation and settling, while the demineralized water (about 16,300 gpm) would be combined with untreated blowdown (about 4500 gpm) and discharged to Lake Granbury. Luminant reports that this system will assure that blowdown discharged to Lake Granbury would have TDS and chloride concentrations below 2500 and 1000 mg/L, respectively.

3.4.2.2 The Cooling System's Operational Modes

Circulating Water System

In the power operation and startup modes, heat is generated, dissipated to the atmosphere, and released in liquid discharges from the CWS. The CWS releases heat to the atmosphere via the CWS cooling tower and to Lake Granbury liquid discharges via blowdown. The quantities of heat released are summarized in Table 3-1.

The CWS provides cooling during the power operation mode. The power operation mode rejects the most heat as the CWS removes heat rejected from the turbine by way of the condenser. The CPNPP Units 3 and 4 are in power operation mode for an estimated 97 percent of the operating cycle. During startup and hot standby, a smaller amount of heat is rejected by way of the condenser. The CPNPP Units 3 and 4 are estimated to be in the startup mode for less than 1 percent of the operating cycle, in refueling for 2 percent of the operating cycle, in the hot standby mode for less than 1 percent of the operating cycle, and in the safe shutdown mode for less than 1 percent of the operating cycle. These estimates do not include forced outages as they cannot be predicted. The power operating mode is paramount, operating for over 23 months out of a 24-month cycle and consuming the most flow. Therefore, all other modes are bounded by the power operation.

Non-Essential and Essential Service Water Systems

The ESWS operates in all six modes of plant operation and releases heat to the atmosphere via the UHS cooling towers, and in liquid discharges to Lake Granbury in the form of blowdown. The amount of heat released during each of these modes of operation in the CWS and the ESWS is shown in Table 3-1.

The NESWS provides heat removal from the TCS during power operation while the ESWS provides cooling water for heat removal from the CCWS during all six modes of normal operation. During refueling, the ESWS also supports a full core offload. CPNPP Units 3 and 4 are estimated to be in the power operation mode for 97 percent of the operating cycle.

3.4.2.3 Transmission Line Operation and Corridor Maintenance

Once placed into service, transmission lines are scheduled for inspection several times per year following an inspection protocol developed on the basis of Oncor's operating experience with its overall transmission system. The purpose of the inspections is to identify any deterioration or damage to the transmission towers or power lines that require repair. The inspections also seek to identify any man-made encroachment onto the ROW or the growth of woody vegetation that might interfere with operation of the system. Inspections can be performed from the ground but are most often performed using light aircraft or helicopters. Ground and aerial inspections generate noise. Maintenance and repair also require persons on the ground to use trucks and other vehicles in the ROW.

Vegetation management occurs on a maintenance cycle dictated by the vigor of local vegetation and Oncor's local experience. This maintenance typically requires cutting herbaceous and low woody growth on a relative short cycle and cutting saplings, larger shrubs, and small trees on a longer cycle that varies within the service area from west to east. The cycle may also vary depending on public concerns, local ordinances, line maintenance, and environmental considerations. ROW maintenance typically involves use of herbicides in addition to light power equipment such as saws, mowers, and hand tools.

Application of herbicides is one of the primary methods used by Oncor for maintaining ROWs once they have been cleared of woody vegetation or reclaimed. After initial clearing by cutting, herbicides are often applied to stumps to limit resprouting of woody species. Foliar application of herbicides is used afterwards if resprouting occurs or if the ROW is invaded by noxious weeds or other undesirable species. Undesirable species are controlled as required by local management plans usually established at the county level. Hand cutting and mowing are used in areas where herbicides may not be effective, difficult to apply, or undesirable. Herbicides are handled and applied only by qualified personnel in accordance with manufacturer specifications and guidance from regulatory agencies that license appropriately trained personnel to perform the work.

Access roads for construction and subsequent maintenance are stabilized wherever necessary with gravel to prevent formation of ruts and gullies in the exposed soil. These road surfaces are allowed to grass-over and are re-cut only as needed to permit occasional vehicular access (Luminant 2009a).

Noise associated with 345-kV transmission systems may be attributed to corona discharge, radio and television interference, and audible noise. Corona discharge is a luminous discharge caused by the ionization of the air surrounding a conductor due to the existing surface voltage gradient (electric field intensity) exceeding a certain critical level. Insulators and line hardware energized to the same potential as the conductor would produce a similar corona discharge. Corona discharge would appear as visible light and can cause an audible hiss or crackling sound as well.

Audible noise from transmission lines primarily occurs during wet weather. In dry conditions, the conductors usually operate below the corona inception level and few corona sources are present. In wet conditions, however, water drops striking or collecting on the conductors may produce corona discharge, causing audible noise (Luminant 2009a). Luminant reports that corona noise along transmission lines is usually of low volume, about 10 dB or less. However, when directly below power lines, one may perceive a "hum" of 50 to 60 dB on a quiet, humid day (Luminant 2009a).

EMFs diminish rapidly with distance. Readings on the strength of magnetic field strength directly under existing 230-kV and 525-kV lines typically range from 15 to 25 mG. At 75 ft from the ROW fence, these levels decrease to a range of 3 to 7 mG (Luminant 2009a).

3.4.3 Radioactive Waste Management System

Liquid, gaseous, and solid radioactive waste management systems would be used to collect and treat the radioactive materials produced as by-products from the operation of the proposed CPNPP Units 3 and 4. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and at levels as low as is reasonably achievable before being released to the environment. Waste-processing systems would be designed to meet the design objectives of 10 CFR Part 50, Appendix I ("Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents").

Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in light-water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. The fission products would be contained in the sealed fuel rods, but small quantities escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system would also be responsible for coolant contamination and for induced radioactivity in reactor components.

This section provides summary descriptions of the liquid, gaseous, and solid radioactive waste management systems for CPNPP Units 3 and 4. These summary descriptions are based on Chapter 11 of the US-APWR DCD (MHI 2009), Chapter 11 of the Luminant FSAR (Luminant 2009b), and Section 3.5 of the Luminant ER (Luminant 2009a).

The liquid and gaseous radioactive source terms for the US-APWR design were provided by Luminant in ER Tables 5.4-6 and 5.4-7 (Luminant 2009a) and were based on its FSAR (Luminant 2009b).

3.4.3.1 Liquid Radioactive Waste-Management System

The liquid waste management system (LWMS) is designed to safely monitor, control, collect, process, handle, store, and dispose of liquid radioactive waste generated as a result of normal operation, including anticipated operational occurrences. The LWMS would be located in the auxiliary building (A/B) and includes the following:

- the equipment and floor drain processing subsystem,
- the detergent drain subsystem,
- the chemical drain subsystem, and
- the reactor coolant drain subsystem.

The LWMS is designed to provide sufficient capacity, redundancy, and flexibility to process incoming waste streams such that discharged liquid effluents are below concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, during periods of equipment downtime, normal operation, and operation at design basis fission product leakage levels. Segregated systems are provided to collect water from floor drains and equipment, separately processing streams that could interfere with other processes, such as flows containing detergents. Liquid waste processing systems use filtration to remove suspended solids, activated charcoal to remove organic contaminants, and ion exchange resin to remove dissolved solids and radionuclides. Spent filtration media, such as filters, ion exchange media, and charcoal media, are sent to the solid waste management system (SWMS) for further processing and packaging. Dewatering of these solid wastes produces liquid waste streams that are returned to the LWMS.

Each system includes holding tanks used to accumulate liquid wastes prior to processing and to allow for sampling and analysis of liquid wastes prior to release. Radiation detection equipment and sampling features would be provided at key locations. Protection against inadvertent discharge of noncompliant waste is provided through the detection and alarm systems, and by administrative controls. Waste monitoring tanks are provided with sample ports and with mixing nozzles inside the tank to allow thorough mixing for representative samples. Analysis of samples is used so that treated waste meets recycle and/or release limits. Once it is confirmed that the treated effluent meets discharge requirements, the effluent is released into SCR via the CPNPP Units 1 and 2 circulating water return line. The liquid effluent is released at ambient temperature, as it would be stored inside the auxiliary building waste monitoring tanks during analysis and prior to release.

All of the LWMS holdup, sampling and monitoring, and processing equipment would be located within the auxiliary building (A/B), and served by the building drain system. No discharges other than planned releases from the monitoring tanks are expected. Subsystems and components of the LWMS are not shared between units. The LWMS is designed for individual unit operation; the LWMS for CPNPP Unit 3 is separate from the system for CPNPP Unit 4.

SCR is not used as a source of drinking water. Table 3.12-2 of the CPNPP Off-site Dose Calculation Manual sets a reporting level of 30,000 pCi/L for tritium in SCR (Luminant 2009b). The tritium concentration in SCR is controlled by additions of water from Lake Granbury and from rainfall, and through evaporation of tritium from SCR and release of tritium in water discharged to Squaw Creek at the SCR dam. Luminant reported that releasing all liquid radioactive wastes to SCR during the maximum tritium generation condition (that is, with all four units operating at full power) could lead to tritium concentration levels approaching 30,000 pCi/l in SCR. To prevent exceeding a tritium concentration of 30,000 pCi/L limit in SCR, Luminant plans to divert a portion of the liquid effluent from CPNPP Units 3 and 4 discharge header to an evaporation pond to be constructed within the site boundary. Under the maximum tritium generation condition, up to half of liquid effluent would be diverted into the evaporation pond.

The evaporation pond is designed to provide sufficient surface area for natural evaporation based on the local area rainfall and evaporation rate and on long-term discharge of half the liquid effluent to the pond. The evaporation pond is sized to prevent overflow due to the local maximum rainfall condition. The pond design includes a transfer pump and discharge line that connects into the CPNPP Units 1 and 2 circulating water return line to keep the pond from overflowing during periods of extreme weather conditions. The airborne dose pathway resulting from evaporation of tritium from the pond is evaluated in Section 5.9.

The CPNPP Units 3 and 4 normal effluent discharge header and the evaporation pond discharge lines are connected to the circulating water return line for CPNPP Units 1 and 2 in two locations before the circulating water is discharged into SCR. The locations of the connections are selected to allow sufficient distance for thorough mixing before the liquid is released into SCR.

In the event that both CPNPP Units 1 and 2 are temporarily not in operation, and there is no dilution flow available, the waste holdup tanks (HTs) and waste monitoring tanks are designed to provide capacity to store at least one month of waste input. An evaluation of the need for circulating water from CPNPP Units 1 and 2 as dilution water for liquid effluents from CPNPP Units 3 and 4 is to be performed before Units 1 and 2 are shut down.

The steam generator blowdown (SGBD) monitor measures the radiation level in the SGBD water after it is treated and before it is returned to the condenser. A sample from the SGBD mixed-bed demineralizers is monitored for radiation. Normally, the treated SGBD water would not contain radioactive material. In the event of significant primary-to-secondary system leakage due to an SG tube leak, the SGBD liquid may become contaminated with radioactive material. Detection of radiation above a predetermined setpoint automatically initiates an alarm in the main control room for operator actions and automatically turns off the valve through which treated liquid is sent to the condenser. Plant personnel are required to manually sample the SGBD water for analysis. If it is confirmed that the liquid is contaminated, the liquid would be routed to the LWMS for processing.

The calculated dose to a maximally exposed individual from liquid effluents is evaluated in Section 5.9 of this EIS.

3.4.3.2 Gaseous Radioactive Waste-Management System

The gaseous waste management system (GWMS) is designed to monitor, control, collect, process, handle, store, and dispose of gaseous radioactive waste generated as the result of normal operation, including anticipated operational occurrences. The main sources of plant radioactive gaseous inputs to the GWMS are the waste gases from the volume control tank (VCT), the containment vessel reactor coolant volume drain tank, the boric acid evaporator, and the chemical and volume control system HTs. Because nitrogen is used as a cover gas for the HTs, the gas is returned back to the HT for reuse. Otherwise, the nitrogen gas is treated and discharged. Most of the waste gas entering the GWMS during normal operation is composed of cover nitrogen gas, a small amount of radioactive gaseous isotopes of krypton and xenon, and to a lesser extent hydrogen and oxygen.

The gaseous wastes from the above sources are processed to reduce the quantity of radioactive material prior to release to the environment. During normal operation, radioactive isotopes, including xenon, krypton, and iodine are generated as fission products. A portion of these nuclides are present in the primary coolant due to fuel cladding defects. These nuclides are to be stripped out of the coolant in the VCT and the HTs into the nitrogen cover gas and carried to the GWMS. Charcoal bed adsorbers are designed to control and minimize the release of radioactive nuclides into the environment by delaying the release of the radioactive noble gases. The charcoal bed adsorbers also contain activated charcoal to remove radioactive iodine.

The GWMSs for CPNPP Units 3 and 4 are independent of each other. Processed gaseous waste is further diluted by HVAC ventilation flow before the gases are released from the plant stack for each unit. The plant stack is the only GWMS release point for both the gaseous waste system and the HVAC systems associated with the reactor building (R/B), A/B, power source building, and the access building. The plant stack runs alongside the containment vessel (C/V) with the release point at the same elevation as the top of the containment vessel (Luminant 2009b). Radiation monitors are provided upstream of the discharge valve on the GWMS. The discharge valves would be closed if the radiation set point is exceeded.

Potential dose to a maximally exposed individual from gaseous effluents is evaluated in Section 5.9 of this EIS.

3.4.3.3 Solid Radioactive Waste-Management System

The SWMS for CPNPP Units 3 and 4 are designed to process, package, and temporarily store solid radioactive waste prior to shipment. This system is located in the auxiliary building and is designed to handle spent resin, sludge, oily waste, spent filters, and dry active waste, including contaminated clothing, broken equipment, and maintenance items that cannot be easily decontaminated and reused.

Normally, no effluent would be released from the SWMS. Water removed from the spent resin is transferred via the vacuum pump back to the waste HTs for further processing in the LWMS. Plant makeup water is used for spent resin sluicing. The water extracted from the spent resin dewatering operation does not contain any chemical impurities. It is contaminated with resin fines and also some dissolved nuclides due to the liquid-solid equilibrium phenomenon. The dewatering area is designed with area drainage collection of decontamination water. In the event that spillage occurs or that the waste container drops and spills, decontamination water is available to clean the area. The drainage would be directed to the waste HTs for processing.

The SWMS for CPNPP Unit 3 is completely independent of the SWMS for CPNPP Unit 4. Estimates of expected waste volume generated annually by each wet and dry waste source are given in the Tables 11.4-1 and 11.4-2 in the US-APWR DCD (MHI 2009). Estimates of the volume and classification of packaged solid wastes shipped by each unit are given in Table 11.4-3 in the US-APWR DCD (MHI 2009). Approximately 30,000 ft^3 would be shipped annually to licensed disposal facilities from the two units combined.

A common radioactive waste interim storage facility is provided between Units 3 and 4 and is designed to store classes A, B, and C wastes from all four CPNPP units for up to 10 years. The interim storage facility also includes a separate storage area for mixed waste and temporary staging of large equipment items for maintenance.

3.4.4 Nonradioactive Waste Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for the CPNPP site, including systems for chemical, biocide, sanitary, and other effluents.

3.4.4.1 Effluents Containing Chemicals or Biocides

This section describes the nonradioactive waste systems and the chemical and biocidal characteristics of each nonradioactive waste stream discharged from the plant. It identifies and quantifies each chemical or biocide added to the receiving water by any discharge stream as well as substances added by corrosion and erosion. It compares the discharged quantities and concentrations with applicable effluent limitations and standards. It also describes naturally occurring substances changed in form or concentrated by plant operations with sufficient detail to enable subsequent evaluation of environmental impacts and compliance with applicable water-quality standards.

Luminant plans to use chemicals to treat water in the CSW and the ESWS as described in Table 3-3. Luminant specifies the effluent concentrations in waste water as (a) less than "0.2 ppm residual sodium hypochlorite (NaOCl) or free chlorine," (b) less than 2.2 ppm sulfuric acid (H_2SO_4), (c) "PO_4 or proprietary [ortho-polyphosphate and phosphonate] agent to permit limit, and (d) sodium bisulfite ($NaHSO_3$) "sufficient to reduce residual chlorine to less than 0.2 ppm" (Luminant 2009a).

Luminant reports that total suspended solids (TSS) in the vicinity of DeCordova Bend Dam near the south end of Lake Granbury average 11 mg/L with a range of results from 2 to 120 mg/L. Luminant does not report discharge of TSS. Luminant reports that TDS in blowdown discharged to Lake Granbury would be limited to 2500 mg/L (Luminant 2009a).

3.4.4.2 Sanitary System Effluents

This section briefly describes the anticipated volumes generated during construction or operation and the method for ultimate disposal of treated wastes.

Luminant reports sanitary wastewater generation of about 50 gal per person per 24-hr shift from operations at Units 1 and 2. Overall, they estimate generation of 25,000 to 50,000 gal per day from current operations. During construction of Units 3 and 4, Luminant expects sanitary wastewater generation of up to 100,000 gal per day by construction personnel. Added to the amounts from current operations they estimate a site total of 125,000 to 150,000 gpd. Because the current sanitary wastewater system has a maximum capacity of 90,000 to 100,000 gpd, the Units 3 and 4 sanitary wastewater system would need to be operational before the construction workforce reaches its higher levels. Until the second sanitary wastewater system is operational, portable toilets would be provided for construction workers (Luminant 2009a).

The treated effluent would be discharged directly to SCR without further treatment. The discharged effluent would meet the following effluent limits: (a) pH between 6 and 9; (b) monthly average TSS no more than 20 ppm, daily maximum no higher than 45 ppm; (c) monthly biological oxygen demand no higher than 20 ppm, daily maximum no higher than 45 ppm; and (d) monthly average coliform bacteria count no higher than 200 per 100 mL, daily maximum no higher than 400 per 100 mL.

Digested sludge would be treated with a few pounds per day of lime and ferric chloride before dewatering. The current sanitary wastewater system produces dewatered sludge at a rate of about 90 lb/day (17 ton/year), except during refueling outages when the rate increases to about 330 lb/day. During construction, sludge generation is expected to average 370 lb/day (67 ton/year); 660 lb/day during refueling outages. After the end of construction, sludge generation will average 180 lb/day (33 ton/year); 500 lb/day during refueling outages (Luminant 2010a).

3.4.4.3 Other Nonradioactive Waste Effluents

Gaseous emissions

Luminant reports that each unit would have four emergency gas turbine generators (GTG) and two GTGs for nonemergency situations for alternating current (AC) power sources when power to the site has been lost, two auxiliary boilers, and one internal combustion engine–driven fire pump. All these systems are diesel fueled. During normal operation of the plant, this equipment is primarily used during periodic testing. There would be no treatment of the gaseous emissions from the GTGs or the fire pump.

Six onsite GTG units, each furnished with its own support subsystems, would provide power to the selected plant AC loads. The GTG units would be housed in the emergency power supply building. Each engine's exhaust gas circuit would consist of the engine exhaust gas discharge pipes from the turbocharger outlets to a single vertically mounted outdoor silencer that discharges to the atmosphere at an approximate elevation of 855 ft above mean sea level.

The primary fuel storage for each GTG and its associated transfer pumps would be located in the yard area, below grade within a concrete vault confinement.

The auxiliary boilers would be used to provide auxiliary steam during plant startup and shutdown. The auxiliary steam boilers would be diesel-fired package boilers with storage tanks capable of storing 300,000 gal of oil and day tanks storing 12,000 gal of oil. The auxiliary boiler and associated equipment would be located outside in the yard. The steam converter and associated equipment would be located in the turbine building, and the common equipment would be located in the auxiliary building. The exhaust for the auxiliary boiler and the vent(s) for the auxiliary boiler oil storage tank have not been located at this time.

Two 2500-gpm capacity fire pumps would be provided for each unit. The lead pump would be electric motor driven, and the second pump would be diesel engine driven. The exhaust for the diesel-driven pump and the vent(s) for the diesel storage tank have not been located at this time. The fuel tank for the diesel-driven fire pump would hold enough fuel to operate the pump for at least 2 hr. Table 3-9 summarizes pollutant emissions from the GTGs, the diesel-driven fire pump, the auxiliary boilers, and the fuel storage tanks that support them.

Table 3-9. Average Annual Pollutant Emissions from CPNPP Unit 3 and 4 Stationary Fuel Burning Equipment (Data Values are in Pounds per Year)

Equipment	Hydrocarbons	Carbon Monoxide	Nitrogen Oxides	Sulfur Dioxide	Particulate Matter
Gas turbine generators	87	1719	24,283	1095	260
GTG fuel storage	433	–	–	–	–
Auxiliary boilers	148	2288	3564	9208	1486
Boiler fuel storage	67	–	–	–	–
Fire pumps	–	16	88	–	4
Fire pump fuel storage	0.3	–	–	–	–
Total	735	4023	27,935	10,303	1750

Source: Luminant 2009a and Luminant 2010a

Solid wastes

Nonradioactive solid wastes would include typical industrial wastes such as metal, wood, and paper as well as process wastes such as nonradioactive resins, filters, and sludge. These nonradioactive wastes would be disposed of in a permitted offsite landfill. The proposed project is classified as a small quantity generator of hazardous waste. Solid wastes would be disposed of offsite by contract at a licensed permitted facility. CPNPP Units 3 and 4 are expected to produce similar amounts of waste per year as CPNPP Units 1 and 2. For 2007, Luminant reports nonhazardous waste production for CPNPP Units 1 and 2 of 2.2 million lb; however, the wastes do not include resins, filters, or sludges (Luminant 2009a).

Periodically, the BDTF evaporation ponds would be drained for solids removal. BDTF solids would be disposed of at an offsite nonhazardous landfill. Luminant presents two estimates of the mass of salts that would be produced by BDTF operations—both nuclear units operating—that would need disposal. Luminant's expected case has 391 million pounds (195,500 tons) of dry salt per year. Luminant's maximum case has 831 million pounds (415,500 tons) of dry salt per year. The maximum case is based on the assumption that the water in Lake Granbury has a TDS of 3525 mg/l all year. While the TDS of Lake Granbury occasionally reaches 3525 mg/l, assuming that the TDS would be that high for an entire year is extremely conservative. Luminant's expected case is an appropriate estimate of the dry mass of salt that could be reasonably expected. However, drying salt to a moisture-free condition would require long periods of warm, dry weather or a device in which the brine would be dried by addition of heat. The first would not occur reliably at the CPNPP site, and the second is not part of Luminant's design. For its estimate of solid waste quantities, Luminant provided zero and 20% moisture estimates. At 20% moisture, Luminant's expected case estimate becomes 244,000 tons of salt per year. Luminant reports that no hazardous wastes would be stored on site and that no hazardous wastes would be discharged from the site (Luminant 2009a).

3.4.5 Summary of Resource Parameters during Operation

Table 3-10 provides a list of the significant resource commitments involved in operating Units 3 and 4 that are relevant to more than one resource evaluation. The values in this table, combined with the affected environment described in Chapter 2, provide a part of the basis for the operational impacts assessed in Chapter 5. These values were stated in Luminant's ER (Luminant 2009a) and in its supplemental Request-for-Additional-Information responses, and the review team has determined that the values are reasonable.

Table 3-10. Parameters Associated with Operation of CPNPP Units 3 and 4

Resource Area	Normal Operating Condition	Maximum Condition	Description
Socioeconomics	1494 workers	2694 workers	Normal condition is for four operating plants, with Units 3 and 4 under start-up testing;; Maximum occurs during refueling outages that will require up to 1200 additional workers on site
Terrestrial Ecology, Radiological Health, Socioeconomics	229 ft	229 ft	Height of tallest structure on site (containment building)
Hydrology – Surface Water	300 gpm	300 ac-ft/yr	Potable and sanitary requirements
	63,550 gpm	137,800 ac-ft/yr	Withdrawal from Lake Granbury; Normal condition is for Units 3 and 4; Maximum is for all four units
	26,076 gpm	42,100 gpm	Blowdown return to Lake Granbury; Normal condition is for Units 3 and 4; Maximum is for all four units
Aquatic Ecology	<0.5 fps	0.5 fps	Intake screen approach velocity
Terrestrial Ecology, Socioeconomics, Nonradiological Health	55 dBA	85 dBA	Cooling tower sound level; Normal value is at 1000 ft; Maximum value is at close proximity
Radiological Health, Transportation, Need for Power	4451 MW(t)		Rated and design core thermal power of each UP-APWR unit
	1600 MW(e)		Rated and design net output of turbine-electric generator
	100 MW(e)		Station load per unit
Radiological Health	95 percent		Expected annual capacity factor
Meteorology/Air Quality	55.4 ft	55.4 ft	Height of mechanical draft cooling towers
	9.90×10^9 Btu/hr	9.90×10^9 Btu/hr	Waste heat to atmosphere

Sources: Luminant 2009a and Luminant 2009b

3.5 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

40 CFR Part 141. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 141, "National Primary Drinking Water Regulations."

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Information for Environmental Review Requests for Additional Information GEN-03 and GEN-07," Luminant Docket Nos. 52-034 and 52-035, Luminant Ref No. TXNB-10023, March 19. Accession No. ML100820402.

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4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with building the proposed Units 3 and 4 at the Comanche Peak Nuclear Power Plant (CPNPP) site as described in the application for combined licenses (COLs) submitted by Luminant Generation Company LLC (Luminant) to the U.S. Nuclear Regulatory Commission (NRC). As part of its application, Luminant submitted (1) an Environmental Report (ER) (Luminant 2009a), which discusses the environmental impacts of building, operating, and decommissioning the proposed new nuclear units, and (2) a Final Safety Analysis Report (FSAR) (Luminant 2009b), which addresses safety aspects of construction and operation.

As discussed in Section 3.3 of this environmental impact statement (EIS), the NRC's authority related to building new nuclear units is limited to construction "activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 FR 57416). The NRC has defined "construction" according to the bounds of its regulatory authority. Many of the activities required to build a nuclear power plant do not fall within the NRC's regulatory authority and, therefore, are not "construction" as defined by the NRC. Such activities are referred to as "preconstruction" activities in Title 10 of the Code of Federal Regulations (CFR) Part 51.45(c). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized with the issuance of the COLs. The environmental effects of preconstruction activities (e.g., clearing and grading, excavation, and erection of support buildings) are included as part of this EIS in the evaluation of cumulative impacts.

As described in Section 1.1.3, the U.S. Army Corps of Engineers (Corps or USACE) is a cooperating agency on this EIS consistent with the updated Memorandum of Understanding (MOU) signed with the NRC (Corps and NRC 2008). The NRC and the Corps established this cooperative agreement because both agencies have concluded it is the most effective and efficient use of Federal resources in the environmental review of a proposed new nuclear power plant. The goal of this cooperative agreement is the development of one EIS that provides all the environmental information and analyses needed by the NRC to make a license/permit decision and all the information needed by the Corps to perform analyses, draw conclusions, and make a permit decision in the Corps' Record of Decision (ROD) documentation. To accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC and Corps team (review team). The review team was composed of NRC staff and its contractors and staff from the Corps.

The information needed by the Corps includes information to perform (1) analyses to determine that the proposed action is the least environmentally damaging practicable alternative (LEDPA), and (2) its public interest assessment. To perform the public interest assessment, the Corps considers the following public interest factors: conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, and mineral needs.

Many of the impacts the Corps must address in its LEDPA analysis are the result of preconstruction activities. Also, most of the activities conducted by a COL applicant that would require a permit from the Corps would be preconstruction activities. Luminant has not submitted an application for a permit from the Corps. However, based on the information it has provided to the NRC and the Corps, Luminant is expected to request a permit from the Corps to conduct the following activities: filling, dredging, excavating, grading, removing or destroying vegetation, and building structures.

While both NRC and the Corps must meet the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321, et seq.) (NEPA 1969), both agencies also have mission requirements that must be met in addition to the NEPA requirements. The NRC's regulatory authority is based on the Atomic Energy Act of 1954, as amended (42 USC 2011, et seq.). The Corps' regulatory authority related to the proposed action is based on Section 10 of the Rivers and Harbors Appropriation Act of 1899 (Rivers and Harbors Act) (33 USC 403, et seq.), which prohibits the obstruction or alteration of navigable waters of the United States without a permit from the Corps, and Section 404 of the Clean Water Act (CWA) (33 USC 1344, et seq.), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the Corps. Therefore, the applicant may not commence preconstruction or construction activities in jurisdictional waters, including wetlands, without a Corps permit. The permit would typically be issued following the Corps' evaluation and public feedback in the form of public comments on its draft environmental review. Because the Corps is a cooperating agency under the MOU for this EIS, the Corps' ROD of whether to issue a permit will not be made until after public comment has been received on this NRC/Corps draft EIS and the final EIS is issued.

The collaborative effort between the NRC and the Corps in presenting their discussion of the environmental effects of building the proposed project, in this chapter and elsewhere, must serve the needs of both agencies. Consistent with the MOU, the staffs of the NRC and the Corps collaborated in the (1) review of the COL application and information provided in response to requests for additional information (developed by the NRC and the Corps) and (2) development of the EIS. NRC regulations (10 CFR 51.45(c)) require that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC's analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts, normally presented in Chapter 7. However, because of the collaborative effort between the NRC and the Corps in the environmental review, the combined impacts of construction activities that would be authorized by the NRC with its issuance of COLs and preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC's definition of construction at 10 CFR 50.10(a). Thereafter, both the assessment of the impacts of 10 CFR 50.10(a) construction activities and the assessment of the combined impacts of construction and preconstruction are used in the description and assessment of cumulative impacts in Chapter 7 of this EIS.

In addition to the guidance provided in NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000), the staff utilized the supplemental guidance in Revision 1 of the NRC Staff Memorandum *Addressing Construction and Preconstruction, Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011), to address preconstruction and construction activities and impacts.

For most environmental resource areas (e.g., terrestrial ecology), the impacts are not the result of either solely preconstruction or solely construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction activities. For most resource areas, the majority of the impacts would occur as a result of preconstruction activities.

This chapter is divided into 13 sections. In Sections 4.1 through 4.11, the review team evaluates the potential impacts on land use, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health effects, radiological exposures to construction workers, nonradioactive waste, and applicable measures and controls that would limit the adverse impacts of building the new units. An impact category level—SMALL, MODERATE, or LARGE—of potential adverse impacts has been assigned by the review team for each resource area using the definitions for these terms established in Chapter 1. In some resource areas, for example, in the socioeconomic area where the impacts of taxes are analyzed, the impacts may be considered beneficial and would be stated as such. The review team's determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.11. A summary of the construction impacts is presented in Section 4.12. Citations for the references cited in this chapter are listed in Section 4.13. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10 of this EIS.

The review team's evaluation of the impacts of building CPNPP Units 3 and 4 draws on information presented in Luminant's ER and supplemental documents, the Corps' permitting documentation, and other government and independent sources.

4.1 Land-Use Impacts

This section provides information on land-use impacts associated with site-preparation activities (preconstruction) and construction of the proposed Units 3 and 4 at the CPNPP site. The breakdown of activities into construction and preconstruction categories and their associated impacts are provided in Section 4.12 of this EIS. Topics discussed in this section include land-use impacts at the site and in the vicinity of the site and in transmission line right(s)-of-way (ROWs) and offsite areas.

4.1.1 The Site and Vicinity

Proposed Units 3 and 4 would be located northwest of existing Units 1 and 2. The proposed locations for Units 3 and 4 and all supporting facilities are entirely within the existing CPNPP site. As described by Luminant, erection of the new units would disturb approximately 675 ac of land on the site for permanent structures and temporary laydown areas, including approximately 123 ac for Units 3 and 4, 152 ac for the proposed cooling towers, and about 400 ac for a Blowdown Treatment Facility (BDTF) and associated evaporation ponds (Luminant 2009a). Of the 675 ac disturbed in building the project, about 125 ac would be landscaped or revegetated once the construction and preconstruction activities are complete, leaving approximately 550 ac occupied by permanent structures or supporting facilities (Luminant 2009a).

Approximately 7 ac of prime farmland at the CPNPP site would be permanently converted to industrial use to accommodate new Units 3 and 4, mostly in previously disturbed areas (Luminant 2009a). The review team overlayed the BDTF construction footprint on a map of prime farmland (Luminant 2009a) and estimated that approximately 154 ac of prime farmland would be converted to industrial use in the area of the BDTF. No agricultural activities currently take place in either area. The total of 161 ac of prime farmland that would be affected represents approximately 15.1 percent of the 1064 ac of prime farmland on the CPNPP site and approximately 0.1 percent of the 144,425 ac of prime farmland in the project vicinity (Luminant 2009a). Most of the 152-acre area affected by the proposed cooling towers is covered by evergreen forest that would require clearing. As discussed in more detail in Section 4.3.2.1 of this EIS, site disturbance activities would permanently fill approximately one-half of a small littoral wetland area covering approximately 0.78 ac. Land use on the CPNPP site is not subject to any municipal, county, or state land use plans or zoning ordinances. No construction and preconstruction activities would take place within a 100-yr or 500-yr floodplain (Luminant 2009a).

Construction equipment and reactor components would be transported to the CPNPP site using Farm-to-Market (FM) Road 56 and an existing railroad spur. Existing roadways onsite would be improved to support the delivery of fabrication materials, and a new heavy haul road would be built to link the railroad spur to the construction site for Units 3 and 4, a distance of approximately 1.1 mi (Luminant 2009a). Section 4.4.1.3 of this EIS states that the increased traffic could have noticeable physical impacts on roads, especially on FM Road 56, and Section 4.4.4.1 concludes that traffic flow on FM Road 56 would be noticeably affected by traffic associated with building the proposed Units 3 and 4. Development of Units 3 and 4 would be expected to produce limited offsite land-use changes in the vicinity, primarily as a result of the need to provide additional short-term housing to accommodate construction workers. Impacts on roads, housing, and infrastructure are described in Section 4.4 of this EIS. While most of the material excavated in building Units 3 and 4 will be used as fill material on-site, some material may be transported off-site for disposal in a construction/demolition landfill or in a state-permitted landfill. Conversely, some fill material for the project may be brought onto the site from off-site locations (Luminant 2009a). It is not expected that the demands for fill or for fill disposal capacity would substantially add to the cumulative demand for these resources. Noise and dust generated by construction and preconstruction activities would have minor effects on the residential area adjacent to the western boundary of the CPNPP site; however, these effects are not expected to be sufficient to lead to changes in the land use of the area.

The impacts of the proposed activities on land use would be limited to the clearing and occupation of forested and other naturally vegetated areas and lands designated as prime farmland, as well as impacts approximately half of a small area (0.78 ac) of wetlands (discussed further in Section 4.3.2.1). The forested areas affected are typical of the vicinity and the region. The designated prime farmland is not currently used for agriculture and, due to its situation within the current site boundaries of the CPNPP, has low potential for future agricultural use. Thus, no mitigation for impacts to onsite forested areas or prime farmlands would be warranted. Measures to mitigate impacts to onsite wetlands are discussed in Section 4.3.2.5 of this EIS.

Based on information provided by Luminant and the review team's independent review, the review team concludes that the combined land use impacts of construction and preconstruction activities on the CPNPP site would be SMALL, and no further mitigation would be warranted. Based on the above analysis, and because the NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the land-use impacts of NRC-authorized construction would also be SMALL.

4.1.2 Transmission Line and Pipeline Right(s)-of-Way and Offsite Areas

Texas law (Texas Statutes, Utility Code, Section 39.051) requires that entities that transmit and distribute electrical power be legally separate from those responsible for generating the power. Power generated by CPNPP Units 3 and 4 would be transmitted along transmission lines owned, operated, and maintained by Oncor Electric Delivery System LLC (Oncor). As depicted on Figure 2-13, the proposed new transmission lines include five 345-kV circuits. Three of the proposed new transmission lines would use vacant circuit positions on tower structures of existing transmission lines and would require no additional ROWs (or widening of ROWs):

- a 22-mi circuit between the onsite switching station and the Johnson Switch 345-kV switching station in Johnson County,
- a 22-mi circuit between the Johnson Switch switching station and the Everman 345/138-kV switching station in Tarrant County, and

- a 42-mi circuit between the onsite switching station and the Parker 345-kV switching station in Parker County.

The remaining two new transmission lines would follow new routes that would require acquiring and clearing a new ROW and erection of new towers. These lines include

- a 45-mi circuit from the onsite switching station to the Whitney 345-kV switching station in Bosque County and
- a 17-mi circuit from the onsite switching station to the DeCordova 345-kV switching station in Hood County.

Figure 2-13 indicates general corridors for the two proposed transmission lines on a new ROW. Specific locations for these transmission circuits would be determined through a Routing Study Process conducted by Oncor and reviewed by the Public Utility Commission of Texas (PUCT). The PUCT considers several factors, including environmental integrity, when reviewing each application for a certificate to construct a transmission line (Texas Statutes, Utilities Code, Sect. 37.056, 2003, 2007). The utility applicant (which for the transmission lines would be Oncor) must give notice of its intent to secure a certificate to neighboring municipalities and affected property owners and may be required to hold a public meeting (Public Utilities Commission of Texas (PUCT), Procedural Rule, Sect. 22.52(a), 2003, 2009). The utility applicant must also reasonably consider a route for the proposed transmission line that would moderate the impact on the affected community and landowners (PUCT, Substantive Rule, Sect. 25.101(b)(3)(B), 2003, 2009). Procedures for this Routing Study Process call for identifying areas from which transmission lines are excluded or where they should be avoided.

While Oncor has not yet determined the exact routes for the proposed new transmission lines, land use in and around the corridor locations shown on Figure 2-13 is typical of the affected region. The typical ROW width for Oncor’s 345-kV transmission lines is 160 ft; hence it is reasonable to assume that the width for the routes ultimately selected for the two new ROWs would be 160 ft.

A representative transmission line route within the proposed DeCordova corridor would require approximately 149 ac of new ROW, of which approximately 108 ac is covered by grassland, 11 ac by water, 11 ac by open development, and 10 ac by deciduous forest, 3 ac by evergreen forest, 2 ac by woody wetlands, 1 ac by high density development, 1 ac by pasture, 1 ac by barren land, and 1 ac by other uses (Luminant 2009a). The line would pass near the AES Corporation’s Wolf Hollow natural-gas-fired, combined-cycle power plant and three residential subdivisions off Mitchell Bend Court in Hood County, but would not interfere with these land uses. Approximately 82 to 90 new steel lattice tower structures would be required for this line, each requiring foundation excavations (Luminant 2009a).

A representative transmission line route within the proposed Whitney corridor would occupy approximately 954 ac including approximately 550 ac of grassland, 176 ac of deciduous forest, 137 ac of evergreen forest, 36 ac of pasture, 23 ac of woody wetlands, 20 ac of open development, 8 ac of cropland, 3 ac of water, and 1 ac of low-density development (Luminant 2009a). The corridor location as currently shown would pass very close to Dinosaur Valley State Park, possibly encroaching on its western boundary. The corridor location as currently shown would also cross the Fossil Rim Wildlife Center. The introduction of a large transmission line supported by steel lattice towers could noticeably reduce the suitability of the state park and wildlife center for their current recreational uses. The proposed Whitney transmission circuit would require approximately 216 to 238 steel lattice tower structures. Each structure would require foundation excavations (Luminant 2009a).

In addition to transmission line impacts, offsite land use in the vicinity would be affected by installation of proposed water intake and discharge structures on Lake Granbury and new pipelines connecting these structures to the CPNPP (see Figure 2-5). The new water intake structure would be built adjacent to the existing intake point. The surrounding residential area could experience some noise and dust during installation, but this effect would be minimized because most disturbances would take place at the base of a steep embankment, whereas the residences are situated atop the embankment. The proposed discharge point would be built at the edge of a low-density residential area adjacent to an existing switchyard. The process of building the proposed water intake and discharge structures would not produce impacts sufficient to result in changes in the use of nearby lands.

Two 42-in. water intake pipelines would carry water from Lake Granbury to CPNPP Units 3 and 4, and two 42-in. (one for each unit) discharge pipelines would return water to the lake. The total length of the pipelines would be approximately 13 mi, with approximately 7.5 mi being outside the CPNPP site. Outside the CPNPP site the intake pipelines would parallel existing pipelines that support CPNPP Units 1 and 2. The discharge pipelines would follow the same route for most of its length but would diverge onto a new location for approximately 1.4 mi to connect to the proposed discharge structure in Lake Granbury. All the new pipelines would be located within an existing 50-ft ROW, which encompasses 50 ac, including approximately 31 ac grassland, 6 ac deciduous forest, 6 ac open development, 4 ac evergreen forest, 1 ac low-intensity development, and 1 ac other land covers. Building activities in this corridor would be expected to temporarily disturb another 64 ac of land adjacent to the ROW , also consisting mostly of grassland with patches of forest. The 64 ac would only be required temporarily and would be available for other land uses once the new pipelines are installed.

The pipeline route would transect two low-density residential areas, in one case cutting through lawn area and in the other following an existing street. In addition, the route would cut through the parking area of a convenience store/gasoline station, possibly disrupting access to the business.

Based on information provided by Luminant and Oncor and the review team's independent review, the review team concludes that land-use impacts of construction and preconstruction activities associated with transmission lines and offsite pipelines would be MODERATE. This conclusion is based primarily on the fact that one of the proposed transmission line corridors (the Whitney corridor) may pass through or close to the edge of Dinosaur Valley State Park and because development of pipelines and transmission lines could sever tracts of public and private property, including Fossil Rim Wildlife Center, and permanently interfere with land uses on some of those tracts. Potential mitigation measures to reduce these impacts could include designating Dinosaur Valley State Park and all areas visible from the park along with the Fossil Rim Wildlife Center property as exclusion areas for the routing study that must be conducted for the proposed Whitney circuit. In addition, temporary impacts to the convenience store/gasoline station affected by installation of the proposed water intake and discharge pipelines could be minimized through mitigation measures such as minimally intrusive construction practices and scheduling. With application of the mitigation measures outlined above, the land use impacts would be much less noticeable.

NRC's 2007 Limited Work Authorization (LWA) rule (10 CFR 50.10 (a)(2)) specifically states that transmission lines are not NRC-authorized construction activities. Additionally, the pipeline that supplies makeup water to the proposed new units would be preconstruction and therefore not part of the NRC-authorized activities. The NRC staff therefore concludes that land-use impacts from NRC-authorized activities would be SMALL and no mitigation would be warranted.

4.2 Water-Related Impacts

Water-related impacts involved in building a nuclear power plant are similar to impacts that would be associated with any large industrial construction project, and not much different than those seen during the building of CPNPP Units 1 and 2. Prior to initiating site preparation or other site work, Luminant would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. These authorizations would likely include the following:

- CWA Section 404 Permit. This permit would be issued by the USACE, which governs impacts of construction activities on wetlands or waters of the United States and management of dredged material.
- CWA Section 401 Certification. This certification would be issued by the Texas Commission on Environmental Quality (TCEQ) and ensure that the project does not conflict with State water-quality management programs.
- CWA Section 402(p) National Pollutant Discharge Elimination System (NPDES) construction and industrial stormwater permits. These permits would regulate point-source stormwater discharges. The U.S. Environmental Protection Agency's (EPA's) stormwater regulations have established requirements for stormwater discharges from various activities including construction activities. The EPA has delegated the authority for administering the NPDES program in the state of Texas to the TCEQ, which issues Texas Pollutant Discharge Elimination System (TPDES) permits. The stormwater management system would be required to comply with TPDES General Permit TXR150000 (Luminant 2009a).

In addition to the above permit requirements, Luminant has committed to design the stormwater management system in accordance with *Edwards Aquifer Technical Guidance on Best Management Practices* (TCEQ 2009), the Texas Department of Transportation *Hydraulic Design Manual*, (TxDOT 2004).

4.2.1 Hydrological Alterations

This section (1) identifies and describes proposed preconstruction and construction activities, including site preparation, plant construction, clearing transmission corridors and building transmission lines, and offsite building activities that could result in hydrologic alterations; (2) describes and analyzes the resulting hydrologic alterations and the physical effects of these alterations on other water users; (3) analyzes the practices proposed to minimize hydrologic alterations having adverse impacts; and (4) assesses compliance with applicable Federal, State, regional, local, and affected Native American tribal standards and regulations.

Building of Units 3 and 4 would result in permanent structures occupying about 275 ac on the 7950-ac CPNPP site to the west and northwest of Units 1 and 2. This includes approximately 123 ac of disturbance for the power plant and approximately 152 ac for the cooling towers. An additional 400 ac would be disturbed for a cooling tower BDTF to the southwest of the Squaw Creek Reservoir (SCR) Dam. Additional areas would be disturbed to build pipelines from the proposed intake structure on Lake Granbury to the proposed Units 3 and 4, pipelines proposed for discharge of treated blowdown water and cooling water to underwater diffusers on Lake Granbury, and pipelines from the cooling towers to the power block area. Building of infrastructure such as roads and stormwater drainage systems, and a potable water supply line from the CPNPP property boundary to the plant site is also expected to result in additional disturbance. Larger areas of the site would be subject to temporary disturbance for laydown yards, temporary buildings, parking areas, and other temporary uses. Much of the building activity for CPNPP Units 3 and 4 would occur in areas in which building activity has previously occurred and stormwater drainage systems and roadways already exist.

Site preparation and the building of the power plant would require the removal and redistribution of several hundred cubic yards of rock and overburden soil material, including the removal of an existing structure, an existing Class II landfill, a foundation, and paved areas and the relocation of an onsite rail line.

Potential erosion and sedimentation from these activities would be controlled using appropriate best management practices (BMPs), as specified by Luminant (2009a) to be included in its Stormwater Pollution Prevention Plan (SWPPP). These controls may include vegetative buffer zones, silt fencing, straw bales, slope breakers, and other soil-erosion-prevention measures, as well as diversionary channels to sedimentation basins. Stormwater retention ponds, which would be designed to accommodate the larger of either the surface water runoff from a 2-year, 24-hr storm or a minimum of 3600 ft^3 per acre drained, would be designed and built to allow sediment-laden water from dewatering activities to pass through ponds prior to discharge. Any effects to SCR and other receiving waters that might occur from site-disturbing activities would be temporary and minor due to the implementation of appropriate stormwater BMPs.

As a result of grading, soil compaction, and creation of impervious surfaces (such as paved areas and roofs), the building of the new units is likely to increase the volume of site stormwater runoff compared with pre-existing conditions. Final site grading would be designed to ensure that runoff would drain away from safety-related structures via drainage channels or sheet flow and subsequently to SCR through catch basins or as unobstructed overland flow. Sedimentation basins would be designed to accommodate flow from a 100-year, 24-hr storm event during facility operations (URS 2008). Any effects to SCR or other receiving waters resulting from increased runoff would be minor, due in part to the implementation of these measures.

Installation of a raw water intake structure for CPNPP Units 3 and 4 adjacent to the existing intake structure on Lake Granbury would require dredging that could lead to a temporary increase in turbidity in the lake. No riprap installation or other measures are expected to be required to stabilize the banks of the lake during and following installation of the new intake. Activities directly affecting Lake Granbury would be subject to regulation by the TCEQ and the USACE, and impacts would be minor and temporary.

The two wetland areas near the proposed site of the cooling towers would not be directly disturbed but could possibly be affected by sediment runoff. Sedimentation basins and other engineering controls would be used to limit any adverse effects to the wetlands, so any impacts to wetlands would be minimal. There would be no direct impact on floodplains, as no portions of the proposed CPNPP Units 3 and 4 site and the pipeline corridor between Lake Granbury and the CPNPP site are within 100- or 500-year floodplains (Luminant 2009a).

No new offsite roads would be required to support the building of CPNPP Units 3 and 4, so there would be no hydrologic alterations for offsite road construction.

The building of CPNPP Units 3 and 4 would not affect the availability or quality of groundwater beyond the site. Undifferentiated fill material, regolith, and bedrock beneath the CPNPP Units 3 and 4 site would be removed and replaced with engineered fill material (Luminant 2009b). At the nuclear island, excavations would extend below the perched water table, but experience during the building of CPNPP Units 1 and 2 indicates there would be minimal need to pump groundwater to dewater excavation areas in order to build Units 3 and 4 (Luminant 2009a). Standard sump pumps would be used for excavation dewatering, as needed, and, but collected water would periodically be removed from excavations and directed to a stormwater retention basis to remove sediment before discharging the water to SCR (Luminant 2009a and Luminant 2009b). Final site grading and drainage would be designed to minimize infiltration and avoid the development of perched groundwater conditions.

Based on these factors, hydrological alterations from construction and preconstruction activities would have only minor impacts on water resources.

4.2.2 Water Use Impacts

This section describes, analyzes, and assesses the proposed project construction and preconstruction activity impacts on water use. It includes identification of the proposed construction and preconstruction activities that could have impacts on water use and analysis and evaluation of proposed practices to minimize adverse impacts on water use.

4.2.2.1 Surface Water Use Impacts

Surface water for use in building CPNPP Units 3 and 4 would be obtained from the Somervell County Water District (SCWD) via a pipeline from Wheeler Branch Reservoir. Water would be used for activities such as fire protection and concrete batch plant operation. Building activities for the proposed project's facilities are estimated to require an average of 300 gpm and a maximum of 1300 gpm (Luminant 2009a) during working hours. Additional water would be supplied from SCWD for potable water for domestic and sanitary needs. Potable and sanitary water requirements are estimated to total 12,900 gpd. A total volume of 200,560 gpd (225 ac-ft/yr) would be obtained from Wheeler Branch Reservoir. This is 11.3 percent of this reservoir's available annual supply and less than the 300 ac-ft/yr volume allocated to Luminant (Section 2.3.2.1), so the impacts to other SCWD water users would be minimal. Impacts of the withdrawal on stream flow in the Paluxy River (which supplies Wheeler Branch Reservoir) would also be minimal, as the withdrawal volume would be equivalent to just 0.3 percent of the mean annual flow and 5 percent of lowest recorded annual flow in the Paluxy River at Glen Rose. Water for dust suppression and general cleanup would be withdrawn from SCR, with average and maximum requirements estimated at 22 and 44 gpm, respectively. At an average withdrawal rate of 22 gpm, withdrawals from SCR would total 35 ac-ft/yr, which would result in a minimal impact compared with the consumptive use of nearly 20,000 ac-ft/yr of SCR water by Units 1 and 2 in 2006 and the discharge of more than 21,000 ac-ft/yr from SCR dam that same year (Section 2.3.2.1). CPNPP is the only consumptive user of water from SCR. There are no other users that depend upon water availability from SCR.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the surface water use impacts of construction and preconstruction activities would be SMALL, and no further mitigation would be warranted. In addition, the NRC staff concludes the surface water use impacts of NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.2.2.2 Groundwater Use Impacts

There would be no groundwater use during construction of CPNPP Units 3 and 4 beyond current limited onsite withdrawals (Luminant 2009a). As a result, there would be no impacts from groundwater use. Based on this information and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the groundwater use impacts of construction and preconstruction activities would be SMALL, and no further mitigation would be warranted. Therefore, in addition, the NRC staff concludes the groundwater use impacts of NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.2.3 Water Quality Impacts

Water quality impacts for construction and preconstruction activities would be similar to those for other large industrial construction projects. Soil erosion and disturbance of sediments could result in increased turbidity in surface waters. Spills of fuels and lubricants from construction equipment could contaminate surface water and groundwater.

4.2.3.1 Surface Water Quality Impacts

Activities that could impact surface water quality include site clearing for buildings, roads, and drainage systems and construction of water supply lines, buildings, parking lots, roads, cooling water intake and discharge structures, the BDTF, retention and evaporation ponds, and temporary construction laydown areas. Some excavations are expected to extend below shallow/perched groundwater by 5 to 15 ft; dewatering effluents from these areas would be directed to a stormwater retention (sedimentation) basin. The sedimentation basin that would be used for stormwater drainage during the building process would be designed to accommodate runoff from a 2-year, 24-hr storm or would provide 3600 ft^3 of storage per acre drained, whichever is greater.

A circulating water blowdown evaporation pond would be built onsite to receive effluent from operation of the BDTF. It would have a surface area of approximately 130 ac and a depth of 4 ft. In addition, a 3-mo storage pond measuring 48 ac by 20 ft deep would be built adjacent to the evaporation pond to maintain an acceptable water level in the evaporation pond. Both ponds would be constructed with geomembrane liners and clay soils and would contain drain systems to detect and collect potential seepage.

Building of the power plant is expected to affect 123 ac of a previously disturbed area of the 7950-ac site. In addition, site preparation for the cooling towers would entail the stripping of vegetation and earthmoving activities on about 152 ac of previously undisturbed land. The BDTF would be built on 384 ac of largely undisturbed land. Because most permanent structures associated with CPNPP Units 3 and 4 would be located on a peninsula extending into SCR, runoff from the disturbed areas would have the potential of impacting water quality in that reservoir. In addition, increased turbidity and sedimentation would occur in Lake Granbury from dredging and installation of intake and discharge structures for the cooling water system.

Vegetation removal and site grading would lead to soil erosion by wind and rainstorms. Vegetation removed in land clearing would be disposed of by chipping/mulching to create mulch that would be spread on the construction area to minimize soil erosion. However, unless intercepted and treated, stormwater runoff would increase turbidity and sedimentation to SCR and Lake Granbury. To reduce the amounts of suspended sediments entering these water bodies, stormwater flows would be directed to settling ponds. The ponds would be designed to accommodate runoff from a 2-year, 24-hr storm or provide 3600 ft^3 of storage per acre drained, whichever is greater. Discharge from the settling ponds would be directed to SCR.

Application of excessive quantities of mulch could result in elevated levels of nutrients and other chemicals in stormwater runoff due to decay of the vegetative material or leaching of chemical binders added to the mulched vegetation waste. If the quantity of vegetation removed by land-clearing exceeds the quantity that can be effectively used in stabilizing the site, potential impacts could be reduced by stockpiling excess mulch for future onsite use or transferring it offsite for other uses, such as erosion control for highway construction projects.

Impacts would be controlled by implementation of a construction SWPPP as required by the TPDES General Permit Relating to Construction Activities (General Permit). BMPs to control runoff may include vegetative buffers, silt fencing, and sedimentation basins.

Because hydrological alterations resulting from site preparation and building activities would be localized and temporary; disturbed land would be stabilized to prevent erosion; and permits, certifications, and the SWPPP require the implementation of BMPs to minimize impacts, the review team concludes that the surface water quality impacts of construction and preconstruction activities would be SMALL, and no mitigation beyond the BMPs would be warranted. In addition, the NRC staff concludes the surface water quality impacts of NRC-authorized construction activities would be SMALL, and no mitigation beyond the BMPs would be warranted.

4.2.3.2 Groundwater Quality Impacts

The SWPPP will include provisions for spill prevention, as well as detection and cleanup of leaks and spills. Therefore, its implementation would reduce the potential for leaks and spills. Shallow groundwater flow within the site is towards SCR (see Figure 4-1), such that any contamination entering shallow groundwater in the onsite fill or Glen Rose Formation due to leaks and spills would migrate toward SCR. Contamination reaching SCR through shallow groundwater would combine with surface water contamination and would be similarly diluted. Any shallow contamination of the perched Glen Rose Formation would not adversely affect groundwater users because this groundwater is not used for water supply. The review team concludes that the groundwater quality impacts of construction and preconstruction activities would be SMALL, and no further mitigation beyond the BMPs for spills would be warranted. The NRC staff also concludes that the impacts of NRC-authorized construction would be SMALL, and no further mitigation would be warranted.

4.2.4 Hydrological Monitoring

Luminant states in the ER that it would incorporate BMPs into a site-specific SWPPP and monitor stromwater discharges associated with the construction and preconstruction activities according to TPDES requirements and state water quality standards (Luminant 2009a). The SWPPP is required to be implemented before starting construction and pre-construction activities (TCEQ 2008).

4.3 Ecological Impacts

This section describes the potential impacts to ecological resources from building and preconstruction activities related to CPNPP Units 3 and 4. The section is divided into two subsections: terrestrial impacts and aquatic and wetlands impacts.

4.3.1 Terrestrial Impacts

This section provides information on the potential impacts to terrestrial ecological resources from preconstruction and construction of proposed Units 3 and 4 at CPNPP. The discussion in Section 4.3.1.1 addresses the CPNPP site and vicinity. Section 4.3.1.2 discusses terrestrial ecosystem impacts associated with building new transmission lines as well as installation of new water intake and discharge pipelines. Topics discussed include erosion and sedimentation control, sensitive resources, spill prevention and response, and construction-related noise.

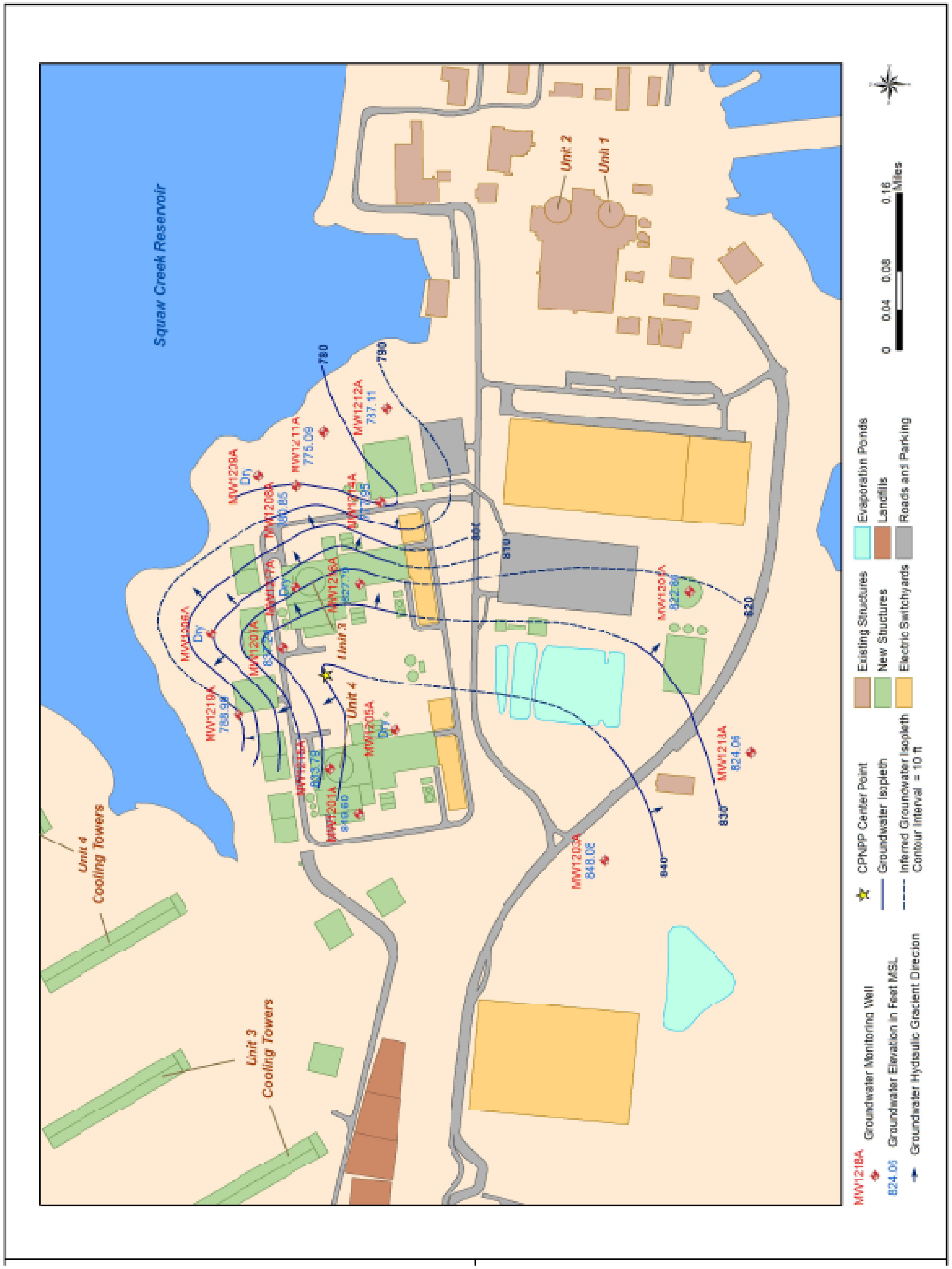

Figure 4-1. Potentiometric Map Showing Groundwater Isopleths and Flow Directions Beneath the CPNPP Site. (Luminant 2009a)

4.3.1.1 Terrestrial Resources – Site and Vicinity

Wildlife Habitat

Overview

Approximately 675 ac on the CPNPP site would be physically disturbed by construction and preconstruction activities associated with Units 3 and 4. Approximately 275 ac of the disturbance would be to accommodate the proposed reactors units, switchyard, cooling towers, and other centralized facilities (Central Project Area, see Figure 4-2 and Table 4-1); and approximately 400 ac of the disturbance would be to accommodate the BDTF (BDTF Area, see Figure 2-5). After the proposed facilities are built, approximately 125 of the disturbed acres would be revegetated; and the remaining 550 ac would be permanently occupied by various project structures and pavement (Table 4-1). However, approximately 105 ac of the 550 ac of permanent impacts constitute former laydown areas from development of Units 1 and 2 that currently provide little ecologically valuable habitat (Luminant 2009a).

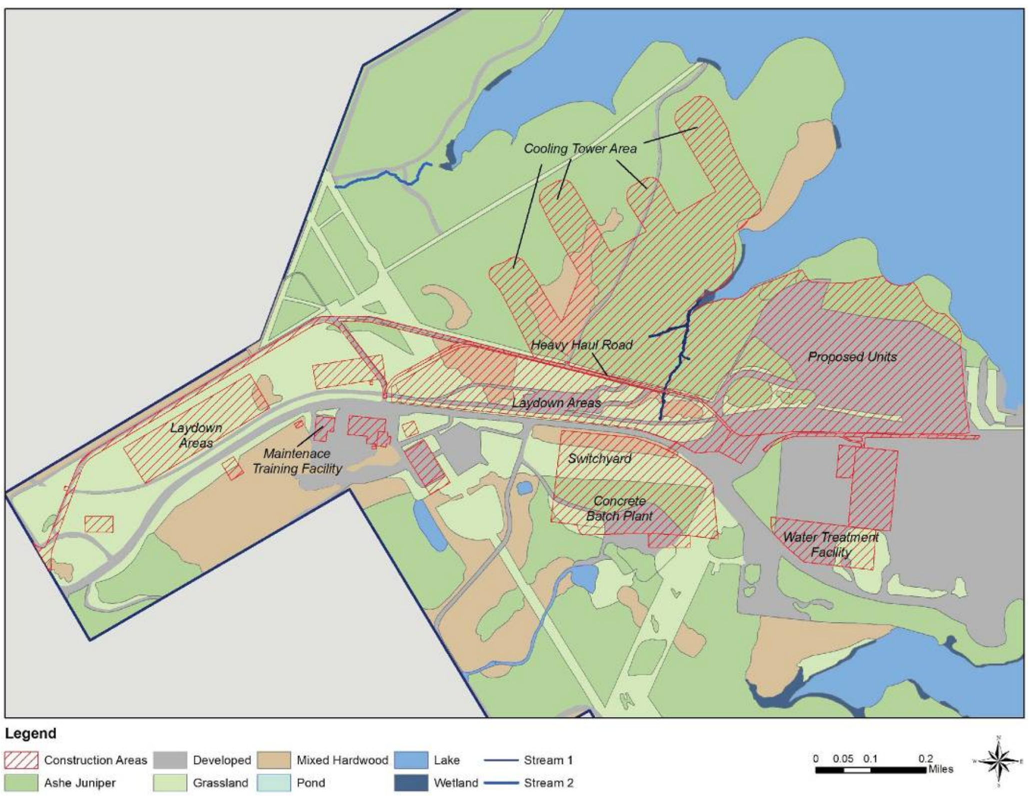

Figure 4-2. Ecological Cover Types Within Development Footprint (Luminant 2009a). Note: This Map Does Not Show the Development Footprint for the BDTF

The net permanent loss of 445 ac of natural terrestrial habitat (without a history of past disturbance from building Units 1 and 2) would affect only about 10 percent of the natural habitat available on the site. The maximum area of soil that would be disturbed on the site at any time would be 675 ac. Most habitat losses would take place during preconstruction activities, that is, after the land was cleared but before construction of safety-related facilities was initiated.

Table 4-1. Acres of Habitat Types Before and After Construction and Preconstruction at the CPNPP Site that Would Be Affected by Development of Units 3 and 4

Habitat Types	CPNPP Site Before Development	CPNPP Site After Development	Acres Lost Entire Project	Acres Lost Central Area Only	Acres Lost BDTF Only
Ashe juniper forest	3071	2658	413	100	313
Mixed hardwood forest	528	465	63	18	45
Grassland	698	604	94	60	34
Open Water (SCR)	3125	3125	0	0	0
Wetland	53	52.6	0.4	0.4	0
Developed and Previously Disturbed	499	394	105	97	8
Acres Disturbed - New Project		675[(a)]	675	275	400
TOTAL	7974[(b)]	7974[(b)]			

(a) This number includes 125 ac of grassland to be restored on disturbed areas following development.

(b) Total differs from 7950 ac reported elsewhere in Luminant ER; the difference is assumed to be due to rounding error.

Source: Compiled from information in Luminant (2009a)

Minimizing Impacts

BMPs would be employed to minimize impacts from erosion, sedimentation, and fugitive dust to areas surrounding the building activities zone. A site-specific SWPPP would be developed and followed to minimize areas to be disturbed by phasing land clearing, protecting vegetated buffers, and employing temporary and permanent seeding to promote soil stabilization. Construction and preconstruction mitigation measures to avoid impacts to stream and riparian areas, where possible, would be described in the SWPPP (Luminant 2009a).

Native grasses would be reintroduced in disturbed areas through seed broadcasting as allowed in accordance with required security measures for the site. Native grasses are the preferred cover for most disturbed areas and promote biodiversity. The Texas Parks and Wildlife Department (TPWD) supports the use of seed mixes containing the native grasses buffalograss (*Bouteloua dactyloides*) and blue grama (*Bouteloua gracilis*) in landscaped areas to establish low maintenance turf grass cover. For less intensively managed areas, TPWD encourages more diverse native grass seed mixes containing those two species along with other native grass species such as green sprangletop (*Leptochloa dubia*), curly mesquite (*Hilaria berlangeri*), Indiangrass (*Sorghum nutans*), little bluestem (*Schizachyrium scoparium*), prairie wildrye (*Elymus canadensis*), Texas cupgrass (*Eriochloa sericea*), sand dropseed (*Sporobolus cryptandrus*), sand lovegrass (*Eragrostis trichodes*), cane bluestem (*Bothriochloa barbinodis*) and sideoats grama (*Bouteloua curtipendula*) (TPWD 2010a). However, in some situations native grasses are not the optimal choice for revegetation due to high erosion probability and/or seasonal conditions or along fence lines for reasons of security due to blocking view of possible intruders. In these areas improved grasses such as rye grass (*Lolium* spp.) would be added to native buffalograss (*Bouteloua dactyloides*) and used to quickly establish cover of disturbed areas. Where practical, natural regeneration of native grasses would be allowed in areas where improved grasses were used to control erosion. In some places native shrubs and trees would be replanted according to a revegetation and/or landscaping plan for the facility (Luminant 2009a). Undesirable and/or invasive species would be controlled through measures identified in a Wildlife Management Plan currently under review by the TPWD as part of the Clean Texas Program (Luminant 2009a).

Types of Habitat Affected

Central Project Area. Expected effects from preconstruction and construction activities in the central project area would include temporary and long-term alteration and loss of vegetative cover, loss of wildlife habitat, increased erosion, and increased interaction between humans and wildlife. As indicated in Table 4-1, within the central project area approximately 100 ac of Ashe juniper woodland - savanna (about 3 percent of that presently onsite), 18 ac of mixed hardwood forest (about 4 percent of that onsite), and 60 ac of grassland (about 9 percent of that onsite) would be disturbed by project development (Luminant 2009a). In the central project area, 0.4 ac of wetlands would be disturbed; wetland impacts are described in Section 4.3.2.1. The remaining acreages of all cover types in the central project area are in areas previously disturbed by development of CPNPP Units 1 and 2 (Luminant 2009a).

Much of the central project area was once used as a large temporary parking lot during construction of the existing CPNPP Units 1 and 2. The area of the former parking lot is a relatively low-quality wildlife habitat lacking the vertical layering of vegetation that favors wildlife diversity. It is occupied primarily by small mammals, ground-nesting birds, and common reptiles (Luminant 2009a). The cooling towers that would support proposed CPNPP Units 3 and 4 would be located on a largely undeveloped peninsula that extends into SCR immediately northwest of the core area of the site. About 152 ac on the peninsula would be disturbed. The peninsula is presently covered primarily by Ashe juniper woodland - savanna and to a lesser extent by mixed hardwood forest. Ashe juniper (*Juniperus ashei*) is an aggressive native woody species that has expanded its range since European settlement due to overgrazing of livestock and fire suppression (Sullivan 1993). Ashe juniper stands lack vertical structure and have low species diversity, making them less valuable habitats than other types of woody vegetation; the mixed hardwood forest in the central project area is more valuable as wildlife habitat (Luminant 2009a).

BDTF Area. Developing the BDTF would permanently affect approximately 400 ac (Table 4-1) (Luminant 2009a). Approximately 313 ac of Ashe juniper woodland - savanna (about 10 percent of that presently onsite), 34 ac of grassland (about 5 percent of that onsite), 45 ac of mixed hardwood (about 9 percent of that onsite), and 8 ac of developed and previously disturbed area have been identified within the 400-ac BDTF area that would be affected by development (Luminant 2009a).

Wildlife Habitat Summary

Development areas shown on Figure 4-2 contain no old growth timber, unique or sensitive plants, or unique or sensitive plant communities. Because the vegetation communities within the CPNPP boundary are common throughout Somervell and Hood counties, the affected terrestrial habitats would be a small percentage of the total acreage of these cover types in the vicinity (less than 2 percent of any cover type in the vicinity, as demonstrated in Table 4-2). Onsite building activities would not noticeably reduce the local diversity of plants or plant communities or associated wildlife.

Construction and preconstruction of CPNPP Units 3 and 4 would comply with Federal and State regulations, permit conditions, existing procedures, and established BMPs. Development and support areas shown on Figures 4-2 and 2-5 contain no unique or sensitive plants or unique or sensitive plant communities. Plants and wildlife found in less disturbed habitats on or near the CPNPP site commonly occur throughout north-central Texas. Because the vegetation communities within the CPNPP boundary are common throughout Somervell and Hood Counties, the wildlife habitat to be disturbed during preconstruction and construction, which would total about 10 to 15 percent of that available onsite and only about 0.5 percent of that in the general vicinity. More than about 1.6 percent of any individual type of wildlife habitat would be lost from the vicinity. Building and operating the new facilities at the CPNPP site are not expected to noticeably impact local movement patterns of wildlife. Development activities onsite would not noticeably reduce the local diversity of plants, plant communities, or wildlife species that inhabit them. Therefore, the review team concludes that impacts to wildlife habitat on the CPNPP site (both in the central project area and BDTF area) would be minimal.

Table 4-2. Terrestrial Habitat Impacts on CPNPP Site as Percentage of Vicinity (6- mi Radius)

USGS Description	Impacts on CPNPPSite (ac)[(a)]	Vicinity (ac)[(a)]	Habitat Loss as Percentage of Total Habitat in Vicinity
Open Water	0	6959	0.0
Developed Areas	105[(b)]	11,747	0.9
Mixed Hardwood Forest	63	18,465	0.3
Evergreen Forest[(b)]	413	26,085	1.6
Grassland/Herbaceous	94	73,292	0.1
Agricultural Lands	0	7311	0.0
Wetlands	0.4	2702	<0.1
TOTAL	675	146,561	0.5

(a) Figures converted from hectares to acres.

(b) Ashe juniper woodland savannah would be included as part of the Evergreen Forest designation used in this table.

(c) Acreage total does not agree with that reported elsewhere in Luminant 2009a or in Table 2-7. The discrepancy is likely attributable to more precise mapping effort performed by Luminant for the site, compared to the more general U.S. Geological Survey (USGS) mapping.

Source: Luminant 2009a, based on land cover mapping developed by USGS.

Flora and Fauna

Removal of woody vegetation can result in increased ecosystem fragmentation that can affect the movement of wildlife. Figure 2-5 suggests that the affected forest cover is already partially isolated from adjacent forested areas. Construction and preconstruction activities that would affect small stands of woody vegetation are not expected to result in additional habitat fragmentation or removal of potential travel corridors available to terrestrial wildlife.

Species with onsite habitats likely to be affected include mammals [e.g., raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), deer mouse (*Peromyscus* spp.), and cotton rat (*Sigmodon* spp.)], birds [e.g., American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), savanna sparrow (*Passerculus sandwichensis*), and northern flicker (*Colaptes auratus*)], reptiles [e.g., western diamond-backed rattlesnake (*Crotalus atrox*) and slider (*Trachemys scripta*)], and amphibians [e.g., bullfrog (*Rana catesbeiana*), leopard frog (*Rana berlandieri*), and Woodhouse's toad (*Bufo woodhousii*)] (see Section 2.4.1.1).

During building of CPNPP Units 3 and 4 and associated offsite facilities, wildlife might be destroyed or displaced, primarily as a result of operating heavy equipment (e.g., during land clearing). Less mobile animals, such as reptiles, amphibians, and small mammals, are expected to incur greater mortality than more mobile animals, such as birds. Although undisturbed habitat would be available nearby for displaced animals during construction and preconstruction, increased competition for available space could result in increased predation and decreased fecundity, ultimately leading to a temporary reduction in population size. Species that can adapt to disturbed or developed areas might readily recolonize portions of the disturbed area where suitable habitat remains or is replanted or restored. The destruction, temporary displacement and reduced productivity, and recolonization of wildlife also apply to offsite disturbances in forest habitat that would result as land was cleared for the new transmission line and pipeline rights-of-way (see Section 4.3.1.2). As construction and preconstruction activity ends and some habitats are restored naturally or through mitigation activities, some areas of habitat not occupied by permanent facilities would again become available to some wildlife species that previously occupied these spaces.

Noise from construction and preconstruction activities can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense (Larkin 1996). However, wildlife often habituates to such noise (Larkin 1996). Construction and preconstruction activities that would generate noise include operation of equipment such as jackhammers, pile drivers, and heavy construction vehicles. In addition, construction noise results from the movement of workers, materials, and equipment. Heavy equipment, such as scrapers and bulldozers, typically emit noise at levels within the 70 to 90 dBA range at distances of 100 ft, although short-term noise levels from construction activities can be as high as 110 dBA. These noise levels would not extend far beyond the boundaries of project activities. The threshold at which birds and small mammals are startled or frightened is 80 to 85 dBA (Golden et al. 1980). The review team expects that noise levels associated with establishment of the transmission lines and pipelines ROW would be similar to those associated with construction and preconstruction at the CPNPP site and would be below threshold levels for wildlife at 400 ft. Thus, impacts on wildlife from construction and preconstruction noise would be negligible.

Avian collisions with fabricated structures such as cooling towers, and other structures, including large cranes and other construction equipment, are a result of numerous factors related to species characteristics. These factors include flight behavior, age, habitat use, seasonal habits, and diurnal habitats. Also, weather, topography, land use, and orientation of the structures are factors in avian collisions. Most authors on the subject of avian collisions with utility structures agree that collisions are not a biologically significant source of mortality for thriving populations of birds with good reproductive potential (EPRI 1993). The NRC (1996) reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that the overall avian mortality is low. Cooling towers at the CPNPP site would be low in profile, 60 ft or less in height (Luminant 2009a), and although located within the central migratory flyway, avian collisions are not expected to be substantial.

Increased traffic due to the large construction force would likely increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if roadkill rates were to exceed the rates of reproduction and immigration. However, while roadkill is an obvious source of wildlife mortality, except for special situations not applicable to the CPNPP site (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on the CPNPP site during building is expected to be negligible.

The review team determined that the development-related impacts of habitat loss, noise, collisions with elevated structures, and increased traffic may affect onsite wildlife. The project could potentially result in some destruction of habitat and disruption or loss of some individuals in the areas of disturbance. The project would include permanent alteration of some habitat areas, potentially resulting in the loss or relocation of biota over the operational lifespan. However, in light of the availability of similar habitat throughout the region, the impacts would be temporary, minor, and mitigable.

4.3.1.2 Terrestrial Resources – Transmission Lines and Cooling Water Pipelines

Transmission Lines

The transmission system addition for CPNPP Units 3 and 4 is being developed as required by Electric Reliability Council of Texas (ERCOT) and the PUCT. ERCOT and the PUCT follow a legal and regulatory process necessary to allow building of additions to the existing transmission system; this includes preparation of a separate Environmental Analysis [Comanche Peak Steam Electric Station (CPSES 2007)].

Three single-circuit transmission lines would be located on existing ROWs and use existing tower structures. No land-use or land management changes, and hence no substantial terrestrial ecological impacts are expected from transmission line alterations existing ROWs. Vegetation maintenance is already performed, and wires could be strung with little disturbance to the ROWs (Luminant 2009a).

Two double circuit expansions would require the establishment of new towers on a new or expanded 160-ft-wide ROW. The first is the 45-mi line to Whitney, and the second is the 17-mi line to DeCordova. Figure 2-14 illustrates the probable location of the transmission lines.

The impacts of land clearing, grading, and levelling to construct transmission lines on the new or expanded ROWs would generally be similar to those experienced onsite with two major exceptions. First, grading would occur at only the locations of the additional transmission towers, where the activity would be limited to that needed to provide a level foundation for the individual towers. Second, the ability to relocate proposed tower sites laterally along the ROW is expected to allow avoidance of grading in most environmentally sensitive areas such as those that might contain small populations of special interest plants, water bodies and waterways, and wetlands.

Land along the DeCordova ROW consists mainly of grassland, while the land along the Whitney ROW primarily consists of grassland with some deciduous and evergreen forest. Table 2-11 shows existing land cover within the proposed transmission line corridors. The new Whitney ROW would occupy approximately 954 ac, and the new DeCordova ROW would occupy approximately 149 ac. It is expected that little of these areas would be disturbed. Grassland would be only minimally disturbed; it is likely that some forest clearing would be required but the extent cannot be determined until actual ROW locations have been determined. Some minimal forest clearing could however be unavoidable to install tower pads and access roads.

Types of impacts that could occur in areas to be disturbed would include direct injury or mortality to wildlife. Nests and burrows could be destroyed during clearing and grading activities. Thus, species with the highest likelihood to be affected would include those with limited mobility, species that burrow, and birds. Building-related disturbances would be short term and confined to the site or adjacent storage areas. Noise, fugitive dust, and activities associated with site clearing and grading, where necessary, and installation of support structures could disturb and displace wildlife within and adjacent to impact areas. These disturbances would be short term and concentrated within the activity area. Depending on the final routing of the transmission ROWs small forest clearings created could contribute to forest fragmentation.

Cooling Water Pipelines

Additional water intake and discharge pipelines are expected to be installed for CPNPP extending from the plant to Lake Granbury. The pipelines are expected to follow an existing 50-ft ROW. The disturbed land along the existing pipeline corridor is presently about 50 ac consisting mainly of grassland and low deciduous and evergreen forest (Table 2-12). During building and development the existing 50-foot wide corridor would be widened to as much as 150 feet. Building activities in this corridor would be expected to disturb another 64-ac area consisting of mostly grassland with some low deciduous and evergreen forest. The new pipelines would largely parallel the existing makeup and return water pipelines. They are illustrated in Figure 2-5. Additional intake and discharge structures would be established on Lake Granbury. The impacts of land clearing, grading, trenching, and levelling to install the water pipeline would generally be the same as those experienced onsite. Following pipeline installation, the approximately 114-ac area disturbed for the pipeline would probably be seeded with annual grasses or other species that would not require periodic fertilizing or application of other amendments. Following initial seeding, the disturbed area would be allowed to revegetate naturally with native herbaceous and small shrub species. Natural succession would eventually result in the establishment of natural grassland cover types. Preventing the future growth and development of large shrubs and trees would establish a permanent corridor that would be maintained as grassland to ensure safety and facilitate visual inspection of the ROW (Luminant 2009a).

The largely grassland types that would be affected contain no wetlands or habitat for threatened or endangered species (Luminant 2009a). Field reconnaissance along the ROW in April and July of 2007 failed to reveal any important species or habitats, including wetlands (Luminant 2009a).

Minimizing Impacts

Transmission line and water pipeline development would be addressed in an SWPPP and a spill prevention plan as well as in the BMPs that are would be incorporated into those plans. Measures used to maintain the transmission line ROWs after installation are discussed in Section 5.3.1.2. The cooling water pipeline is not expected to require much vegetation maintenance beyond occasional control of large trees and shrubs (Luminant 2009a). The new ROWs would be subject to pre-disturbance investigations, possibly including, but not limited to, reconnaissance to ascertain the presence or absence of plant species of special concern and other important species and habitats defined in NUREG-1555 (NRC 2000) or as required by Federal or State agency regulatory requirements (Luminant 2009a).

TPWD stated that it understands that the proposed transmission line ROW routes are preliminary and subject to change. Therefore, the information TPWD has provided regarding resources within the vicinity of the proposed new ROWs as discussed below would need to be updated for the USACE permit action and State permit actions. TPWD and the USACE would re-evaluate the assessment of potential impacts to rare resources and waters of the United States (US) after specific routes are identified (TPWD 2009b).

Given the relatively small acreage that would actually be affected by construction and preconstruction and the nature of the land that would be committed, impacts on terrestrial resources from the expansion of the Whitney and DeCordova ROWs would be minor. Because the cooling water pipelines would mostly follow an existing pipeline ROW, most of which is grassland, and the additional area that would be required for pipeline placement would be disturbed only temporarily, impacts on terrestrial resources from placement of the cooling water pipeline would be minimal.

4.3.1.3 Important Terrestrial Species and Habitats

Important Terrestrial Species – Site and Vicinity

This section describes the potential construction and preconstruction related impacts to important species, including commercially and recreationally valuable species, Federally proposed, threatened, or endangered terrestrial species and State-listed species as well as other ecologically important species resulting from building Units 3 and 4 at the CPNPP site and the associated transmission line and cooling water pipeline ROWs. The potential impacts of construction and preconstruction activities on these species are described in the following sections. There are no areas designated as critical habitat in the vicinity of the CPNPP site.

Recreational hunting on the CPNPP property is not presently permitted. Any loss of recreationally valuable species or their continuing unavailability to local hunters would have no impact on opportunities for recreational hunting in the area. Thus, the impact to commercially and recreationally valuable species would be negligible. Most species at the CPNPP are common to the region; those rare species potentially present are more abundant elsewhere in the region. There is no evidence suggesting that any species present is critical to the structure or function at the ecosystem level or that any species might function as a true biological indicator. Thus, there would be no impacts to critical and indicator species. With the exception of the recreation areas, campgrounds, boating areas, and wildlife viewing sites in the vicinity of the CPNPP listed in Table 2-8 and the wetlands discussed in Section 4.3.2, there are no important terrestrial habitats on or in the immediate area of the site. Of these areas, Dinosaur Valley State Park and Fossil Rim Wildlife Center are close enough to project activities that they could potentially be affected by creation of a new transmission line ROW.

The Whitney ROW might pass through the northwest corner of Dinosaur Valley State Park. The corridor location for the Whitney ROW as currently shown could potentially cross the Fossil Rim Wildlife Center. Potential impacts of transmission line establishment on a new ROW are discussed in Section 4.3.1.2. Recorded occurrences of two Federally and State-listed endangered species—black-capped vireo and golden-cheeked warbler—have been documented in Dinosaur Valley State Park (TPWD 2009b) and also in Fossil Rim Wildlife Center (TPWD 2010a). In order to obtain approval from ERCOT and PUCT to build the transmission lines, Oncor is expected to have to perform surveys for threatened and endangered species on the transmission line ROWs once the final routes are determined. It is likely that with adjustment of the ROW location, and tower placement within the proposed corridor, and timing of project activities to avoid the breeding season of these species, impacts to the species could be minimized (See Biological Assessment in Appendix F). Fossil Rim Wildlife Center also specializes in captive breeding of native and exotic rare and endangered species on its 3000-acre site (Fossil Rim Wildlife Center 2011). Due to the large area of this facility and the relatively small area of the ROW that would traverse it, it is likely that the ROW location could be adjusted, as necessary, to avoid impacts to the breeding programs.

Thus, other than for Dinosaur Valley State Park and Fossil Rim Wildlife Center, construction and preconstruction at the CPNPP site and vicinity would have minimal impact on known important habitat. Distance from the site to the other areas listed in Table 2-8 would provide a suitable buffer to any construction noise originating from the CPNPP site. The building of the Whitney transmission line near or in the Dinosaur Valley State Park and Fossil Rim Wildlife Center could have noticeable effect on Federal and State-listed species and habitat. Oncor could likely adjust the timing of building and the location of the transmission lines to avoid adverse impacts to Federal and State-listed endangered species.

Federally Listed Species

The only Federally listed terrestrial species with recorded occurrences within 10 mi of the CPNPP site and proposed new power transmission and cooling water pipeline ROWs are the endangered black-capped vireo and endangered golden-cheeked warbler (see Biological Assessment in Appendix F). The site also lies within the flyway for the Aransas-Wood Buffalo population of the endangered whooping crane (*Grus americana*). Each of these species are also State listed as endangered (TPWD 2009b). They are the only Federally listed species that have been documented or are known to occur in Somervell County (USFWS 2006). They are discussed below.

Black-capped vireo (*Vireo atricapillus*) (Federally and State-listed as endangered).

Due to the absence of the black-capped vireo and suitable habitat on the CPNPP site, the potential for impacts to black-capped vireos due to project construction and preconstruction at the site would be negligible. However, the black-capped vireo is known to occur in Dinosaur Valley State Park and Fossil Rim Wildlife Center, which lie within the corridor that would be used by Oncor to select a route for the Whitney transmission line, one of the transmission lines needed to serve the proposed new CPNPP units. The building of the Whitney transmission line through the Dinosaur Valley State Park and Fossil Rim Wildlife Center could have a noticeable effect on the black-capped vireo. Oncor could adjust the timing of building and the location of the transmission lines to avoid any adverse impacts on the black-capped vireo.

Golden-cheeked warbler *(Dendroica chrysoparia)* (Federally and State-listed as endangered).

This species is typically dependent on mature Ashe juniper habitat and various species of oak. Pair territory size is about 16.5 ac (Pulich 1976).

A survey conducted following U.S. Fish and Wildlife Service (USFWS) protocol during breeding season in April and May 2008 to determine the presence or absence of golden-cheeked warblers in the peninsula area proposed for placement of the new cooling towers found neither golden-cheeked warblers nor habitat considered suitable [Post, Buckley, Schuh & Jernigan, Inc. (PBS&J 2008)]. The only patch of Ashe juniper forest with maturity and adequate hardwoods suitable to provide favorable golden-cheeked warbler habitat was 3.7 ac, which was considered by the investigators to be too small to support a breeding pair (PBS&J 2008). In the BDTF area a habitat survey was performed in November 2007 and compared to a reference site where known golden-cheeked warbler populations exist. Additional site reconnaissance was performed on February 4, 2009. Both surveys indicated that favorable golden-cheeked warbler habitat is absent from the area of the BDTF (Luminant 2009a). See the Biological Assessment in Appendix F for further details.

Due to the absence of the golden-cheeked warbler and its favored habitat on the CPNPP site, the potential for impacts to golden-cheeked warblers due to project development at the CPNPP site would be minimal. However, the golden-cheeked warbler is known to occur in Dinosaur Valley State Park and Fossil Rim Wildlife Center, which lie within the area that would be used by Oncor to select a route for the Whitney transmission line, one of the transmission lines needed to serve the proposed new CPNPP units. The building of the Whitney transmission line near the Dinosaur Valley State Park and Fossil Rim Wildlife Center could therefore have a noticeable effect on the golden-cheeked warbler. Oncor could however adjust the timing of building and the location of the transmission lines to avoid or minimize adverse impacts on the golden-cheeked warbler.

Whooping crane *(Grus americana)* (Federally and State-listed as endangered)

As noted previously (Sections 2.4.1.1 and 2.4.1.3), the migratory corridor of the Federal- and State-listed endangered whooping crane extends over the CPNPP site. However, no occurrences of whooping cranes have been reported within a 10-mi radius of the CPNPP site or the proposed transmission line and pipeline corridors (TPWD 2009f). The area of the migratory corridor used by the Aransas-Wood Buffalo population (the last remaining self-supporting wild population) of 247 individual whooping cranes is approximately 560,000 square mi, based on a chart presented in Canadian Wildlife Service and U.S. Fish and Wildlife Service (2007). The total area of land that would be altered during building of new project features would be less than about 3 square mi. Thus the statistical likelihood of stopover of whooping cranes near project features during the period of time while they are being built would be slight. Nevertheless, it is possible that whooping cranes could stopover in the vicinity during migration.

Preferred whooping crane migration stopover habitat consists of croplands and marshy wetlands, which are typically shallow and contain emergent vegetation for feeding (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2007). At the CPNPP plant site, only small areas of wetlands occur, and they tend to be in narrow bands along the shoreline and coves of SCR (see Sections 2.4.1.4 and 2.4.2.3). These wetlands are limited in extent and lack large areas of shallow water typical of migration stopover habitat. Along the ROWs that would be disturbed by the project only about 25 ac of wetlands are present (Table 2-11). In addition the noise associated with building activities would be expected to act as a localized deterrent to wildlife. For these reasons the CPNPP site, and associated new rights-of-way, would not be conducive to use as stopover habitat for whooping cranes during the building of the project. Given these factors it would be unreasonable to conclude that there would be a likely adverse impact to whooping cranes. Therefore, the review team considers the possibility of harm due to project building activities to be minimal.

State-Listed Species

As explained in Section 2.4.1.3, State-listed and rare species potentially in the vicinity of the CPNPP site, including the pipeline ROW and the proposed new transmission line ROWs, include three bird, three reptile, and two plant species. Potential construction and preconstruction impacts to these species, with the exception of black-capped vireo, the golden-cheeked warbler, and the whooping crane, which are also Federally endangered and were discussed above, are described below. Species considered are those with known occurrences in one or more of the three counties potentially affected by the proposed CPNPP Units 3 and 4 project, including the two proposed new transmission line ROWs (Somervell, Hood, and Bosque Counties). Also considered are species without recorded occurrences, but that TPWD considers could be present and impacted by the project when suitable habitat is present (TPWD 2007).

Site-specific information is not available for all of these species, and TPWD has commented that absence of information about a species in an area of potentially suitable habitat does not mean that the species is absent from the area (TPWD 2009b). Thus, TPWD recommends performing onsite habitat surveys for the species, avoiding suitable habitat if found, developing minimization and compensatory measures to reduce impacts when habitat cannot be avoided, and informing construction crews to avoid disturbance of such species when found (TPWD 2009b).

Luminant has stated that in rare instances development activities might inadvertently encounter special status wildlife species, their habitat, and vegetation, in which case work in the immediate area would be halted and appropriate State agency officials and environmental consultants would be contacted to determine proper mitigation measures so that work could resume.

Fauna

Bald eagle (*Haliaeetus leucocephalus*) (State-listed as Threatened). No large, deciduous trees such as mature cottonwoods that might be capable of supporting a large eagle nest are expected to be removed by development activities in either the Ashe juniper or mixed hardwood woodlands at SCR or Lake Granbury. Locations for project activities away from SCR and Lake Granbury are unlikely to provide favourable nesting habitat for bald eagles. Bald eagles transiently visiting these locations would likely disperse to other locations while work activities take place. Therefore, the proposed development activities are not expected to adversely affect bald eagles.

Texas garter snake (*Thamnophis sirtalis annectens*) (considered Rare by TPWD, but with no regulatory listing). According to NatureServe, there are no existing natural heritage records of Texas garter snake occurrences for Hood, Somervell, or Bosque Counties (NatureServe 2009). TPWD lists one occurrence within 10 mi of the proposed Whitney transmission line ROW (TPWD 2009b). Because of the paucity of recorded sightings in the project area and because disturbance could possibly be avoided by adjusting locations of power transmission line towers if the Texas garter snake was encountered during building, potential for impacts to this species would be minimal.

Texas horned lizard (*Phrynosoma cornutum*) (State-listed as Threatened). There are no recorded occurrences of Texas horned lizard within 10 mi of the CPNPP site or proposed new power transmission or pipeline ROWs (TPWD 2009b). The Texas horned lizard is typically associated with sandy and rocky soils and short or sparse vegetation. While its preferred food source, the harvester ant, was identified on the CPNPP site during directed field surveys, the ants were found in an area dominated by tall grass and forbs rather than the sparser habitat used by the horned lizard. No Texas horned lizards were found (Luminant 2009a). The potential for impacts to this species due to construction and preconstruction at the CPNPP or proposed power transmission or pipeline ROWs would be minimal.

Timber (canebreak) rattlesnake (*Crotalus horridus*) (State-listed as Threatened). There are no recorded occurrences of timber rattlesnakes within 10 mi of the CPNPP site or proposed new power transmission or pipeline ROWs (TPWD 2009b). This species was not observed on the site during field visits in 2007 (Luminant 2009a).

Timber rattlesnakes are most frequently associated with riparian and bottomland forest or partially wooded hillsides. Although no timber rattlesnakes were observed at the CNPP site, proposed building activities could potentially affect them in mixed hardwood habitat at the proposed locations of the new cooling towers and BDTF, and in such habitats along the transmission and pipeline ROWs.

Mechanical clearing in these areas may adversely affect small numbers of timber rattlesnakes through (1) direct mortality of those who fail to flee or are torpid when equipment is in use or (2) loss of habitat and food resources. Given the amount of similar habitat elsewhere at the CPNPP, this impact would be expected to be negligible, with little to no impact on populations of the rattlesnake elsewhere in the area.

Comanche Peak prairie clover (*Dalea reverchonii*) (Considered Rare by TPWD, but with no regulatory listing). This prairie clover is only known from about 20 occurrences within a very small geographic area in north-central Texas and is considered extirpated from the Comanche Peak area (NatureServe 2009). The single recorded occurrence of Comanche Peak prairie clover within 10 mi of the CPNPP site and proposed new power transmission or pipeline ROWs is more than 3 mi to the north of areas to be affected by project activities based on the map provided by TPWD (TPWD 2009f). There should therefore be no impacts to Comanche Peak prairie clover from project activities.

Glen Rose yucca (*Yucca necopina*) (Considered Rare by TPWD, but with no regulatory listing). Three known occurrences of Glenn Rose yucca lie in the vicinity of the proposed DeCordova transmission line and cooling water pipeline ROWs (TPWD 2010a). Glen Rose yucca may occur wherever suitable habitat is present. If this Glen Rose yucca is encountered during pipeline or transmission line placement, work in the immediate area would be halted and appropriate TPWD officials and environmental consultants would be contacted to determine proper mitigation measures so that work could resume (Luminant 2009a). With development of suitable mitigation, impacts to Glenn Rose yucca due to project activities, if any, would be minimal.

Summary

Based on threatened and endangered species surveys, historical records, life history information, known threatened and endangered species locations, and information provided by Luminant in the ER (Luminant 2009a) and in its request for additional information (RAI) responses, the review team concludes that the impacts on terrestrial Federally and State-listed threatened, endangered, and rare species from construction and preconstruction activities on the CPNPP site and associated new power transmission and cooling water pipeline ROWs would be negligible, and additional mitigation beyond that stated above would not be warranted. However, the black-capped vireo and golden-cheeked warbler are known to occur in Dinosaur Valley State Park and Fossil Rim Wildlife Center, which lie within the corridor that would be used by Oncor to select a route for the Whitney transmission line, one of the transmission lines needed to serve the proposed new CPNPP units. The building of the new transmission line through Dinosaur Valley State Park and Fossil Rim Wildlife Center would have a noticeable effect on these species or their habitat. In order to obtain approval from ERCOT and PUCT to build the transmission lines, it is expected that Oncor would have to perform surveys for threatened and endangered species on the transmission line ROWs once the final routes are determined. The potential for impacts to these species could be assessed as part of the review process of ERCOT and PUCT, and coordinated with TPWD and USFWS. It is likely that with adjustment of the ROW location, and tower placement and timing of project activities to avoid the breeding season of these species, impacts to them could be minimized.

4.3.1.4 Terrestrial Monitoring during Construction and Preconstruction

During construction and preconstruction activities at the CPNPP site and along the expanded power transmission and water pipeline ROW, monitoring would take place for the presence of special-status wildlife habitats or vegetation (i.e., for areas used by USFWS- and TPWD-protected species). In the event that any were located, work in the immediate area would be halted, and appropriate State agency officials and environmental consultants would be contacted to determine proper mitigation measures so that work could resume (Luminant 2009a).

Only personnel with a TPWD scientific collection permit are allowed to handle and move state-listed species (TPWD 2010a). Should Luminant require moving of state-listed species out of harm's way for construction activities, the person handling the species must possess a scientific collection permit, which can be obtained from TPWD (TPWD 2010a).

4.3.1.5 Potential Mitigation Measures for Construction- and Preconstruction- Related Terrestrial Impacts

The existing CPNPP site environmental procedures and BMPs address regulatory and permit requirements. Additional permit requirements might be developed by the USACE and/or State agencies that address specific measures for mitigation of environmental impacts during the building. Various types of environmental protection procedures for the construction and preconstruction of CPNPP Units 3 and 4 were discussed in general in Section 4.3.1.1.

The review team expects that new transmission lines could be sited to avoid Dinosaur Valley State Park, Fossil Rim Wildlife Center, and other areas that might contain suitable habitat for black-capped vireo and golden-cheeked warbler, or foraging habitat for whooping cranes. In addition, strategic transmission line placement and use of bird collision deterrent devices, such as those described in “Mitigating Bird Collisions with Power Lines: State of the Art in 1994 and 2006,” by the Avian Power Line Interaction Committee could reduce the likelihood of other impacts to terrestrial wildlife (TPWD 2010a, DOI 2010). USFWS notes that development of transmission lines may potentially take nesting migratory birds (eggs, nestlings, or adults) if it occurs during the nesting season (DOI 2010). Nesting disturbance would constitute a violation of the Migratory Bird Treaty Act (MBTA) (DOI 2010). To avoid take under the MBTA, actions that could disturb migratory birds should be completed outside of their nesting seasons (DOI 2010). Such actions include clearing, cutting, or grubbing vegetation. Nesting seasons for migratory birds vary greatly among species and geographic locations, but generally peak in central Texas from early April to mid-July. However, the breadth of the nesting season for some species could extend from early February through late August, with a few species even nesting into November. Eagles may initiate nesting as early as late December or January in some areas. Due to this variability, USFWS recommends that project proponents should consult with the USFWS Regional Migratory Bird Office (P.O. Box 1306, Albuquerque, New Mexico 87103;) for information on specific nesting seasons at the locality in question (DOI 2010). The USFWS recommends completion of all disruptive activities outside the peak of migratory bird nesting season to the greatest extent possible and avoiding any habitat alteration, removal, or destruction during the primary nesting season. The USFWS also recommends clearing vegetation in the year prior to construction (but not within the nesting season) if possible, thereby discouraging birds from attempting to return to the disturbance area to nest while work is in progress (DOI 2010).

4.3.1.6 Summary of Impacts to Terrestrial Resources during Construction and Preconstruction Activities

The impact of construction and preconstruction on wildlife habitat within the CPNPP site (including permanent and temporary losses of Ashe juniper, mixed hardwood, and grassland and other natural habitats) when compared with the total acreage of these habitats in the general area would be minimal. Luminant would be required to comply with conditions of any permits, such as Section 404 permits from the USACE, including any wetland mitigation discussed in Section 4.3.2.3. The potential onsite impact on wildlife populations would be minimal, and Luminant would implement mitigation measures at the CPNPP site and within the transmission line and cooling water pipeline ROWs, including BMPs for erosion and dust control, proper equipment maintenance, and adherence to all applicable permit conditions. The review team reviewed the potential impacts of developing Units 3 and 4 on terrestrial ecological resources on the CPNPP site, including loss of habitat and wetlands (see Section 4.3.2 for more discussion of wetlands), noise, traffic mortality, and avian collisions. Based on information provided by Luminant, including the BMPs identified in the ER, and the review team's independent evaluation, the review team concludes that the combined impacts of construction and preconstruction activities for the proposed CPNPP Units 3 and 4 upon terrestrial ecosystems would be SMALL to MODERATE, depending on the exact route ultimately selected for the Whitney power transmission line. The potential for MODERATE impacts is due primarily to the possibility of impacts to black-capped vireo and golden-cheeked warbler habitat from building of those segments of the Whitney transmission line that might have to traverse Dinosaur Valley State Park and Fossil Rim Wildlife Center. Further avoidance, minimization, and other mitigation measures might be required by other State or Federal agencies. For example, the Corps may require wetland mitigation when issuing the required Department of the Army permit.

The LWA rule (72 FR 57416) specifically states that transmission lines are not included in the definition of construction. Since onsite terrestrial resource impacts would be SMALL, and the MODERATE impacts are attributable only to transmission line development with respect to habitat for black-capped vireos and golden-cheeked warblers, NRC staff concludes that the impacts to terrestrial ecosystems from NRC authorized construction activities would be SMALL, and no further mitigation would be required.

4.3.2 Aquatic Ecology and Wetlands Impacts Related to Construction and Preconstruction

Impacts to aquatic and wetlands resources, from construction and preconstruction activities for CPNPP Units 3 and 4 would mainly be associated with impacts to SCR from activities at the proposed site of Units 3 and 4 and to Lake Granbury from activities associated with installation of the makeup water intake and blowdown discharge structures. There also is a potential for aquatic impacts from the installation of new transmission line and pipeline ROWs across waterbodies. As discussed in Section 4.2.2.1, water withdrawals for CPNPP from the Wheeler Branch Reservoir and the Paluxy River during construction and preconstruction would result in only a very small reduction in flow in the Paluxy River at Glen Rose (0.3 percent of mean annual flow, 5 percent of the lowest recorded annual flow). Also, the installation of a pipeline to carry water from Wheeler Branch Reservoir to CPNPP would not cross or affect water resources. Thus, impacts on Wheeler Branch Reservoir and the Paluxy River from construction and preconstruction activities for CPNPP Units 3 and 4 would be negligible and are not further evaluated below. All work would be conducted in accordance with applicable regulatory permits, including Section 10 of the Rivers and Harbors Act and Section 404 of the CWA.

4.3.2.1 Aquatic Resources and Wetlands – Site and Vicinity

Impacts of Construction and Preconstruction on Squaw Creek Reservoir

The construction and preconstruction activities associated with CPNPP Units 3 and 4 and related facilities are described in detail in Section 3.3.1. Building of the power plant facilities would not result in the loss of aquatic habitat in SCR, though impacts on the aquatic resources of SCR could potentially result from soil erosion and other runoff from building activities. If stormwater erodes exposed soil from the areas being developed and runoff carries it into the lake, the resulting sedimentation and turbidity could adversely affect the aquatic community in the adjacent area of the reservoir. However, an SWPPP would be developed and implemented prior to site clearing and other construction and preconstruction activities to substantially reduce or eliminate such erosion-related impacts. In accordance with the SWPPP, BMPs would be implemented, including the installation and maintenance of silt fencing, the maintenance of vegetated buffer zones between SCR and areas undergoing development, and the diversion of runoff to sediment retention basins (Luminant 2009a).

There would be no modifications to the existing intake and discharge structures on SCR, development related to the proposed Units 3 and 4 would not occur in the water, and a vegetated buffer zone would be maintained between the shoreline and areas undergoing development. As a result, noise from development activities would not be expected to affect aquatic biota in SCR. Any noise transmitted through the water would likely be attenuated sufficiently to prevent physiological damage to aquatic biota, and if noise was to reach stressful levels near the site, fish and other motile species would be able to leave the area and avoid its effects.

As a result of the management practices and development plans described above, the building of the proposed CPNPP Units 3 and 4 facilities would be unlikely to adversely affect the aquatic ecosystem of SCR. The review team concludes that the impacts of construction and preconstruction activities on aquatic resources in SCR would be minimal and that additional mitigation beyond the practices described above would not be warranted.

Impacts of Construction and Preconstruction on Streams, Ponds, and Wetlands at the Site

No perennial streams that flow into SCR are located in the vicinity of the CPNPP site. Only a small, intermittent stream located between the power plant area and the cooling tower area would be affected (Figure 2-13). Except during wet periods, the rocky bed of this stream is almost completely dry, with only a few small pools retaining water. The stream originates near the main road through the existing facility and flows approximately 1600 ft down a forested hillside before entering a small (0.78 ac), littoral, wetland community that has developed at the mouth of the stream where it joins SCR. This stream would be considered subject to USACE Section 404 jurisdiction (Enercon 2009). Based on current site plans, this stream would be entirely within the footprint of the proposed facility (Enercon 2009). As a result, the stream channel would be filled by development of the site. Current plans indicate that about 0.3 mi of the intermittent stream would be replaced with a pipe and covered with fill (Enercon 2009). However, given its small size, intermittent flow, and minimal aquatic community, development of this stream drainage would not result in a substantial ecological impact and would not noticeably affect the aquatic community of SCR.

As described in Section 2.4.3.1, only two of the 48 wetlands delineated on the CPNPP site lie within construction and preconstruction areas and, thus, would be directly affected by the addition of Units 3 and 4 at CPNPP (Figure 2-13) (Enercon 2009). These two wetlands together constitute less than 2 percent of the wetland area at the CPNPP site. One of these wetlands is the 0.78-ac littoral wetland at the mouth of the intermittent stream described above (Figure 2-17). This wetland would be subject to the jurisdiction of the USACE (Enercon 2009). Given its location along the shoreline of the lake, the hydrology of this wetland is likely determined mainly by SCR water levels. However, increases in impervious surfaces associated with development in the watershed of the intermittent stream may increase the magnitude of storm flows and increase erosion of the stream's banks as it passes through the wetland, which could further reduce its area and functionality. In addition, current plans show about half of the area of this wetland being graded and filled (Enercon 2009). USFWS requested that this wetland area be isolated from the development area by surrounding it with a 100-ft buffer to (1) protect potential golden-cheeked warbler habitat in the area, (2) provide a wildlife corridor, and (3) provide an additional vegetative filter to minimize the effects of runoff on existing water quality (USFWS 2009). The plans as drawn do not provide sufficient area for the establishment of the buffer. If these plans become final, mitigation measures (such as onsite or offsite compensation through creation of additional wetland area), which would be considered by

USACE as part of the Section 404 permitting process necessary for building activities, may be required.

Within the area where the BDTF would be built immediately south of SCR (Figure 2-13), there are two streams that drain northeast to enter Squaw Creek below the reservoir dam. Some portions of these streams have defined banks and a high-water mark and appear to be intermittent, but in other portions these characteristics are undefined. Based on interpretation of information reported in Enercon (2009), the current conceptual design for the BDTF indicates that approximately 1.5 mi of these drainages may be within the footprint of the BDTF facility. USACE jurisdiction concerning these streams has not been determined. Also within the BDTF footprint and upgradient of these drainages is an old livestock pond that is isolated (Enercon 2009), very small (less than 1 ac), and essentially unvegetated. Given the intermittent flow of these streams, the small size of the streams and pond, and their minimal aquatic communities, development of this area would not result in a substantial ecological impact. Impacts to these aquatic features would not noticeably affect the downstream aquatic community of Squaw Creek.

Building of the proposed CPNPP Units 3 and 4 facilities would be likely to result in the filling of several small aquatic resources within the footprint of the proposed facility adjacent to SCR. However, based on the small sizes of the potentially affected intermittent streams, wetlands, and stock pond and the minimal aquatic communities they support, the review team concludes that the impacts of construction and preconstruction activities on these aquatic resources would be minimal. Additional mitigation beyond the BMPs in the SWPPP likely would be required by the USACE in conjunction with permitting under CWA Section 404 of the development activities affecting these streams and wetlands. The overall cumulative impacts to waters of the United States from these activities would be considered by USACE as part of the permitting process.

Impacts of Construction and Preconstruction on Lake Granbury

The installation of the intake and discharge structures would result in the loss of aquatic habitat in Lake Granbury. The construction and preconstruction activities associated with the intake and discharge structures are described in detail in Section 3.3.1. These activities would affect limited areas and sediment volumes and would be conducted in accordance with USACE permit requirements.

The proposed location of the intake structure is on the southwest bank of Lake Granbury approximately 75 ft upstream of the existing intake and pumping station for CPNPP Units 1 and 2 makeup water (Luminant 2010a) and approximately 7200 ft (1.3 mi) upstream of the DeCordova Bend Dam. The intake screens would be located approximately 110 ft from shore at a depth of approximately 34 ft at a location where the depth of the lake is approximately 40 ft (Luminant 2009a). The intake structure (Figure 3-4) is expected to be approximately 80 ft long by 40 ft wide, resulting in a footprint of about 3200 sq ft (0.07 ac) (Luminant 2010a). The design of the discharge structure is expected to include two multiport diffuser pipes, each 82 ft long with 18 diffuser nozzles angled at 30 degrees from vertical in the downstream direction (Luminant 2010a). The discharge structure would be installed on the bottom of the reservoir approximately 900 ft upstream of the dam (Luminant 2009a). The pipes would be installed using one of three options: buried beneath the lake bottom, resting on the lake bottom and covered by riprap, or strapped to concrete supports placed on the lake bottom (Figure 3-5). Each option would affect the same area of lake bottom, which would have a width approximately three times the diameter of each pipe, resulting in a footprint for each pipe about 12 ft wide by 82 ft long (Luminant 2010a) and covering 984 sq ft. The total area covered by both discharge pipelines would be approximately 0.05 ac (Luminant 2010a).

The benthic habitat within the footprints of the intake and discharge structures would be permanently lost. However, these areas would be very small in comparison to the large area of the lower portion of the reservoir. In addition, the benthic community in this area is limited in abundance and diversity, and the fish community of the reservoir is not dependent on this area for spawning or other needs. Increases in turbidity and settling/deposition of suspended sediment are expected to occur during development in the immediate vicinity of the proposed intake and discharge structures. These impacts would be temporary and localized, affecting a relatively very small area of Lake Granbury only during the period of construction and preconstruction. Cofferdams would be installed around the in-water work areas, further limiting the potential for sediment disturbance and impacts beyond the footprint areas. Given the close proximity of the existing CPNPP Units 1 and 2 makeup water intake downstream of the proposed intake for Units 3 and 4, there is a potential for benthic invertebrates that may be suspended with the disturbed sediments to be transported to the existing intake and entrained or impinged on the screens during the temporary period of disturbance. However, the benthic macroinvertebrate community in this area consists predominantly of small, common species of insect larvae (flies and midges), and the occurrence of such entrainment/impingement effects would not substantially reduce their populations.

Building of the onshore components of the intake and discharge structures would not result in the loss of aquatic habitat in Lake Granbury. Development-related impacts on the aquatic resources of the reservoir could potentially result from soil erosion and other runoff during building activities. If stormwater erodes exposed soil from the areas being developed and runoff carries it into the lake, the resulting sedimentation and turbidity could adversely affect the aquatic community in the adjacent area of the lake. However, an SWPPP would be developed and implemented prior to site clearing and other construction and preconstruction activities to substantially reduce or eliminate such erosion-related impacts. In accordance with the SWPPP, BMPs would be implemented, including the installation and maintenance of silt fencing, the maintenance of vegetated buffer zones between the lake shore and development areas where possible, and the possible diversion of runoff to sedimentation basins.

Because facilities would be installed within Lake Granbury and on the shoreline, there would be the potential for aquatic organisms to be adversely affected by related noise. Hearing impairments caused by loud activities, such as pile driving, have been shown to reduce some fishes' abilities to locate prey, increase their risk of predation, and possibly reduce their reproductive success (Hastings and Popper 2005). However, activities generating loud underwater noise would be very localized and temporary, and fish could readily avoid proximity to the source. Information on the effects of noise on aquatic invertebrates is extremely limited, and the invertebrate community of the lake in this area is characterized by a limited diversity and abundance of species, most of which are common insects. Although some individual fish or aquatic invertebrates could suffer injury or mortality due to development-related activities and noise, the number of individuals affected would likely be very small, and populations would be essentially unaffected because most species could quickly move away from the area to suitable habitat elsewhere in the reservoir. Thus, noise resulting from the installation of these facilities would not be expected to have a substantial impact on aquatic biota in Lake Granbury.

As a result of these management practices, the installation of the proposed intake and discharge structures would be unlikely to adversely affect aquatic ecosystems. The review team concludes that the impacts of construction and preconstruction activities on aquatic resources in Lake Granbury would be minimal and that additional mitigation may be required by the USACE permit.

4.3.2.2 Aquatic Resources and Wetlands – Transmission Lines and Cooling Water Pipelines

The proposed new transmission lines and potentially affected aquatic resources, including wetlands, are described in Section 2.4.2.2. Of the five new transmission lines proposed, three would be added to vacant positions on existing towers within existing ROWs and would not require new tower installation or ROW clearing that could impact aquatic resources. The other two lines would require the clearing of new ROWs and the installation of new towers. The DeCordova line would extend approximately 17 mi northeast to the DeCordova switching station on the west bank of Lake Granbury, and the Whitney line would extend approximately 45 mi southeast to the Whitney switching station below the Lake Whitney dam (Figure 2-14).

The DeCordova transmission line would likely cross Squaw Creek and several inlets along the shoreline of SCR, the Brazos River, and Lake Granbury (Figure 2-14). The entire length of the DeCordova ROW would parallel an existing ROW, so existing culverts or other infrastructure at stream crossings within that ROW could be used during installation and long-term maintenance of the new, parallel ROW (Luminant 2010a). The Whitney transmission line would likely cross only one major waterbody, the Paluxy River, and several small tributaries of the Brazos River and Lake Whitney (Figure 2-14). The initial 18-mi segment of the Whitney line, from CPNPP south to where the line turns east near the town of Walnut Springs in northern Bosque County, would require the clearing and preparation of new ROW. This segment of ROW would cross approximately nine intermittent streams at 23 locations and the Paluxy River at one location (Table 4-3). In order to facilitate access for installation and long-term maintenance, culverts likely would be installed at the stream crossings. At the Paluxy River, however, existing bridges and crossings could be used and no additional culverts or bridges would be needed. The remaining 27 mi of the Whitney line would parallel an existing transmission line ROW from Walnut Springs to Whitney. Where the widened ROW crosses streams in this 27 mi segment, existing stream crossings within the existing ROW would be used and no new bridges or culverts would be required (Luminant 2010a). The total area of intermittent stream channel that may be affected by culvert installation along the Whitney line is estimated at approximately 0.5 ac (Table 4-3). This estimate is expected to be conservative because it is unlikely that a culvert would be needed at every stream crossing.

The wetland areas that may be crossed by these two lines are relatively small, about 23 ac for Whitney and 1.6 ac for DeCordova, together composing less than 2.5 percent of the vegetated acreage crossed (Table 2-11). Because tower locations can be adjusted based on terrain, it is likely that towers could be located entirely outside the limited wetland areas that may be included within the ROWs. However, there is the possibility that limited areas of wetland within the ROWs could be affected by the installation and use of access roads.

The potential for installation of these transmission lines to affect aquatic resources would be principally associated with the potential for soil erosion and stormwater runoff to cause sedimentation impacts in adjacent waterbodies and wetlands. However, an SWPPP would be implemented prior to construction to substantially reduce or eliminate such erosion-related impacts. In accordance with the SWPPP, BMPs would be implemented, including the installation and maintenance of silt fencing and the maintenance of vegetative buffer zones between areas being cleared and potentially affected waterbodies and wetlands. As a result of these management practices, the installation of the proposed transmission lines would be unlikely to adversely affect aquatic ecosystems and wetlands. If it is determined that impacts on wetlands or streams potentially would result from proposed transmission line installation activities, USACE would be consulted in advance. If any USACE jurisdictional waters would be affected, mitigation may be required.

Table 4-3. Stream Crossings Within the 18-mi Segment of New ROW for the Whitney Transmission Line

Stream Crossing ID	Stream Name	Stream Type	Estimated Stream Width (ft)	Affected Area (ac)[(a)]
TSC-1	Panther Branch	intermittent	40	0.02
TSC-2	unnamed	intermittent	40	0.02
TSC-3	Opossum Branch	intermittent	40	0.02
TSC-4	Opossum Branch	intermittent	40	0.02
TSC-5	Opossum Branch	intermittent	40	0.02
TSC-6	Opossum Branch	intermittent	40	0.02
TSC-7	Opossum Branch	intermittent	40	0.02
TSC-8	Opossum Branch	intermittent	40	0.02
TSC-9	Paluxy River	river	(b)	(b)
TSC-10	unnamed	intermittent	40	0.02
TSC-11	Bowden Branch	intermittent	40	0.02
TSC-12	Bowden Branch	intermittent	40	0.02
TSC-13	Bowden Branch	intermittent	40	0.02
TSC-14	Barker Branch	intermittent	40	0.02
TSC-15	Barker Branch	intermittent	40	0.02
TSC-16	Barker Branch	intermittent	50	0.02
TSC-17	Barker Branch	intermittent	40	0.02
TSC-18	Barker Branch	intermittent	40	0.02
TSC-19	South Fork Hill Creek	intermittent	40	0.02
TSC-20	South Fork Hill Creek	intermittent	50	0.02
TSC-21	Mustang Creek	intermittent	40	0.02
TSC-22	Mustang Creek	intermittent	40	0.02
TSC-23	Steele Creek	intermittent	90	0.04
TSC-24	Steele Creek	intermittent	110	0.05
Total Affected Acreage from Culvert Installation at Stream Crossings				0.51

(a) Based on assumption that a culvert of length 20 ft would be installed at each stream crossing: affected area = stream width x culvert length. Stream widths were estimated using topographic maps and aerial photographs. The actual affected area of streambeds may be lower than the estimate because a culvert is unlikely to be needed at every stream.
(b) Existing bridges and crossings will be utilized at the Paluxy River crossing, so a culvert is not expected to be needed.

Source: Luminant 2010a

The cooling water intake and blowdown discharge pipelines for the proposed CPNPP Units 3 and 4 mainly would follow an existing ROW containing the 48-in. water pipeline for Units 1 and 2 that connects Lake Granbury to SCR (Figure 2-5). Although the new pipelines would be installed within the existing 50-ft-wide pipeline ROW, a corridor up to 125 ft wide may be disturbed during installation (Luminant 2009a). ROWs for the new pipelines would diverge from the existing ROW at each end: where they would extend around the south side of SCR, and where the discharge pipeline would extend southeast from the intake location on Lake Granbury to the discharge location near the dam. Aquatic resources within the ROW areas where the pipelines potentially would be installed include stock ponds, several small tributaries of the Brazos River and Squaw Creek. A field survey of the pipeline ROW found no wetlands present (Luminant 2009a). The stock ponds are small, isolated, man-made impoundments that provide minimal habitat for aquatic species.

The pipeline ROW would cross approximately seven intermittent streams at ten locations and Squaw Creek, which flows continually below the SCR dam, at one location (Table 4-4). In order to prevent or minimize disturbance of stream beds and riparian zones, tunneling would be used to install the pipelines at all stream crossings. In addition, infrastructure currently present to allow vehicles to cross streams in the existing pipeline ROW would be used during new pipeline installation and long-term maintenance (Luminant 2010a). The tributaries are intermittent streams (HDR 2008), which typically lack surface flow during dry periods and support minimal aquatic communities. Squaw Creek immediately below the dam is a small stream in which a minimum flow of 1.5 cfs is maintained by routine discharges from the dam (Luminant 2009a). Assuming the methods described above are used and that BMPs would be employed to minimize impacts from sediment transport into the waterbodies, there would be minimal adverse impacts on aquatic resources from pipeline installation.

The review team concludes that the impacts of transmission line, pipeline, and ROW preconstruction activities on aquatic resources and wetlands would be minimal and that additional mitigation beyond the practices described may be required in the USACE permit.

Table 4-4. Stream Crossings for the New Pipelines to be Installed in the Existing ROW Between CPNPP and Lake Granbury

Stream Crossing ID	Stream Name	Stream Type	Estimated Stream Width (ft)	ROW Area at Stream Crossing (ac)[(a)]
PSC-1	unnamed	intermittent	40	0.05
PSC-2	unnamed	intermittent	40	0.05
PSC-3	unnamed	intermittent	40	0.05
PSC-4	unnamed	intermittent	40	0.05
PSC-5	unnamed	intermittent	40	0.05
PSC-6	unnamed	intermittent	40	0.05
PSC-7	Squaw Creek	intermittent [(b)]	50	0.06
PSC-8	Panther Branch	intermittent	40	0.05
PSC-9	Panther Branch	intermittent	40	0.05
PSC-10	Panther Branch	intermittent	40	0.02
PSC-11	Panther Branch	intermittent	40	0.02
Total Pipeline ROW Acreage at Stream Crossings				0.56

(a) ROW area at each stream crossing = estimated stream width x ROW width. Width of existing ROW is 50 ft.
(b) Squaw Creek is depicted as an intermittent stream on the topographic map; however, its flow is perennial downstream of the SCR dam in the area of the proposed pipeline crossing.

Source: Luminant 2010a

4.3.2.3 Important Aquatic and Wetlands Species and Habitats

This section describes the potential effects on important aquatic and wetlands species and their habitats, including recreationally important fishes and the forage fishes on which they feed, and

Federally or State-listed threatened or endangered aquatic species that may result from building the proposed CPNPP Units 3 and 4 and associated new transmission line and pipeline ROWs. The biology and life histories of important species are presented in Section 2.4.2.4. The nonnative and nuisance species discussed in Section 2.4.2.4 can have important ecological effects, which are predominantly adverse, but these species would not be affected by construction and preconstruction activities. The potentially affected wetland habitats are small, of limited value, and are not critical to important aquatic species. The potential impacts of construction and preconstruction activities on important aquatic species of the potentially affected water bodies are described in the following sections.

Recreational Fishery and Forage Species

Although SCR was stocked with fish and opened for public fishing soon after its completion, fishing by the public was banned in SCR for security reasons in September 2001. CPNPP employees and certain invited groups were allowed to fish from the banks of SCR, but boats were not permitted (Luminant 2009a). SCR has been reopened to the public for full recreational uses, including fishing and boating, but access will be controlled. There would be no in-water facilities installed on SCR in conjunction with CPNPP Units 3 and 4, so the recreational fishery and forage fish populations of the reservoir would not be affected.

Water-based recreation is among the uses for which Lake Granbury is operated by the Brazos River Authority. The overall fishing opportunities provided by Lake Granbury are rated by TPWD as good for largemouth bass (*Micropterus salmoides*), striped bass (*Morone saxatilis*), white bass (*M. chrysops*), channel catfish (*Ictalurus punctatus*), and sunfish (*Lepomis* spp.) and fair for white crappie (*Pomoxis annularis*) (TPWD 2009a). Lake Granbury populations of game fish and forage fish, such as threadfin shad (*Dorosoma petenense*) and gizzard shad (*D. cepedianum*), have been reduced annually since 2001 by toxic blooms of golden alga (*Prymnesium parvum*). Stocking has been used to mitigate the losses of striped bass and largemouth bass (Baird and Tibbs 2006). Relatively small areas of habitat potentially used by these or other fishery and forage species in Lake Granbury would be lost due to installation of the proposed intake and discharge structures upstream from the dam. These species are mobile and could avoid areas where construction and preconstruction activities and associated effects, including noise, are occurring. Use of erosion prevention and stormwater management practices in areas adjacent to SCR and Lake Granbury would prevent or minimize the potential for sediment-related effects on fishes. Accordingly, the review team concludes that impacts on important fishery and forage species from construction activities associated with CPNPP Units 3 and 4 would be minimal.

Aquatic and Wetlands Threatened and Endangered Species

As discussed in Section 2.4.2.4, Federally listed aquatic species are not known or likely to occur in SCR or Lake Granbury or in the stream segments or wetlands that would be crossed by the proposed new transmission lines. Consequently, the potential for Federally listed aquatic species to be affected by activities related to facility development would be negligible. The Brazos water snake (*Nerodia harteri*) is the only State-listed aquatic species with recorded occurrences in the counties potentially affected by the proposed CPNPP Units 3 and 4 facilities (Somervell and Hood Counties) or the two proposed new transmission line ROWs (Somervell, Hood, and Bosque Counties).

The Brazos water snake has a State listing status of threatened. This status has been attributed to its limited range and specific habitat requirements (McAllister and Bursey 2008). Threats to the species' range and distribution include dams, which can inundate streams and reduce available riverine habitat. However, the standing waterbodies that result from such barriers may also provide suitable habitat for this snake. According to the Rare Resource Occurrences database maintained by the TPWD (TPWD 2009c), three Brazos water snakes were sighted within 10 mi of the proposed CPNPP Units 3 and 4 site between 1984 and 1989. A study by McAllister and Bursey (2008) reported that a total of seven individuals of this species (juveniles and adults) were collected in Somervell County in July 1987 and between May and July 1988. Scott et al. (1989) identified the snake along the PKL and Lake Granbury shorelines but stated that the exact distribution within Lake Granbury is unknown. In addition, more recent surveys were conducted throughout the range of the species including stretches of the river system that were listed as uninhabited by others (McBride 2009). Results of these surveys identified habitat for this species just below the DeCordova Dam but not in Lake Granbury itself, which is probably an artifact of high lake levels and sampling techniques (McBride 2009).

The shoreline of SCR would not be substantially affected by the proposed development associated with Units 3 and 4, and the area of shoreline on Lake Granbury that would be affected by installation of the intake structure and discharge pipeline would be very small compared to the available shoreline of the reservoir. It is possible that the rip-rap associated with the proposed structures would provide suitable habitat for the Brazos water snake. The BMPs that would be employed to minimize or prevent sediment-related impacts on water quality would prevent impacts on the populations of small forage fishes on which the Brazos water snake would potentially feed. In addition, snakes are highly mobile and able to avoid areas of activity related to the building of facilities. Therefore, it is unlikely that the snake would be adversely affected during the development period.

Three species of freshwater mussels that are State-listed as threatened are designated by TPWD as potentially occurring or having been recorded in at least one of the three counties in which proposed facilities would be located: the Texas fawnsfoot (*Truncilla macrodon*) in Hood, Somervell, and Bosque Counties; and the false spike mussel (*Quincuncina mitchelli*) and smooth pimpleback (*Quadrula houstonensis*) in Bosque County. Two other mussels, the pistolgrip (*Tritogonia verrucosa*) and rock pocketbook (*Arcidens confragosus*), are State species of concern designated by TPWD as potentially occurring or having been recorded in all three of the counties in which proposed facilities would be located (TPWD 2010b, 2010c, and 2010d).

The Texas Natural Diversity Database includes no reported observations of any of these mussels within 10 mi of the proposed CPNPP Units 3 and 4 or the proposed new transmission line ROWs (TPWD 2009c). The false spike mussel possibly has been extirpated in Texas (TPWD 2010c). Although habitats supportive of all five species potentially could be present in the Brazos River between Lake Granbury and Lake Whitney, these mussels are not known to occur in this river segment and were not found in recent biological surveys at a location downstream of the DeCordova Bend Dam (Bio-West 2008). Although the smooth pimpleback and rock pocketbook may occur in reservoirs, they have not been reported in recent surveys of invertebrate organisms in Lake Granbury and SCR. Thus, none of the five species of mussels is likely to occur in Lake Granbury or SCR, which is where construction or preconstruction activities potentially could affect benthic invertebrates, and these activities would not occur in the river.

An additional species designated as a State species of concern with the potential to occur in Bosque County is the Guadalupe bass (*Micropterus treculii*) (TPWD 2010b). The Guadalupe bass utilizes habitats with flowing water, preferring downstream segments of small streams, and it would not occur in reservoirs such as Lake Granbury or SCR. The range of the Guadalupe bass is limited to the northern and eastern parts of the Edwards Plateau region of south-central Texas, including portions of the Brazos River drainage well downstream of Lake Whitney, such as the Lampasas, Leon, and Little Rivers (Lee et al. 1980). Thus, the Guadalupe bass does not occur in the Brazos River drainage in Hood or Somervell Counties, and review of available records in the Texas Natural Diversity Database indicates that its last reported observation within 10 mi of the proposed new CPNPP Units 3 and 4 transmission line ROWs in Bosque County was in 1979 (TPWD 2009c). Consequently, the Guadalupe bass would not be likely to occur in these reservoirs or the Brazos River above Lake Whitney and would not be affected by construction or preconstruction activities on the reservoirs. Based on threatened and endangered species surveys, historical records, life history information, known species occurrence locations, and information provided by Luminant (Luminant 2009a) and responses to RAI responses, the review team concludes that the impacts on aquatic Federally or State-listed threatened and endangered species from construction and preconstruction activities associated with CPNPP Units 3 and 4 would be minimal.

4.3.2.4 Monitoring of Aquatic Ecosystems and Wetlands during Development

Luminant does not plan to conduct formal development-related monitoring of aquatic and wetlands ecosystems due to the small potential for adverse impacts. In the event that a protected species was found to be present, work in the immediate area would be halted, and appropriate Federal and State agency officials and environmental consultants would be contacted to determine proper mitigation measures so that work could resume (Luminant 2009a). In addition, monitoring and reporting requirements as specified in USACE permits would be applicable.

4.3.2.5 Potential Mitigation Measures for Development-Related Aquatic Ecology and Wetlands Impacts

Upon completion of the final design for CPNPP Units 3 and 4, associated impacts to aquatic and wetlands resources would be evaluated, and appropriate permitting would be obtained from the USACE prior to construction or preconstruction activities. USACE coordination would include analysis of the identified impacts and a functional assessment of the proposed mitigation plan to ensure in-kind replacement of lost resources according to each design alternative (Luminant 2009a). The analysis would include how each project alternative was designed to avoid, minimize, and compensate for impacts to the aquatic resources. Impacts would be offset through the development of a USACE approved compensatory mitigation plan for the final design as part of the Section 404 permitting process.

4.3.2.6 Summary of Impacts to Aquatic and Wetlands Resources during Construction and Preconstruction

The review team reviewed the proposed construction and preconstruction activities for CPNPP Units 3 and 4 and the potential impacts to aquatic biota in the affected waterbodies and wetlands. Any impacts that would occur would be temporary and largely mitigable; compensatory mitigation may be required by the USACE permit. Based on this information, information provided by Luminant, and the review team’s independent evaluation, the review team concludes that the impacts of construction and preconstruction activities for the proposed CPNPP Units 3 and 4 upon aquatic resources would be SMALL and that further mitigation beyond the actions stated above and arising from USACE permits would not be warranted.

The NRC staff concludes that essentially all impacts to aquatic resources would be from preconstruction activities. Therefore, the NRC staff concludes that the impacts to aquatic ecosystems from NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.4 Socioeconomic Impacts

Building activities at CPNPP Units 3 and 4 could affect individual residents and communities in the surrounding region. Although the review team considered the entire 50-mi CPNPP region when assessing socioeconomic impacts, as described in Section 2.5, the primary Economic Impact Area (EIA) would be the six-counties in which more than 96 percent of the current CPNPP workforce resides: Somervell, Hood, Bosque, Erath, Johnson, and Tarrant Counties.

The review team reviewed the ER prepared by Luminant and verified the data sources used in its preparation by examining cited references. The review team requested clarifications and additional information from Luminant where needed to verify data in the ER. Unless otherwise specified in the following sections, the review team has drawn upon verified data from Luminant's ER and responses to requests for additional information. Where the review team used different analytical methods or additional information for its own analysis, the following sections include explanatory discussions and citations for additional sources.

4.4.1 Physical Impacts

Building activities at CPNPP Units 3 and 4 would cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, and dust. Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section addresses the physical impacts that could affect people, buildings, and roads. Section 4.4.2 addresses the potential impacts of building-related population growth, jobs, incomes, and taxes on the EIA.

4.4.1.1 Workers and the Local Public

As discussed in Section 2.5.1.1, the area near the CPNPP site is rural, with a relatively low population density. The 2007 estimated population within 5 mi of the CPNPP site was only 3530 individuals, with a population density of 45 people per square mile.

People in the project area who could be vulnerable to noise, fugitive dust, and gaseous emissions resulting from building activities at CPNPP Units 3 and 4 are listed below in order of most vulnerable to least vulnerable.

- Workers on the site.
- People working or living immediately adjacent to the CPNPP site.
- Transient populations such as temporary employees, recreational visitors, and tourists.

Workers within the CPNPP site boundary would experience the most direct physical impact related to building activities. However, the workers would have adequate training and personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care would be available at the site, and regular health and safety monitoring would be conducted. These activities would be performed in compliance with local, State, and Federal regulations and site-specific permit conditions. Reasonable efforts would be taken to make transient populations aware of the potential impacts of building activities.

Approximately 675 ac of the CPNPP site would be disturbed to build Units 3 and 4. Most of the disturbance would occur on previously disturbed areas or ones that are currently forested. Offsite work would include developing the transmission line ROWs and of the water pipeline from Lake Granbury. Building activities would result in elevated noise and dust levels and traffic on roads. In addition to dust, construction equipment would increase local air pollution emissions. Blasting to remove native rock could result in both noise and shock impacts. Erection of cranes and buildings might affect the aesthetic qualities of the community.

4.4.1.2 Buildings

Building activities would not be likely to affect any offsite buildings, primarily due to distance. The nearest residence is 0.8 mi southwest of the CPNPP Units 3 and 4 center point, to the east of FM 56 and adjacent to the CPNPP site boundary. Because of their distance from the CPNPP site, no offsite industrial or commercial facilities would be affected by building activities.

Many existing onsite buildings related to the safety of CPNPP Units 1 and 2 were constructed to meet seismic qualification criteria, which makes them resistant to the effects of vibration and shock similar to that which could occur during onsite building. Other onsite facilities were constructed to the appropriate building codes and standards, which included consideration of seismic loads. Regardless of the applicable design standard, building activities would be planned, reviewed, and conducted in a manner that would ensure no adverse effect on CPNPP Units 1 and 2 and the other buildings onsite.

Historically significant buildings or recognized cultural resources within the CPNPP site boundary are discussed in Section 2.7, and impacts on historically significant buildings are discussed in Section 4.6.

The distance of the nearest offsite structures would minimize the interaction of the buildings with development activities, while the design of onsite buildings would ensure no adverse effects on CPNPP Units 1 and 2. Thus, the impact of plant development on buildings would be minimal, and no mitigation would be warranted.

4.4.1.3 Roads

Building activities at CPNPP Units 3 and 4 would increase vehicular traffic on local roads and highways because additional workers and delivery trucks would drive to and from the CPNPP site each day and in-migrating workers and their families would drive on local roads and highways for personal travel. Section 2.5.2.3 describes the local transportation network around the CPNPP site, and Figure 2-21 illustrates the road and highway systems in Somervell and Hood counties.

Given the size of the traffic increases that would occur due to worker trips to and from the CPNPP site and to personal trips by workers and their families (Section 4.4.4.1), it is likely that building activities at Units 3 and 4 would have noticeable physical impacts on some roads in the EIA, especially FM 56 north of the CPNPP entrance. This would be most evident when the physical impacts of traffic generated at the CPNPP site are combined with the existing physical impacts of the large trucks used for gas exploration and drilling in the project area. These impacts could warrant increased road repairs and maintenance (especially on FM 56) and additional mitigation measures from Luminant and the Texas Department of Transportation (TxDOT). Section 4.4.4.1 discusses the socioeconomic impacts of the additional vehicular traffic on local roads and highways in the context of existing traffic volumes, road capacities, and level of service (LOS).

4.4.1.4 Aesthetics

Building activities at CPNPP Units 3 and 4 would be visible primarily to workers onsite and nearby residents because visibility from other areas offsite would be obstructed by the hilly topography of the area. Luminant has committed to using materials and lighting that would reduce visual impacts, as described in Section 3.1 of its ER.

Federal regulations require that any temporary or permanent structure, including all accompaniments, that exceeds an overall height of 200 ft above ground level be appropriately marked with lighting. The tallest structures onsite during the building period are expected to be the cranes used for building facilities. Because these cranes primarily consist of iron framework, they tend to be less visible from a distance than solid structures such as the Units 1 and 2 reactor domes, which are the tallest and most visible structures on the site. However, the cranes and other tall equipment would be outfitted with lights, which would create an additional visual impact.

The CPNPP Units 1 and 2 reactor domes are 266 ft tall and would be taller than any permanent structures associated with Units 3 and 4. Thus, because CPNPP Units 1 and 2 have been in operation since 1990 and 1993, respectively, it is likely that the most severe visual impacts have already occurred. The Units 1 and 2 reactor domes are visible from Dinosaur Valley State Park and Oakdale Park. Because visual effects are inversely related to distance, the effects of the CPNPP reactor domes on most other parks in the region are minimal. ER Section 2.2.1 discusses the visual effect of the reactor domes as a function of distance and angle of vision occupied by the domes; as distance from the domes increases, the angle of vision occupied by the domes decreases. Most of the parks in the region are located more than 14 mi from the CPNPP site. Although the Units 1 and 2 reactor domes may be visible at that distance, they occupy less than 1 degree of vision. Thus, the visual impact of building Units 3 and 4 at the CPNPP site would be minimal and would warrant no mitigation beyond the measures proposed by Luminant in its ER.

4.4.1.5 Noise

Building activities at CPNPP Units 3 and 4 would create noise primarily associated with heavy equipment and vehicular traffic. Noise levels diminish with distance from the source due to geometric attenuation, sound absorption in air, and sound absorption by barriers (walls, trees, hills, etc.). Higher frequencies are absorbed more easily, and those frequencies are more attenuated at a distance. While the attenuation of the power density in the sound is proportional to the inverse of the distance squared, the loudness is determined by the sound pressure level, measured in decibels. There is an approximately 3 decibels (acoustic) (dBA) decrease in sound volume for a doubling in distance from a line source and an approximately 6 dBA decrease in volume when the distance from a point source is doubled.

Neither the State of Texas nor Hood and Somervell counties has developed a noise regulation that specifies the community noise levels that are acceptable. Luminant's ER identifies locations near the CPNPP site with potential sensitivity to noise, such as residences, churches, and the Happy Hill Children's Home. The distances to these locations ranged from 4193 ft (a road intersection within the CPNPP site) to 18,725 ft (a highway east of the CPNPP site). The nearest residence is 0.9 mi southwest of the site, just outside the site boundary.

Heavy equipment, such as scrapers and bulldozers, typically produces noise levels in the range of 70 to 90 dBA at distances of 100 ft. Noise at the nearest residence should be comparable to background levels (50 to 55 dBA). The development area nearest the CPNPP site boundary, a transmission line location, would be about 264 feet within the site boundary. Even there, a 90-dBA equipment noise level would be reduced to less than 80 dBA, exclusive of topography and vegetation effects. This activity would also be brief compared to the main building work at Units 3 and 4.

Overall, the impacts of noise from building activities at the CPNPP site would be minimal and would not warrant mitigation. However, Luminant has stated that specific measures may be used to reduce noise impacts as much as possible, including the use of quieter, newer equipment and mufflers, limiting noisy work to the daylight hours, and notifying the affected areas before unusual noise events (Luminant 2009a).

4.4.1.6 Air Quality

Building activities at CPNPP Units 3 and 4 would result in temporary impacts to local air quality as a result of emissions associated with building activities. Similar to any large-scale building project, dust particle emissions would be generated during ground-clearing, grading, and excavation activities. Fugitive dust particles would be generated from the movement of machinery and materials as well as during windy periods over recently disturbed or cleared areas. There would also be emissions of particulate matter, volatile organic compounds (VOCs), nitrogen oxides, sulfur dioxides, and carbon monoxide associated with the fueling and combustion of fuels in heavy equipment and off-road vehicles and the operation of a concrete batch plant. These emissions would be of similar type and magnitude to those associated with the building of any other facility of a similar size.

To minimize air quality impacts associated with these emissions, Luminant would need to modify the current air permit for the CPNPP facility, as well as the air permit for the concrete batch plant. These permits prescribe emissions limits and a variety of mitigation measures that would be implemented during building activities. Prior to site development, Luminant would develop a Dust Control Plan (or equivalent) describing the specific actions to be taken to mitigate the magnitude, duration, and timing of emissions to avoid releasing them during periods of high winds or poor air quality. These actions would include managing the use of unpaved roads (setting speed limits, using dust suppression, and minimizing dirt tracking onto paved roads); covering haul trucks; phasing grading activities to minimize the exposed amount of disturbed soils; stabilizing onsite roads and excavated areas with coarse material covers or vegetation; and performing proper maintenance of vehicles, generators, and other equipment.

As discussed in Section 2.9, Somervell County is in attainment or unclassified for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 FR 81.344). As a result, a conformity analysis on direct and indirect emissions would not be required (58 FR 63214).

4.4.1.7 Summary of Physical Impacts

Based on the information provided by Luminant and the review team's independent evaluation, the review team concludes that for workers and the local public, buildings, aesthetics, noise, and air quality, the physical socioeconomic impacts of construction and preconstruction activities for the CPNPP Units 3 and 4 would be SMALL and temporary, and no mitigation beyond that proposed by Luminant would be warranted. Therefore, NRC staff concludes that the physical socioeconomic impacts from NRC-authorized construction activities would also be SMALL, and no mitigation beyond that proposed by Luminant would be warranted.

Based on the size of the traffic increases that would occur due to construction and preconstruction activities at CPNPP Units 3 and 4, the review team concludes that the physical impacts on most roads in the EIA would be SMALL, but that the physical impacts on FM 56 (particularly north of the CPNPP entrance) would be MODERATE. Luminant estimates that the labor hours associated with NRC-authorized construction would be approximately 98 percent of the total labor hours required to develop CPNPP Units 3 and 4, such that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a). Based on this estimate, NRC staff also concludes that the physical impacts from NRC-authorized construction on most roads in the EIA would be SMALL, but that the physical impacts on FM 56 (particularly north of the CPNPP entrance) would be MODERATE. Thus, NRC staff concludes that NRC-authorized construction could warrant increased road repairs, maintenance, and additional mitigation measures on FM 56 from Luminant or TxDOT.

4.4.2 Demography

Section 2.5.1 provides population estimates and projections for the region and the EIA. Section 2.5.2.1 provides data on the labor force, employment, and unemployment in the EIA.

The expansion of drilling operations in the Barnett Shale area has increased the demand for skilled workers substantially in the region, with unemployment levels in 2008 below 5 percent. Luminant's ER shows the number of workers in the North Central Workforce Development Area (WDA) and the Tarrant WDA who are skilled in the various types of craft labor that would be required to build Units 3 and 4. The crafts with the most plentiful workers in the two WDAs are laborers, carpenters, and electricians. The crafts with the least numbers of workers are millwrights, structural ironworkers, and boilermakers. Luminant expects a shortage of skilled workers, with very high shortages of boilermakers, carpenters, cement masons, and pipefitters and high shortages of ironworkers, electricians, and sheet metal workers.

Using Luminant's projection of the peak construction workforce (4953 workers), building Units 3 and 4 would require almost 10 percent of the boilermakers, 43 percent of the millwrights, and 62 percent of the structural ironworkers in the North Central and Tarrant WDAs (Luminant 2009a). Luminant states that it is very unlikely that such high percentages of skilled craftsmen would be available to work on Units 3 and 4. Also, many types of craft labor are location-dependent, and the workers must travel from site to site, sometimes across the country. Thus, Luminant expects that a large number of the workers needed to build Units 3 and 4 would come from outside the region and perhaps even outside the state of Texas (Luminant 2009a).

A 1983 study of nuclear power plant construction found that up to 30 percent of the construction workforce came from the local area (Pijawka and Chalmers 1983). The cases with the largest percentages of local workers occurred when there was rapid population growth in the area and a large indigenous workforce. Somervell and Hood counties are experiencing rapid population growth along with the Fort Worth metropolitan area. In addition, the North Central and Tarrant WDAs are forecast to have more than 17,000 laborers by 2014 (Luminant 2009a). Thus, the review team expects that the CPNPP region would provide a similarly large percentage of local workers to develop CPNPP Units 3 and 4. For this analysis, the review team assumes that 30 percent of the construction workers would come from inside the region and 70 percent from outside the region.

As indicated in Tables 4-5 and 4-6, Luminant estimates that there would be 4953 construction workers onsite during the peak building period in late 2014. For most socioeconomic resources, the review team analyzed only the impacts of the peak building period as an upper bound to potential impacts, recognizing that impacts would likely be smaller during the rest of the building period. From Luminant's estimate, the review team assumes that 30 percent of the construction workers (1486 workers) would come from inside the region, and that 70 percent (3467 workers) would in-migrate from outside the region. Because jobs such as those developing CPNPP Units 3 and 4 provide employment for only a few years, most of the in-migrating construction workers would choose not to relocate their families to the region. Thus, this analysis assumes that only 25 percent of the in-migrating construction workers (867 workers) would bring a family and that 75 percent (2600 workers) would not bring a family.

In 2000, the average household size in Texas was 2.74 persons (USCB 2009b). However, the state average includes households that do not typically have children (e.g., elderly people). This analysis assumes an average household size of 3.0 as a more reasonable estimate of the family size that would be associated with the construction workforce. Consequently, the expected increase in population in the region due to in-migrating workers with families can be determined by multiplying the average household size (3.0) by the number of construction workers expected to in-migrate with their families (867 workers), for a total of 2601 new people in the region. When added to the 2600 in-migrating construction workers without families, the total population increase due to the in-migrating workforce would be 5201 people (Table 4-5).

Table 4-5. Total Number of Units 3 and 4 Construction and Operations Workers Onsite Each Year During Building[(a)]

Year	Construction	Operations	Total
2008	0	22	22
2009	0	60	60
2010	119	76	195
2011	621	92	713
2012	886	168	1054
2013	2423	213	2636
2014	4953	248	5201
2015	3739	378	4117
2016	598	457	1055
2017	0	494	494
2018	0	464	464
2019	0	412	412

(a) Does not include existing operations workers or outage workers at CPNPP Units 1 and 2.

Source: Luminant 2009a

Luminant also estimates that there would be 248 operations workers for Units 3 and 4 onsite during the peak building period in 2014. Luminant expects that 50 percent of these operations workers (124 workers) would come from inside the region and that 50 percent (124 workers) would in-migrate from outside the region. Luminant also expects that all the in-migrating operations workers would bring a family. Using an average household size of 3.0 persons, the in-migration of 124 operations workers would result in an additional 372 people in the region.

Thus, the combined in-migration of construction and operations workers and their families during the peak building period for Units 3 and 4 would result in a total population increase of 5573 in the region. There would also be about 800 - 1200 additional workers onsite in 2014 for a scheduled outage at CPNPP Unit 1. This analysis of population growth does not include these outage workers because they are part of the existing baseline. This analysis also does not include any population growth related to the creation of indirect jobs during the building period because the review team expects that all the indirect jobs would be filled by existing residents of the EIA (Section 4.4.3.1).

Based on the residential pattern of current CPNPP workers (Table 2-19), the review team assumes that 23 percent of the total in-migrants (1282 persons) would reside in Somervell County and that 44 percent (2452 persons) would reside in Hood County. The review team further assumes that 11 percent (613 persons) would reside in Johnson County, 9 percent (501) in Tarrant County, 5 percent (279) in Erath County, and 4 percent (223) in Bosque County. The remaining 4 percent (223) would reside in Hamilton and Parker counties. Table 4-6 presents the calculations behind these assumptions. This influx of construction and operations workers and their families during the peak building period would represent 16.7- and 5.0-percent increases in the projected 2010 populations (Table 2-19) of Somervell and Hood counties, respectively. The percentage increases in the projected 2010 populations for the other study area counties would be much smaller, as follows: Johnson County (0.4 percent), Tarrant County (0.03 percent), Erath County (0.7 percent), and Bosque County (1.2 percent).

Based on these factors and information provided by Luminant and the review team's independent evaluation, the review team concludes that the number of in-migrating construction workers and their families would represent a MODERATE population increase for Somervell and Hood counties, but only a SMALL population increase for the four other counties in the EIA. Luminant estimates that the labor hours associated with NRC-authorized construction would be approximately 98 percent of the total labor hours required to develop CPNPP Units 3 and 4, such that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a). Based on this estimate, NRC staff also concludes that the number of workers and their families in-migrating because of NRC-authorized construction would represent a MODERATE population increase for Somervell and Hood counties, but only a SMALL population increase for the four other counties in the EIA. The impacts of this population growth on transportation, recreation, housing, public services, and education in the EIA are discussed in Sections 4.4.4.1 through 4.4.4.5.

4.4.3 Economic Impacts to the Community

This section evaluates the economic impacts on the region during the building of CPNPP Units 3 and 4. The evaluation focuses on the impacts that would occur because of the presence of the large workforce during the peak building period.

4.4.3.1 Economy

The impacts of developing Units 3 and 4 on the local and regional economy would depend on the region's current and projected population and economy. Section 2.5.1 provides population estimates and projections for the region and the EIA. Section 2.5.2.1 describes the economic characteristics of the EIA, including the labor force, employment by industry type, unemployment, total personal income, and per capita income.

Building CPNPP Units 3 and 4 would have economic impacts in the EIA by creating direct and indirect jobs and incomes, increasing purchases of goods and services, and generating tax revenues (tax revenues are discussed separately in Section 4.4.3.2.) As indicated in Tables 4-3 and 4-4, the peak number of workers (construction and operations) onsite during the building period would be 5201, with 70 percent of the construction workers (3467 workers) and 50 percent of the operations workers (124 workers) in-migrating from outside the region or the state. Thus, the project would provide 1486 construction jobs and 124 operations jobs for workers who already reside in the EIA. These direct jobs would help reduce unemployment in the study area, which had a total of 49,062 unemployed workers in 2008 (Table 2-19).

Table 4-6. Potential Population Growth in the EIA Due to Peak Building Year (2014) Employment at CPNPP Units 3 and 4

	Total	Somervell County	Hood County	Bosque County	Erath County	Johnson County	Tarrant County	Other counties
Construction workers	**4953**							
In-migrants (70% of total)	3467	797	1525	139	173	381	312	139
With family (25%)	867	199	381	35	43	95	78	35
Avg. household size = 3.0								
Total including family	2601	598	1144	104	130	286	234	104
Without family (75%)	2600	598	1144	104	130	286	234	104
Total building-related in-migrants	5201	1196	2288	208	260	572	468	208
Operations workers[(a)]	**248**							
In-migrants (50% of total)	124	29	55	5	6	14	11	5
With family (100%)	124	29	55	5	6	14	11	5
Avg. household size = 3.0								
Total including family	372	86	164	15	19	41	33	15
Without family (0%)	0	0	0	0	0	0	0	0
Total operations-related in-migrants	372	86	164	15	19	41	33	15
Total in-migrants	5573	1282	2452	223	279	613	501	223

(a) Includes only the Unit 3 and 4 operations workers who would be on-site during building; does not include existing operations workers at CPNPP Units 1 and 2 or outage workers.

Source: The review team, based on Luminant 2009a

In addition, the 3591 in-migrating construction and operations workers would create new indirect jobs in the EIA through a process referred to as the multiplier effect. The U.S. Department of Commerce Bureau of Economic Analysis provides regional multipliers (RIMS II Multipliers) for industry jobs and earnings. Luminant used RIMS II multipliers to estimate the number of indirect jobs and expenditures that would result from developing CPNPP Units 3 and 4. For the construction workforce, Luminant used the construction industry from the RIMS II Multipliers, resulting in a multiplier value of 1.48. This means that for every new construction worker in the project area, 0.48 indirect jobs would be created. Thus, the 3467 in-migrating construction workers would result in 1664 indirect jobs. For the 124 in-migrating operations workers, Luminant used the power generation and supply multiplier from the RIMS II Multipliers, resulting in a multiplier value of 2.1. This means that for every new operations worker in the project area, 1.1 indirect jobs would be created. Thus, the 124 in-migrating operations workers would result in 136 indirect jobs. Together, the in-migrating construction and operations workers would create a total of 1800 indirect jobs during the peak building period. Because most of these indirect jobs would be service-related and not highly specialized, the review team assumes that all of the indirect jobs would be filled by existing residents of the EIA. Therefore, these indirect jobs would help reduce unemployment in the EIA, which had a total of 49,062 unemployed workers in 2008 (Table 2-19).

The employment of a large construction workforce and a growing operations workforce at CPNPP Units 3 and 4 over the 7-year building period would also have positive effects on income in the EIA. Luminant estimated that the average annual salary for a construction worker at CPNPP would be about $30,000. However, based on experience in Texas, the review team estimates that the average annual salary would be closer to $54,000. Thus, assuming a peak construction workforce of 4953, the CPNPP construction workforce could earn a total of about $268 million at peak. Over the course of the 7-year building period, the workforce would earn over $1.2 billion in wages. Earnings of this magnitude would have a positive effect on the total and per capita income of the EIA (Table 2-22), which would be enhanced by the earnings of the 248 Units 3 and 4 operations workers who would be onsite during the building period and the 1800 indirect workers who would be employed during the building period.

Luminant estimates that, when combined, direct annual expenditures for labor and materials over the 7-year building period would average $240 million per year, with a peak of approximately $516 million in 2014. Most of the labor expenditures would occur in the EIA, but most of the materials expenditures would occur outside the area. Based on the construction multiplier of 1.58 from the RIMS II Multipliers, every dollar spent for direct expenditures would add an additional 0.58 dollar in indirect expenditures to the area. This would result in the generation of approximately $139 million per year in indirect expenditures over the 7-year building period, with a peak of approximately $299 million in 2014.

Building CPNPP Units 3 and 4 would have a beneficial effect on the economy of the EIA, and to a lesser extent the entire region, by creating direct jobs, incomes, and expenditures that would generate indirect jobs, incomes, and expenditures. The review team expects that labor expenditures would follow the residential pattern of CPNPP Unit 3 and 4 workers (Table 4-6), so about two-thirds of the labor expenditures ($177 million at peak; $800 million in total) would occur in Somervell and Hood counties and about one-third ($91 million at peak; $400 million in total) would be distributed among the other four counties.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the economic impacts of construction and preconstruction activities in Somervell County, and to a lesser extent in Hood County and the rest of the EIA, would be LARGE and beneficial. However, the review team concludes that the beneficial economic effects of construction and preconstruction activities in the rest of the region would be relatively SMALL. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the economic impacts of NRC-authorized construction in Somervell County, and to a lesser extent in Hood County and the rest of the EIA, would be LARGE and beneficial. NRC staff also concludes that the beneficial economic effects of NRC-authorized construction in the rest of the region would be SMALL.

4.4.3.2 Taxes

Section 2.5.2.2 discusses current tax revenues within the EIA. Building activities and purchases at CPNPP Units 3 and 4 and personal expenditures made by construction and operations workers would generate several types of taxes, including income taxes on corporate profits, wages, and salaries; sales and use taxes on corporate and employee purchases; real property ad valorem taxes related to the CPNPP facilities; and personal property taxes associated with employees.

While the State of Texas has no personal income tax, the wages paid to the construction and operations workers during the building period would generate Federal income tax revenue. The review team estimates that over the course of the 7-year building period the potential workforce income for Federal tax purposes could total over $1.2 billion.

As discussed in Section 2.5.2.2, the sales and use tax rate in populated areas in the EIA is 8.25 percent including local and State taxes. The review team's experience is that applicants purchase approximately 10 percent of their construction materials locally. Assuming the same percentage for CPNPP, the review team estimates that sales and use tax revenues on Luminant's local expenditures for materials would average $13 to $15 million per year during the 7-year building period. Of this tax revenue, 73 percent would go to the state of Texas, with the remaining revenue going to counties, cities, and local districts within the region.

Luminant currently pays ad valorem taxes on CPNPP Units 1 and 2 to Somervell and Hood counties and to several taxing jurisdictions within those counties (Section 2.5.2.2), and it is expected that Luminant would pay ad valorem taxes on Units 3 and 4 to the same jurisdictions. Although the tax rates for Units 3 and 4 have not been finalized, Table 4-7 provides an estimate of the potential tax revenues for affected jurisdictions assuming that Luminant pays the same ad valorem taxes on Units 3 and 4 as on Units 1 and 2. The review team expects that the amount of ad valorem taxes paid would increase each year as building progresses and property improvements are completed. For Units 1 and 2, Luminant paid ad valorem taxes on the partially completed units throughout the building period. If the same tax payment schedule is established for Units 3 and 4, and assuming a 7-year building period, the review team estimates that Luminant would pay approximately 1/7 of the full ad valorem tax the first year of building, 2/7 the second year, and so on until the end of the sixth year, when Luminant would pay 6/7 of the full ad valorem tax. In the next year, building would be completed and the full ad valorem tax would be considered part of operations, which is discussed in detail in Section 5.4. Given this estimated payment schedule, the review team anticipates that the total ad valorem taxes paid during the building period would be $52 million for the Glen Rose Independent School District (ISD) and $15 million for Somervell County (Table 4-7). These ad valorem tax revenues would surpass the current property tax revenues for both the Glen Rose ISD ($24.8 million) and Somervell County ($8.5 million) (Table 2-23).

Table 4-7. Potential Total Ad Valorem Taxes Paid on CPNPP Units 3 and 4

Somervell County	$15,370,812
Glen Rose	$105
Somervell County Water District	$5,646,612
Glen Rose ISD	$52,065,513
Hood County	$25,785
Tolar	$111
Granbury ISD	$56,202
Tolar ISD	$45,219
Hood County Library District	$765

ISD = Independent School District

Source: The review team, based on Luminant 2009a

Local tax revenues, especially from ad valorem taxes and sales and use taxes, would increase in the EIA during the building period. These increased tax revenues would be particularly beneficial for the local jurisdictions in Somervell and Hood counties.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the tax revenue impacts of construction and preconstruction activities in Somervell County, and to a lesser extent in Hood County, would be LARGE and beneficial. However, the review team expects that the beneficial effects of construction and preconstruction activities on tax revenues in the rest of the EIA and the rest of the region would be relatively SMALL. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the tax revenue impacts of NRC-authorized construction activities in Somervell County, and to a lesser extent in Hood County, would be LARGE and beneficial. However, NRC staff expects that the beneficial effects of NRC-authorized construction on tax revenues in the rest of the EIA and the rest of the region would be SMALL.

4.4.4 Infrastructure and Community Service Impacts

The local infrastructure and community services that would be affected by building activities at CPNPP Units 3 and 4 include transportation, recreation, housing, public services (including water and wastewater, solid waste, police, fire, medical, and social services), and education.

4.4.4.1 Transportation

Building activities at CPNPP Units 3 and 4 would increase vehicular traffic on local roads and highways because additional workers and delivery trucks would drive to and from the CPNPP site each day and in-migrating workers and their families would drive for personal travel. Section 2.5.2.3 describes the local transportation network around the CPNPP site and Figure 2-21 illustrates the road and highway systems in Somervell and Hood counties.

This section discusses the impacts of the additional vehicular traffic on local roads and highways in the context of existing traffic volumes, road capacities, and LOS. The review team's bounding analysis focuses on the two times each day when building would generate the most additional traffic—the morning and afternoon peak traffic hours when construction workers would enter and exit the CPNPP site from FM 56.

Luminant has stated that building would take place during a single shift each day and that all traffic would access the CPNPP site via the existing entrance from FM 56 (Luminant 2009a). The review team's traffic analysis does not include the 248 Units 3 and 4 operations workers who would be on-site during building (because they could arrive during off-peak hours) or the daily deliveries (because they would arrive at various hours throughout the day). Also, the review team does not include the current Units 1 and 2 operations and outage workers because their trips are already included in TxDOT traffic counts. To estimate the number of construction worker vehicles that would travel to and from the CPNPP site each day, the review team used the average worker vehicle occupancy recorded during development of CPNPP Units 1 and 2 in 1987 (2.34 workers per vehicle) (DeShazo, Starek & Tang, Inc. 1987). Based on this average occupancy, the 4953 construction workers would generate about 2117 vehicle trips to and from the CPNPP site each day.

As discussed in Section 2.5.2.3, TxDOT's 2007 traffic data indicate that FM 56 has an Annual Average Daily Traffic (AADT) count (bidirectionally) of 3500 vehicles just south of the CPNPP entrance and 8500 vehicles just north of it. Luminant states that FM 56 currently has a LOS of "A," meaning that there are no traffic delays on the road (Luminant 2009a). However, Luminant has not conducted a transportation study for building Units 3 and 4 and has provided no data on *peak* daily traffic counts on FM 56 or other roads.

Assuming the current percentages of average daily traffic south (30 percent) and north (70 percent) of the CPNPP entrance on FM 56, the addition of 2117 trips each day during the building peak would add 635 trips south of the entrance and 1482 trips north of it. This would increase the AADT bidirectional count on FM 56 south of the CPNPP entrance to 4135 and north of the CPNPP entrance to 9982. However, because AADT counts represent only the average daily flow of traffic in two directions (rather than the peak hourly flow in one direction), the review team believes that they do not accurately represent the traffic that would be added to FM 56. Because of the limitations in using an annual average, TxDOT adjusts AADT counts by using design hourly volume (DHV), which is usually "the 30th highest hourly volume for the design year" (TxDOT 2009). However, DHV also assumes a bi-directional flow of traffic. Therefore, the review team uses the DHV methodology to determine design hour maximum traffic counts on FM 56, but applies only half of the DHV to reduce the existing traffic count from bidirectional to unidirectional.

To calculate DHV, TxDOT uses the "K Factor," which is the percentage of the peak AADT that represents the 30th highest hourly traffic volume. For typical main rural highways such as FM 56, K Factors generally range from 12 to 18 percent (TxDOT 2009). DHV can be calculated by multiplying AADT by the K Factor, where K is the percentage of AADT occurring in the design hour:

$$DHV = (AADT)(K).$$

Applying this formula to the existing AADT on FM 56 (i.e., 3500 vehicles south of the CPNPP entrance and 8500 additional vehicles north of it) and using a K Factor of 18 percent, the review team derives the following:

- estimated DHV on FM 56 south of CPNPP is 3500 × 0.18 = 630 trips (315 trips in each direction) during the daily peak traffic hour and
- estimated DHV on FM 56 north of CPNPP is 8500 × 0.18 = 1530 trips (765 trips in each direction) during the daily peak traffic hour.

For an analysis of the impacts of building CPNPP Units 3 and 4, the review team believes that a K Factor of 18 percent is too low because most of the additional traffic generated on FM 56 would occur during 1-hr morning and afternoon traffic peaks as workers travel to and from the CPNPP site. To provide a more reasonable estimate of potential impacts, the review team assumes a K Factor of 75 percent for additional traffic during the building period (i.e., 75 percent of the additional trips on FM 56 would occur twice daily during 1-hr peaks, one in the morning and one in the afternoon).

Applying this formula to the projected increase in traffic on FM 56 due to building CPNPP Units 3 and 4 (i.e., 635 additional vehicles south of the CPNPP entrance and 1482 additional vehicles north of it) and using a K Factor of 75 percent, the review team derives the following:

- the increase in traffic on FM 56 south of CPNPP would be 635 × 0.75 = 476 trips during daily peak traffic hours and
- the increase in traffic on FM 56 north of CPNPP would be 1482 × 0.75 = 1112 trips during daily peak traffic hours.

As indicated in Table 4-8, the total traffic expected on FM 56 during peak morning and afternoon traffic hours would be 2668 vehicles, with 791 vehicles (315 existing + 476 new) south of the CPNPP entrance and 1877 vehicles (765 existing + 1112 new) north of it. According to the Transportation Research Board's 2000 *Highway Capacity Manual* (TRB 2000), the capacity of a two-lane highway such as FM 56 is 1700 vehicles per hour for each direction of travel (Luminant 2009a).

Thus, the total number of peak hour trips south of the CPNPP entrance (791 trips) would be less than half the design capacity of FM 56 (1700 trips), but the total number north of the CPNPP entrance (1877 trips) would exceed the design capacity of FM 56 by about 10 percent during the morning and afternoon peaks. An hourly traffic volume of this magnitude would have noticeable impacts on traffic flow and LOS on FM 56, primarily for workers traveling to and from the site from Granbury or Tolar. The review team believes that this impact would occur only during the peak traffic hours each day, and would be most severe during the morning peak for workers traveling south from Granbury or Tolar who would have to make a left turn (crossing north-bound traffic) to enter the CPNPP site.

Traffic increases associated with a total of 2117 worker trips to and from the CPNPP site each day during the building period would also affect other roads in the EIA, but the impacts would likely be less severe than on FM 56. Based on the residential pattern of current CPNPP workers (Table 2-21), the review team assumes that:

- 23 percent of the total increase in traffic (487 round trips) would originate in Somervell County
- 44 percent (931 round trips) in Hood County
- 11 percent (233 round trips) in Johnson County
- 9 percent (190 round trips) in Tarrant County
- 5 percent (106 round trips) in Erath County, and
- 4 percent (85 round trips) in Bosque County.
- 4 percent (85 round trips) in Hamilton and Parker counties.

Table 4-8. Peak Hour[(a)] Traffic Impacts on FM 56 During the Peak Building Year at CPNPP Units 3 and 4

			FM 56 South of the CPNPP Entrance				FM 56 North of the CPNPP Entrance			
Current Peak Hour Traffic Volume[(b)]	**Projected Peak Hour Traffic from CPNPP Construction Workers[(b,c,d)]**	**Projected Total Peak Hour Traffic Volume[(b)]**	**Current Peak Hour Traffic Volume[(b)]**	**Projected Peak Hour Traffic from CPNPP Construction Workers[(b,d)]**	**Projected Total Peak Hour Traffic Volume**	**Existing Capacity[(e)]**	**Current Peak Hour Traffic Volume[(b)]**	**Projected Peak Hour Traffic from CPNPP Construction Workers[(b,d)]**	**Projected Total Peak Hour Traffic Volume**	**Existing Capacity[(e)]**
1080	1588	2668	315	476	791	1700	765	1112	1877	1700

(a) The review team assumes two daily peak traffic hours (i.e., morning and afternoon shift changes).
(b) Calculated using TxDOT 2007 AADT data and K Factors of 18 percent (existing traffic) and 75 percent (CPNPP building-related traffic) based on TxDOT's *Roadway Design Manual* (TxDOT 2009).
(c) Does not include deliveries (which are assumed to occur throughout the day) or current CPNPP Units 1 and 2 operations or outage workers because their trips are already included in TxDOT traffic counts.
(d) Assumes 2.34 workers per vehicle based on DeShazo, Starek & Tang, Inc. 1987.
(e) Based on Transportation Research Board's 2000 *Highway Capacity Manual* (TRB 2000, as cited in Luminant 2009a).

Source: The review team, based on Luminant 2009a

Building CPNPP Units 3 and 4 would also affect roads and highways throughout the EIA because the in-migrating workers and their families would drive for personal travel (i.e., in addition to daily trips to and from CPNPP). As discussed in Section 4.4.2, the combined in-migration of construction and operations workers and their families during the peak building period would result in a total population increase of 5573 people in the region.

Assuming one household for each of the 991 in-migrating construction and operations workers with families, and one-half household for each of the 2600 in-migrating workers without families (for 1300 households, because many workers without families would tend to share housing as discussed in Section 4.4.4.3), the review team estimates that there would be 2291 new households in the EIA. According to the *Transportation Energy Data Book* (DOE 2008), the average U.S. household generates 3.4 vehicle round trips per day. Thus, subtracting the round trip to and from the CPNPP site each day, each of these 2291 new households could generate 2.4 additional vehicle round trips per day, for a total of about 5498 additional vehicle round trips each day. Based on the residential pattern of current CPNPP workers (Table 2-21), the review team assumes that the distribution of personal trips would be the same as that discussed above for worker trips (Table 4-9). The extent to which these additional personal trips would affect each county would depend on the existing traffic volume, capacity, and LOS of each county's roads.

Based on the size of the traffic increases that would occur due to construction and preconstruction activities at CPNPP Units 3 and 4, the review team concludes that impacts on traffic flow and LOS on most roads in the EIA would be SMALL, but that impacts on FM 56 (particularly north of the CPNPP entrance) would be MODERATE. Based on the estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction on traffic flow and LOS would be SMALL on most roads in the EIA, but MODERATE on FM 56 (particularly north of the CPNPP entrance).

Table 4-9. Expected Daily Traffic Distribution During the Peak Building Period at CPNPP Units 3 and 4

County	Percent of total increase in traffic	Worker trips to and from CPNPP	Personal trips by CPNPP workers and family
Somervell	23	487	1265
Hood	44	931	2419
Johnson	11	233	605
Tarrant	9	190	494
Erath	5	106	275
Bosque	4	85	220
Hamilton and Parker	4	85	220
TOTAL	100	2117	5498

Source: The review team, based on Luminant 2009a

This is especially true when the additional traffic is combined with the existing traffic impacts of the large trucks used for gas exploration and drilling in the project area. These impacts to traffic flow and safety on FM 56 could warrant additional mitigation measures from Luminant (such as two shifts each day, staggered shift change times, and mandatory carpooling for workers) and

TxDOT (such as improvements to traffic signals, lane width, turn lanes, and signage in the immediate area of the CPNPP site).

Figure 2-21 shows the railways in the immediate vicinity of the CPNPP site. The Ft. Worth Western Railroad Company owns and operates the railroad line that runs through Tolar approximately 10 mi northwest of the CPNPP site. The spur line that provides rail access to the CPNPP site connects with this main line in Tolar. Although Luminant would use the existing CPNPP rail spur for the delivery of materials, the additional rail traffic generated by building Units 3 and 4 is not expected to adversely affect rail service on the Ft. Worth Western Railroad main line through Tolar.

4.4.4.2 Recreation

Building activities at CPNPP Units 3 and 4 could affect recreation in the region by creating visual impacts near the site and increasing the residential population (which would increase the use of existing and planned recreational facilities), traffic on local roads and highways, and competition for hotel and motel rooms and spots in recreational vehicle (RV) parks.

Section 4.4.1 discusses the potential visual impacts of building at CPNPP Units 3 and 4. As of June 2010, Luminant began allowing controlled access for the public to the SCR for fishing and boating activities. Since the access is limited by Luminant, few individuals from the public would be affected by the building of the new reactors and thus the visual impacts would be minimal. The public recreational or tourist attraction closest to the CPNPP site other than the SCR is Dinosaur Valley State Park, located 3.3 mi to the southwest. The Units 1 and 2 reactor domes are visible from the park; therefore, building CPNPP Units 3 and 4 is expected to have a small, incremental visual impact. The Texas Amphitheater, located on a hill overlooking SCR 3.7 mi southeast of the CPNPP, hosts outdoor events, so building could result in a slight, temporary visual impact. Although the new recreational facilities at the Wheeler Branch Reservoir would be located only 1 mi south of the CPNPP site, it is likely that activities at the CPNPP site would not be visible because of the topography surrounding the reservoir. Other outdoor attractions are more than 5 mi away and probably would not be affected by the visual impacts of construction and pre-construction activities. Because of the distance of area attractions from the CPNPP site, the visual impacts on recreation would be minimal and temporary and would warrant no mitigation.

Section 4.4.2 discusses the population growth that could occur in the EIA as a result of developing CPNPP Units 3 and 4. The review team expects that population growth of the magnitude projected for the peak building period (i.e., 5573 new residents) would increase the use of existing recreational facilities and the demand for additional ones. However, it is also likely that the potential effects of this increased use and demand, such as the cost to repair or replace existing recreational facilities or provide new ones, could be offset by increased funding related to user fees and local and State tax revenues. Thus, the impacts of population growth would be minimal and would warrant no mitigation.

Section 4.4.4.1 assesses the potential impacts of developing CPNPP Units 3 and 4 on transportation in the EIA. The increases in vehicular traffic that would occur on local roads and highways (particularly FM 56) could adversely affect traffic flow and safety, which could affect the ability of tourists and recreational transients to travel near the CPNPP site. These impacts would be temporary, however, and would decrease with distance from the CPNPP site. Overall, the potential impacts of the increased traffic on FM 56 are likely to be noticeable (especially during the morning and afternoon peak traffic hours), but the impacts on other roads in the project area are likely to be minimal and would warrant no mitigation.

As discussed in Section 4.4.4.3, the short-term nature of many of the CPNPP construction jobs makes it likely that a large percentage of these in-migrating workers would opt for short-term housing in hotels, motels, or RV parks. It is likely that the presence of these workers during the peak building period would make it more difficult for recreational transients to find hotel or motel rooms or spots in RV parks, which might displace some of the transients to other housing in the region, such as cabins, bed and breakfasts, and lodges. However, as discussed in Section 4.4.4.3, the impacts on short-term housing availability and price for recreational transients would be minimal and would warrant no mitigation.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of construction and preconstruction activities at CPNPP Units 3 and 4 on recreation would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction activities on recreation would be SMALL and would warrant no mitigation.

4.4.4.3 Housing

Building CPNPP Units 3 and 4 would increase the demand for both short- and long-term housing in the EIA due to the in-migration of construction and operations workers and their families. Section 2.5.2.5 provides data on existing housing in the EIA, including the total number of units, total number and types of occupied units, total number of vacant units, and vacancy rates. As discussed in Section 2.5.2.5, most of the current CPNPP employees (more than 66 percent) live in Hood and Somervell counties, and more than 96 percent live in the EIA. This analysis assumes that most of the construction workers and almost all of the operations workers for Units 3 and 4 would follow this same residential pattern.

The combined in-migration of construction and operations workers and their families during the peak building period would result in a population increase of 5573 people in the region (Section 4.4.2). The review team's analysis assumes that each of the 991 in-migrating construction and operations workers with families would represent one household. However, the review team also assumes that each of the 2600 workers in-migrating without families would each represent one-half of a household (i.e., 1300 households) because many of these workers would tend to share housing. Given these assumptions, the peak building period at CPNPP Units 3 and 4 would create 2291 new households in the EIA. Thus, the total demand for short- and long-term housing units for the in-migrating construction and operations workers would be 2291 units.

There would be several refueling outages at CPNPP Units 1 and 2 during building at Units 3 and 4. Each of these outages would bring 800-1200 additional workers to the CPNPP site, including an outage scheduled for Unit 1 during the peak building year. However, these additional outage workers are already included in the baseline of existing housing demand, so the review team does not include them in the discussion of impacts to long-term housing.

Based on the residential pattern of current CPNPP workers (Table 2-21), the review team assumes that 23 percent of the additional housing units (527 units) would be needed in Somervell County and that 44 percent (1008 units) would be needed in Hood County. The review team further assumes that 11 percent (252 units) would be needed in Johnson County, 9 percent (206 units) in Tarrant County, 5 percent (115 units) in Erath County, and 4 percent (92 units) in Bosque County. The remaining 4 percent (92 units) would be needed in Hamilton and Parker counties. The data in Table 4-10 indicate that each of the counties in the EIA has an adequate number of existing vacant housing units to accommodate projected worker demand.

Table 4-10. Vacant Permanent and Temporary Housing Units[(a)] and Projected Housing Demand from In-Migrating CPNPP Workers (2014) in the EIA

	Vacant Permanent Units	Temporary Units	Projected Demand	Surplus (or Shortage)
Somervell County	312	471	527	256
Hood County	2880	834	1008	2706
Bosque County	1918	NA[(b)]	92	1826
Erath County	2473	363	115	2721
Johnson County	4708	260	252	4716
Tarrant County	65,514[(c)]	NA[(c)]	206	65,308

(a) Data are for 2007, except for 2000 data used for Somervell and Bosque counties.
(b) Data not available for Bosque County.
(c) Tarrant County includes the southwestern portion of the city of Forth Worth; data for Tarrant County include the entire county and the city of Forth Worth, so the number of temporary units is not included.

Sources: The review team, based on USCB 2007; USCB 2009a; Luminant 2009a

As indicated in Table 4-10, there are numerous hotels and motels in the EIA. When combined with houses and apartments for rent, these hotels and motels would help meet the increased demand for short-term housing. However, there would be competing demands for these short-term housing units from recreational transients as well as workers involved in Barnett Shale mining. It is likely that the number of construction and outage workers during the peak building period would make it difficult for recreational transients to find hotel rooms, which might displace some of the transients to other housing in the region, such as cabins, bed and breakfasts, RV parks, and lodges.

Another alternative for short-term worker housing would be the 11 RV parks located in Somervell and Hood counties (Section 2.5.2.5). These RV parks have a combined total of 619 spots, with possible expansion at two parks for a total of 90 additional spots. Almost all of the RV parks are frequented by CPNPP Units 1 and 2 outage workers, so the review team expects that some construction workers would also find lodging at these locations. As with hotels and motels, the construction workers would likely displace some recreational transients at these RV parks. However, there are numerous RV parks in the other cities in the region, including Cleburne, Stephenville, Joshua, and Alvarado. These cities are located approximately 30 minutes from the CPNPP site, so it is likely that some of the construction and outage workers would commute from these locations and the adverse impacts in terms of displaced recreationists would be minimal and would warrant no mitigation.

Given the number of short-term and long-term housing units available in the EIA, the review team expects that the in-migrating workers would be able to find sufficient housing within a relatively short commuting distance. Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of construction and preconstruction activities at CPNPP Units 3 and 4 on housing availability and price would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction activities on housing availability and price would be SMALL and would warrant no mitigation.

4.4.4.4 Public Services

Building activities at CPNPP Units 3 and 4 would increase the demand for a variety of public services in the EIA due to the in-migration of construction and operations workers and their families. Section 2.5.2.6 provides data on existing public services in the study area, including water and wastewater; solid waste; police, fire, and medical services; and social services. (Educational services are discussed separately in Sections 2.5.2.7 and 4.4.4.5.) This analysis of public service impacts assumes more than 66 percent of the onsite workers during the building of CPNPP Units 3 and 4 would live in Hood and Somervell counties and more than 96 percent would live in the EIA (Section 2.5.2).

As discussed in Section 4.4.2, the combined in-migration of construction and operations workers and their families during the peak building period would result in a population increase of 5573 people in the region. Given the assumptions described in Sections 4.4.2 and 4.4.4.1, the peak building period would create 2291 new households in the EIA. Thus, the total demand for public services would increase by 5573 people or 2291 housing units.

Based on the residential pattern of current CPNPP workers (Table 2-21), the review team assumes a similar residential pattern for in-migrating construction and operations workers at Units 3 and 4 (Section 4.4.2). The following subsections discuss the impacts of this population growth on existing and planned public services.

Water and Wastewater

Building CPNPP Units 3 and 4 would increase the demand for water and wastewater services in the EIA due to the projected in-migration of 5573 new residents during the peak building period. (Sections 3.3.1 and 4.2 discuss the increased demand for water and wastewater due to onsite building activities.) In 2006, municipal water use [defined as "city-owned, districts, water supply corporations, or private utilities supplying residential, commercial (non-goods-producing businesses), and institutional (schools, governmental operations)"] in the EIA averaged 148 gal per person per day (TWDB 2009).

Based on the population growth patterns discussed in Section 4.4.2 and the Texas Water Development Board's (TWDB) estimated demand of 148 gal of water per person per day, the review team estimates that 189,736 additional gallons per day would be used in Somervell County and that 362,896 additional gallons per day would be used in Hood County. The review team also estimates that the four other counties in this analysis would require additional water per day as follows: Johnson County (90,724 gal), Tarrant County (74,148 gal), Erath County (41,292 gal), and Bosque County (33,004 gal).

The data in Table 4-11 indicate that, with the exception of Bosque County, all of the counties in the EIA have adequate water treatment capacity to accommodate the additional demand that would result from population growth during the peak building period. Moreover, Somervell, Hood, and Johnson counties are planning expansions of their existing water supply and treatment systems (Section 2.5.2.6), so the available capacity in those counties should be even larger in 2014.

In Bosque County, the city of Walnut Springs has a current daily water usage of 6000 gpd serving 315 connections. However, maximum capacity data for the city's water treatment plant are not available. Assuming the same usage for additional connections, the approximate maximum capacity of the Walnut Springs water treatment plant is 38,100 gpd. The in-migrating residents could increase water usage by 33,004 gpd, bringing the total demand to more than 86 percent of existing facility capacity. Walnut Springs relies solely on groundwater, so it is likely that additional public or private wells would be needed to meet demand (Luminant 2009a).

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the increased demand for water associated with population growth from construction and pre-construction activities would have a SMALL impact. However, the city of Walnut Springs has an existing water treatment capacity problem that could be exacerbated by the in-migrating CPNPP construction workers. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the increased demand for water associated with NRC-authorized construction-related population growth would have only a SMALL impact. However, NRC staff concludes that the city of Walnut Springs has an existing water treatment capacity problem that could be exacerbated by the in-migrating workers associated with NRC-authorized construction.

Conventional wastewater planning assumes that all of the water consumed by residents is disposed of through wastewater treatment facilities. The data in Table 4-11 indicate that all of the counties in the EIA have adequate wastewater treatment capacity to accommodate the additional demand during the peak building period. However, some of the existing systems would be approaching their capacities, especially in Somervell, Hood, Bosque, and Johnson counties. Hood and Johnson counties are planning expansions of their existing wastewater treatment systems independent of the decision to construct CPNPP Units 3 and 4 (Section 2.5.2.6), so the available capacity in those counties should be sufficient. There are no current plans to expand the existing wastewater treatment systems in Somervell and Bosque counties, which have existing wastewater treatment capacity problems that would be exacerbated by the in-migrating construction workers.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the increased demand for wastewater treatment associated with population growth from construction and pre-construction activities would have a SMALL impact in most of the EIA, but could have a SMALL to MODERATE impact in Somervell and Bosque counties. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the increased demand for wastewater treatment associated with NRC-authorized construction-related population growth would have a SMALL impact in most of the EIA, but could have a SMALL to MODERATE impact in Somervell and Bosque counties.

Table 4-11. Existing Excess Water and Wastewater Treatment Capacity and Projected Water Demand from In-Migrating CPNPP Workers (2014) in the EIA

	Existing Excess Water Treatment Capacity (MGD)	Existing Excess Wastewater Treatment Capacity (MGD)	Projected Additional Water Demand (MGD)	Projected Surplus (or Shortage) Water Treatment Capacity (MGD)	Projected Surplus (or Shortage) Wastewater Treatment Capacity (MGD)
Somervell County	0.91	0.28	0.19	0.72	0.09
Hood County	7.10	0.99	0.36	6.74	0.63
Bosque County	0.03	0.06	0.03	0.0	0.03
Erath County	3.20	7.60	0.04	3.16	7.56
Johnson County	7.70	0.9	0.09	7.61	0.81
Tarrant County	320.02	57.5	0.07	319.95	57.43

Sources: The review team, based on Luminant 2009a

Solid Waste

Building CPNPP Units 3 and 4 would increase the generation of solid waste in the EIA due to the projected in-migration of 5573 new residents during the peak building period. (Section 3.3.1 discusses the increased generation of solid waste due to onsite building activities.) In 2007, per capita solid waste generation in the United States was more than 4.6 lb/day (or 1679 lb/yr) (EPA 2008).

Based on the population growth patterns discussed in Section 4.4.2 and a per capita generation rate of 1679 lb of solid waste per year, the review team estimates that 1076 additional tons of solid waste per year would be generated in Somervell County, 2058 additional tpy in Hood County, 515 tpy in Johnson County, 421 tpy in Tarrant County, 234 tpy in Erath County, and 187 tpy in Bosque County.

As discussed in Section 2.5.2.6, there are no active landfills in Somervell or Hood counties. In 2005 the IESI, Inc., Somervell County Transfer Station handled 14,284 tons of waste, and the IESI, Inc., Granbury Transfer Station handled 16,153 tons. Thus, the additional solid waste generated by the in-migrating residents of Somervell and Hood counties during the building peak would represent a 7.5 percent increase for the IESI, Inc., Somervell County Transfer Station and a 12.7 percent increase for the IESI, Inc., Granbury Transfer Station.

The total amount of additional solid waste from these two stations (3134 tons) would be transported to the IESI, Inc., Weatherford Landfill in Parker County. The Weatherford Landfill has an estimated 1.1 million tons of space remaining, so the total amount of solid waste generated by the new residents of Somervell and Hood counties during the building peak would represent only 0.3 percent of that excess capacity. Even considering the combined 1357 tons of additional solid waste that would be generated in Bosque, Erath, Johnson, and Tarrant counties, the review team expects that solid waste management and landfill capacity in the EIA would be adequate.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of increased solid waste associated with population growth from construction and pre-construction would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of increased solid waste associated with NRC-authorized construction-related population growth would be SMALL and would require no mitigation.

Police, Fire, and Medical Services

A temporary increase in population associated with the onsite workforce for a new nuclear facility can increase the burdens on local police and fire departments and medical services. Once building is completed, however, many of the onsite workers would leave, relieving the burden on public services.

Building CPNPP Units 3 and 4 would increase the need for services in the EIA due to the projected in-migration of 5573 new residents during the peak building period, 1196 into Somervell and 2288 into Hood Counties. (Section 3.3.1 discusses CPNPP onsite security, fire, and medical services during project building). The projected population of Somervell County in 2010 is 7693 (TSDC 2009a); given the county's current number of full-time police officers (19), it would have 2.5 officers per 1000 residents without the CPNPP in-migrating workers. With the CPNPP in-migrating workers during the peak building period, the number of police officers per 1000 residents in Somervell County would drop to 2.1. To maintain the current ratio of officers per 1000 residents, Somervell County would need to add about three police officers during the building peak employment period (2014).

Based on a projected 2010 population for Hood County of 48,396 (TSDC 2009a), the county's 67 full-time police officers represents 1.4 police officers per 1000 residents without the CPNPP in-migrating workers. With the CPNPP in-migrating workers during the peak building employment period, the number of police officers per 1000 residents in Hood County would drop to 1.3. To maintain the current ratio of officers per 1000 residents, Hood County would need to add about three police officers during peak employment.

Local police officials have stated that they already have plans to expand services due to population growth in Somervell and Hood counties independent of developing CPNPP Units 3 and 4 (Luminant 2009a). However, local police officials indicate that the planned building of CPNPP Units 3 and 4 would hasten the intended expansions of staffing and infrastructure. Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of construction and pre-construction on local police resources would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction activities on local police resources would be SMALL and would warrant no mitigation.

The projected population of Hood County in 2010 is 48,396 (TSDC 2009a). Given the county's current number of volunteer firefighters (250), it would have 5.2 firefighters per 1000 residents without the CPNPP in-migrating workers. With the CPNPP in-migrating workers during the peak building period, the number of firefighters per 1000 residents in Hood County would drop to 4.9. To maintain the current ratio of firefighters per 1000 residents, Hood County would need to add about 12 firefighters during peak employment.

The projected population of Hood County in 2010 is 48,396 (TSDC 2009a); given the county's current number of volunteer firefighters (250), it would have 5.2 firefighters per 1000 residents without the CPNPP in-migrating workers. With the CPNPP in-migrating workers during the peak building period, the number of firefighters per 1000 residents in Hood County would drop to 4.9. To maintain the current ratio of firefighters per 1000 residents, Hood County would need to add about 12 firefighters during peak employment.

CPNPP employs its own fire brigade to respond to all onsite emergencies; however, CPNPP uses local firefighters when necessary in such situations. Local fire officials have stated that they already have plans to expand services due to population growth in Somervell and Hood counties independent of developing CPNPP Units 3 and 4 (Luminant 2009a). However, local fire officials indicate that the planned building of CPNPP Units 3 and 4 would hasten the intended expansions of staffing and infrastructure. Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of construction and pre-construction on local firefighting capabilities would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction activities on local firefighting capabilities would be SMALL and would warrant no mitigation.

Currently, the combined daily load at Glen Rose Medical Center and Lake Granbury Medical Center is 23 beds. When planned expansions are complete, the two medical centers will have a combined capacity of 142 beds, well above the current demand. The population growth associated with onsite workers during the building peak would increase the populations of Somervell and Hood counties by 16.7 percent and 5.0 percent, respectively (Section 4.4.2).

However, these increases would be temporary, and the review team expects that the existing medical facilities would be more than adequate to accommodate the demands of this in-migrating population. Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of construction and pre-construction on local medical services would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction activities on local medical services would be SMALL and would warrant no mitigation.

Social Services

Social services in the EIA are provided by the Texas Department of Family and Protective Services, nongovernmental organizations (NGOs), and religious groups. To the extent that Luminant and its contractors would hire individuals who would otherwise rely on these social services, building CPNPP Units 3 and 4 would help reduce demands on the service providers. In addition, the beneficial economic effects of building CPNPP in terms of direct and indirect jobs and incomes (Section 4.4.3.1) and State and local tax revenues (Section 4.4.3.2) would enhance residents' and governments' ability to provide financial support for social services. However, some of the new residents in-migrating to the area because of CPNPP construction jobs would increase the demand for social services. Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the impacts of construction and pre-construction on social services would be SMALL and would warrant no mitigation. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction activities on social services would be SMALL and would warrant no mitigation.

4.4.4.5 Education

Section 2.5.2.7 contains information about current enrollments and capacities of the school districts most likely to be affected by CPNPP worker in-migration in Somervell and Hood counties. For the peak building period, the review team estimates that 867 construction workers and 124 operations workers would in-migrate with families to the EIA (Section 4.4.2). As discussed in Section 4.4.2, the review team's analysis assumes an average household size of 3.0 persons. With respect to CPNPP worker households, the review team further assumes that a family would average one child (aged between 0 and 18 year) per household, for a total of 991 new children in the EIA. Of these 991 new children, the review team assumes that 73.5 percent (728 children) would be school-aged (i.e., 5 to 18 year old) based on an even distribution of children aged 0 to 18 year. Thus, the review team's analysis assumes that the in-migrating workers would bring 728 new K–12 students to the study area during the peak building period.

Based on the residential pattern of current CPNPP workers (Table 2-21), the review team estimates that 167 new K-12 students would reside in Somervell County, 320 in Hood County, 80 in Johnson County, 66 in Tarrant County, 37 in Erath County, and 29 in Bosque County. The remaining 29 students would reside in Hamilton and Parker counties.

In Somervell County, Glen Rose ISD has a maximum capacity of 2862 students, with enrollment for the 2007–2008 school year at 1657 students. Thus, the addition of 167 new students would not put Glen Rose ISD at capacity. Officials with Glen Rose ISD have indicated that the school system would be capable of handling the influx of students generated by the anticipated construction workforce (Luminant 2009a).

In Hood County, Granbury ISD has a maximum capacity of 8556 students and a September 2007 enrollment of 6882 students. Thus, the addition of 320 new students would not put Granbury ISD at capacity.

Based on these factors and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the adverse impacts of construction and preconstruction activities on local school districts would be SMALL. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the adverse impacts of NRC-authorized construction on local school districts would be SMALL. One possible exception is Walnut Springs ISD in Bosque County, where enrollment could increase by 29 students (14 percent of current enrollment). However, during the building of CPNPP Units 1 and 2, the district accommodated an influx of approximately 140 students. Local officials have stated that the Walnut Springs ISD would be able to accommodate the additional students and would make any necessary expansions (Luminant 2009a).

4.4.4.6 Summary of Infrastructure and Community Service Impacts

In Sections 4.4.4.4 and 4.4.4.5, the review team evaluated the potential impacts to infrastructure and community services in the areas of public services (water and wastewater; solid waste; police, fire, and medical services; and social services) and education. Based on the information presented in those sections and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the infrastructure and community services impacts of construction and preconstruction activities would be SMALL, with the exception of potential MODERATE impacts to wastewater treatment facilities in Somervell and Bosque counties. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the impacts of NRC-authorized construction on infrastructure and community services would be SMALL, with the exception of potential MODERATE impacts to wastewater treatment facilities in Somervell and Bosque counties.

4.4.5 Potential Mitigation Measures for Socioeconomic Impacts

Most of the adverse socioeconomic impacts of developing CPNPP Units 3 and 4 would be SMALL and temporary and would not warrant additional mitigation. However, as discussed in Section 4.4.4.1, the traffic increases that would occur due to worker trips to and from the CPNPP site would have MODERATE impacts on traffic flow and LOS on FM 56 (particularly during the morning and afternoon peak traffic hours north of the CPNPP entrance). This is especially true when this additional traffic is combined with the traffic impacts of the large trucks used for gas exploration and drilling in the project area, which may not be fully characterized by the 2007 AADT data. These impacts could warrant increased road maintenance and repairs or additional mitigation measures from Luminant (such as two shifts each day, staggered shift change times, and mandatory carpooling for workers) and TxDOT (such as improvements to traffic signals, lane width, turn lanes, and signage in the immediate area of the CPNPP site). Prior to commencing project building, Luminant should coordinate with TxDOT and the governments of Somervell and Hood counties to plan for and implement appropriate mitigation.

4.4.6 Summary of Socioeconomic Impacts

The review team has assessed the proposed construction and preconstruction activities related to building CPNPP Units 3 and 4 and the potential socioeconomic impacts in the region. Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. Overall, construction and preconstruction activities at CPNPP Units 3 and 4 would have both adverse and beneficial impacts on socioeconomic resources in the EIA as explained below.

Based on information supplied by Luminant, the current availability of services, and additional taxes that would likely compensate the need for additional services, the review team concludes the impacts from construction and preconstruction activities on the affected local economies would be beneficial and SMALL in the EIA. The effect on tax revenues would be beneficial and SMALL, except for tax revenues in Somervell County (and to a lesser extent, Hood County), which would be beneficial and LARGE. The site is relatively isolated, so aesthetic and recreational impacts near the site would be SMALL.

The impacts on public services would be SMALL throughout the region. The review team expects the overall impact on infrastructure and community services would be SMALL with the exception of transportation. Increased vehicular traffic would occur, especially on FM 56, during the peak building period. Given the size of the traffic increases that would occur due to worker trips to and from the CPNPP site and to personal trips by workers and their families, it is likely that building would have SMALL impacts on traffic flow and LOS on most roads in the EIA, but MODERATE impacts on traffic flow and LOS on FM 56 (particularly during the morning and afternoon peak traffic hours north of the CPNPP entrance). These traffic impacts could warrant mitigation, as discussed in Section 4.4.5.

Population growth resulting from the in-migration of CPNPP construction and preconstruction workers during the peak periods would create additional demand for recreation, housing, public services (water and wastewater; solid waste; police, fire, and medical services; and social services), and education. However, the review team concludes that the impacts of this increased demand would be SMALL given existing and planned resources and facilities.

4.5 Environmental Justice Impacts

The review team evaluated whether building CPNPP Units 3 and 4 would have disproportionately high and adverse human health or environmental effects (Executive Order 12898) on minority or low-income populations in the region. To conduct this assessment, the review team: (1) identified all potentially significant pathways for human health and environmental effects, (2) determined the impact of each pathway for potentially affected minority and low-income populations identified in Section 2.6, and (3) determined whether the unique characteristics or practices of the populations would result in disproportionately high and adverse effects on the minority or low-income populations.

The closest minority population of interest shares a boundary with the CPNPP site to the south and west. Two small Census block group clusters lie about six mi from the CPNPP. At much greater distances (more than ten miles from the site) clusters of Census block groups can be found scattered throughout the southwest and the northeast of the site, with the largest concentrations of minority populations of interest near Fort Worth. Of these Census blocks, about 1.3 percent had an Aggregate Minority population that exceeded one of the above criteria, and about 5.1 percent had an Aggregate Minority plus Hispanic population that exceeded one of the above criteria. The closest Census block group cluster with a low-income population of interest lies between 30 and 35 mi of the CPNPP to the southwest, near Dublin in Erath County.

4.5.1 Health and Environmental Impacts

The review team evaluated whether the health or welfare of minority and low-income populations in those Census blocks identified in Section 2.6 of this EIS could experience disproportionately high and adverse effects from building the proposed Units 3 and 4 at the CPNPP site. To perform this assessment, the review team followed the methodology described in Section 2.6.1. In the context of construction and pre-construction activities at the CPNPP site, the review team considered the questions outlined in Section 2.6.1.

As discussed in Section 2.6.3, the review team did not find any evidence of unique characteristics or practices in the region that could lead to a disproportionately high and adverse effect on any minority or low-income population.

For all three health-related considerations described in Section 2.6.1, the review team determined through consultations with NRC staff health physics experts that the expected building-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and cannot impose a disproportionately high and adverse radiological health effect on any identified minority or low-income populations.

The health and environmental effects of building a nuclear power plant are very similar to those of constructing any large-scale industrial project. There are three primary exposure media in the environment: soil, water, and air. The following subsections discuss the potential impacts of project development through each of these pathways.

4.5.1.1 Soil Pathway

Building activities on the CPNPP site would represent the largest potential source of soil-related environmental impacts. However, soil-disturbing activities would be temporary, localized to the CPNPP site, and at least 0.9 mi from the nearest surrounding populations. Further, soil migration is not likely to occur due to adherence to regulations and permits and the use of BMPs. In addition, the building site would be well-defined, access would be restricted, and no minority or low-income populations or individuals would be relocated from the site. Therefore, the review team concludes that soil-related environmental impacts during the building of CPNPP Units 3 and 4 would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

4.5.1.2 Water Pathway

Water Quality: As discussed in Section 4.2.3, water quality impacts from building CPNPP Units 3 and 4 would be similar to those for other large industrial construction projects. Hydrological alterations resulting from site preparation and building activities would be localized and temporary, disturbed land would be stabilized to prevent erosion, and permits, certifications and the SWPPP would warrant the implementation of BMPs to minimize impacts. Therefore, in Section 4.2.3.1 the review team concludes that the surface water quality impacts of construction and preconstruction activities would be minimal. Similarly, in Section 4.2.3.2 the review team concludes that the groundwater quality impacts of construction and preconstruction activities would be minimal. Given these conclusions regarding surface water and groundwater, the review team concludes that the water-related environmental impacts of building CPNPP Units 3 and 4 would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

Water Quantity: As discussed in Section 4.2.2.1, CPNPP is the only consumptive user of water from SCR and there are no other users that depend upon water availability from SCR. Therefore, the review team determined there is no potential surface water pathway from building activities by which a disproportionately high and adverse impact could be imposed upon any minority or low-income population. In addition, as discussed in Section 4.2.2.2, there would be no groundwater use during construction of CPNPP Units 3 and 4 beyond current limited onsite withdrawals and there would be no impacts from groundwater use that could lead to a water quantity pathway to a disproportionately high and adverse impact from building activities.

4.5.1.3 Air Pathway

During the building of CPNNP Units 3 and 4, air emissions would be expected from increased vehicle traffic, construction equipment, and fugitive dust from building activities. Emissions from vehicles and construction equipment would be unavoidable, but they would be localized and small. Criteria pollutant emissions from fugitive dust would be localized, and particulate matter (primarily dust and diesel carbon exhaust) control measures would be implemented to maintain compliance with NAAQS. Because Somervell and Hood counties are currently in attainment of all of the NAAQS air pollutants, the marginal degradation of air quality that can be associated with the building activities of CPNPP Units 3 and 4 would impose negligible impacts on all populations. Therefore, the review team concludes that air quality-related impacts during project building would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

4.5.1.4 Noise

Building activities at CPNPP Units 3 and 4 would create noise primarily associated with heavy construction equipment and vehicular traffic. As discussed in Section 4.4.1.5, Luminant has stated that it would use specific measures to reduce noise impacts as much as possible, including using quieter, newer equipment, using mufflers, limiting noisy work to daylight hours, and notifying the affected areas before unusual noise events (Luminant 2009a). Because any noise impacts would be temporary and localized to the CPNPP site, the review team concludes that noise-related impacts during the building of CPNPP Units 3 and 4 would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

4.5.2 Socioeconomic Impacts

The review team reviewed the socioeconomic impacts of building CPNPP Units 3 and 4 (Section 4.4) to evaluate if there would be any disproportionately high and adverse human health or environmental effects on minority or low-income populations. Based on those evaluations, the socioeconomic areas in which disproportionately high and adverse effects are most likely would be in transportation and housing.

For transportation, increases in vehicular traffic during the peak building period would impede traffic flow and reduce LOS on area roads, especially FM 56 (Section 4.4.4.1). However, the review team concludes that these impacts would not have any disproportionately high and adverse effects on minority or low-income populations because the severity of the impacts on individual drivers would depend on where and when they drove rather than on their race, ethnicity, or income. Further, the area where local roads would be most affected (i.e., within 10-mi of the CPNPP) has much lower percentages of minority and low-income populations than the region and the state of Texas (Section 2.6). Therefore, in terms of transportation, the adverse impacts of building CPNPP Units 3 and 4 would not disproportionately affect minority and low-income populations.

The increased demand for short-term housing during the peak building period at CPNPP could decrease the availability and increase the price of short-term housing in the EIA (Section 4.4.4.3). Although increases in housing prices could have a temporary but noticeable effect on low-income populations because their ability to afford short-term housing would be reduced relative to that of higher-income populations the review team believes the impact would still be minimal, given the temporary nature of any potential price increase and the fact that low income housing prices are often subsidized or otherwise controlled, and that the amenities found in low income housing are not a good match with the factors driving the demand for construction worker housing.

4.5.3 Subsistence and Special Conditions

As discussed in Section 2.6.3, the review team's scoping and outreach did not identify any special socioeconomic or health circumstances or potential pathways that could lead to disproportionately high and adverse health and environmental impacts. Regarding subsistence populations, the review team did not identify any unique resource dependencies or practices or other circumstances that could result in disproportionately high and adverse impacts to minority or low-income populations. Specifically, based on U.S. Census data, the review team identified no low-income populations near the CPNPP site, where potential power plant related impacts would be expected to be most significant. Moreover, the low-income populations identified in the larger region are principally located within urban areas near the city of Forth Worth where subsistence-type dependence on natural resources (e.g., fish, game, agricultural products, and natural water sources) is less likely.

4.5.4 Summary of Environmental Justice Impacts

The review team found no evidence that the construction and preconstruction activities for CPNPP Units 3 and 4 would have any disproportionately high and adverse human health or environmental effects on minority or low-income populations through the pathways of soil, water, and air. Similarly, the impacts of construction and preconstruction activities on most socioeconomic resources would not have disproportionately high and adverse effects on minority or low-income populations.

Based on the information presented in this section and on information provided by Luminant and the review team's independent evaluation, the review team concludes that the environmental justice impacts of construction and preconstruction activities would be SMALL, and no further mitigation would be warranted.

4.6 Historic and Cultural Resources

The NEPA 1969, as amended, requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966 (NHPA 1966), as amended through 2000, also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the *National Register of Historic Places* (NRHP) (such resources are referred to as "historic properties" in NHPA). As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC coordinated compliance with Section 106 of NHPA in meeting the requirements of NEPA.

Construction and preconstruction of new nuclear power plants can affect either known or undiscovered cultural resources. The NRC has determined that evaluating the suitability of the existing CPNPP site for building, operating, and decommissioning a new nuclear unit is an undertaking that could possibly affect either known or potential historic properties that may be located at the site. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good-faith effort to identify historic properties in the Area of Potential Effect (APE) and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing in the NRHP) are present or affected, the NRC is required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve any adverse effects of the undertaking.

For specific historic and cultural information on the CPNPP site, see Section 2.7 of this EIS. As explained in Section 2.7, previous cultural resource identification efforts indicated the presence of several archaeological sites, one of which is eligible for listing in the NRHP. The NRHP-eligible site, 41SV30, lies outside of the APE for building impacts and was found to no longer retain its archaeological integrity (Luminant 2009a). Luminant reports that in February 2007 the SHPO concurred that no historic properties would be affected (Luminant 2009a).

Luminant plans to monitor land disturbing activities during the building of CPNPP Units 3 and 4 and associated transmission lines to identify potential cultural resources that may not have been identified during the Section 106 review process (Luminant 2009a). In the event of an inadvertent find, Luminant plans to stop work and notify the appropriate county authority, State Historic Preservation Office (SHPO), and Tribal Historic Preservation Office (THPO).

Transmission service for the CPNPP site is provided by Oncor, an independent system operator for the region. Oncor is responsible for operating, maintaining, building, dispatching, and marketing the electric transmission system from the generator bus bars on the CPNPP site through the distribution substations. Section 3.2.2.3 provides more details regarding Oncor's responsibilities.

Oncor has not finalized the routes and designs of the proposed transmission lines ROWs. Oncor has established procedures for identifying historic and cultural resources when siting and building new transmission line ROWs (Oncor 2008). The full extent of potential historic and cultural resource impacts in the transmission line ROWs would be estimated only after following the PUCT process for routing and alignment of such transmission lines (Luminant 2009a). Once this process is completed, Oncor would undertake the appropriate cultural resource studies to ensure that resources were identified and addressed before the transmission lines are built (Oncor 2008). In addition, consultation by Oncor with the Texas Historical Commission would establish requirements to follow should archaeological, historical, or other cultural resources be uncovered during building of the transmission lines (Oncor 2008). According to 10 CFR 50.10 (a)(2)(vii), transmission lines are not included in the definition of construction and are not an NRC-authorized activity.

Based on (1) the construction and preconstruction measures that Luminant would take to avoid adverse impacts to significant cultural resources, (2) the measures that Oncor would be expected to take to avoid adverse impacts to significant cultural resources, and (3) the review team's cultural resource analysis and consultation, it is the review team's conclusion that the potential impacts on historic and cultural resources would be SMALL. Mitigation might be warranted in the event of an inadvertent discovery.

The NRC staff believes that most of the impacts on cultural resources would be the result of preconstruction activities. Based on this information, the NRC staff concludes that the cultural resource impacts of NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.7 Meteorological and Air Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air quality of the CPNPP site. The primary impacts of building CPNPP Units 3 and 4 on local meteorology and air quality would be from dust from land clearing and building activities, open burning of debris, emissions from equipment and machinery, concrete batch plant operations, and emissions from vehicles used to transport workers and deliver materials to and from the plant site.

The ER (Luminant 2009a) describes the activities that would be conducted at the CPNPP site in Section 3.9. Sections 3.9.3 and 3.9.4 of the ER specifically address air quality impacts associated with land clearing and building activities. Air quality impacts directly associated with these activities are described in the next section (4.7.1); air quality impacts associated with transportation of construction workers are addressed in Section 4.7.2.

4.7.1 Construction and Preconstruction Activities

Preconstruction and construction activities at the CPNPP site would result in temporary impacts to local air quality. Fugitive dust particle emissions would be generated during earthmoving, concrete batch plant operation, and movement of vehicular traffic. Fugitive dust particles would be generated from the movement of machinery and materials as well as during windy periods over recently disturbed or cleared areas. There would also be emissions of particulate matter, VOCs, nitrogen oxides, sulfur dioxides, and carbon monoxide associated with the fueling and combustion of fuels in equipment, off-road vehicles, and the operation of a concrete batch plant. Because Somervell County is in attainment or unclassified for all criteria pollutants for which NAAQS have been established (40 CFR 81.344), a conformity analysis on direct and indirect emissions is not required (58 FR 63214).

To minimize impacts associated with these emissions, the facility would require a concrete batch plant air permit and a State Construction Air Permit. The concrete batch plant process would generate particulates during the loading of dry concrete and aggregate. Based on the estimated volume of concrete required, the total amount of particulates that would be generated is estimated to be less than 53 tons, which would qualify the concrete batch plant as a minor source of emissions. Both the concrete batch plant permit and State Construction Air Permit would prescribe emissions limits and a variety of mitigation measures that would be implemented.

In the ER (Luminant 2009a) Luminant has committed to the development and use of a Construction Environmental Controls Plan prior to beginning construction and preconstruction activities. The Construction Environmental Controls Plan would include air quality protection procedures to be used to minimize the generation of fugitive dust and the release of emissions from equipment and vehicles. These actions would include managing the use of unpaved roads (speed limits, use of dust suppression, and minimization of dirt tracking onto paved roads); covering haul trucks; phasing grading activities to minimize the exposed amount of disturbed soils; stabilizing roads and excavated areas with coarse material covers or vegetation; and performing proper maintenance of vehicles, generators, and other equipment.

Construction activities would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr construction period and typical construction practices, the review team estimates that the total construction equipment CO_2 emission footprint for building two nuclear power plants at the CPNPP site would be of the order of 70,000 metric tons (an emission rate of about 10,000 metric tons annually, averaged over the period of construction), as compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA 2010). Appendix J provides the details of the review team estimate for a reference 1000 MW(e) nuclear power plant. Based on its assessment of the relatively small construction equipment carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including greenhouse gas emissions) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. Considering the information provided by Luminant and its commitment to comply with all federal, state, and local regulations that govern emissions, the review team concludes that the impacts from CPNPP Units 3 and 4 construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted.

4.7.2 Transportation

The maximum number of site workers for proposed CPNPP Units 3 and 4 would be 4953 construction workers and 258 operations workers, but this number would be maintained for less than 1 year. During the 5-year period from 2013 through 2017, the number of onsite workers would be an average of 2927 (Luminant 2009a). As discussed in Section 4.4.4.1, Luminant estimated, based on prior experience on Units 1 and 2, that carpooling for the workers would occur at an average rate of 2.340 workers per car, resulting in 2117 added vehicle trips each morning and each afternoon, compared to a current level of 12,000 trips per day. Air quality impacts associated with these trips would include exhaust emissions from the vehicles. Assuming that the length of each trip and types of vehicles would be approximately the same as current vehicle traffic, exhaust emissions within the local area would increase, at peak construction, by about 18 percent over current levels.

Construction workforce transportation would also result in greenhouse gas emissions, principally carbon dioxide (CO_2). Assuming a 7-yr construction period and a typical workforce, the review team estimates that the total construction workforce CO_2 emission footprint for building two nuclear power plants at the CPNNP site would be of the order of 300,000 metric tons (an emission rate of about 43,000 metric tons annually, averaged over the period of construction); again, this is compared to a total United States annual CO_2 emission rate of 6,000,000,000 metric tons (EPA 2010). Appendix J provides the details of the review team estimate for a reference 1000 MW(e) nuclear power plant. Based on its assessment of the relatively small construction workforce carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of greenhouse gases from construction workforce transportation would not be noticeable and additional mitigation would not be warranted.

Based on the limited increase in local vehicle traffic and the potential mitigation measures listed in the ER, the review team concludes that the impact on the local air quality (including the effect of greenhouse gas emissions) related to construction and preconstruction activities would be temporary and would not be noticeable because appropriate mitigation measures would be adopted.

4.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions during CPNPP site development activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of CPNPP site development on air quality from emissions of criteria pollutants and CO_2 emissions are SMALL and that no further mitigation is warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air quality impacts of NRC-authorized construction activities would also be SMALL, and no further mitigation beyond those Luminant has committed to implement would be warranted.

4.8 Nonradiological Health Impacts

Luminant indicated that the physical impacts of building activities, including public health, occupational health, noise, and transportation, would be minimal. Luminant qualitatively discussed them in the ER (Luminant 2009a).

The area around the CPNPP site is a mixture of farmland and residential properties. The site follows the shore of SCR on the north, east, and south (Luminant 2009a). The 2007 population within 10 mi of the site, based on the 2000 U.S. Census, was about 32,500 (Luminant 2009a). In addition to nine major pipelines, there are three other major industrial sites in the vicinity: the DeCordova Compressor Station, Wolf Hollow gas-fired power plant, and the DeCordova Steam Electric Station (Luminant 2009a). The following sections discuss the results of the review team's assessment of nonradiological health impacts for the CPNPP site.

4.8.1 Public and Occupational Health

4.8.1.1 Public Health

Luminant stated in its ER that the physical impacts to the public from construction and preconstruction activities at the CPNPP site might include inhalation of dust and vehicle exhaust as sources of air pollution during site preparation and redress (Luminant 2009a). Luminant stated that operational controls would be imposed to mitigate dust emissions, employing such methods as stabilizing construction roads and spoils piles, periodically watering unpaved roads, limiting vehicle speeds, covering haul trucks, phased grading, and revegetating road medians and slopes (Luminant 2009a).

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order (Luminant 2009a). Luminant (Luminant 2009a) stated that applicable Federal, State, and local emission requirements would be adhered to as they relate to open burning or the operation of fuel-burning equipment.

The public would not be close to the construction site. The nearest accessible area is about 0.8 mi from the construction site for CPNPP Units 3 and 4, and the nearest residence is approximately 0.9 mi from the construction site (Luminant 2009a). Luminant has opened SCR for public use with controlled access; therefore, boaters and fisherman might be able to get closer than 0.8 mi for limited periods of time.

4.8.1.2 Construction Worker Health

In general, human health risks for construction workers and other personnel working onsite would be expected to be dominated by occupational injuries (e.g., falls, electrocution, asphyxiation) to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. According to the U.S. Bureau of Labor Statistics (BLS) (BLS 2009), the fatal work injury rate has continued a gradual drop from 5.8 to 3.8 per 100,000 workers from 1992 through 2007. Luminant (Luminant 2009a) expects that the construction workforce for proposed Units 3 and 4 would range from 119 in 2010 to more than 4953 (2014) over the 7 years of expected construction. The total workforce for the construction of Units 3 and 4, varies over 12 years, beginning at 22 in 2008, increasing to a maximum of 5201 in 2014, and back down to 412 in 2019.

While statistical rates show some variation, they can be used to get a rough idea of health impacts on the construction workers. The total labor force involved in the expansion of CPNPP (Luminant 2009a) was multiplied by 2007 rates and totaled over the years of construction. (If the current trend of declining deaths continues, these numbers should be bounding.) Using the BLS fatal injury rate for the workforce overall and for construction (BLS 2009), one would not expect a fatality (0.06–0.17 expected fatalities) during the expansion. With slightly older (and higher) risk factors from the Center for Construction Research and Training (CPWR 2008a, 2008b), one might project one to two fatal accidents during this time.

The BLS also tracks different kinds of nonfatal work injuries (BLS 2008a, 2008b, 2008c, 2008d). Applying the 2007 rates to the same work force over the years of work produced the projected occupational illnesses and injuries in Table 4-12. The total number of reportable injuries and occupational illnesses could range from 558 to 887 over the length of the project. The smallest number used the 2007 rate for utility construction in Texas. Projected nonfatal accidents and occupational illnesses severe enough to cause days away from work would be much smaller, ranging from 197 to 361, with Texas utility construction again at the lower end.

Table 4-12. Projected Total Nonfatal Occupational Illnesses and Injuries to Construction Force Using 2007 Rates for Various Groups

	Total Reportable Occupational Illnesses and Injuries				**Occupational Illnesses and Injuries with Days Away from Work**			
	All Private Industry	All Construction	Texas Construction	Texas Utility Construction	All Private Industry	All Construction	Texas Construction	Texas Utility Construction
Rate per 100 full-time workers per year	4.2[(a)]	5.4[(b)]	3.8[(c)]	3.4[(c)]	1.2[(a)]	1.9[(d)]	2.2[(c)]	1.2[(c)]
Illnesses and injuries	690	887	624	558	197	312	361	197

Sources:

(a) BLS 2008a
(b) BLS 2008b
(c) BLS 2008c
(d) BLS 2008d

Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks associated with construction. The review team assumes that Luminant would adhere to NRC, OSHA, and State safety standards, practices, and procedures during construction activities. Luminant states that workers would have adequate training and personal protective equipment to reduce the possibility of harmful exposures. A safety and medical program will be provided for construction workers, and all construction contractors and site staff would be required to comply with site safety, fire, radiation, and security policies, procedures, and safe work practices; State and Federal regulations; and site-specific permit conditions. Emergency first aid would be available at the construction site (Luminant 2009a). These actions would help minimize or prevent injury, illness, and death.

Other nonradiological impacts to construction workers discussed in this section include noise, fugitive dust, and gaseous emissions resulting from construction activities. Mitigation measures discussed in this section for the public also would help limit exposure to construction workers. Onsite impacts to construction workers would also be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposures. In addition to emergency first-aid care, regular health and safety monitoring of construction personnel could be undertaken.

4.8.1.3 Summary of Public and Construction Worker Health Impacts

Based on mitigation measures identified by Luminant in its ER (Luminant 2009a), permits and authorizations required by State and local agencies, and the review team's independent review, the review team concludes that the nonradiological health impacts to the public and workers from construction and preconstruction activities would be SMALL, and additional mitigation beyond the actions stated above would not be warranted.

4.8.2 Noise Impacts

Preconstruction and construction actions for a nuclear power plant are similar to those for other large projects. They involve many noise-generating activities. Regulations governing noise from construction-type activities are generally limited to protecting workers' hearing. Federal regulations governing construction noise are found in 29 CFR 1910 and 40 CFR 204. The regulations in 29 CFR 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR 204 generally govern the noise levels of compressors. Neither the state of Texas nor Hood or Somervell counties have specific noise regulations that specify acceptable community noise levels (Luminant 2009a).

The ER (Luminant 2009a) indicates that activities associated with new construction at the CPNPP site would have equipment producing peak noise levels in the 93- to 108-dBA range. As illustrated in Table 4-13, noise strongly attenuates with distance. A 10-dBA decrease in noise level is generally perceived as cutting the loudness in half. At a distance of 50 ft from the point source, these peak noise levels would generally decrease to the 73- to 102-dBA range, and at distance of 400 ft, the noise levels would generally be in the 58- to 84-dBA range, depending on the source of the construction equipment. For context, Tipler (1982) lists the sound intensity of a quiet office as 50 dBA, normal conversation as 60 dBA, busy traffic as 70 dBA, and a noisy office with machines or an average factory as 80 dBA. Construction noise (at 10 ft) is listed as 110 dBA, and the pain threshold is 120 dBA.

Table 4-13. Construction Noise Sources and Attenuation with Distance

Source	Noise Level (dBa) (Peak)	Noise Level (dBa) Distance from Source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84–89	78–83	72–77	66–71
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80–89	74–82	68–77	60–71
Dozer	107	87–102	81–96	75–90	69–84
Generator	96	76	70	64	58
Crane	104	75–88	69–82	63–76	55–70
Loader	104	73–86	67–80	61–74	55–68
Grader	108	88–91	82–85	76–79	70–73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: Golden et al., 1980

The ER (Luminant 2009a) states that the exclusion area boundary of the CPNPP site would be greater than 0.8 mi from construction activities for new units. A 100-dBA noise level at 50 ft from an activity would be expected to decrease to about 60 dBA at the exclusion area boundary. There are no major roads, public buildings, or residences within the exclusion area. Similarly, a 100-dBA noise level would be expected to decrease to about 60 dBA (TRs 2009) at the nearest residence, which is approximately 0.9 mi from the construction area. These estimates do not include the noise attenuation associated with vegetation and topography. The use of several noise-producing machines at one time could result in higher noise levels than a single-point noise source.

Noise is more intrusive during sleeping hours than during work hours. For that reason construction at night would be limited to essential operations. Most construction activities are expected to occur between 0700 and 1700, although there would be some occasions when construction had to continue at night, such as during continuous concrete pours. Unusual construction noise, such as steam blows or blasting, could produce temporary excessive noise levels (Luminant 2009a). Noise mitigation could be accomplished by maintenance of equipment, verifying that noise control equipment on vehicles and equipment is in proper working order, restriction of noise- and vibration-generating activities to daylight hours, prohibiting construction activities from specific roads and neighborhood, and notifying people in surrounding areas before periods of higher noise (Luminant 2009a). Occupational exposure would be monitored, and construction personnel would be provided with hearing protection when appropriate.

According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in NUREG-0586, Supplement 1 (NRC 2002). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts…are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts…are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Considering the temporary nature of construction activities and the location and characteristics of the CPNPP site, the review team concludes that noise impacts from construction and preconstruction activities would be SMALL, and no further mitigation beyond the actions identified above would be warranted.

4.8.3 Transporting Construction Materials and Personnel to the CPNPP Site

In 1987 during the construction of Units 1 and 2, a traffic study was commissioned to improve traffic flow on FM 56 at the CPNPP entrance. During that time approximately 8694 people were employed onsite. The study identified 3710 vehicles entering the site per day, or approximately 2.34 persons per vehicle. After the completion of the study, improvements in the form of traffic signals, widened lanes, turn lanes, and additional signage were made in the immediate area to handle the volume of traffic (Luminant 2009a).

Luminant estimates the peak construction workforce at 4953 (in late 2014), with 248 additional operations workers onsite. Assuming a conservative 1.8 people per vehicle, the onsite workforce of 5201 (Luminant 2009a) results in about 2900 vehicles. Approximately 100 truck deliveries per day would add little to the traffic volume. This number of vehicles would be less than the 3710 vehicles experienced during construction of Units 1 and 2. (There was an average of 2.34 people per vehicle at that time [Luminant 2009a.]) Units 1 and 2 need refueling every 18 months, which requires 800 to 1200 additional workers. Unit 1 is scheduled to be refueled during the peak construction period, which would bring the total number of workers onsite to 6401 for less than a month (Luminant 2009a), or about 3556 vehicles under the same occupancy assumptions. Even with the 100 trucks per day, the traffic would still be less than that during the construction of Units 1 and 2. Not all daily traffic would be traveling the same direction or on the road at the same time, and there have been many improvements in the roads since the construction of the previous units. On the basis of the manageable increase in traffic volume, little change is expected in the potential for vehicular accidents.

About 30% of the workforce is expected to come from the existing Granbury micropolitan area (composed of Hood and Somervell Counties) (OMB 2005), which has an estimated 2010 population of 56,089 (TSDC 2009b). The other 70% of the peak construction force (3467 persons) are assumed to move into the area from outside. Given these assumptions, traffic fatalities associated with the increase in population would be expected to rise by about 6%. Given a national fatality rate of 13.6 per 100,000 population per year in 2007(NHTSA 2009), approximately 8 fatalities per year would be anticipated in the Granbury micropolitan area and less than 0.5 additional deaths due to the additional construction workers who moved into the area (NHTSA 2009). These numbers were essentially unchanged when the 2007 Texas fatality rate of 14.1 per 100,000 people was used. (NHTSA 2009)

The review team concludes that approximately 2900 additional vehicles might be required to transport workers to and from Units 3 and 4 construction sites on FM 56 plus 100 truck shipments per day. This volume would be substantially less than the volume during construction of Units 1 and 2. Because improvements have been made in the roads since that time, the impact to the construction workers would be typical for vehicular traffic and expected to be SMALL. Based on these factors, on the information provided by Luminant, and on the review team's independent evaluation, the review team concludes that impacts of transporting building materials and personnel to the proposed CPNPP Units 3 and 4 site during construction and preconstruction activities would be SMALL, and no further mitigation would be warranted.

4.8.4 Summary of Nonradiological Health Impacts

Based on the mitigation measures identified by Luminant in the ER (Luminant 2009a), the permits and authorizations required by State and local agencies, and the review team's independent evaluation, the review team concludes that nonradiological health impacts to the local population and construction workers at the CPNPP site from fugitive dust, occupational injuries, noise, and transport of materials and personnel would be SMALL and that additional mitigation beyond the actions identified above would not be warranted. In addition, the NRC staff concludes that because construction and preconstruction impacts would be SMALL, the nonradiological health impacts of NRC-authorized construction would be SMALL, and no further mitigation beyond the actions identified above would be warranted.

4.9 Radiological Exposure to Construction Workers

The sources of radiation exposure for construction workers would include direct radiation exposure, exposure from liquid radioactive effluents, and exposure from gaseous radioactive effluents from the existing CPNPP Units 1 and 2 during the site-preparation and construction phase. Doses from operation of Unit 3 to workers constructing Unit 4 were not considered because the construction and fueling of Unit 4 would be completed before Unit 3 began operation. For the purposes of this discussion, construction workers were assumed to be members of the public, not radiation workers; therefore, the dose estimates were compared to the dose limits for the public, pursuant to 10 CFR 20, Subpart D. Luminant noted that the construction activities for Units 3 and 4 would occur outside the protected area for CPNPP Units 1 and 2 but inside the restricted area boundary (Luminant 2009a).

4.9.1 Direct Radiation Exposures

In the ER (Luminant 2009a) Luminant identified the refueling water storage tanks (RWSTs) as the principal contained source of direct exposure at the construction site. The contribution from this source is significantly reduced at CPNPP because the RWSTs have 2 1/2-ft, -thick concrete walls. Luminant plans to build an Independent Spent Fuel Storage Installation (ISFSI) and states that, in general, the dose rate at the ISFSI protected area fence (1000 ft from the source) would be below 5.0 x 10^{-6} mrem/hr (Luminant 2009a). Assuming a 2500 hr/yr exposure period, the annual dose to a construction worker 1000 ft from the ISFSI would be 1.25 x 10^{-2} mrem/yr (Luminant 2009a). At certain times during construction, Luminant would also receive, possess, and use specific radioactive by-product, source, and special nuclear material in support of construction and preparations for operation. These sources of low-level radiation are required to be controlled by Luminant's radiation protection program and have very specific uses under controlled conditions. The NRC staff did not identify any additional sources of direct radiation during the site visit or document reviews.

The Comanche Peak general area monitoring program uses thermoluminescent dosimeters (TLDs) at defined points within the protected area to monitor direct radiation (Luminant 2009a). Dosimeter readings at the protected area fence were equal to or less than 0.001 mr/hr in 2006 (Luminant 2009a). These TLDs are read quarterly and measure the contribution to dose from all sources, including natural background and the current reactor operations. The TLD dose should provide an upper-bound dose to construction workers because the protected area fence is closer to Units 1 and 2 than the construction area for Units 3 and 4 (Luminant 2009a). Using the same assumption of a 2500 hr/yr exposure, the direct radiation dose from the existing nuclear operations would be much less than 2.5 mrem/yr because much of the TLD readings would come from natural background.

The annual direct dose to a construction worker at least 1000 ft from the ISFSI and outside the protected area for Units 1 and 2 would still be much less than 2.5 mrem/yr. This dose rate conservatively assumes that the construction worker is always at this location. The dose to construction workers from by-product, source, and special nuclear material is expected to result in a negligible contribution to this estimate.

4.9.2 Radiation Exposures from Gaseous Effluents

Some radioactive gaseous effluents are released during the operation of Units 1 and 2. Potentially radioactive gases are continuously discharged from the fuel building, safeguards building, auxiliary building ventilation exhaust system, and condenser off-gas system. There are occasionally intentional discharges through the vent stacks from the containment purge exhaust and waste gas decay tanks (Luminant 2009a).

Gaseous effluent releases are reported to the NRC annually for Units 1 and 2. Luminant used the 2007 gaseous effluent data (Luminant 2008) to estimate the dose by submersion in cloud, inhalation, and deposition as 0.004 mrem/yr total body.

4.9.3 Radiation Exposures from Liquid Effluents

Luminant estimated radiological dose to construction worker from liquid effluents to be small. Although construction workers are not expected to be exposed to water pathways at the construction site, Luminant assumed that construction workers receive the same dose as the maximally exposed individual for the water pathway. The only pathways for liquid effluents from

CPNPP Units 1 and 2 to reach humans are sport fish ingestion and exposure to contaminated shoreline. Luminant estimated the effective dose equivalent to be less than 0.14 mrem/yr (Luminant 2008).

4.9.4 Total Dose to Construction Workers

Luminant estimated the annual dose to a construction worker of 2.5 mrem, assuming an occupancy of 2500 hr/yr. The estimated annual dose to construction workers is less than the 100 mrem annual dose limit to an individual member of the public found in 10 CFR 20.1301.

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during building of the proposed Units 3 and 4 are well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by Luminant and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts to construction workers for the proposed Units 3 and 4 would be SMALL, and no further mitigation would be warranted. Radiation exposure from all NRC-licensed activities including operation of CPNPP Units 1 and 2 is regulated by the NRC. Therefore, the NRC staff concludes the radiological health impacts for NRC-authorized construction activities would be SMALL, and no further mitigation would be warranted.

4.10 Nonradioactive Waste Impacts

This section describes the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during building activities for Units 3 and 4. The potential types of nonradioactive waste that would be generated, handled, and disposed of during building activities include construction debris, municipal waste, spoils, dust, stormwater runoff, sanitary waste, and air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following subsections.

4.10.1 Impacts to Land

Building activities related to the proposed Units 3 and 4 would generate wastes, such as construction debris and spoils (i.e., earthen debris, including soil and rock). Luminant would sort these wastes so that it could be reclaimed as recyclable or reusable material or shipped to appropriate landfills for disposal (Luminant 2010a). Luminant plans to provide sufficient waste receptacles and management for waste segregation for proper offsite disposal of these types of wastes (Luminant 2009a). Most of the waste would be non-hazardous; however, there is potential for some of the material to be contaminated during construction and preconstruction (Luminant 2009a). Hazardous and nonhazardous solid wastes would be managed in accord with county and state-specific handling and transportation regulations. Waste minimization activities and recycling of certain nonhazardous wastes would be used to further mitigate the impacts of solid wastes (Luminant 2009a).

Luminant indicates that the majority of soil and rock excavated while building the new reactor units would be beneficially used as fill material on surface areas on the CPNPP site. Non-hazardous construction wastes would be transported off-site by road and rail to be disposed of at an industrial waste landfill licensed by the TCEQ. Any hazardous wastes would be treated, stored, and disposed of in compliance with the Resource Conservation and Recovery Act (RCRA) and other applicable federal, state, and local laws (Luminant 2009a).

The CPNPP site currently implements a successful waste minimization plan for Units 1 and 2. Luminant proposes to apply this plan to building activities for Units 3 and 4 to reduce the amount of waste generated and disposed of. In addition, Luminant intends to restrict soil stockpiling and reuse to designated areas on the site and to train construction employees in the appropriate handling and disposal of hazardous wastes (Luminant 2009a).

Based on the effective waste minimization program already in place for CPNPP Units 1 and 2 and Luminant's plans to manage solid and liquid wastes in a similar manner in accordance with all applicable federal, state, and local requirements and standards, the review team expects that impacts to land from nonradioactive wastes generated during the building of Units 3 and 4 would be minimal and no further mitigation would be warranted.

4.10.2 Impacts to Water

Surface water runoff from site development activities would be controlled under the development and implementation of a SWPPP. Water collected in this manner may then be discharged under a TPDES permit. As discussed in Section 4.2.3.1, stormwater runoff generated by site development activities could increase turbidity and sedimentation to SCR and Lake Granbury, but impacts would be minimized through the use of settling ponds and other BMPs that would be implemented under the SWPPP. There would be an increase in the generation of sanitary wastewater at the CPNPP site as a result of the presence of construction workers, but the additional sanitary wastewater could be managed in existing onsite sewage treatment facilities and through provision of portable toilets.

Based on the regulated practices for managing liquid discharges, including wastewater, and the plans for managing stormwater, the review team expects that impacts to water from nonradioactive effluents when building Units 3 and 4 would be minimal, and additional mitigation would not be warranted.

4.10.3 Impacts to Air

As discussed in Sections 4.4.1.1 and 4.7.1, fugitive dust generated by site development activities is to be managed. Luminant has committed to the development and use of a Construction Environmental Controls Plan prior to beginning construction and preconstruction activities (Luminant 2009a). The Construction Environmental Controls Plan would include air quality protection procedures to be used to minimize the generation of fugitive dust and the release of emissions from equipment and vehicles. These actions would include managing the use of unpaved roads (speed limits, use of dust suppression, and minimization of dirt tracking onto paved roads); covering haul trucks; phasing grading activities to minimize the exposed amount of disturbed soils; stabilizing roads and excavated areas with coarse material covers or vegetation; and performing proper maintenance of vehicles, generators, and other equipment.

Based on the regulated practices for managing air emissions from construction equipment and temporary stationary sources, best management practices for controlling fugitive dust, and vehicle inspection and traffic management plans, the review team expects that impacts to air from nonradioactive emissions while building Units 3 and 4 would be minimal, and no further mitigation would not be warranted.

4.10.4 Summary of Impacts

Solid, liquid, and gaseous wastes generated when building Units 3 and 4 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste would ensure compliance with the CWA and TCEQ water quality standards. Air emissions would be generated by vehicles and heavy equipment and site development activities would create fugitive dust when building Units 3 and 4. These air quality impacts would be managed through the use of traffic management plans, vehicle inspections, and best management practices. Based on information provided by Luminant and the review team's independent evaluation, the review team concludes that nonradioactive waste impacts to land, water, and air would be SMALL and that additional mitigation would not be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradioactive waste impacts of NRC-authorized construction activities would be SMALL, and; no further mitigation would be warranted.

Cumulative impacts to water and air from nonradioactive emissions and effluents at the CPNPP site are discussed in Sections 7.2 and 7.6, respectively. For the purposes of Chapter 9 (alternatives), the review team expects that there would be no substantive differences between the impacts of nonradioactive waste for the CPNPP site and the alternative sites, and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

4.11 Measures and Controls to Limit Adverse Impacts during Construction and Preconstruction Activities

In its evaluation of environmental impacts during building activities for the proposed CPNPP Units 3 and 4, the review team relied on Luminant's compliance with the following measures and controls that would limit adverse environmental impacts:

- Compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, hazardous material management).
- Compliance with applicable requirements of permits or licenses required for construction of the new units (e.g., USACE Section 404 Permit, NPDES permit).
- Compliance with existing Luminant processes and/or procedures applicable for environmental compliance activities during construction and preconstruction at the CPNPP site (e.g., solid waste management, hazardous waste management, and spill prevention and response).
- Incorporation of environmental requirements into construction contracts.
- Identification of environmental resources and potential impacts during the development of the ER and the COL process.

Table 4-14 summarizes the measures and controls to limit adverse impacts when building the proposed Units 3 and 4 based on Table 4.6-1 supplied by Luminant (2009a), as adapted by the review team. The review team considered these measures and controls in its evaluation of the impacts of building proposed Units 3 and 4.

4.12 Summary of Construction Impacts

The impact category levels determined by the review team in the previous sections are summarized in Table 4-15. The impact category levels for NRC-authorized construction discussed in this chapter are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Impact levels for the combined construction and preconstruction activities are similarly noted. Some impacts, such as the addition of tax revenue from Luminant for the local economies, are likely to be beneficial and are noted as such in the Impact Level column.

Table 4-14. Summary of Measures and Controls Proposed by Luminant to Limit Adverse Impacts During the Construction Period

Resource Area	Specific Measures and Control
Land-Use Impacts	
The Site and Vicinity	• Limit ground disturbances to the smallest amount of area necessary to construct and maintain the plants • Ground disturbing activities are to be performed in accordance with regulatory and permit requirements; use adequate BMPs erosion control measures to minimize impacts • Limit vegetation removal to the area within the CPNPP site designated for construction activities • Minimize potential spills of chemicals and petroleum materials through training, spill prevention plans, and rigorous compliance with applicable regulations and procedures • Restrict soil stockpiling and reuse to designated areas on the CPNPP site
Transmission Line and Pipeline Corridors	• Site new corridor(s) to avoid impact on critical or sensitive habitats/species as much as possible • Limit vegetation removal and construction activities to corridor(s) • Restrict sites regarding access to corridor(s) for construction equipment • Minimize potential spills of hazardous wastes/materials through training and rigorous compliance with applicable regulations • Minimize potential impacts through avoidance, compliance with permitting requirements, and BMPs
Water-Related Impacts	
Hydrological Alterations	• Adhere to applicable regulations and permits • Minimize sizes of cleared areas and employ BMPs to control erosion • Limit extent of dewatering to only that necessary to proceed with construction • Comply with TCEQ and USACE permit conditions using BMPs during construction • A formal SWPPP is expected to define specific control measures during construction using BMPs appropriate to the specific activity
Water Use and Quality	• TPDES permit requirements are expected to minimize discharge impacts to receiving waters

Table 4-14. (contd)

Resource Area	Specific Measures and Control
Ecological Impacts	
Terrestrial Ecosystems	• Limit clearing to the smallest amount of area necessary to construct the plant and transmission line ROW(s) • Use established (SWPPP) procedures for minimizing erosion or sediment deposition on terrestrial habitat • Confine vehicles to roadways and authorized stream crossings • Avoid, if possible, Dinosaur Valley State Park, Fossil Rim Wildlife Center, and other potentially suitable habitat for Federally listed endangered species when selecting exact route for Whitney transmission line.
Aquatic Ecosystems	• Develop and implement a SWPPP for building activities • Develop and implement a site-specific spill prevention control and countermeasure plan for building activities • Implement erosion and sediment control plans that incorporate recognized BMPs • Install appropriate barriers and use BMPs during construction • Limit construction and preconstruction area to minimum required to complete building activities
Socioeconomic Impacts	
Physical Impacts	• Make public announcements or give prior notification of atypically loud construction activities • Train and appropriately protect employees and construction workers to reduce the risk of potential exposure to noise, dust, and exhaust emissions • Provide on-site services for emergency first aid, and conduct regular health and safety monitoring • Use dust control measures such as watering, stabilizing disturbed areas, covering trucks • Establish procedures and perform audits to ensure that all waste is disposed of according to applicable regulations such as the Resource Conservation and Recovery Act (RCRA)

Table 4-14. (contd)

Resource Area	Specific Measures and Control
Social and Economic Impacts	• Stagger shifts, encourage car pooling, and time deliveries to avoid shift change or commute times • Erect signs alerting drivers of construction and potential for increased construction traffic • Mitigate housing shortage through new construction in anticipation of arrival of construction workforce • Use procedures and employee training program to reduce potential for traffic accidents
Environmental Justice	• No mitigating measures or controls required
Historic Properties and Cultural Resources	• Consult with SHPO if a cultural resource is discovered • Follow established procedures to halt work if a potential unanticipated historic, cultural, or paleontological resource is discovered
Radiation Exposure to Construction Workers	• Total Effective Dose Equivalent (TEDE) from all exposures has been determined to be below limits set in 10 CFR 20.1301 • Implement ALARA practices at construction site
Nonradiological Health	• Implement site-wide Safety and Medical Program, including safety policies, safe work practices, as well as general and topic-specific training • Take measures that could include monitoring workers, providing radiation worker training, and developing work plans that minimize worker radiation exposure • Ensure compliance with all Federal and State regulatory requirements pertaining to the radiation protection program

Table 4-15. Summary of Impacts from Building Proposed CPNPP Units 3 and 4

Resource Area	Comments	Impact Category Level(s) for NRC-Authorized Construction	Impact Category Level(s) for Construction and Preconstruction
Land-Use Impacts			
The Site and Vicinity	Construction activities would take place within the existing site boundaries	SMALL	SMALL
Transmission Line and Pipeline Corridors	Existing right-of-ways would be used for new pipeline corridors. New transmission line corridors could affect public and private recreational land uses. Transmission lines are not construction activities under 10 CFR 50.10(a)(2).	SMALL	MODERATE
Water-Related Impacts			
Water Use			
Surface Water	Any effects on surface water bodies would be temporary and minimal due to implementation of appropriate BMPs. Surface water usage would be a small fraction of available water supplies.	SMALL	SMALL
Groundwater	No groundwater would be used	SMALL	SMALL
Water Quality			
Surface Water	BMPs will be used to limit construction stormwater impacts	SMALL	SMALL
Groundwater	BMPs will prevent or mitigate spills.	SMALL	SMALL
Ecological Impacts			
Terrestrial Ecosystems	Total areas of wildlife habitat affected would be minimal; depending on exact final routes selected, transmission line could cross Dinosaur Valley State Park, Fossil Rim Wildlife Center, and other habitat potentially suitable for two Federally listed as endangered species.	SMALL	SMALL to MODERATE
Aquatic and Wetlands Ecosystems	Limited construction footprint in Lake Granbury; BMPs would minimize runoff impacts on Lake Granbury, SCR, and a few small, intermittent streams. Only 2 of 48 delineated wetlands lie in the CPNPP building area; mitigation through permit with the Corps would limit or minimize impacts.	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	Physical impacts would be minimal except for impacts to roads. Physical impacts to some roads in the six-county study area would be noticeable, but physical impacts on FM 56 would be significantly greater.	SMALL to MODERATE	SMALL to MODERATE
Demography	Population growth would be somewhat large in Somervell and Hood Counties, but minimal in the rest of the six-county study area.	SMALL to MODERATE	SMALL to MODERATE

Table 4-15. (contd)

Resource Area	Comments	Impact Category Level(s) for NRC-Authorized Construction	Impact Category Level(s) for Construction and Preconstruction
Taxes and Economy Impacts	Tax revenues and economic impacts would be significant and beneficial in Somervell and Hood Counties, but the beneficial impacts would be small in the rest of the six-county study area.	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)
Infrastructure and Community Services	Impacts on infrastructure and community services would be minimal, with the exception of potential moderately greater impacts to wastewater treatment facilities in Somervell and Bosque Counties. Impacts on traffic flow and LOS would be minimal on most roads in the six-county study, but MODERATE on FM 56 (particularly north of the CPNPP entrance).	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice Impacts	Environmental justice impacts would be SMALL, except for the area of socioeconomics. Impacts on the availability and price of temporary housing could have disproportionate and adverse effects on low-income populations. In such an instance, the environmental justice impacts could be significant.	SMALL	SMALL
Historic and Cultural Resource Impacts	NRC staff believes that any impacts to historic and cultural resources would be exclusively associated with preconstruction activities	SMALL	SMALL
Air Quality Impacts	Construction would be conducted in accordance with applicable State requirements. Dust emissions would be minimized through a dust-control plan. Vehicle emissions would not be significant.	SMALL	SMALL
Nonradiological Health Impacts	Emission controls and remote location would minimize nonradiological health impacts. Adherence to Federal and State Regulations is assumed to protect occupational workers.	SMALL	SMALL
Radiological Health Impacts	Exposures would be below NRC annual occupational and public dose limits	SMALL	SMALL
Nonradiological Waste Impacts	Impacts to water, land, and air from the generation of nonradioactive waste would be minimal.	SMALL	SMALL

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5.0 Operational Impacts at the Proposed Site

This chapter examines environmental issues associated with operation of the proposed Units 3 and 4 at the Comanche Peak Nuclear Power Plant (CPNPP) site for an initial 40-year period as described by the Applicant, Luminant Generation Company LLC (Luminant). As part of its application for combined construction permits and operating licenses (COLs), Luminant submitted an Environmental Report (ER) that discussed the environmental impacts of station operation (Luminant 2009a). In its evaluation of operational impacts, the staffs of the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Army Corps of Engineers (Corps or USACE) (hereafter known as the “review team”) relied on operation details supplied by Luminant in its ER and its responses to NRC Requests for Additional Information (RAIs), and additional information.

This chapter is divided into 14 sections. Sections 5.1 through 5.12 discuss the potential operational impacts on land use, water, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health effects, radiological health effects, nonradioactive waste, postulated accidents, and applicable measures and controls that would limit the adverse impacts of station operation during the 40-year operating period.

In accordance with Title 10 of the Code of Federal Regulations (CFR) Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned by the review team to each impact category. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such. The review team’s determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various state and county governments, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of these impacts is presented in Section 5.13. The references cited in this chapter are listed in Section 5.14.

5.1 Land-Use Impacts

Sections 5.1.1 and 5.1.2 contain information regarding land-use impacts associated with operation of the proposed Units 3 and 4 at the CPNPP site. Section 5.1.1 discusses land-use impacts at the site and in the vicinity of the site. Section 5.1.2 discusses land-use impacts with respect to offsite transmission line corridors and other offsite areas.

5.1.1 The Site and Vicinity

Onsite land-use impacts from operation of proposed Units 3 and 4 are expected to be minimal. Of the 675 ac disturbed in building the project, about 125 ac would be landscaped or revegetated, leaving approximately 550 ac (6.9 percent of the 7950 ac site) occupied by permanent structures and supporting facilities over the operational life of the units (Luminant 2009a). Approximately 161 ac of prime farmland would be permanently dedicated to power-generation use; however, this land is not currently used for agriculture, and, because it is located within the boundaries of the power plant site, it has low potential for future agricultural use. The amount of prime farmland affected represents approximately 15.1 percent of the 1064 ac of prime farmland on the CPNPP site and 0.1 percent of the 144,425 ac of prime farmland in the project vicinity (Luminant 2009a).

Proposed Units 3 and 4 would use four mechanical draft cooling towers equipped with drift eliminators. Aerosols drifting from cooling towers have the potential to affect land use by harming surrounding vegetation (NRC 1996). However, since Section 5.3.1.1 of this environmental impact statement (EIS) concludes that operation of the cooling towers would have little impact on vegetation, there would also be little impact on land use.

Operations of Units 3 and 4 could affect a low-density residential area located immediately outside the site boundary to the west-southwest through south. The closest residence in this area would be approximately 0.8 mi from the proposed cooling towers. Luminant reports that cooling tower plumes, resembling high cumulus clouds, would commonly extend over this area during all seasons (Luminant 2010g). As indicated in Table 5-1, the eastern edge of this residential area, which is located south of the proposed cooling towers, could experience fogging for up to 20.5 hours per year and icing for up to 7.5 hours per year. No arterial roads are within one mile of the proposed cooling towers. Project operations are not expected to noticeably increase noise levels in the residential area (see Section 5.4.1.5). These effects would not interfere with the residents' current overall uses and enjoyment of their properties through most of the year and thus are unlikely to result in land-use changes in the area.

Table 5-1. Annual Hours of Fogging and Icing Affecting Residential Area Adjacent to CPNPP Boundary

Distance (mi)	Fogging				Icing			
	Direction from Cooling Towers				Direction from Cooling Towers			
	S	SSW	SW	WSW	S	SSW	SW	WSW
0.75	20.5	1	2	0	7.5	0	2	0
0.81	20.5	1	0	0	7.5	0	0	0
.087	20.5	1	0	0	7.5	0	0	0
0.93	19.4	0.6	0	0	7.5	0	0	0
0.99	19	0.5	0	0	7.5	0	0	0

Source: Luminant 2010g

The proposed design of the CPNPP Blowdown Treatment Facility (BDTF) calls for the use of mister units located in the proposed evaporation ponds to facilitate evaporation by spraying the salty blowdown water into the air. A schematic layout of the proposed BDTF is shown on Figure 5-1. Luminant estimates that the salt spray could drift up to 1300 ft from the misters during wind speeds of 10 mph (Luminant 2009d). The review team estimates that in this case, salt could be deposited over an area of approximately 199 ac. Most of this area would be within the boundary of Luminant's property, but about 16 ac would be outside the CPNPP boundary. As shown on Figure 5-1, the affected off-site land would be at the northern edge of a rural residential area located along County Roads 313 and 313 Loop immediately south of the CPNPP boundary. While this level of salt deposition would not be expected to affect occupied portions of the residential area, vegetation at the rear edge of some properties could be injured.

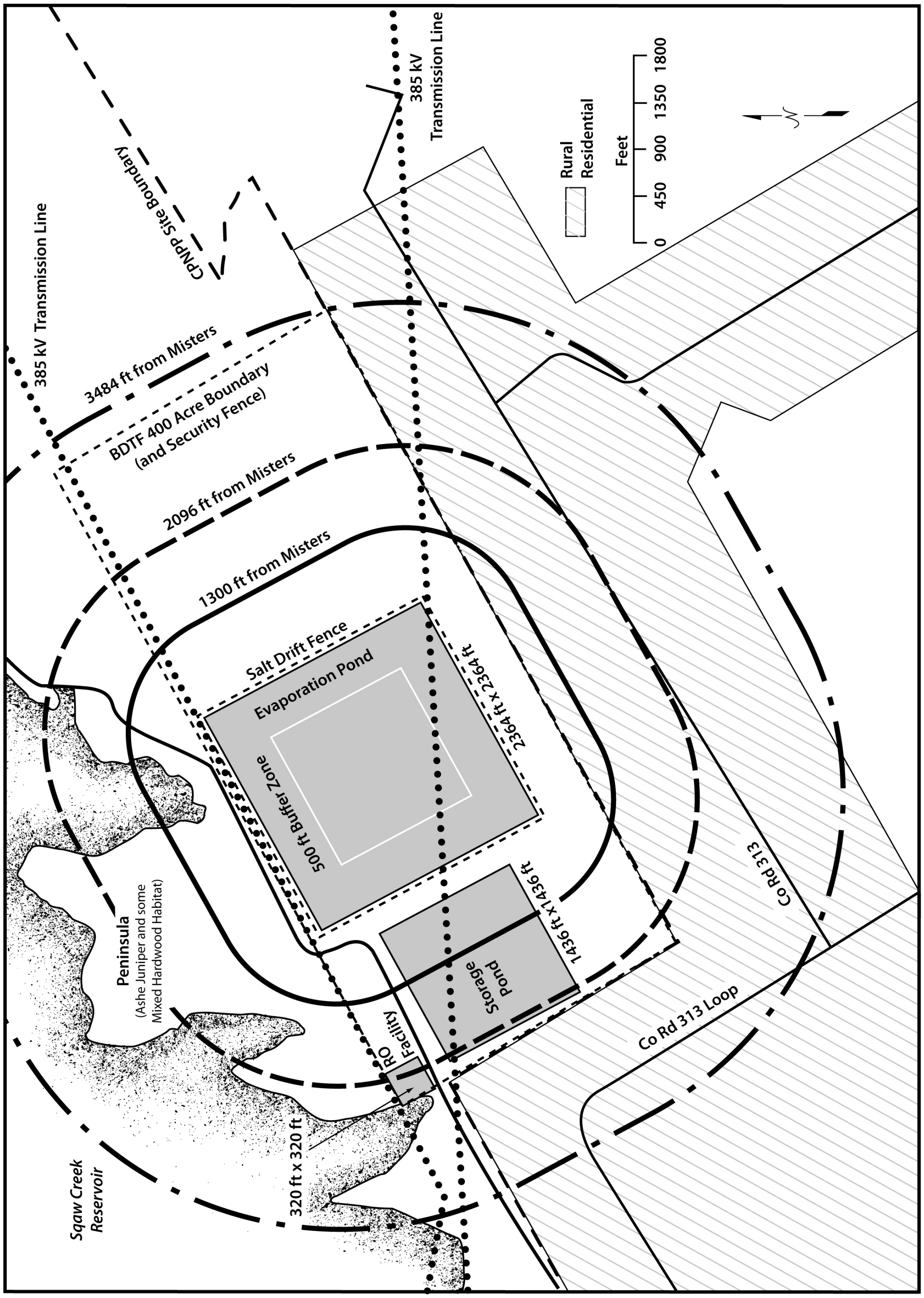

Figure 5-1. Schematic Layout of the Proposed Blowdown Treatment Facility Showing Distances from the Misters to Nearby Locations (Adapted from Luminant 2010f using drift distance estimates developed by the applicant [1300 ft] and the review team [2095 ft and 3484 ft])

However, as described in Section 5.3.1.1 of this EIS, the results of a study of salt deposition from a mister system similar to that proposed by Luminant suggests that salt drift and deposition could extend beyond the 1300 ft estimated by Luminant, reaching as far as 3484 ft from the misters. In this case, the review team estimates that salt drift and deposition could affect up to 1226 ac beyond the evaporation pond. As depicted on Figure 5-1, much of this area would be on the CPNPP site, but the review team estimates that as much as 438 ac outside the CPNPP boundary could also be affected. The land in the affected area is covered by grassland, deciduous and evergreen forest, and pasture, some of which lies within large rural residential lots in an area of low density residential development. Most of the affected off-site land is within the rural residential area described in the preceding paragraph. Based on examination of aerial photographs, the review team estimates that up to 44 residences in this area could be exposed to noticeable salt deposition levels. Salt deposition could reduce the ability of residents to use and enjoy their properties.

To limit salt drift from the misters, Luminant proposes to surround the evaporation ponds with a 5 m (16-ft) tall salt fence that, according to Luminant, would reduce salt deposition to less than 1 kg/ha/yr outside the 400 ac boundary of the BDTF(Luminant 2010f). Further, Luminant states that precautions would be taken to contain the salt within the BDTF by using directional spray misting units in addition to the salt fences (Luminant 2010e). If the salt fence in combination with the directional spray misting units were 100 percent effective, then the off-site properties would not be affected.

However, the information provided by Luminant (Turbomist 2010) is not extensive enough to eliminate uncertainty regarding the potential for salt to be deposited beyond the salt fence. Considering the limited case history data available to the review team regarding the misters and the salt fence, it is uncertain if the measures proposed by Luminant could prevent salt drift from the BDTF from affecting off-site land. The applicant has not quantified salt deposition potential from the BDTF further because the facility is only in initial design phase. Due to the high volumes of salt that would be processed by the facility, even a small percentage loss of salt to the surrounding environment could have the potential to affect off-site lands. Without more detailed information about the BDTF, such as its exact location, directional spray misting, and more case history data on the efficacy of the salt fence, the extent of land-use impacts is uncertain. The review team acknowledges that if the mitigation measures proposed by Luminant could effectively eliminate salt drift from exiting the BDTF, then the impacts to land use could be minimal. However, the review team must also acknowledge the uncertaintiy inherent regarding the efficacy of the proposed mitigation measures. If the mitigation measures were not completely effective over the operational life of the BDTF, then the effects of salt drift could be noticeable.

Any indirect offsite land use changes incidental to project operations, such as conversion of land to housing for operations and outage workers, are expected to be minor. The analysis of housing impacts in Section 5.4.4.3 finds that sufficient vacant permanent housing is available to accommodate the projected demand from workers who would operate CPNPP Units 3 and 4. Refueling outage workers, who would come to CPNPP for 1-month periods on an average of every 9 months during project operations, would primarily seek short-term housing in hotels, motels, and recreational vehicle (RV) parks. This could lead to limited development of additional hotels, motels, and RV parks in the region. However, this impact would be lessened because the much larger construction workforce, which would have also relied mainly on short-term housing, would have left the area before the outage workers arrived. Because of the adequate availability of housing for operations workers and the limited need for additional short-term housing for outage workers, no substantialoffsite land use impacts are expected due to Unit 3 and 4 employment during project operations.

In addition, increased property tax revenue from the two new units could result in infrastructure improvements (e.g., new roads and utility services) that encourage further growth and property conversion. (Operations-related infrastructure impacts are discussed further in Section 5.4.4 of this EIS.) Any such induced development would likely be scattered throughout Somervell and Hood Counties. Because of the rural nature of the project vicinity and region and the abundance of flat to moderately sloped grassland and forested land, this potential development would have minor impacts on land use.

The evaporation ponds at the proposed BDTF could generate as much as 195,610 tons of dry waste salt annually during project operations. Luminant indicated that the waste salt generated by the BDTF could have moisture content as high as 20 percent (Luminant 2010f). Under this condition the BDTF could potentially generate waste salt up to 519,375 tons per yr (Luminant 2010e, 2010f). Luminant states that this waste salt would be disposed of in a licensed solid waste landfill (Luminant 2009d, 2010e, 2010f).

The impacts of such disposal would depend on the classification of the waste, which would be determined by analysis of the actual waste product during project operations. Luminant expects the waste would be determined to be Class 2 or 3 non-hazardous industrial waste, but states that, in a worst-case scenario, the waste could be classified as Class 1 non-hazardous industrial waste (Luminant 2009d). The Texas Commission on Environmental Quality (TCEQ) reports that in 2007 there were 13 landfills in the state that accepted 114,506 tons of Class 1 non-hazardous industrial waste and 48 landfills that accepted 1,564,352 tons of Classes 2 and 3 non-hazardous industrial waste (TCEQ 2008). In a worst-case scenario (519,375 tons annually of Class 1 waste), the BDTF would generate 4.53 times as much Class 1 non-hazardous industrial waste annually as was disposed of in Texas in 2007. This amount and type of waste would likely lead to the conversion of additional land for use as waste disposal sites. If, on the other hand, the waste is classified as Class 2 or 3 non-hazardous industrial waste, the BDTF would annually contribute between 12.5 percent and 33.2 percent of the amount of similarly classified waste that was disposed of in the state in 2007. The TCEQ estimates that the types of landfills that often accept this waste have a remaining capacity of 44 years (TCEQ 2008). In this case, it is unlikely that operation of the BDTF would require the conversion of additional land to use for waste disposal. To put these amounts in perspective, the TCEQ reports that a total of 33,183,488 tons of non-hazardous waste (all classes) were disposed of in Texas in 2007. The maximum amount of waste salt from the BDTF would be approximately 1.6 percent of this amount. Any resulting increase in the total amount of land in the state devoted to solid waste disposal, as a result of disposing the salt waste generated by the BDTF, would be minimal. The total additional solid waste generated by CPNPP Units 3 and 4 during operations is estimated to be 207 tons annually and is not a significant quantity in comparison to the salt waste generated by the BDTF.

In summary, operation of proposed Units 3 and 4 could result in limited but noticeable land-use changes on the CPNPP site and in the surrounding area. In Somervell and Hood Counties, land use plans and zoning ordinances are in place only in the incorporated areas of Glen Rose and Granbury. Thus, local governments would have limited influence over project-induced land use changes taking place outside the city limits. However, because of the relatively minor degree of the expected changes and the large amount of undeveloped land available, the review team concludes that the impacts of these changes in land use would be SMALL to MODERATE. The SMALL to MODERATE conclusion also reflects the potential for salt drift from operation of the BDTF to affect rural residential properties adjoining the CPNPP perimeter. The most serious potential adverse effect of the salt drift on those properties would be salt-induced injury to sensitive landscape vegetation, as well as possible increased corrosion rates for aluminum siding and other metal structural components of houses. Possible mitigation measures, in addition to the salt fence and directional spray misting units proposed by Luminant, might include provision of salt-tolerant vegetation, compensation for corrosion of metal property, and, in the worst case, purchase of affected residential properties.

5.1.2 Transmission Line and Pipeline Corridors

During project operations, impacts due to proposed offsite transmission line corridors and water intake and discharge facilities would be minimal. Transmission line rights-of-way would have been acquired and cleared and any necessary access roads would have been built prior to operation of the lines and towers. Other than barring permanent structures and vegetation that interferes with line maintenance, Oncor's transmission line easements do not restrict land use in the rights-of-way. Farming and ranching activities, for example, may continue unobstructed. Oncor would cut back overgrown vegetation in the rights-of-way periodically and grass would be allowed to grow over access roads except when vehicular access is required. Similarly, the right-of-way of underground water intake and discharge pipelines would be allowed to revegetate with native grasses and would be disturbed only if required for line repairs. The review team concludes that the offsite land-use impacts of transmission line corridors and water intake and discharge pipelines during operation of Units 3 and 4 would be SMALL, and no mitigation would be warranted.

5.2 Water-Related Impacts

This section discusses water-related impacts to the surrounding environment from operation of the proposed Units 3 and 4 at the CPNPP site. Details of the operational modes and cooling water systems associated with operation of the proposed units can be found in Chapter 3. Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. At the CPNPP site, these objectives include recreation, habitat for fish and other aquatic life, and a variety of beneficial consumptive uses of water. The primary responsibility for regulating water use and water quality is delegated to the TCEQ. Other public agencies with responsibilities related to managing or protecting water in the local area include the Texas Water Development Board (TWDB), Brazos River Authority (BRA), Somervell County Water District (SCWD), and Texas Parks and Wildlife Department (TPWD).

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with any large thermoelectric power generation facility. Accordingly, Luminant must obtain the same water-related permits and certifications as any other large industrial facility. These would include:

Clean Water Act, Section 401 Certification. This certification would be issued by the TCEQ and would ensure that operation of the plant would not conflict with State water-quality-management programs. Luminant has applied to the TCEQ for water quality certification under Section 401 (Luminant 2010a).

Texas Pollutant Discharge Elimination System (TPDES) Discharge Permit. This permit would be issued by the TCEQ under Clean Water Act, Section 402(p) and would regulate limits of pollutants in liquid discharges to surface water Luminant has stated its intention to amend its TPDES permit for Units 1 and 2 to include Units 3 and 4 discharge (outfall) to Lake Granbury (see Section 5.2.3.6 in Luminant 2009a).

Clean Water Act, Section 316(a). This section regulates the cooling water discharges to protect the health of the aquatic environment.

Clean Water Act, Section 316(b). This section regulates cooling water intake structures to minimize environmental impacts associated with location, design, construction, and capacity of those structures.

Multi-Sector Stormwater Permit. A general or individual permit may be required by TCEQ to regulate discharge of stormwater (see Texas Water Code, Chapter 26). Luminant has within its general stormwater permit from TCEQ a Stormwater Pollution Prevention Plan (SWPPP) for Units 1 and 2, which would be revised to include facilities required for Units 3 and 4.

5.2.1 Hydrological Alterations

The physical alterations to the hydrologic setting that would occur during construction and preconstruction activities for CPNPP Units 3 and 4 are discussed in Section 4.2. CPNPP Units 3 and 4 plant water uses during operations are described in Section 3.4.2.1 of this EIS. This section addresses impacts that may occur during operation of the two proposed units. Operation of CPNPP Units 3 and 4 is not expected to require maintenance dredging of Lake Granbury, bank stabilization, or other physical alterations of the hydrologic system beyond those described in Section 4.2.

Water for the operation of CPNPP Units 3 and 4 would originate from Lake Granbury and the Wheeler Branch Reservoir (WBR). During plant operations, raw water for the makeup water system (MWS) and other in-plant uses in CPNPP Units 3 and 4 would be withdrawn from Lake Granbury through five 50 percent capacity pumps. Two pumps would be used for each unit and one spare pump in standby which would be common to both Units 3 and 4. The MWS supplies water to the CWS and the essential service water system (ESWS). The CWS removes heat from the main condensers by transferring it to mechanical draft cooling towers. Luminant proposes to use four wet mechanical draft cooling towers, two for each unit. The MWS supplies water to the ESWS cooling tower to make up for water consumed through evaporation, drift, and blowdown. The ESWS releases heat to the atmosphere through the ultimate heat sink (UHS) mechanical draft cooling towers, which are separate components not related to the mechanical draft cooling towers used for the CWS. There would be four 50 percent wet mechanical draft cooling towers used for the UHS. Portions of the make-up water would be treated then discharged to Lake Granbury.

Hydrologic alterations during the operation of the proposed new units are expected to be limited to the following activities:

- Alteration of water uses in the Brazos River Basin as a result of diversion of make-up water to CPNPP Units 3 and 4 CWS;
- Alterations of surface water quality as a result of changes in water management and discharges from CPNPP Units 3 and 4; and
- Alterations in groundwater quality as a result of proposed re-grading and re-contouring, drainage and treatment ponds, and structures.

Operation of CPNPP Units 3 and 4 would not introduce any additional hydrologic alterations affecting groundwater beyond those discussed in Section 4.2.1.

5.2.2 Water-Use Impacts

The following subsections discuss water-use impacts to surface water and groundwater. As described in Section 3.4, water for use in the operation of proposed Units 3 and 4 would come from Lake Granbury and WBR. Lake Granbury would be the primary source, supplying raw water for use in cooling systems and some water for other in-plant uses. WBR would supply potable water and would be the primary source of water for some process water. Operation of

CPNPP Units 3 and 4 would not use groundwater or Squaw Creek Reservoir (SCR) surface water.

In Texas, surface water use is regulated by the Texas Water Code, which specifies that surface water belongs to the State of Texas (Texas Water Code, Chapter 11, Section 11.021). The right to use surface waters of the State of Texas can be acquired in accordance with the provisions in Chapter 11 of the Code, currently administered by the TCEQ. Consistent with these provisions, Luminant obtains its water for operation of CPNPP Units 1 and 2 through the BRA, which operates Lake Granbury and diverts water for its users under existing rights. Luminant has proposed to enter into a contract with the BRA for the additional water needed for the operation of Units 3 and 4. The BRA has filed an application for a system operations permit (SOP) with the TCEQ that would grant it rights to additional water from TCEQ, allowing it to fulfill this contract by more efficient and integrated operations throughout the Brazos River Basin.

Water from WBR would be obtained through a contract with the SCWD. The SCWD owns rights to divert water from the Paluxy River for storage in WBR and to divert and use water from WBR.

5.2.2.1 Surface Water Use Impacts

The feasibility of water rights and appropriations in Texas is analyzed by Water Availability Models (WAM) sanctioned and maintained by the TCEQ. The WAM are used by TCEQ staff and others to determine whether water would be available for a newly requested water right or amendment. A modified WAM for the Brazos River Basin was used in the Technical Strategy Evaluation (HDR Engineering 2008) provided in conjunction with the proposed amendment to the Brazos Region G water plan allowing for withdrawal and consumptive use by the proposed Units 3 and 4. The findings of the evaluation were that the additional water for Units 3 and 4 operation could be made available without reducing existing supplies to other Brazos Region G water users and without a reduction in existing supplies to downstream users in Brazos Region H, relative to the supplies that were assumed to be available in the 2006 Brazos Region H Water Plan.

The WAM provided in support of the BRA application implements more efficient system-wide operations and full utilization of prior water rights. Luminant has stated that water for Units 3 and 4 will be obtained primarily from the more efficient system-wide operations and would not threaten the availability of water for holders of senior rights. The BRA has filed an application for a SOP with the TCEQ that would enable it to implement system-wide operations to achieve these efficiencies and additional water yield for its customers. Luminant has also stated that the availability of stored or "banked" water in BRA reservoirs under BRA current or future water rights would not be subject to calls by senior water rights holders. This banked water is assumed to mitigate the risk of supplies being inadequate for Units 3 and 4 during extreme droughts. Luminant has further stated that in severe drought conditions requiring curtailment of contracted water supplies, its expectation is that BRA would apportion the reductions in water availability to all of its contract customers.

Withdrawal and use of water from Lake Granbury for use by CPNPP Units 3 and 4 would result in lower water levels in Lake Granbury and decreased flows in the Brazos River downstream from Lake Granbury. In addition, Brazos River system operations would be altered to accommodate the additional withdrawals. These operational changes would include changes in the timing of water releases from Possum Kingdom Lake (PKL), resulting in lower water levels in that lake.

Conditions in the Brazos River and these reservoirs were modeled using hydrologic data from 1940 to 2007 (a period of 68 years), reservoir sediment buildup projections for 2020, and

Brazos River system water demands projected by the Brazos G Water Planning Group for 2020, including full utilization of all water rights (Albright 2009). Under these assumptions and with current river operating policies, the model estimates that Lake Granbury would be at full pool (approximately 693 ft above mean seal level [MSL]) 57 percent of the time. Additional water use by CPNPP Units 3 and 4 (the modeling assumed annual withdrawal of 103,717 ac-ft and consumptive use of 61,617 ac-ft) would result in a full pool condition occurring for just 46 percent of the 68-year period. PKL would be full about 34 percent of the time under current conditions and 26 percent of the time with CPNPP Units 3 and 4 operating. Operation of CPNPP Units 3 and 4 would reduce the average water levels by 0.6 ft in Lake Granbury and by 1.5 ft in PKL. The water level in Lake Granbury is estimated to fall 2 ft or more below full pool about 10 percent of the time under current conditions and about 25 percent of the time with CPNPP Units 3 and 4 operating. For Lake Granbury, water levels 5 ft or more below full pool are estimated to occur about 3 percent of the time under current conditions and 5 percent of the time with Units 3 and 4 operating. PKL water level is estimated to be 5 ft or more below full pool about 10 percent of the time under current conditions and about 25 percent of the time with CPNPP Units 3 and 4 operating. For PKL, the frequency of lake levels 20 ft or more below full pool is estimated to be well below 1 percent under current conditions, and between 1 and 2percent with Units 3 and 4 operating. The largest drops in lake water level predicted by the model are associated with the conditions encountered during the drought of record in 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions—and without CPNPP Units 3 and 4—Lake Granbury's water level is estimated to drop down to 6.5 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 9.4 ft below full pool. During these drought conditions PKL's water level is estimated to drop down to 22.6 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 37.4 ft below full pool.

Because of the conservative assumptions made, the model could overstate the severity of lake-level impacts, both with or without the new units. However, the model predictions for conditions without the new units compare reasonably well with historical data. According to the BRA, since its completion in 1969, Lake Granbury has been 1 ft or more below full pool for 23 percent of the time, 2 ft or more below full pool for 9 percent of the time, and 3 ft or more below full pool for 4 percent of the time (BRA 2010a). For comparison, the model results for conditions without the new units show Lake Granbury falling 1 ft or more below full pool about 17 percent of the time, 2 ft more below full pool about 10 percent of the time, and 3 ft or more below full pool about 5 percent of the time.

Operation of Units 3 and 4 would result in somewhat smaller releases from Lake Granbury and lower resulting streamflow in the Brazos River near Glen Rose, except during low flow periods (when a minimum release would be maintained) and peak flood flows. Stream flows at Glen Rose would be lower throughout the year, and the incidence of average monthly flows of 10 cfs or less would increase from 39 percent of the time without the new units to 44 percent of the time with the new units operating (Luminant 2010e). May and June, which typically have the highest stream flows at Glen Rose, would still have the highest annual flows, but median monthly streamflow would be an estimated 29 to 37 percent lower. Stream flows at Glen Rose would be reduced by more than 50 percent in the winter months of January and February, in which flows are low under current conditions, and would be reduced by one-third to one-half in March and April. Reductions in late summer and autumn median stream flows at Glen Rose would be more moderate, in the 10 to 24 percent range. Seasonal distribution of streamflow downstream from PKL would also be altered, with lower flows during the wetter months (typically May and June) and higher flows during the drier months of the year.

During operation of CPNPP Units 3 and 4 water for potable and sanitary requirements and other uses (Section 3.3.2) would be obtained from the SCWD via a pipeline from WBR. Withdrawals from WBR would occur at a rate of up to 350 gpm (about 565 ac-ft/yr). This volume, which is 28 percent of this reservoir's available annual supply, is expected to be allocated to Luminant (Section 2.3.2.1) and the reservoir's capacity to supply water exceeds current and projected total demand for the water. Therefore, no impacts to other SCWD water users would be expected. Use of WBR water also would have no more than minor impacts on stream flow in the Paluxy River (which supplies WBR). The annual withdrawal to supply CPNPP would be equivalent to just 0.8 percent of the mean annual flow in the Paluxy River at Glen Rose. Also, because the environmental bypass provisions in the Wheeler Branch water right permit do not allow diversions of water from the Paluxy River to supply WBR to cause the flow in the river to fall below specified values (Albright 2010), there would no adverse effects on low flows.

Based on the above analysis, the review team concludes that water use for operation of CPNPP Units 3 and 4 would have MODERATE impacts on surface water resources. The MODERATE impact level is based on the decrease in percentage of time that both Lake Granbury and PKL will be at full pool and changes to flow of the Brazos River downstream of Lake Granbury and PKL. These pool level changes would have a noticeable effect but not destabilize potential water uses on the reservoirs. Luminant has participated fully in the Brazos Region G Water Planning Group process to ensure that Units 3 and 4 water use impacts are managed in coordination with other users. No mitigation measures beyond this participation are necessary.

5.2.2.2 Groundwater Use Impacts

There would be no increase in the use of groundwater at the CPNPP site due to operation of CPNPP Units 3 and 4. As discussed in Section 2.3.2.2, under agreements between Luminant, TCEQ, and U.S. Environmental Protection Agency (EPA), groundwater usage at the site has decreased from 50 gpm to 16 gpm and is expected to decrease further when WBR water becomes available. As a result, impacts to groundwater quantity from plant operation, including impacts due to hydrologic alterations, are determined to be SMALL and no mitigation would be warranted.

5.2.3 Water-Quality Impacts

This section discusses impacts on the quality of water resources resulting from the operation of proposed CPNPP Units 3 and 4. Impacts to the quality of surface water can include thermal, chemical, and radiological effects due to discharge of effluents or changes in streamflow. Section 5.2.3.1 discusses impacts on surface-water quality and Section 5.2.3.2 discusses impacts on groundwater quality. Thermal impacts on surface water resources are discussed in Section 5.3.2.1. Impacts on water resources due to radiological releases are discussed in Section 5.9.2.1.

5.2.3.1 Surface Water Quality Impacts

This section explores potential impacts on surface water quality from several different sources. Possible sources of impacts that are considered are changes in the concentrations of contaminants found in Lake Granbury water, addition of water treatment chemicals in the facilities, alteration of flow patterns in Lake Granbury, and discharge of sanitary wastewater and stormwater.

Constituents of Lake Granbury water

The BRA would operate Lake Granbury to provide additional water for Units 3 and 4. The proposed contract between Luminant and BRA will modify the operating schedules for release of water from PKL and Lake Granbury in order to provide supplies needed for proposed Units 3 and 4.

Water entering Lake Granbury from PKL carries relatively high concentrations of total dissolved solids (TDS) and chlorides due to naturally occurring salt deposits in upper portions of the Brazos River watershed. Increased consumptive use of water that removes water from this portion of the Brazos River System without also removing the salt dissolved in that water will increase the salinity of Lake Granbury and the downstream Brazos River. Such increases are likely to occur even in the absence of Units 3 and 4 because the 2060 Brazos G Water Plan calls for full utilization of the water yield of the Brazos River System.

Luminant used the WAM results for the 2060 plan to develop a baseline scenario without operations of Units 3 and 4, as well as a scenario including withdrawal and consumptive use for Units 3 and 4 (Ward 2008). The results of those model comparisons, combined with refinements to account for differences in upper and lower Lake Granbury concentrations, showed that operation of Units 3 and 4, with return of blowdown to Lake Granbury without treatment to remove salts, would increase TDS concentrations in the lower 10-mi section of Lake Granbury by about 530 mg/L (Ward 2008). This increase would occur in the context of Lake Granbury historical TDS concentrations ranging from 500 mg/L to almost 3000 mg/L since 1970. The modeling results indicated that this increase would cause the Texas Surface Water Quality Standard (TSWQS) of 2500 mg/L TDS for Lake Granbury to be exceeded 26 percent of the time, compared with 2 percent of the time without the two new units (Ward 2008). To minimize the effect of the proposed units on TDS in Lake Granbury, Luminant has stated that the proposed BDTF would be placed into service to treat effluent from Units 3 and 4 and maintain discharge concentrations below the TSWQS for Lake Granbury of 2500 mg/L and 1000 mg/L of TDS and chloride, respectively. While the proposed facilities are projected to meet TDS and chloride standards, the dissolved solids concentration of the effluent discharged to Lake Granbury (2500 mg/L TDS) will be higher than the average TDS concentration in the reservoir, thus resulting in a small net increase in the TDS concentration in Lake Granbury and downstream.

Wastewater will be generated by the CWS, ESWS, non-essential service water system (NESWS), potable and sanitary water system (PSWS), demineralized water system (DWS), and fire protection systems (FPS). Nonradioactive wastewater streams from the CPNPP Units 3 and 4 include cooling tower blowdown, auxiliary boiler blowdown, water treatment waste, floor and equipment drains, and nonradioactive laboratory waste. By volume, cooling tower blowdown would account for more than 90 percent of the wastewater. Cooling tower and auxiliary boiler blowdown would be discharged to Lake Granbury, either directly or through the BDTF. Wastewater from floor and equipment drains, laboratories, and sanitary wastes would be processed through a waste treatment system and discharged to SCR.

The CWS will withdraw surface water from Lake Granbury and, as a result of evaporative cooling loss, concentrate the natural minerals in the water to an average of about 2.4 times their original concentrations. Table 5-2 shows Luminant's estimates of the concentrations of selected water quality constituents that could result from a 2.4-cycle cooling tower operation and the potential effects if this effluent were discharged directly to Lake Granbury. In addition to those constituents listed in Table 5-2, samples of ambient water from Lake Granbury were also tested for several trace metals that may be present naturally or due to other activities in the watershed and that can be toxic to humans or aquatic organisms. The water contained copper, barium, magnesium, and zinc concentrations above the laboratory detection limits, but arsenic, cadmium, chromium, lead, selenium, and nickel were not detected. Any of these constituents, if present in Lake Granbury water, would be concentrated in the CWS blowdown effluent.

Table 5-2. Estimated Concentrations of Selected Water Quality Constituents at the Discharge of CPNPP Units 3 and 4 When Diluted in Lake Granbury. All Concentrations Expressed as mg/L

Water Quality Constituent	Ambient Concentrations in Lake Granbury		Concentrations in Blowdown After 2.4 Cycles in Cooling Tower		Diluted Effluent at Low Flow Through Lake Granbury		Diluted Effluent at Annual Mean Flow Through Lake Granbury		Regulatory Criterion
	Mean	Max	Mean	Max	Mean	Max	Mean	Max	
Chloride	296	594	711	1426	776	1556	334	670	1000[(a)]
Iron, total	0.47	2.16	1.12	5.18	1.22	5.66	0.53	2.44	1[(b)]
Nitrate-N	0.08	.019	0.20	0.44	0.22	0.48	0.09	0.21	0.37[(c)]
Phosphorus, total	0.186	2.460	0.447	5.904	0.488	6.445	0.210	2.775	0.2[(c)]
Sulfate	122	232	292	557	319	608	137	262	600[(a)]
Total dissolved solids	1012	7010	2429	16824	2652	18366	1142	7908	2500[(a)]

(a) Texas Surface Water Quality Standard for Lake Granbury.

(b) TPDES Permit for Comanche Peak Nuclear Power Plant Units 1 and 2.

(c) Screening levels for nutrient parameters.

Source: Burgess 2009a

Without additional treatment, concentrated dissolved solids (primarily dissolved salts), certain metals, and other constituents in the blowdown waste stream would cause or contribute to exceedances of regulatory limits in Lake Granbury, particularly under average or low-flow ambient conditions. Luminant has proposed the addition of the BDTF to provide additional treatment of the waste stream so that the effluent discharge through the diffuser will meet the Texas State Water Quality Criteria of 2500 mg/L and 1000 mg/L for TDS and chloride, respectively, in Lake Granbury. Luminant has stated that the BDTF would reduce concentrations of the aforementioned metals and other water quality constituents to below regulatory limits. Luminant has also stated that the screening and regulatory limits for those constituents would be determined within the application process for TPDES permit for the Units 3 and 4 discharge to Lake Granbury.

Water treatment chemicals

Chemicals that will be added to the ESWS and NESWS include sodium hypochlorite, sulfuric acid, and corrosion inhibitors (Table 2-2). Blowdown from the ESWS and NESWS will be combined with effluent from the CWS, treated in the BDTF as necessary, and discharged to Lake Granbury. The liquid waste stream from the BDTF, which will have an estimated TDS concentration of 19,370 mg/L, will be routed to an onsite evaporation pond. To evaluate the potential for the use of water treatment chemicals (corrosion inhibitors) containing phosphorus to increase phosphorus loading to Lake Granbury and the Brazos River when the water is discharged (thus contributing to impacts such as nuisance algal blooms), the review team calculated the total potential annual loading of phosphorus resulting from the quantities of corrosion inhibitors listed in Table 2-2 and compared it to the total amount of phosphorus released from Lake Granbury at DeCordova Dam. To provide an upper estimate of the impact, the calculation assumed that all phosphorus-bearing compounds are received in the form of solid trisodium phosphate, no phosphorus is lost in the facilities, and all phosphorus containing water is discharged to Lake Granbury. The annual amount of phosphorus at DeCordova Dam was calculated from the mean monthly streamflow of 1031 cfs and the lowest concentration of phosphorus reported from measurements at the dam. With these conservative assumptions, the analysis found that the use of water treatment chemicals could increase phosphorus concentrations by a factor of 6.3×10^{-7} (about one part in 1.6 million). The effects of this addition are negligible. Impacts from other chemical additives also would be inconsequential due to small amounts, losses in the facilities, and compliance with effluent permit limits (Table 2-2).

Alteration of flow patterns

The withdrawal and discharge of large volumes of water can affect water quality in a reservoir by altering flow patterns. Normal power operation of Units 3 and 4 would increase the combined withdrawal rate from Lake Granbury (for all four units) significantly. The existing withdrawal rate for Units 1 and 2 is approximately 29,000 gpm (65 cfs) on average (based on reported 2006 withdrawals from Lake Granbury for Units 1 and 2 make up water). The proposed intake structure for Units 3 and 4 will be adjacent to the existing intake structure and withdraw an additional 62,932 gpm to serve Units 3 and 4. Thus, the combined withdrawal for all four units will increase from 29,000 gpm (65 cfs) to 92,000 gpm (205 cfs) on average. This 205 cfs withdrawal rate may be compared to the average monthly mean discharge of 1031 cfs for DeCordova Bend Dam.

The impact of this combined 205 cfs withdrawal on flow patterns in the lake will be imperceptible when flow releases from the dam are well above this average release. When the dam release is above this average flow rate and greater than the four-unit withdrawal rate of 205 cfs, there would be a readily observable effect on the flow pattern of Lake Granbury in the vicinity of the intake structure. When the release of flow from the dam is comparable to or less than the four-unit withdrawal rate of 205 cfs, the withdrawal of flow will dominate the flow patterns in the vicinity of the intake structure and in the area between the intake structure and DeCordova Bend Dam. Under these low-flow conditions, recirculation of some or all of the proposed 58 cfs of Unit 3 and 4 effluent from the discharge structure to the intake structures is inevitable.

The ER did not include field measurements of flow patterns or hydrodynamic modeling that would enable resolution of low flow condition flow patterns in Lake Granbury. In the absence of field measurements of flow patterns or hydrodynamic modeling the NRC staff has done a conservative bounding evaluation of the effects of low flow condition on ambient water in Lake Granbury. Additionally the NRC staff has done a bounding analysis to account for recirculation or significant alteration of flow patterns by the proposed intake structure not addressed in the CORMIX computer model provided by Luminant.

Blowdown will be discharged to Lake Granbury at a TDS concentration at or below 2500 mg/L. The blowdown discharged to Lake Granbury (26,076 gpm) is 5.6 percent of the average Brazos River flow (462,745 gpm) at DeCordova Bend Dam. As stated above, flow patterns in the vicinity of the intake and discharge structures for Units 3 and 4 will be altered to the extent that withdrawal flows exceed the release rate of water through DeCordova Bend Dam. During these low-flow conditions, the diffuser may operate less effectively than during high-flow periods, and although the effluent concentrations are designed to be within water quality criteria, they may be above ambient concentrations in Lake Granbury and result in locally elevated concentrations in the vicinity of the diffuser due to less-effective mixing. The resulting elevated concentrations of dissolved solids would temporarily reduce the suitability of the water for various uses. When dam releases are much greater than withdrawal flow, blowdown effluent from Units 3 and 4 will be diluted effectively and pass downstream through the dam to the Brazos River. Modeling conducted by Luminant for a BDTF-operation scenario similar to the one currently proposed indicated that the long-term average TDS concentration in Lake Granbury would increase by 50 to 60 mg/L (Freese and Nichols 2008).

Sanitary wastewater and stormwater

Treated water from the PSWS (for domestic use and human consumption) would be processed by the sanitary wastewater treatment system (SWWTS), which collects and treats sanitary wastes from various plant areas such as restrooms and locker rooms. Treated effluent from the 100,000-gpd SWWTS would be discharged directly to SCR without dilution. No nutrients or pH adjustment chemicals are expected to be needed for treatment of sanitary wastewater, and no chemicals will be added to the treated effluent prior to discharge to SCR. Effluent from the SWWTS would be treated to comply with the TPDES permit.

Both the DWS and the FPS supply water to the plant on an as-needed basis. Water from these systems is discharged into building sumps and transferred to the wastewater system (WWS) for treatment. The WWS collects and processes water from equipment and floor drains in building areas. Water collected by the WWS is expected to be piped to the CPNPP Units 1 and 2 wastewater retention ponds for treatment and disposal.

Stormwater runoff from the plant site is divided into two categories: clean and potentially contaminated. Clean runoff is directed to SCR. Potentially contaminated runoff (stormwater that may have come into contact with oil, sediments, and chemicals) will be directed to an appropriate waste stream prior to discharge, including routing to retention/sedimentation basins. Discharges of stormwater will be carried out in compliance with the Stormwater permit.

Conclusions

The review team concludes that impacts on surface water quality from operation of CPNPP Units 3 and 4 would be SMALL to MODERATE. The MODERATE level is based on the potential impacts to ambient water conditions and downstream users from increased dissolved solids, particularly during low flow conditions. Higher levels of dissolved solids would increase the need for treatment to make the water suitable for public water supply and other uses.

5.2.3.2 Groundwater Quality Impacts

The potential sources of impacts to groundwater quality associated with operation of CPNPP Units 3 and 4 are leaks, spills, and salt drift. There would be no intentional release of wastewater to groundwater.

The potential for operational impacts to groundwater quality would be limited by site characteristics and protective measures to be included in project plans. All evaporation and holding ponds would be lined with clay and low-permeability membrane liners, so there should be little or no leakage to groundwater. Additionally, monitoring of pond underdrains should ensure early detection of any leakage that does occur, so that leakage can be stopped and any contamination can be remediated quickly. Implementation of the SWPPP would reduce the potential for other leaks and spills that could result in contamination of subsurface water. However, because the ponds associated with the BDTF would (as currently designed) have capacity for 10-yr, 2-hr rainfall, they could potentially overflow on occasions when rainfall amounts exceed this capacity. Overflow water could move rapidly to shallow groundwater below the ponds. Any contamination entering shallow groundwater in the onsite fill or shallow Glen Rose Formation due to spills, should not adversely affect groundwater users because groundwater in these units is not used for water supply within a 2-mi radius and the proposed site for Units 3 and 4 is bounded on three sides by SCR. Most of the shallow groundwater flows into the SCR, where any contamination introduced by groundwater would add to any contaminant loading from surface sources and be diluted. Potential for migration to deeper aquifers is limited by the low permeability of the Glen Rose Formation relative to the higher permeability shallow fill and regolith which enhances lateral flow of groundwater.

Over time, however, salts from the BDTF ponds could infiltrate to the Twin Mountains Formation aquifer below the Glen Rose Formation, particularly if there are undetected preferential flow paths through the Glen Rose or if future water-level drawdowns in the aquifer lead to the development of strong downward gradients. Some release and deposition of salts would occur during operation of the cooling towers for Units 3 and 4. The maximum predicted water deposition rate from the cooling towers is 49,000 kg/km^2 per month at a downwind distance of 100 m from the cooling towers (Section 2.3.2 in Luminant 2010g). This deposition rate is the equivalent of a rainfall rate of just 0.002 in per month, which is a trivial amount compared with the normal monthly precipitation of 2 to 3 in. Therefore, considerable dilution of the salts deposited from the cooling tower plume would occur prior to infiltration into the onsite fill, resulting in minimal impacts on groundwater quality.

Salt spray discharged by the misters at the BDTF evaporation pond also could infiltrate to shallow groundwater after being deposited on soil surfaces outside the liner of the evaporation pond. Salt concentrations would be higher than in cooling tower drift. The rate of salt spray deposition to the ground surface, both between the perimeter of the pond liner and the 16-ft-high fabric enclosure to be built around the pond and outside the pond area, has not been determined. Due to the high salt concentration in the spray, much of the salt likely would precipitate in soil and would not infiltrate to shallow groundwater. Shallow groundwater in the vicinity of the evaporation pond site is not used for water supply and potential for migration to deeper aquifers is limited by the low permeability of the Glen Rose Formation, so adverse impacts to groundwater users would be unlikely.

Based on the above analysis, the review team concludes that impacts on groundwater quality from operation of CPNPP Units 3 and 4 are expected to be SMALL, but in view of various uncertainties and the potential impacts of pond overflows, MODERATE impacts are a possibility.

5.2.4 Water Monitoring

As part of its operation of existing CPNPP Units 1 and 2, Luminant currently monitors its effluent discharges to SCR, as required by its current TPDES permit. Data are reported monthly to the TCEQ. Similar monitoring of effluent discharges to Lake Granbury from operation of CPNPP Units 3 and 4 would be conducted in accordance with the TPDES permit that would be issued for that discharge.

Luminant maintains and implements a written Groundwater Protection Program for existing CPNPP Units 1 and 2 (Burgess 2009b). Additional hydrological monitoring for CPNPP Units 3 and 4 would be incorporated into the CPNPP Groundwater Protection Program. Some existing groundwater monitoring wells at the site for CPNPP Units and 3 and 4 could be used for groundwater monitoring during operation of proposed Units 3 and 4, but other existing monitoring wells would need to be abandoned during construction and would be replaced to support monitoring of groundwater after construction and during operation (Burgess 2009b).

Changes to the groundwater monitoring program as a result of the abandonment and replacement of monitoring wells would be assessed following construction of Units 3 and 4.

5.2.5 Potential Mitigation Measures for Operation-Related Water Impacts

The intake structure may alter flow patterns in the vicinity of the proposed diffuser during periods of low flow through DeCordova Bend Dam, which may diminish the effectiveness of the diffuser in mixing effluent. Locally elevated concentrations of effluent chemicals and temperature are possible under these conditions. Luminant has stated that BRA controlled releases from PKL upstream would supply the flow required by the intake structure, thereby mitigating the potential for flow pattern alteration and any resultant local water quality perturbations. Additional measures and procedures that could be taken by Luminant and the BRA to support the effectiveness of their mitigation measures would be to include hourly or daily local flow monitoring, decision-support systems and processes, or water management policies.

In addition to the groundwater monitoring that would be conducted as described in Section 5.2.4, monitoring of groundwater in the vicinity of the BDTF ponds could be done to provide early detection of impacts to groundwater quality from pond overflows, spills, and salt drift, thus allowing for response measures to reduce the possibility of adversely affecting groundwater users.

5.3 Ecological Impacts

This section describes the potential impacts to ecological resources from operation of two new units at the CPNPP site, operation of transmission lines, and maintenance of transmission and cooling water pipeline right(s)-of-way (ROWs). The impacts are discussed for terrestrial ecosystems and aquatic ecosystems and wetlands ecosystems.

5.3.1 Terrestrial Impacts Related to Operations

Concerns for potential impacts on terrestrial ecological resources from operation of nuclear power plants are usually associated with cooling system operations and transmission line operation and maintenance. Operation of cooling systems can result in deposition of dissolved solids; increased local fogging, precipitation, or icing; a greater risk of bird collision mortality; shoreline alteration of the source waterbody; and noise. Operation and maintenance of transmission systems may affect terrestrial species through avian (bird) collision mortality and electrocution, electromagnetic fields (EMFs), and the maintenance of vegetation within transmission corridors (NRC 1996).

As described in Chapter 3, the proposed cooling system for proposed Units 3 and 4 at the CPNPP site would be a closed-loop system with mechanical draft (wet) cooling towers. The heat would be transferred to the atmosphere in the form of water vapor and drift. Vapor plumes and drift can affect crops, ornamental vegetation, and native plants, and water losses can affect shoreline habitat. Bird collisions and noise-related impacts are possible with mechanical draft cooling towers, although avian mortality is usually only a factor with much taller natural draft cooling towers (NRC 1996).

The water to be used for cooling Units 3 and 4 would be drawn directly from Lake Granbury. After passing through the cooling tower, some blowdown water would be treated at a proposed onsite BDTF to remove salts and then combined with untreated blowdown water and returned to Lake Granbury. The conceptual design of the BDTF includes two ponds, an evaporation pond approximately 130 ac by 4 ft in depth and a three-month storage pond approximately 47 ac by 20 ft in depth, located on 400 ac of land south of existing Units 1 and 2 (Luminant 2009a).

Evaporation would be enhanced in the evaporation pond by a mister system consisting of 182 units comprised of 30 nozzles each. These units would create an aerosol with a water droplet size of 90 microns (Luminant 2009a).

A power transmission line presently extends diagonally across the 400 ac area proposed for development of the BDTF (see Figure 2-5). Bird collisions with the existing transmission line are a potential concern if the ponds are built under that transmission line because the ponds could act as attractants to the area underneath the conductors. The location of the proposed ponds in relationship to the existing transmission lines has not, however, been finalized (Luminant 2009a).

Electric transmission systems can affect terrestrial ecological resources through corridor maintenance, bird collisions with transmission lines, and EMFs (NRC 1996). Two new 345-kV transmission line rights-of-way would be required to distribute the additional generation from the proposed CPNPP Units 3 and 4 (Luminant 2009a). Two double circuit expansions would require the construction of new towers on new or expanded transmission right-of-way 160 ft wide. The first is the 45-mi line to Whitney, and the second is the 17-mi line to DeCordova. Three additional circuits, named Parker, Johnson, and Everman, would be added on existing towers on presently maintained rights-of-way (see Figure 2-14). These transmission lines are owned and maintained by Oncor, who would also own and maintain the new segments (Oncor 2008).

5.3.1.1 Terrestrial Resources – Site and Vicinity

Cooling System Impacts on Vegetation

As described in Section 2.4.1, vegetation on and in the vicinity of the CPNPP site consists mostly of Ashe juniper (*Juniperus ashei*) stands (Ashe juniper woodland – savanna), mixed hardwood forest, grassland, open water, wetlands, and developed land and openings from previous disturbance (see Section 2.4.1.1). There is no agriculture on the CPNPP site.

The following analysis reflects the revised data. Although the cooling towers would be equipped with drift eliminators to reduce the amount of liquid particle loss, some droplets containing dissolved particles would be ejected from the cooling towers. Potential impacts of salt exposure on native vegetation and agricultural crops include salt-induced leaf damage and growth and seed yield reduction if salt deposition rates are high. Maintaining a deposition rate below 1 to 2 kg/ha/month is expected to prevent damage to vegetation, whereas deposition rates approaching or exceeding 10 kg/ha/month in any month during the growing season could cause leaf damage in many species (NRC 2000b). Maximum salt deposition rates predicted from the cooling towers have been modeled (Luminant 2009a). The revised cooling tower drift modeling data indicated that at a point 100 m north of the towers the modeled rate is 3.49 kg/ha/month (1.37 kg/ha/month for sodium + 2.12 kg/ha/month for chlorides), and at a point 200 m north of the towers the modeled rate is 3.23 kg/ha/month (1.27 kg/ha/month for sodium + 1.96 kg/ha/month for chlorides) (Luminant 2010g). Because the modeling data indicate that salt deposition stemming from cooling tower operation would not exceed 10 kg/ha/month, leaf damage is unlikely. The review team therefore concludes that the potential risk from the cooling tower drift to vegetation would be minimal.

Salt drift from the BDTF misting system has not been modeled in detail, but salt concentrations leaving the misters are estimated to be approximately 576 kg/minute (Luminant 2009d). Thus, the potential for salt drift exists. Luminant estimates that salt drift from the misting units could be deposited up to 1300 ft from the source during wind speeds of 10 mph (Luminant 2009d). The tentative location of the evaporation pond is close to the CPNPP site boundary (Figure 2-5) and nearby vegetation is primarily Ashe juniper woodland - savanna (Figure 2-15). Although the exact location of the BDTF has not yet been determined, Luminant provided a conceptual sketch of the location of the evaporation ponds (see Figure 2-5).

Luminant's response states that a salt fence would surround the evaporation ponds, and a 500 ft wide buffer would be provided between the first bank of misters and the outside edge of the ponds to provide sufficient distance between the mister nozzles and the fence to ensure proper functioning (Luminant 2010f). The salt fence (Luminant 2010f) would be 5 m (16 ft) high agricultural shade cloth netting which would be attached to a framework at the top, but loose at the bottom so it could blow in the wind to cause the fabric to shed accumulated salt. The manufacturer of the salt fence claims that salt passing through the fabric falls out within one meter (about 3 ft) (Turbomist 2010). Further, Luminant states that precautions would be taken to contain the salt within the BDTF by unidirectional operation of spray misting units in addition to the salt fences (Luminant 2010e). With these measures in place, Luminant anticipates salt deposition of less than 1 kg/ha/yr beyond the BDTF perimeter (Luminant 2010j).

The review team does not consider the information provided by Luminant (Turbomist 2010) to be extensive enough to eliminate uncertainty regarding the potential for salt deposition beyond one meter from the salt fence. Luminant states that without the salt fence, salt could drift 1300 ft from the misters (Luminant 2010f). If salt drifts to that distance, the review team estimates that deposition could spread over an area of about 199 ac beyond the evaporation pond (Quarles 2010). Much but not all of the potentially affected area would lie within the 400-ac BDTF perimeter, where native vegetation would be removed during development of the BDTF and not allowed to regenerate during the operational life of the BDTF.

Information available to the review team suggests that the potential for salt drift may be even greater than 1300 ft, however. A study of salt deposition from an evaporative spray system using the same general type of mister proposed by Luminant found that deposition rates of salt were substantially increased at a distance of 2096 to 3484 ft surrounding the misters (Alonso et al. 2005). Based on this study and Luminant's sketch of mister locations (Luminant 2010f), the review team estimates that drift could affect an area beyond the BDTF perimeter of about 494 to 1226 ac, including an area of about 96 to 438 ac of vegetation off of the CPNPP site on private property south and west of CPNPP boundary (Quarles 2010). The area of increased salt deposition, assuming drift over the range of 1300 to 3484 ft, would extend over part of an isolated peninsula to the north of the proposed BDTF perimeter that is covered by Ashe juniper woodland - savanna and mixed hardwood forest (Figure 2-15).

Considering the limited case history data available to the review team regarding the misters and the salt fence, the measures proposed by Luminant (including but not limited to salt fence and unidirectional operation of the misters) may not prevent BDTF salt drift from noticeably affecting nearby natural vegetation. Due to the high volumes of salt that would be processed by the facility, even a small percentage loss of salt to the surrounding environment could have the potential to noticeably damage vegetation. If the mitigation measures proposed by Luminant are effective at eliminating salt drift from the BDTF the effects to terrestrial ecology could be minimal. However, the review team must acknowledge the uncertainty inherent regarding the efficacy of the proposed mitigation measures. If the mitigation measures were not completely effective over the operational life of the BDTF, then the effects of salt drift on terrestrial resources could be noticeable.

Fogging, precipitation, and icing in the area around the cooling towers for proposed Units 3 and 4 would increase due to condensation released from operations (see Section 5.7.1). The resultant plume from the cooling towers would cause most fog and ice to occur within about 0.37 mi, primarily both north-northwest and south-southeast of the towers, based on information presented in a table provided by Luminant (Luminant 2010h). The area affected around the cooling towers would include a portion of the SCR and a small amount of wetlands (see Figure 2-16). Considering the relatively high average winter low temperature, the icing impact would likely consist of rime ice only, which is less dense than clear ice and, therefore, less likely to cause damage. Impacts could be similar to those from the occasional sleet events in the region which can occur from December through March (see Section 2.9). These impacts would occur when much of the vegetation is dormant, and therefore less susceptible to damage.

Operation of the BDTF evaporation pond might cause localized fogging, but potential for fog formation and other meteorological effects is considered to be much less than for the cooling towers due to much smaller heat differential between the water in the pond and the surrounding atmosphere (Luminant 2009g; Luminant 2010h). Impact to vegetation from fogging, precipitation, and icing from cooling tower and BDTF operation is therefore expected to be minimal.

Avian Collisions due to Cooling System Operation

The cooling towers proposed for CPNPP would be no more than 60 ft high (Luminant 2009a); most authors report bird collisions only on objects four to ten times as tall (CEC 1995) (Kerlinger 2000). As opposed to taller natural-draft towers, mechanical-draft towers like those that would be used at CPNPP are associated with only negligible avian mortality (NRC 1996). Thus, the low profile of the proposed towers is expected to prevent most collisions. Because much of the peninsula where the cooling towers would be located would be cleared and graded to a level surface, there would be few topographic or ecological features left on the peninsula that would attract birds to this location or “funnel” them into the vicinity of other elevated features of the project (Luminant 2009a). The closest tall structure to the cooling towers would be Unit 4 which would have a 226 ft tall dome (Luminant 2009a). This unit lies about 0.20 mi southeast of the edge of the closest tower, based on distances scaled from a map of the cooling towers presented in Figure 2 of Enercon (2009). At this location the duration of fogging would be between about 100 to 130 hours per year based on information provided by Luminant subsequent to the publication of the Draft EIS (Luminant 2010g). Due to the limited duration of fogging at the location of the closest tall structure, the noise associated with the mechanical draft cooling towers which would tend to repel wildlife in the cooling tower area, and the operating history of other nuclear plants with mechanical draft cooling towers at which only negligible avian mortality has been observed (NRC 1996), the review team believes that it is unlikely that there would be sufficient collision-related mortality to noticeably affect local bird populations. Therefore, impacts to bird populations from collision mortality associated with cooling tower operation are expected to be minor.

Avian collisions with existing power transmission lines through the BDTF are a potential concern. Luminant’s sketch of the tentative BDTF layout shows that both the storage pond, and the evaporation pond, would be built beneath an existing power transmission line, and immediately adjacent to another transmission line to the north (Luminant 2010f). These ponds could attract waterfowl, and any fogging associated with their operation could reduce visibility to birds flying through the area. Inclement weather, particularly fog, has been associated with waterfowl mortality (Stout and Cornwell 1976). Reduced visibility from fogging combined with the fact that the ponds may be potentially attractive habitat features to some species may cause birds to collide with transmission lines and be killed or injured.

Due to the possibility of ponds attracting birds, U.S. Fish and Wildlife Service (USFWS) recommends relocation of the ponds or installation of bird diversion apparatus for the lines (USFWS 2009). TPWD also recommends that because the design of the BDTF is not yet finalized, Luminant should consider a proactive design approach by locating the BDTF ponds away from existing or proposed transmission lines, or relocating the existing transmission lines away from the proposed ponds. (TPWD 2010a). TPWD states that this would eliminate the need for avoidable long-term, labor-intensive, or costly preventative measures, and that it prefers locating the BDTF in areas of previous disturbance or low-quality habitat, where feasible (TPWD 2010a).

Luminant states that potential for fog development from the ponds is limited due to the lack of extreme heat differential of water in the ponds with the atmosphere, and that all visible plumes would terminate within 295 ft (Luminant 2010j). Further, Luminant states that noise and violent spray action from the misters in the evaporation pond could act as a deterrent, discouraging birds from flying near the lines or landing on the evaporation pond (Luminant 2009d). Potential impacts on birds would be monitored and bird deterrent procedures and equipment would be used as needed (e.g., noise cannons, netting, artificial predators, periodic patrols, and minimizing periods of time in which standing water is present) (Luminant 2009d). Luminant states that bird deterrents or other devices that might be used would be selected during the final design stage based on discussions with the TPWD and the USFWS (Luminant 2009d). However, Luminant has stated that it does not plan to reroute the existing transmission lines in the vicinity of the BDTF (Luminant 2010i).

Noise

The noise levels from cooling tower operation are anticipated to be 55 dBA at 1000 ft, which extends beyond the CNNPP site perimeter fence (Luminant 2009a). No important terrestrial species are known to be located within this area (Section 4.3.1.3). This noise level is well below the 80- to-85-dBA threshold at which birds and mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating the cooling towers would not be likely to disturb wildlife beyond the CNNPP site perimeter fence. The noise might disturb onsite wildlife, but the wildlife would likely become habituated or relocate. Noise levels from the proposed BDTF have not been modeled but are assumed to be similar to those from the cooling towers. Consequently, the potential impact on wildlife posed by the incremental noise resulting from the operation of the cooling towers and the BDTF proposed for CPNPP Units 3 and 4 would be minimal.

Artificial Lighting

Artificial light can disrupt wildlife by both disorientation and attraction. Many species of birds migrate at night and it is well known that fires and artificial lights attract birds during migration, particularly when the sky is cloudy and the ceiling is low (Longcore and Rich 2005). Down-shielding of lights to prevent light from being directed up into the night sky can help reduce this effect, that is, lights can be shielded so that the pattern of illumination is below the horizontal plane of the light fixture (Longcore and Rich 2005).

No information has been provided by Luminant on the quantity of additional light that would result from the addition of Units 3 and 4. However, the additional lighting required for Units 3 and 4 would be lessened by using low sodium lighting. Luminant has already changed to low sodium lighting for Units 1 and 2 in response to complaints from residents about not being able to see stars in the night sky (Luminant 2009a). Down shielding, as described above, could be employed to further mitigate impacts. Operating experience with Units 1 and 2 has not shown that bird collisions with the units have been a noticeable issue (Luminant 2009a). Although, as explained above for cooling system operation, fog formation to the southeast of the cooling towers would occasionally extend over the locations where Unit 4 (the closest tall structure) would be constructed and thus increase the possibility of collision for birds, especially those flying at night. The duration of fogging at this location would be less than 130 hours per year based on information provided by Luminant (Luminant 2010g). It is not expected that the incremental impact of the lighting to be added for Units 3 and 4 would raise the level of impacts to noticeable levels, particularly if down shielding were to be employed. Therefore, impacts to wildlife from the additional lighting for Units 3 and 4 are expected to be minimal.

Shoreline Habitat

Consumptive water use for cooling CPNPP Units 3 and 4 would cause lower lake levels at PKL and Lake Granbury, and decreased flows in the reach of the Brazos River between Lake Granbury and Lake Whitney (Luminant 2009a). Based on modeling of water use provided by Luminant, water elevations in PKL would be 1.5 ft lower on average, and elevations in Lake Granbury would be 0.6 ft lower on average due to Unit 3 and 4 water consumption (Albright 2009). The maximum modeled change during periods of extreme drought in Lake Granbury would be 2.9 ft, and during drought at PKL would be 14.8 ft (Albright 2009). To add perspective, as explained further in Section 5.2.2.1, the largest drops in lake water level predicted by the model (using conservative assumptions which might overstate the magnitude) are associated with the conditions encountered during the drought record of 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions— and without CPNPP Units 3 and 4—Lake Granbury's water level is estimated to drop down to 6.5 ft below full pool elevation; operation of Units 3 and 4 would increase the maximum drawdown to 9.4 ft below full pool elevation. During these drought conditions— and without CPNPP Units 3 and 4—the PKL's water level is estimated to drop down to 22.6 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 37.4 ft below full pool (Albright 2009). All but the highest outflows from Lake Granbury would be reduced as well, thus lowering flows in the Brazos downstream of Lake Granbury.

Developed areas predominate the PKL shoreline followed by hardwood forest, Ashe juniper vegetation, and to a lesser extent grasses and savanna habitat; emergent wetlands are limited because the shoreline is steep and rocky (Luminant 2010j). Lake Granbury shoreline is about 85 percent developed with the remainder consisting of hardwood forest, Ashe juniper vegetation, and some pasture or grasslands (Luminant 2010h). Wetlands occur in coves but generally not on banks, which also tend to be steep and rocky (Luminant 2010j).

Generally, cove areas would be the first affected by drawdown, as coves tend to be shallower than the main portion of the lake. Ashe juniper habitat would not be affected by drawdown because junipers are drought resistant upland trees. Hardwood trees such as pecans and cottonwoods may be minimally affected along the periphery of the riparian zone; however, the roots of mature trees tend to be deep and hence largely unaffected by temporary groundwater drawdowns.

Because the lakes already experience water level fluctuations from existing water use demands, shoreline vegetation on the lakes is expected to already be adapted to some water level fluctuations. The increased drawdown from operations of Units 3 and 4 would constitute an added fluctuation that may noticeably further stress plant communities by lessening availability of water to vegetation on the existing shoreline. Through time the zone of shoreline-adapted vegetation is expected to respond by moving waterward. The stress of occasional extreme drawdowns could cause death of some of the limited herbaceous wetland species present, but these species would likely become reestablished once more typical water levels resumed. In addition, opportunities for colonization by invasive vegetation such as *Phragmites australis* could result. Although the zone of shoreline habitat would noticeably migrate to a somewhat lower elevation, overall impacts would not be drastic enough to destabilize important attributes of the resource.

5.3.1.2 Terrestrial Resources—Transmission Lines and Cooling Water Pipelines

This section discusses the environmental impact of operating the transmission lines and cooling water pipelines and maintaining ROWs associated with proposed CPNPP Units 3 and 4.

Vegetation Management

New and expanded transmission rights-of-way would be managed by Oncor in the same manner as its existing rights-of-way, that is on a regular cycle to prevent disruptions in service resulting from overgrown or diseased woody vegetation falling or encroaching on the power lines. This maintenance requires cutting herbaceous and low woody growth on a relatively short cycle and cutting saplings, larger shrubs, and small trees on a longer cycle that varies within the service area. Right-of-way maintenance typically involves use of herbicides in addition to light power equipment such as saws, mowers, and hand tools (Luminant 2009a).

Undesirable species would be controlled as required by local management plans usually established at the county level. Hand cutting and mowing would be used in areas where herbicide use would be ineffective or inappropriate. Herbicides would be handled and applied by trained and licensed personnel in accordance with manufacturer specifications and regulatory requirements (Luminant 2009a).

Vegetation management to control tree growth in the rights-of-way exposes the area between trees to more sunlight and therefore usually results in rapid growth of grasses, forbs, saplings, and low shrubs. Cycles of management increase ecotone or edge habitat in what would otherwise be homogeneous woodland or shrub habitat. This benefits edge-adapted species including ground-nesting birds, small mammals, and white-tailed deer (Odocoileus virginianus), while removing some habitat preferred by forest interior species. Conversely, maintenance of edge habitat through woodlands can increase opportunity for nest parasites such as the brown-headed cowbird (Molothrus ater) to penetrate woodlands and impair the nesting success of woodland species. Increased nest parasitism would be a negative but minimal adverse impact on local populations.

The impact of transmission line corridor maintenance on wildlife habitats, including floodplains and wetlands was evaluated in NUREG-1437 (NRC 1996), and the impact was found to be of small significance at operating nuclear power plants with associated transmission line corridors of variable widths (NRC 1996). This is because control of trees and large shrubs is normally required only in forested areas where trees grow tall enough to physically interfere with operation of the power lines. Oncor has procedures in place that minimize adverse impacts to wildlife habitat, as well as to important habitats such as floodplains and wetlands. Consequently, the potential effects on terrestrial ecology from transmission line maintenance in the new and expanded transmission corridor would be minimal, and mitigation beyond the use of standard best management practices (BMPs) would not be warranted. Because the cooling water pipeline right-of-way would be managed less intensively than the transmission rights-of-way, and because only trees and large shrubs would be controlled, impacts would be minimal.

Impacts of Avian Mortality from Transmission Structures

Deterrents to prevent electrocution of large birds (e.g., great blue herons and eagles) have been installed on transmission towers at CPNPP. The deterrents are inverted "Vs" that are aligned along tower arms to discourage perching and nesting behaviors along the arms and lower the chance for electrocution. Based on a review of the Unit 1 and 2 corrective action program there have been some instances of great blue herons building nests on transmission towers and subsequent electrical circuit trips associated with their droppings, but there has been only one reported occurrence of great blue heron mortality (Luminant 2009d). Similar deterrent structures could be used where warranted to protect large birds from electrocution on new power lines that would be constructed for CPNPP Units 3 and 4. The lack of previous occurrences provides reasonable assurance that the threat of electrocution is minimal if appropriate deterrent structures are used.

The NRC (1996) has determined that avian mortality from collisions with transmission lines and other man-made structures is of concern if the stability of a local population of any bird species is threatened or if the reduction in the numbers within any bird population significantly impairs its function within the ecosystem. Collision potential typically is dependent on site-specific variables such as the line location in relation to high use habitats (e.g., nesting, foraging, roosting areas), line orientation to flight patterns and movement corridors, species composition, visibility, and line design. Avian mortality resulting from collisions with transmission lines is considered to be of minimal significance if there is no threat to the stability of local populations and if there is no noticeable impairment of their functioning within the ecosystem. None of the studies reviewed by the NRC (1996) suggests that collision mortality is a significant factor in reducing the populations of common bird species; the conclusion presented is that bird collisions with transmission lines are of small significance at operating nuclear power plants, including corridors with variable numbers of transmission lines. Therefore, with the exception of transmission lines crossing and adjacent to the BDTF impacts of avian mortality from collisions due to operation of the new transmission lines for the proposed CPNPP Units 3 and 4 are expected to be minimal, and mitigation would not be warranted.

Electromagnetic Fields

Flora. Although strong electric fields can cause minor damage to plant foliage and buds by heating leaf tips and margins, damage does not occur at lower electric field levels and even the damage from strong fields would not significantly affect plant growth (NRC 1996). The NRC determined that EMFs produced by operating transmission lines for existing U.S. nuclear power plants up to 1100-kV were not linked to significant harmful effects on flora (NRC 1996). The transmission lines that would be constructed for CPNPP would operate only at 385 kV, which is much lower than the 1100-kV threshold for EMF effects on flora. Therefore, the increased EMF posed by the operation of the proposed transmission lines is expected to have only a minimal impact on flora.

Fauna. EMFs have been demonstrated to affect some fauna. Voltage buildup can affect the overall health of honeybee hives (NRC 1996). Birds that nest within transmission line corridors experience chronic EMF exposure, but lines energized at levels less than 765-kV do not affect most terrestrial fauna (NRC 1996), and the transmission lines that would be constructed for CPNPP would operate only at 385-kV. The NRC concluded that the impacts of EMFs on terrestrial fauna are of small significance at operating U.S. nuclear power plants, including transmission systems with variable numbers of transmission lines (NRC 1996). Therefore, the increased EMF posed by the operation of the proposed transmission lines is expected to have only a minimal impact on fauna.

5.3.1.3 Important Terrestrial Species and Habitats

This section discusses the environmental impact of operating Units 3 and 4 at the CPNPP site, and the associated transmission line and cooling water pipeline rights-of-way, to ecologically important species, including commercially and recreationally valuable species, and Federally and State-listed species. There are no areas designated as critical habitat in the vicinity of the CPNPP site or the rights-of-way.

Recreationally valuable species that would be affected by project operations include avian game species and white-tailed deer. As described in Section 5.3.1.2, the avian game species could experience increased mortality, due to operation of ponds in the BDTF area.

Most species at CPNPP are common to the region, as discussed in Section 2.4.1.3, and those rare species potentially present are more abundant elsewhere in the region. There is no evidence suggesting that any species present is critical to structure or function at the ecosystem (landscape) level or that any species might function as a true biological indicator. Thus, there would be no operational impacts to critical and indicator species.

Dinosaur Valley State Park and Fossil Rim Wildlife Center, as discussed in Section 4.3.1.3, are the only known important terrestrial habitat within the area likely to be affected by project operations except for wetlands, which are discussed in Section 5.2.3. Operational impacts to the Dinosaur Valley State Park and Fossil Rim Wildlife Center may result from the Whitney transmission line ROW, which might pass through portions of these parks. Oncor would have to periodically maintain vegetation in the ROW, including any portion that crosses the park. Additionally, there could be some increase in avian mortality in the parks due to electrocution of large birds, if present, unless appropriate deterrent structures are used.

Federally Listed Species

The only Federally listed terrestrial species with recorded occurrences within 10 mi of the CPNPP site and proposed new power transmission and cooling water pipeline rights-of-way are the endangered black-capped vireo (*Vireo atricapillus*) and endangered golden-cheeked warbler (*Dendroica chrysoparia*) (see Biological Assessment in Appendix F). The site also lies within the flyway for the Aransas-Wood Buffalo population of the endangered whooping crane (*Grus americana*). Each of these species is also State listed as endangered (TPWD 2009d). They are the only Federally listed species that have been documented or are known to occur in Somervell County (USFWS 2006). They are discussed below.

Black-capped vireos and golden-cheeked warblers have been observed foraging and nesting in Dinosaur Valley State Park within about 3.5 mi of the CPNPP site and in Fossil Rim Wildlife Center within about 8 mi of the CPNPP site (TPWD 2010a). If the Whitney transmission line ROW crosses through the parks, it could pass through areas where the vireos and warblers are present. As stated in Section 5.3.1.2 the risk for avian collisions with structures is low. Furthermore, these two bird species are too small to be at risk from electrocution due to transmission lines. Other operational impacts to these species associated with the transmission lines would be unlikely.

As discussed in Section 4.3.1.3 and in the Biological Assessment in Appendix F, various surveys for the golden-cheeked warbler presence have been conducted in the Ashe juniper forest areas of the CPNPP site that would be cleared for construction and preconstruction activities, including the area of the BDTF. These surveys revealed only marginal habitat; and no golden-cheeked warblers were actually observed. Areas other than those surveyed, however, could be affected by operations due to salt drift from the BDTF as discussed in Section 5.3.1.1 above. The area of possible increased salt deposition, using a worst case scenario of drift extending over the range of 1300 to 3484 ft, would extend over some or all of a peninsula that is covered by Ashe juniper and mixed hardwood forest to the north of the proposed BDTF location and (Figure 2-15). Depending on the exact extent of drift that results from operation of the BDTF, some of this vegetation could be susceptible to salt drift injury. While no surveys or observations for golden-cheeked warbler presence or habitat suitability are known to have been conducted on this peninsula, if this area contains suitable habitat for golden-cheeked warbler, golden cheeked warblers may be present in this area. If, in a worst case scenario, salt drifts this far, depending on its magnitude, then salt drift could affect this habitat and thereby could potentially affect golden-cheeked warblers present in the area. Otherwise, impacts to golden-cheeked warbler would be minimal.

As noted previously (Sections 2.4.1.1 and 2.4.1.3), the migratory corridor of the Federal- and State-listed endangered whooping crane extends over the CPNPP site. However, no occurrences of whooping cranes have been reported within a 10-mi radius of the CPNPP site or the proposed transmission line and pipeline corridors (TPWD 2009d). The area of the migratory corridor used by the Aransas-Wood Buffalo population (the last remaining wild population) of 247 individual whooping cranes is approximately 560,000 square mi, based on a chart presented in Canadian Wildlife Service and U.S. Fish and Wildlife Service (2007), The total area of land altered for new project features would be less than about 3 square mi. Thus the statistical likelihood of stopover of whooping cranes near project features would be slight. Nevertheless, it is possible that whooping cranes could stop over in the vicinity during migration.

Preferred whooping crane migration stopover habitat consists of croplands and marshy wetlands which are typically shallow and contain emergent vegetation for feeding (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2007). At the CPNPP plant site, only small areas of wetlands occur, and they tend to be in narrow bands along the shoreline and coves of SCR (see Sections 2.4.1.4 and 2.4.2.3). These wetlands are limited in extent and lack large areas of shallow water typical of migration stopover habitat. The ponds associated with the BDTF would be relatively deep (32 ft for the storage pond and 4 ft for the evaporation pond) and would be lined, and they are therefore expected to be devoid of emergent vegetation that could be used as food (see Section 3.3.1.4). Further, whooping cranes are daytime migrants (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2007), and thus would be at little risk for navigation problems due to artificial lighting, or nighttime fogging conditions. In addition the noise associated with use of the misters would be expected to act as a localized deterrent to wildlife. For these reasons the CPNPP site, including the BDTF area, would not be conducive to use as stopover habitat for whooping cranes. These factors would decrease the possibility of any transmission line strikes by whooping cranes (transmission line strikes are leading cause of mortality to fledged whooping cranes) (Canadian Wildlife Service and U.S. Fish and Wildlife Service 2007). Given these factors it would be unreasonable to conclude that there would be a likely adverse impact to whooping cranes. Therefore, the review team considers the possibility of harm to be low enough to support a conclusion that the addition of Units 3 and 4 may affect, but is not likely to adversely affect, whooping cranes. Further, should bird diversion apparatus be used for the transmission lines in the vicinity of the BDTF, as recommended by USFWS (2009), and on other project transmission lines as well, the chances of strikes by whooping cranes would be even less.

Further, as discussed earlier above, due to the possibility of ponds attracting birds (which would include whooping cranes), USFWS recommends relocation of the ponds or installation of bird diversion apparatus for the transmission lines crossing over the ponds (USFWS 2009). TPWD also recommends that because the design of the BDTF is not yet finalized, Luminant should consider a proactive design approach by locating the BDTF ponds away from existing or proposed transmission lines, or relocating the existing transmission lines away from the proposed ponds. (TPWD 2010a). TPWD states that this would eliminate the need for avoidable long-term, labor-intensive, or costly preventative measures and that it prefers locating the BDTF in areas of previous disturbance or low quality habitat, where feasible (TPWD 2010a). Luminant has stated however that at this time it is not considering rerouting the existing transmission lines in the vicinity of the BDTF (Luminant 2010i).

State-Listed Species

As explained in Section 2.4.1.3, State-listed and rare species potentially in the vicinity of the CPNPP site, including the pipeline right-of-way, and the proposed new power transmission rights-of-way, include three bird, three reptile, and two plant species. Potential impacts to these species, with the exceptions of black-capped vireo, golden-cheeked warbler, and whooping crane, which are also Federally endangered and were discussed above, are described below. Species considered are those with known occurrences in the three counties potentially affected by the proposed CPNPP Units 3 and 4 facilities and the two proposed new transmission line rights-of-way (Somervell, Hood, and Bosque Counties). Also considered are species without recorded occurrences, but which TPWD considers could be present and impacted by the project when suitable habitat is present (TPWD 2007).

Fauna

Bald eagle (*Haliaeetus leucocephalus*) (State-listed as threatened*)*.

CPNPP site personnel report that wintering bald eagles forage and perch along the shore of SCR. Eagle mortality could increase due to placement of ponds in the blowdown treatment area beneath an existing power transmission line. There could also be some increase in eagle mortality due to collisions with or electrocution by the proposed new transmission lines unless appropriate deterrent structures would be used. With appropriate mitigation, as discussed in Section 5.3.1.1, impacts to bald eagles would be minimal.

Texas garter snake (*Thamnophis sirtalis annectens*) (Considered rare by TPWD, but with no regulatory listing). Recorded occurrences are rare in the CPNPP vicinity (TPWD 2009d). This species is therefore unlikely to be affected by project operational impacts.

Texas horned lizard (*Phrynosoma cornutum*) (State-listed as threatened). Recorded occurrences are rare in the CPNPP vicinity (TPWD 2009d). This species is therefore unlikely to be affected by project operational impacts.

Timber (canebreak) rattlesnake *(Crotalus horridus*) (State-listed as threatened). Recorded occurrences are rare in the CPNPP vicinity (TPWD 2009d). This species is therefore unlikely to be affected by project operational impacts.

Comanche Peak prairie clover (*Dalea reverchonii*) (Considered rare by TPWD, but with no regulatory listing). The single recorded occurrence of Comanche Peak prairie clover within 10 mi of the CPNPP site and proposed new power transmission rights-of-way is more than 3 mi to the north of areas to be affected by project activities based on the map provided by TPWD (TPWD 2009d). Therefore, habitat is likely too distant to be affected by project operations.

Glen Rose yucca (*Yucca necopina*) (Considered rare by TPWD, but with no regulatory listing). Three known occurrences of Glenn Rose yucca lie in the vicinity of the proposed DeCordova transmission line and cooling water pipeline rights-of-way (TPWD 2010a). Glen Rose yucca may occur wherever suitable habitat is present (TPWD 2010a). If this Glen Rose yucca is encountered during pipeline development, work in the immediate area would be halted and appropriate TPWD officials and environmental consultants would be contacted to determine proper mitigation measures so that work could resume (Luminant 2009a).The mitigation to be developed would address protection of any individuals present from maintenance operations to be conducted in the pipeline right-of-way. With development of suitable mitigation, impacts to Glenn Rose yucca due to periodic right-of-way maintenance would be minimal.

5.3.1.4 Terrestrial Monitoring during Operation

Luminant has stated that potential impacts on birds (due to collisions with the existing transmission line that would remain above the new evaporation pond in the BDTF) would be monitored and bird deterrent procedures and equipment would be used as needed. (Luminant 2009d). There are no other terrestrial monitoring activities planned related to transmission line or plant operations on the CPNPP site or identified for proposed Unit 3 or 4 operation. However, there may be a need to monitor the efficacy of the salt fence at the BDTF evaporation ponds.

5.3.1.5 Potential Mitigation Measures for Operation-Related Terrestrial Impacts

Luminant has proposed the use of salt fences and unidirectional operation of misters to reduce the impacts of salt drift from BDTF operation. Luminant has also indicated that they plan to confer with USFWS and TPWD regarding possible measures to reduce operational impacts from the BDTF. There could also potentially be a need for the following additional mitigation measures:

- Redesign and/or change the proposed location for the BDTF to reduce potential for salt drift and fogging.
- Employ bird collision deterrent devices, such as those described in "Mitigating Bird Collisions with Power Lines: State of the Art in 1994 and 2006," by the Avian Power Line Interaction Committee could reduce the likelihood of other impacts to terrestrial wildlife (TPWD 2010a, DOI 2010).
- Reroute existing transmission lines away from BDTF before beginning BDTF operations.

Further, TPWD recommends Luminant mitigate for the shoreline ecosystem impacts resulting from drops in water levels, and suggests that Luminant delineate and quantify shoreline habitat from PKL to the Brazos River at Lake Whitney and utilize these data to develop a strategic monitoring and mitigation plan to account for impacts to the Brazos River ecosystem, including impacts to shoreline habitat and wetlands (TPWD 2010a). TPWD states that habitats should be delineated preoperation and at incremental periods once operation begins; mitigation could include monitoring and controlling undesirable or invasive species and restoring diverse wetland habitats along the lake and river shorelines (TPWD 2010a).

Luminant has not committed to these three additional mitigation measures, and the conclusions presented in the EIS, that operational impacts to terrestrial resources would be noticeable, but would not destabilize these resources, therefore do not assume that the mitigation measures would be implemented. Should Luminant ultimately elect to implement these measures, they could substantially reduce the potential for adverse impacts to terrestrial biota over the operational life of the proposed facilities.

5.3.1.6 Summary of Impacts to Terrestrial Resources during Operation

The potential impacts of operating the proposed CPNPP Units 3 and 4 and mechanical draft cooling towers on vegetation, birds and other wildlife are likely to be minimal. The potential impacts of transmission line corridor maintenance and similar impacts on important habitats including birds, and other biota because of EMFs would be minimal, assuming BMPs are followed and State and federal agencies are consulted, as appropriate. Salt drift from operation of the BDTF could impact nearby vegetation, and birds attracted to the BDTF ponds could collide with an existing transmission line that crosses the BDTF site. Impacts due to cooling system operation to shoreline vegetation on Lake Granbury and Possum Kingdom Reservoir would be noticeable, but not potentially drastic enough to destabilize important attributes of the resource. The review team therefore concludes that operational impacts to terrestrial resources would be MODERATE, and additional monitoring or mitigation may be warranted.

5.3.2 Aquatic and Wetlands Impacts

This section discusses the potential impacts of the operation of the proposed CPNPP Units 3 and 4 on the aquatic and wetlands ecosystems of Lake Granbury, SCR, the Brazos River, PKL, WBR, the Paluxy River, and waterbodies crossed by the ROWs for the proposed transmission lines and pipelines.

5.3.2.1 Impacts on the Lake Granbury Ecosystem

Lake Granbury would be the source of makeup water for the proposed CPNPP Units 3 and 4 cooling water system and also would receive blowdown effluent from the CWS, ESWS, and NESWS. Consequently, Lake Granbury is the waterbody with the greatest potential for adverse impacts on its aquatic ecosystem from operation of the intake and discharge for Units 3 and 4.

CPNPP Units 3 and 4 Intake

For aquatic resources, the primary concerns related to water intake and consumption are the impacts related to the relative amount of water drawn from the cooling water source (Lake Granbury) and the potential for organisms to be impinged on the intake screens or entrained within the cooling water system. Impingement occurs when organisms are trapped against the intake screens by the force of the water passing through the intake structure (66 FR 65256). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling of fish (66 FR 65256). Entrainment occurs when organisms are drawn through the intake structure into the cooling system. Organisms that become entrained normally are relatively small forms that float (plankton) or freely swim (nekton) in the water column or live on the bottom (benthos), including early life stages of fish and shellfish, and that often serve as prey for larger organisms (66 FR 65256). As entrained organisms pass through a plant's cooling system, they are subject to mechanical, thermal, pressure-related, and toxic stresses that usually are lethal.

In developing its regulations addressing cooling water intake structures for new facilities that withdraw water for cooling purposes, the EPA identified a number of factors that can greatly influence the degree to which aquatic biota are affected by impingement and entrainment. These factors include (1) the intake capacity (volume of water that can be withdrawn over a period of time), which is dependent on the type of cooling system used; (2) the design and construction of the intake; (3) the location of the intake; and (4) the proportion of water withdrawn from the source waterbody (66 FR 65256).

Capacity. Luminant stated in its ER that the type of cooling system that would be used for the proposed CPNPP Units 3 and 4 would be a closed-cycle, wet, mechanical-draft, cooling tower system (Luminant 2009a). Relative to once-through power plant cooling systems, closed-cycle cooling systems do not use large volumes of water; therefore, impingement and entrainment of aquatic organisms would be minimal. During normal operation, the rate of water withdrawal through the intake would be 62,932 gpm for both Units 3 and 4 combined (Section 5.2.1).

Design and construction. A second factor that greatly influences the rate of impingement and entrainment of fish and shellfish at a facility is the design through-screen velocity of the intake structure. The higher the through-screen velocity, the greater the number of fish likely to be impinged or entrained. Therefore, EPA has established a national standard requiring that the maximum design through-screen velocity be no more than 0.5 ft/s (66 FR 65256). EPA determined that species and life stages of fishes evaluated in various studies could endure a velocity of 1.0 ft/s. It then applied a safety factor of two to derive the threshold of 0.5 ft/s. The data from the studies suggested that a velocity of 0.5 ft/s would protect 96 percent of the fish tested.

To limit through-screen velocity and otherwise minimize the impact of the intake system on aquatic biota, a number of features were incorporated into the design of the CPNPP Units 3 and 4 intake structure. The structure would use wedge wire screens. Wedge wire screens are identified by EPA as a passive intake system technology that minimizes (reduces to the smallest amount reasonably possible) impingement mortality and entrainment of all life stages of fish and shellfish (66 FR 65256).

Luminant has stated that the proposed CPNPP Units 3 and 4 intake would have a design through-screen velocity of less than 0.5 ft/s. The maximum velocity through clean screens at a normal lake water level of 693 ft above MSL is projected to be 0.38 ft/s, which would increase to 0.42 ft/s at a high water level of 712.8 ft above MSL. If the screens are assumed to be 15 percent blocked by debris or fouling, the corresponding velocities are projected to be 0.44 ft/s and 0.49 ft/s (Luminant 2009a). Thus, the maximum through-screen velocity is expected to remain below 0.5 ft/s even under conditions in which the water level is high and the screens are 15 percent clogged (Luminant 2009a). To clean the screens, an air blast system would be employed. High-pressure bursts of air would be released through a manifold of nozzles within each screen assembly to dislodge material from the surface of the screens and cause the material to rise in the water column with the rising air. The cleaning would be done periodically based on use of a monitoring system that would measure differential pressure (head loss) across the screen. Cleaning would be automatically initiated when clogging caused an increase in head loss beyond a preselected differential, and this setting could be changed as necessary to prevent clogging from causing the through-screen velocity to exceed 0.5 ft/s. Cleaning approximately once every 24 hours is currently anticipated (URS 2008). The cylindrical screen assembly (Figure 3-6) would be aligned approximately parallel to the shoreline, so water would enter the screens in a direction perpendicular to the flow direction in the reservoir (Luminant 2009a). As a result, when current flows past the intake, it likely would sweep organisms past the screens and reduce their potential to be impinged or entrained.

The CPNPP Units 3 and 4 intake structure would contain five pumps to supply makeup water to Units 3 and 4 (two pumps for each unit and one spare pump) (Figure 3-6). A maximum of 18,000 gpm could be supplied by each pump, for a maximum withdrawal rate of 72,000 gpm with four pumps operating to supply both reactor units (Luminant 2009a). Water would enter the structure containing the pumps through four cylindrical, 6.5-ft-diameter, passive screen modules. Each module would have a tee arrangement, with two 6-ft-long wedge wire drums perpendicular to and separated by a central, 48-in.-diameter inlet pipe. Each 16-foot-long module would have 12 ft of screen with a total area of 245 sq ft. Thus, there would be 490 sq ft of screen for each reactor unit and a total of 980 sq ft for both Units 3 and 4 (Luminant 2009a).

The wedgewire screens would have a slot opening size of only 1 mm (URS 2008). The fish species occurring in Lake Granbury (Table 2-16) have eggs with diameters ranging from 0.8 mm to 4 mm (Hassan-Williams and Bonner 2007). Thus, the eggs of most fishes in the lake are larger than the size of the screen openings. The species that have eggs smaller than 1 mm (white crappie [*Pomoxis annularis*], gizzard shad [*Dorosoma cepedianum*], threadfin shad [*D. petenense*], and white bass [*Morone chrysops*]) have eggs that are demersal (i.e., eggs that sink) and adhesive, so that they adhere to the bottom or other substrates. As a result, they would not be suspended in the water column and thus would not be subject to entrainment. The screens would prevent the entrainment of the larger, more buoyant fish eggs that have a potential to be present in the water column at the intake. However, the presence of fish eggs at the intake is very unlikely given the egg characteristics and spawning habits and habitats of the fishes in the lake (Table 5-3). For example, most of these species deposit their eggs in nests or over other bottom structure to which they can adhere, usually at relatively shallow depths in the littoral zone. The larvae of these fishes similarly are likely to remain in contact with or in close proximity to substrates (Hassan-Williams and Bonner 2007). The lake bottom in the vicinity of the proposed intake slopes steeply into the former river channel, resulting in very limited shallow-water habitat suitable for nesting by fishes. This area also lacks coves or other protected habitats that would support vegetation and generally lacks underwater structure (other than boat docks and the water intakes for CPNPP Units 1 and 2 and the Wolf Hollow electric power plant) that may be attractive to fish and invertebrates. Thus, viable eggs and numerous larvae of these species would not be expected to be present in the water column in the deep area of the lake where the intake would be located. (The relationship between the locations of fish spawning habitat and the intake is discussed further below.) Spawning may occur from March to October depending on the species, but most of these species spawn in the spring and early summer.

The eggs of all but two of the species in Table 5-3 are demersal and adhesive. The two species that lack demersal, adhesive eggs are the striped bass (*M. saxatilis*) and freshwater drum (*Aplodinotus grunniens*). The striped bass is a nonnative species that is stocked in the reservoir and is unlikely to successfully spawn there. It typically spawns in riverine habitats from mid February through April, and egg survival appears to be dependent on sufficient flow to keep the fertilized eggs suspended in the water column for the 2 to 3 days between fertilization and hatching (Hassan-Williams and Bonner 2007). The freshwater drum, which spawns in the water column and has buoyant eggs, is the only species collected in the reservoir with a reproductive strategy that could result in a notable potential for viable eggs to be present at the intake. Its fertilized eggs are 1.4 mm to 1.5 mm in diameter (Hassan-Williams and Bonner 2007), sufficiently large that they may be impinged but not entrained. Freshwater drum spawn in May and June, so their eggs and larvae would be unlikely to be present after early summer (Hassan-Williams and Bonner 2007).

A review of the Brazos water snake's biological characteristics indicates that this species is not likely to be affected by impingement or entrainment from operating the proposed intake system. The design specifications for CPNPP Units 3 and 4 adhere to EPA regulations (66 FR 65256) describing intake velocity (0.5 ft/s), which would allow for the majority of free-swimming species to avoid impingement or entrainment. Furthermore, the intake is located 110 ft from shore at a depth of 34 ft. Juvenile Brazos water snakes do not inhabit habitat settings of this kind and limit their activity to shoreline habitats with flat rocks at least 10 cm in size (McBride 2009). Juveniles range from 323 to 846 mm in total length and from 7.5 to 200 g in total weight, with averages of 431 mm and 31.2 g, respectively (McBride 2009). Additionally, Brazos water snakes are typically found in 1-m-deep water and usually within 3 m of shore (Scott et al. 1989).. Given these life history requirements and the intake design features, such as wedgewire screens, this species would not be adversely affected by operation of the proposed intake.

Thus, the design and construction of the screen system is expected to prevent the entrainment of fish eggs and most organisms other than plankton, and to prevent the impingement of most of the fish or other swimming organisms that may come into contact with the intake structure. Fish eggs or other small organisms that become impinged would be dislodged periodically from the screen surface by the air-blast cleaning system and may survive, depending upon the duration of impingement and any associated injuries.

Location. A third factor that influences impingement and entrainment mortality is the location of the intake structure. EPA indicated that the optimal design requirement for the intake location is that it is in an area of the source waterbody that is away from areas with the potential for high productivity. Such a location would be identified by taking into account the location of the shoreline, the depth of the waterbody, and the presence and abundance of aquatic organisms or sensitive habitat (66 FR 65256). The proposed location of the intake structure is on the southwest bank of Lake Granbury next to the existing intake and pumping station for CPNPP Units 1 and 2 makeup water and approximately 7200 ft (1.3 mi) upstream of the DeCordova Bend Dam (Figure 2-11). The intake screens would be located approximately 110 ft from shore at a depth of approximately 34 ft at a location where the depth of the lake is approximately 40 ft.

As discussed above, the slope of the bottom in this area of the lake is relatively steep and the water is deep, providing minimal littoral habitat and unsuitable conditions for nesting by fishes. In addition, this area of the shoreline lacks coves or other protected habitats supportive of an abundant or diverse biota and generally lacks underwater structure that may be attractive to fish and invertebrates, except for scattered submerged trees and man-made structures such as boat docks and water intakes. Accordingly, a 2007–2008 fish survey of this area of the lake above the dam collected few individuals of only ten species (Bio-West 2008a). Thus, the area of Lake Granbury in which the intake structure would be located is not particularly supportive of fish or invertebrate foraging or reproduction and does not appear to be highly productive relative to other areas, such as the upstream reaches of the lake.

Proportion of water withdrawn. A fourth factor affecting impingement and entrainment losses is the proportion of the flow of the source waterbody that is withdrawn by the intake. EPA developed requirements for proportional flow limitations that vary according to the type of waterbody in which the intake is located; that is, the requirements differ for intakes in an estuary or tidal river, a freshwater river or stream, or a lake or reservoir. Because the proposed CPNPP Unit 3 and 4 intake is in a reservoir, the relevant requirement is that the intake "must not disrupt the natural thermal stratification or turnover pattern (where present) of the source water except in cases where the disruption is determined to be beneficial to the management of fisheries for fish and shellfish by any fishery management agency(ies)" (66 FR 65256). This requirement was intended to protect aquatic organisms in mainly small to medium-sized lakes and reservoirs by limiting the intake flow to a capacity appropriate for the size of the waterbody (66 FR 65256).

This requirement is expected to be met in Lake Granbury, which is a large reservoir that experiences relatively weak stratification during the warmest part of the year, usually late spring to early fall. Temperatures were measured in the lower portion of Lake Granbury in April, July, and October 2007 and January 2008 in three locations at two depths: 0.3 ft below the surface and 35 to 50 ft below the surface. The differences in temperature at these three locations between the surface and bottom was approximately 5ºF in April, 3ºF in July, less than 1ºF in October, and 1ºF in January. At a fourth location where the deeper temperature was recorded at only 10 ft, temperatures were essentially equal throughout the year (Luminant 2009a), indicating that the thermocline was between 10 and 35 ft deep in depth and not well-defined. These temperature differences indicate a weak thermocline and relatively limited differences in water density, which indicate that the reservoir is well-mixed and likely turns over frequently (Bio-West 2008a).

Table 5-3. Egg and Spawning Characteristics of Lake Granbury Fish Species

Family Scientific Name	Common Name	Egg Diameter (mm)	Egg and Spawning Characteristics
Catostomidae			
Ictiobus bubalus	smallmouth buffalo	1.6 - 2.4	Demersal, adhesive; attach to bottom
Centrarchidae			
Lepomis cyanellus	green sunfish	1.0 - 1.4	Demersal, adhesive; deposited in nest
Lepomis gulosus	warmouth	1	Demersal; deposited in nest (gravel)
Lepomis macrochirus	bluegill	1.1 - 1.4	Demersal, adhesive; deposited in nest
Lepomis megalotis	longear sunfish	1	Demersal, adhesive; deposited in nest
Lepomis microlophus	redear sunfish	1.3 - 1.6	Demersal, adhesive; deposited in nest
Micropterus salmoides	largemouth bass	1.4 - 1.8	Demersal, adhesive; attach to nest
Pomoxis annularis	white crappie	0.9	Demersal, adhesive; attach to nest or nearby
Clupeidae			
Dorosoma cepedianum	gizzard shad	0.8	Demersal, adhesive; sink slowly and adhere to surfaces
Dorosoma petenense	threadfin shad	0.75 - 1.2	Demersal, adhesive; attach to plants, brush, or other objects
Cyprinidae			
Cyprinus carpio	common carp	1.5 - 2.1	Demersal, adhesive; attach to plants, brush, or other objects
Ictaluridae			
Ictalurus punctatus	channel catfish	3.5 - 4.0	Demersal; laid in holes
Moronidae			
Morone chrysops	white bass	0.8 - 0.9	Demersal, adhesive; attach to bottom
Morone saxatilis	striped bass	2.4 - 3.9	Nonadhesive, semibuoyant; hatch best if stay suspended
Sciaenidae			
Aplodinotus grunniens	freshwater drum	1.4 - 1.5	Buoyant; released to water column

Sources: Hassan-Williams and Bonner (2007) for all information except gizzard shad egg diameter, which was obtained from Willis (1987)

The stratification in Lake Granbury appears to be sufficiently weak that it may be disrupted by natural disturbances such as thunderstorms or floodwater inflows. Under conditions of high flow, data for the lower reach of the lake were not indicative of stratification even in summer (Luminant 2009d). Thus, the existing aquatic community of Lake Granbury would not be expected to be dependent on the maintenance of stable, stratified conditions from spring to fall. In addition, the proposed intake structure would be installed such that the top of the inlet screens would be at a depth slightly less than 34 ft below the lake surface, and the bottom of these 4-ft-diameter screens would be approximately 38 ft below the surface (Figure 3-6). At this depth, the intake would be near the approximate lower depth of the thermocline, resulting in the withdrawal of water of moderate temperatures intermediate between the warmer surface water and the cooler bottom water. Based on these lines of evidence, the withdrawal of water by the CPNPP Units 3 and 4 intakes from a localized area of this large reservoir would not be expected to disrupt the normal thermal stratification pattern of the lake.

Entrainment/impingement studies have not been conducted for the existing CPNPP Units 1 and 2 makeup water intake on Lake Granbury. This intake is located adjacent to the planned location of the intake for Units 3 and 4. From 1994 to 2006, the annual average withdrawal through this intake was 34,128 ac-ft/yr, in 2006 the withdrawal was 46,746 ac-ft/yr, and an agreement between the BRA and Luminant provides for up to 48,300 ac-ft/yr to be withdrawn (Luminant 2009a). The latter withdrawal is less than half the expected withdrawal from Lake Granbury through the proposed intake for Units 3 and 4. Studies that identified ecological impacts in Lake Granbury attributable to the current Units 1 and 2 makeup water withdrawals were not found.

Intake conclusions. Based on the use of closed-cycle cooling, the design and construction of the intake, the location of the intake, and the proportion of water that would be withdrawn, the review team concludes that impacts from entrainment and impingement of fish and other organisms due to the operation of the proposed CPNPP Units 3 and 4 would be minimal, and additional mitigation of such impacts would not be warranted.

CPNPP Units 3 and 4 Cooling Water Discharge

The effluent from the proposed CPNPP Units 3 and 4 would be discharged into Lake Granbury. Section 3.3.1.13 discusses the location and design of the discharge structure (shown in Figure 3-7). Impacts on aquatic organisms due to the discharge could result from thermal effects, chemical effects, and physical effects on the substrate.

Thermal impacts from the discharge. Thermal impacts may include heat stress, cold shock, and potential effects on the growth of invasive nuisance organisms.

Heat stress. The thermal tolerance of aquatic organisms can be measured and described in a variety of ways. Among the metrics used are temperatures that are preferred for spawning, temperatures that are avoided, and temperatures (upper and lower) that may kill individual fish. Terms for these metrics include maximum tolerance temperatures, preferred temperatures, upper avoidance temperatures, and upper lethal temperatures. A list of the thermal tolerances for several species found in Lake Granbury is presented in Table 5-4.

Under TCEQ regulations, the TPDES program regulates discharges of waste heat into state waters. TCEQ specifies 93ºF as the thermal water quality criterion for Lake Granbury. In addition, TCEQ mixing-zone regulations require that for freshwater lakes and impoundments the temperature increase within the thermal plume beyond the mixing zone not exceed 3ºF above the ambient water temperature (TCEQ 2000). Luminant's assessment conservatively assumed the temperature of the effluent discharge to be equal to the water quality criterion of 93ºF, although the actual discharge temperature is expected to be lower (Luminant 2009a). The thermal plume was modeled under conditions of minimum downstream flow (28 cfs discharge through the dam) and three water temperature scenarios in the reservoir (minimum, mean, and maximum) based on historical data for Lake Granbury from 1997 to 2007. The rate of effluent discharge was assumed to be 58 cfs, representing the maximum expected blowdown in combination with other effluents from the operation of CPNPP Units 3 and 4 (Luminant 2009a).

The review team's independent assessment included modeling of the extent of the thermal plume based on the isotherm defined by the 3ºF temperature increase above ambient. The maximum temperature difference (44.4ºF) would occur when the reservoir temperature is lowest, based on the maximum discharge temperature (93ºF) and a low ambient temperature in winter (48.6ºF). Under the worst-case scenario of minimum lake temperature, maximum discharge temperature, and maximum discharge flow, the model indicated that the largest thermal plume based on the 3ºF isotherm would have a length of approximately 682 ft and a width of 356 ft. The longer dimension of the plume would extend in a downstream direction toward the dam. The reservoir width in the area of the discharge is approximately 1950 ft. The 356-ft width of the plume would extend across only about 18 percent of the width of the reservoir and would not create a thermal barrier that would impede the movement of fish through this area. In summer, assuming an ambient water temperature of 89.2ºF, the maximum temperature difference between the discharge and ambient water temperatures in Lake Granbury would be much less than in winter, and the potential for measurable increases in downstream water temperatures would be similarly minimized.

Table 5-4. Thermal Tolerances of Some Fish Species of Lake Granbury

Species	Maximum Temperature Tolerance[(a)]		Preferred Temperature Range[(b)]		Upper Lethal Temperature[(b)]	
	°C	°F	°C	°F	°C	°F
white crappie	31.0	87.8	–	–	–	–
white bass	31.4	88.5	–	–	–	–
freshwater drum	32.6	90.7	–	–	–	–
gizzard shad	34.0	93.2	–	–	–	–
green sunfish	34.0	93.2	–	–	–	–
longear sunfish	34.0	93.2	–	–	–	–
smallmouth buffalo	34.0	93.2	–	–	–	–
warmouth	34.0	93.2	–	–	–	–
common carp	35.0	95.0	16-36	60-96	37	98
channel catfish	35.0	95.0	–	–	35	95
largemouth bass	35.5	95.9	25-29	77-85	–	–
bluegill	36.0	96.8	16-27	60-80	34	94

(a) Maximum weekly average temperature tolerance, determined using a technique that matched fish presence records from throughout the U.S. with stream temperature records to estimate the highest weekly mean temperatures encountered by each species in its natural environment (Eaton and Sheller 1996).

(b) Source: Bell 1991

A thermal plume may cause heat stress or heat shock to fish when the water temperature exceeds the thermal tolerance of the fish. The occurrence of heat stress is also affected by the duration of exposure to high water temperatures. Fish thermoregulate by avoiding extreme temperatures and seeking optimal temperatures. As shown by the data in Table 5-4, the thermal tolerances of many of the fishes that occur in Lake Granbury are similar to or exceed the maximum permitted discharge temperature of 93ºF. Thus, adult fish would be unlikely to be exposed to potentially lethal temperatures even under worst-case conditions, and they could readily avoid adverse effects from the relatively small area of the thermal plume. Although it is possible that eggs or larvae drifting near the discharge could enter the plume, the small area of the plume and the limited numbers of pelagic eggs and larvae in the reservoir would minimize the potential for mortality or impacts on fish populations as a result.

Based on reviews of literature and operational monitoring reports, consultations with utilities and regulatory agencies, and public comments, thermal effects were not found to cause reductions in aquatic populations near any existing nuclear power plants with closed-cycle cooling systems (NRC 1996). Those findings are consistent with the results of this evaluation of the potential thermal impacts from the proposed CPNPP Units 3 and 4 discharge on Lake Granbury. The thermal plume is predicted to be small, to dissipate within a limited area near the dam, and to have negligible ecological effects on the reservoir. Based on the foregoing, the review team concludes that thermal impacts on populations of fish or other organisms due to the discharge of waste heat from CPNPP Units 3 and 4 into Lake Granbury would be minimal, and additional mitigation would not be warranted.

Cold shock. Another factor related to thermal discharges that may affect aquatic biota is cold shock. Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant's discharge canal, are exposed to a sudden temperature decrease. This sometimes occurs when power plants shut down suddenly in winter (NRC 1996). Cold shock is less likely to occur at a multiple-unit facility because the temperature decrease from shutting down one unit is moderated by the heated discharge from the units that continue to operate; it is not common to shut down all units simultaneously. Given the very small area of Lake Granbury near the dam that potentially would be affected by the thermal discharge, the small additional contribution of both Units 3 and 4 to the discharge, and the warm climate where the reservoir is located, the likelihood of fish populations being affected by cold shock is negligible. Accordingly, the review team concludes that impacts on fish populations due to cold shock would be minimal, and additional mitigation would not be warranted.

Invasive nuisance organisms. As described in Section 2.4.2.3.2, with the exception of golden alga (*Prymnesium parvum*) in some years, non-native and nuisance species of aquatic plants are not currently a problem in Lake Granbury. The conditions that promote fish kills by golden alga, described in Section 2.4.2.1.1, are not well understood but appear to be conditions that are stressful to golden alga, including low temperatures (TWRI 2009, Wythe 2008). Golden alga grows optimally at warm temperatures of 25 to 30ºC (77 to 86ºF), yet it blooms in Texas mainly in winter and causes the majority of fish kills when the water is cold. This seeming paradox may be the result of reduced competition from green algae under cold conditions (TPWD 2009c) and/or the proliferation of cyanobacteria (blue-green algae), which release cyanotoxins that impair competitors, in warmer water (TWRI 2009, Wythe 2008). Thus, the release of heated water from the CPNPP Units 3 and 4 discharge near the Lake Granbury dam would not be expected to promote golden alga blooms or associated fish kills.

Two nuisance animals present in Lake Granbury, the Asian clam (*Corbicula fluminea*) and estuarine mud crab (*Rhithropanopeus harrisii*), have the potential to cause biofouling problems, but the thermal discharge from CPNPP Units 3 and 4 would not be expected to promote increases in their populations.

Chemical impacts from the discharge. In Section 5.2.3.1, the review team describes its independent assessment of the impacts of the proposed CPNPP Units 3 and 4 discharge on water quality in Lake Granbury. Discharge-related ecological impacts may result from the concentration of metals and other naturally occurring inorganic constituents in the blowdown (Table 5-2) and also may result from chemicals added to treat the facility water systems that contribute to the discharge. Chemicals would be added to various water systems within the CPNPP Units 3 and 4 facilities to control water quality, inhibit scale and corrosion, and prevent biological fouling (Luminant 2009a). As a result, these chemicals would be present in the effluent discharged to Lake Granbury. The chemicals expected to be used include sodium hypochlorite (source of chlorine for biocide to control bacteria and algae), sulfuric acid (pH adjustment), orthopolyphosphate and phosphonate (corrosion/scale inhibitor), and sodium bisulfite (dechlorination of blowdown) (Luminant 2009a).

Table 5-2 provides a list of the water quality constituents expected to be present in the effluent discharged to Lake Granbury. As a result of evaporative cooling losses, the natural minerals in the water of Lake Granbury would be concentrated in the blowdown to about 2.4 times their concentration in the water withdrawn from the lake. Without additional treatment, concentrated dissolved solids (mainly salts), certain naturally occurring metals, and other constituents in the blowdown would exceed regulatory limits under average or low flow conditions in Lake Granbury. Therefore, Luminant has proposed to use a BDTF, constructed and operated as described in Chapter 3, to provide additional treatment of the waste stream so that the effluent discharged through the diffuser would meet the Texas State Water Quality Criteria for Lake Granbury of 2500 mg/L for TDS and 1000 mg/L for chloride, as well as the criteria for the other constituents present. Discharges to Lake Granbury would be regulated under a TPDES permit from TCEQ specifying acceptable chemical concentrations at the proposed CPNPP Units 3 and 4 diffuser. Luminant has stated that the BDTF would reduce concentrations of these water quality constituents and metals to below regulatory limits. The concentrations of these constituents, which are anticipated to be within regulatory criteria when discharged into Lake Granbury, would be further diluted by mixing of the discharged water with the water of the lake.

Section 5.2.1 describes changes in the flow patterns in the vicinity of the intake and discharge structures for CPNPP Units 3 and 4 that would occur under low-flow conditions, when the flow released from the dam would be comparable to the total rate of water withdrawal for all four CPNPP units. Under these low-flow conditions, recirculation would occur, in which a flow pattern would develop between the discharge structure and the intakes for all four units, and the diffuser would operate less effectively than during conditions of higher flow in mixing and diluting the effluent. Such a recirculation pattern may result in constituent concentrations that are locally elevated above ambient concentrations in a larger than normal area in the vicinity of the diffuser. However, the effluent concentrations discharged would remain below water quality criteria.

Because the concentrations of TDS, metals, and other water quality constituents in the discharge from the diffuser are expected to be less than water quality criteria established by TCEQ to be protective of aquatic life, the aquatic ecology of Lake Granbury would not be adversely affected by chemicals discharged as a result of the operation of CPNPP Units 3 and 4.

Physical impacts from the discharge. The operation of a discharge potentially can have physical impacts on the receiving waterbody in the form of effects such as scouring, siltation, and increased turbidity. Section 3.3.1.13 discusses the location and design of the discharge structure. The design is expected to include two multiport diffusers, each 82 ft long with 18 diffuser nozzles, resting on or buried in the bottom of the reservoir (Luminant 2009a). The diffuser nozzles would be angled away from the substrate (30 degrees from vertical) in the downstream direction to provide optimal dispersion of the effluent into the waters of Lake Granbury while avoiding scouring of the bottom (Luminant 2009a) and any associated increases in turbidity and siltation.

Discharge conclusions. Based on the analyses presented above of the potential for thermal, chemical, and physical impacts on the aquatic ecosystem from the discharge of cooling system blowdown to Lake Granbury, and the review team's independent review, the review team concludes that impacts due to discharges from operation of the proposed CPNPP Units 3 and 4 would be minimal, and additional mitigation would not be warranted.

Impacts from Hydrological Changes

As discussed in Section 5.2.3.1, the BRA would alter its operation of the Brazos River system, including Lake Granbury and PKL, in order to provide the additional water needed for CPNPP Units 3 and 4 as well as other future water uses. Water entering Lake Granbury from PKL carries relatively high concentrations of chloride and TDS due to naturally occurring salt deposits in the PKL watershed. Increased consumptive use of water that removes water from this portion of the Brazos River System without also removing the salt dissolved in that water would increase the salinity of Lake Granbury and the downstream Brazos River.

These increases are likely to occur even without the operation of CPNPP Units 3 and 4 because the 2060 Brazos G Water Plan calls for full utilization of the yield from the Brazos River system between now and 2060. This would require increased releases from PKL, which would be allocated to Units 3 and 4 and/or other water users, or would be allocated entirely to other users eventually if Units 3 and 4 were not built.

Historical TDS concentrations in Lake Granbury since 1970 have ranged from 500 mg/L to almost 3000 mg/L. Evaluation by Luminant of modeling results from the WAM indicated that the operation of CPNPP Units 3 and 4 would increase TDS concentrations in the lower 10-mi reach of Lake Granbury by about 530 mg/L (Ward 2008). Thus, TDS concentrations would remain within the historical range under most conditions, but the upper and lower boundaries of the range of TDS concentrations in Lake Granbury potentially would increase under extreme conditions. Because the aquatic biota of Lake Granbury are adapted to the range of TDS concentrations that have occurred in the lake historically, they would not be expected to be adversely affected by the predicted TDS increases under most conditions. However, under extreme conditions in which TDS may increase potentially over 500 mg/L beyond the upper end of the historical range, some organisms may be adversely affected if their salinity tolerance is exceeded.

Alterations in the operation of the Brazos River system also would result in changes in water levels in Lake Granbury, which could cause ecological impacts. As discussed in Section 5.2.1, consumption of water from Lake Granbury by the operation of CPNPP Units 3 and 4 would result in lake water levels that typically are lower than in the past. Based on historical data from 1940 to 2007, modeling by the review team for the year 2020 indicates that Lake Granbury would be at full pool about 57 percent of the time in the absence of CPNPP Units 3 and 4, but it would be at full pool only 46 percent of the time if Units 3 and 4 were operating. The modeling also indicated that in the absence of Units 3 and 4 Lake Granbury would be 2 ft or more below full pool about 10 percent of the time, but with Units 3 and 4 operating, the lake would be 2 ft or more below full pool about 25 percent of the time. Thus, with Units 3 and 4 operating, Lake Granbury would be expected to be 2 ft or more below full pool an additional 15 percent of the time. The modeling also indicated that the operation of Units 3 and 4 would reduce the average water level in Lake Granbury by 0.6 ft.

The aquatic biota of Lake Granbury historically has been exposed to fluctuating water levels of similar magnitude though somewhat different frequency compared to the levels predicted by the model for operation of CPNPP Units 3 and 4. If the increased frequency of lower water levels were to occur during spawning season and result in the desiccation of shallow habitats where fish nest or otherwise deposit their eggs, the spawning success of these fish potentially could be reduced. The potential for populations of fish to be measurably affected by reductions in reproductive success would be dependent on the timing and duration of low water levels, the characteristics of the species, and the proportion of their spawning habitats affected. Given these uncertainties, adverse effects on aquatic biota and habitat may range from negligible to noticeable.

5.3.2.2 Impacts on the Squaw Creek Reservoir Ecosystem

Discharges to SCR from the existing CPNPP Units 1 and 2 are regulated by a TPDES permit granted by the TCEQ. The majority (more than 90 percent by volume) of the effluents from the proposed CPNPP Units 3 and 4 would be blowdown and would be discharged to Lake Granbury rather than SCR. Effluents that would discharge into SCR include treated effluent from the sanitary wastewater treatment plant for Units 3 and 4 facility and treated effluents from the liquid waste management system, including radioactive wastewaters. (See Section 5.9.5 for discussion of radiological dose and lack of impacts to aquatic biota of SCR.) Also, a minor quantity of process wastewater (from equipment and floor drains from nonradioactive building areas) would be discharged to the Units 1 and 2 wastewater treatment system (Luminant 2009a). Thermal effluents from operation of the proposed CPNPP Units 3 and 4 would not enter SCR, and these effluents would have essentially no effect on the temperature of makeup water withdrawn from Lake Granbury and pumped to SCR in conjunction with the operation of Units 1 and 2. Therefore, impacts from discharges to SCR as a result of the operation of the proposed Units 3 and 4 would be negligible.

Because CPNPP Units 3 and 4 would be located adjacent to the shoreline and upgradient of SCR, the reservoir could be affected by stormwater drainage during the period of operation. The facility would have an extensive stormwater drainage system to manage runoff prior to discharge to SCR, in accordance with a stormwater management plan to be developed. Potentially contaminated stormwater runoff that may have contacted contaminants, such as oil or chemicals, would be directed to an appropriate wastewater stream for treatment prior to discharge. Other stormwater runoff, such as from roof drains, would be directed into retention/sedimentation basins that would be located northeast of Unit 3 and northwest of Unit 4.

Based on this analysis of the potential for thermal, chemical, or physical impacts on the aquatic ecosystem of SCR, and the review team's independent review, the review team concludes that impacts on SCR from the operation of the proposed CPNPP Units 3 and 4 would be minimal, and additional mitigation would not be warranted.

5.3.2.3 Impacts on the Brazos River Ecosystem

The operation of the proposed CPNPP Units 3 and 4 would involve the diversion of water from Lake Granbury as makeup water as well as the discharge into Lake Granbury of blowdown from the cooling water system. Consequently, the Brazos River downstream of the DeCordova Bend Dam potentially could be affected by hydrological changes resulting from the diversion of river flow from the reservoir and by water quality changes resulting from the effluent discharged to the reservoir.

Impacts from Hydrological Changes

In Section 5.2.1, the review team describes its independent assessment of the impact of the diversion of makeup water for the proposed CPNPP Units 3 and 4 on the hydrology of the Brazos River downstream of Lake Granbury, as well as the impact of changes in water management practices on the river upstream between Lake Granbury and PKL. The hydrology assessment determined that the seasonal distribution of streamflow in the reach downstream from PKL and upstream of Lake Granbury would be altered, with lower flows during the wetter months of the year (typically May and June) and higher flows during the drier months. Such alterations likely would reduce the variability of the flow regime in this reach, further attenuating the naturally wide range of flow that was characteristic of the river before PKL was built. Reductions in flow variability may be beneficial for aquatic organisms that prefer a stable environment and cannot move rapidly to avoid desiccation, such as certain mussels. However, reductions in flow variability may have adverse effects on other native organisms that are adapted to the highly variable flow regime and sediment transport of the natural river before it was impounded.

The hydrology assessment determined that the operation of Units 3 and 4 would result in somewhat smaller releases from Lake Granbury and lower resulting streamflow in the Brazos River downstream near Glen Rose, except during peak flood flows and periods of low flow, when a minimum release would be maintained. Thus, there would be somewhat lower flows in the river between Lake Granbury and Lake Whitney the majority of the time (when not flooding or affected by drought). This likely would reduce the average extent and volume of aquatic habitat available in the river relative to existing conditions. As a result, fish and invertebrates could lose protective cover and nesting, spawning, foraging and nursery areas. Such habitat losses could result in increased predation, crowding, and competition. Lower flows also can affect substrate characteristics by altering processes such as sediment transport, suspension, siltation, and sorting. Changes in sediment composition and other characteristics could alter the benthic habitats available on and within the substrate for invertebrates, fish, and their eggs. In addition, lower flows and shallower water can increase water temperatures and reduce turbulence, which may reduce dissolved oxygen levels in some areas of the river. Effects on riverine habitat such as these potentially could result in reductions in populations of some species of fish and invertebrates.

The magnitude of potential changes in flow in the Brazos River above and below Lake Granbury has not been well defined, and the likelihood and magnitude of associated effects on the aquatic communities of these river reaches similarly are undefined. Riverine organisms are adapted to the highly variable flow regime of the Brazos River, and there is uncertainty about the magnitude of the impacts on riverine biota that may result from the relatively limited alterations in river flow associated with the operation of CPNPP Units 3 and 4. Such impacts may range from negligible to substantial depending on the species and the degree to which its habitat is affected.

Water Quality Impacts

As discussed above for Lake Granbury, the greatest temperature increase above ambient in the thermal plume within Lake Granbury would occur during winter, and any associated increase in temperature of the river would not result in river temperatures approaching the thermal tolerances of resident fishes. Increases above ambient in Lake Granbury in summer would be much less than in winter, and the potential for measurable increases in downstream water temperatures would be similarly minimized. Based on the foregoing, the review team concludes that thermal impacts on populations of fish or other organisms downstream in the Brazos River due to the discharge of waste heat from CPNPP Units 3 and 4 into Lake Granbury would be minimal, and additional mitigation would not be warranted.

Also as discussed above, discharges to Lake Granbury and SCR would be regulated under a TPDES permit at the proposed CPNPP Units 3 and 4 outfall in Lake Granbury. The concentrations of the constituents in the effluent, which are anticipated to be within State surface water criteria protective of aquatic life when discharged into Lake Granbury, would be further diluted by mixing of the discharged water with the water of the lake. Therefore, the concentrations of TDS, metals, and other water quality constituents in the river below the dam are expected to be substantially lower than surface water criteria, and the aquatic ecology of the Brazos River would not be adversely affected by chemicals discharged as a result of the operation of CPNPP Units 3 and 4.

Based on this analysis of the potential for thermal and chemical impacts on the aquatic ecosystem of the Brazos River, and the review team's independent evaluation, the review team concludes that impacts from the operation of the proposed CPNPP Units 3 and 4 would be minimal, and additional mitigation would not be warranted.

5.3.2.4 Impacts on Possum Kingdom Lake

As discussed in Section 5.2.3.1, the BRA would alter its operation of the Brazos River system, including PKL, in order to provide the additional water to Lake Granbury needed for CPNPP Units 3 and 4. These operational changes would include increases in the release of water from PKL to Lake Granbury. These increases are likely to occur even without the operation of CPNPP Units 3 and 4 because the 2060 Brazos G Water Plan calls for full utilization of the yield from the Brazos River system between now and 2060, which would require increased releases from PKL to provide for the water allocated to Units 3 and 4 and/or other downstream water users. Increased water releases from PKL would result in changes in water levels in PKL, which could cause ecological effects. As discussed in Section 5.2.2.1, releases of water from PKL to support the operation of CPNPP Units 3 and 4 would result in lake water levels that typically are lower than in the past. Based on historical data from 1940 to 2007, modeling by the review team for the year 2020 indicates that PKL would be at full pool about 34 percent of the time in the absence of CPNPP Units 3 and 4, but it would be at full pool only 26 percent of the time if Units 3 and 4 were operating. During the time that PKL would be below full pool in the absence of Units 3 and 4, the modeling indicated that it would be 5 ft or more below full pool about 10 percent of the time. But during the time that the lake would be below full pool with Units 3 and 4 operating, the modeling indicated that it would be 5 ft or more below full pool about 25 percent of the time. Thus, with Units 3 and 4 operating, PKL would be expected to be 5 ft or more below full pool an additional 15 percent of the time. The modeling also indicated that the operation of Units 3 and 4 would reduce the average water level in PKL by 1.5 ft.

The aquatic biota of PKL historically has been exposed to fluctuating water levels of similar magnitude though somewhat different frequency compared to the levels predicted by the model for operation of CPNPP Units 3 and 4. If the increased frequency of lower water levels were to occur during spawning season and result in the desiccation of shallow habitat where fish nest or deposit their eggs, the spawning success of these fish potentially could be reduced. Declines in water levels of several feet, particularly in spring or early summer, could expose fish nests or eggs adhering to surfaces. As shown in Table 5-4, the majority of fishes inhabiting Lake Granbury, which also occur in PKL, have demersal, adhesive eggs that are deposited in nests or attached to other surfaces. Thus, these eggs remain in place and would die if present where they are exposed by a decline in water levels. If the increased frequency of lower water levels were to occur during spawning season and result in the desiccation of shallow habitats where fish nest or otherwise deposit their eggs, the spawning success of these fish potentially could be reduced. The potential for populations of fish to be measurably affected by reductions in reproductive success would be dependent on the timing and duration of low water levels, the characteristics of the species, and the proportion of their spawning habitats affected. Given these uncertainties, adverse effects on aquatic biota and habitat may range from negligible to noticeable.

5.3.2.5 Impacts on Wheeler Branch Reservoir and the Paluxy River

As discussed in Sections 2.3.2.1 and 5.2.2.1, water withdrawals from the recently completed WBR have been allocated to Luminant for use at CPNPP (up to 565 ac-ft/yr, which is 28 percent of available annual supply from the reservoir). The Paluxy River, which supplies water to WBR from an impoundment behind a low channel dam 1.8 mi to the southeast in the City of Glen Rose, would experience only a very small reduction in flow from the use of this allocation: 0.4 percent of the mean annual flow in the Paluxy River at Glen Rose. Also, because the WBR water right permit does not allow diversions of water from the Paluxy River for supplying WBR to cause the flow in the river to fall below specified values, there would be no adverse effects on low flows in the river. The low dam on the Paluxy River at Glen Rose is approximately 2.5 river mi upstream of the confluence of the Paluxy River with the Brazos River, so this is the short reach of the Paluxy River where flows potentially would be affected. Given the planning for and management of the CPNPP water supply allocation by the SCWD, the minimal effects on Paluxy River flow, and regulations to prevent low-flow withdrawals, adverse effects on the aquatic communities of WBR and the Paluxy River from water supply withdrawals associated with the operation of CPNPP Units 3 and 4 would be negligible.

5.3.2.6 Impacts on Wetland Ecosystems

Wetlands that could be affected by operation of Units 3 and 4 are those that lie along the edges of the southwest peninsula on which the cooling towers would be located (Figure 2-17). As reported in Section 5.3.1.1, salt deposition from the cooling towers would be too low to be a factor, but some surface fogging and icing at the CPNPP site are expected. Impacts would probably be similar to those from the occasional natural icing events in the region (freezing rain and sleet), which occur from December through March (see Section 2.9). These impacts would occur when the vegetation is dormant. Therefore, impacts to wetlands from fogging and icing associated with cooling tower operation are expected to be minimal, and mitigation would not be warranted.

5.3.2.7 Impacts on Aquatic and Wetland Resources from Transmission Lines and Cooling Water Pipelines

Maintenance activities along the 345-kV transmission line ROWs that would be utilized during operation of the proposed CPNPP Units 3 and 4 potentially could have periodic, temporary impacts on streams, ponds, and waterways crossed by the lines. The lines and potentially affected aquatic resources were described in Section 2.4.2.2. The exact routes to be followed by these two new lines have not been determined pending completion of transmission routing studies, so this evaluation is based on approximate routes (Figure 2-14). The DeCordova transmission line would cross Squaw Creek and several inlets along the shoreline of SCR, the Brazos River, and Lake Granbury. The Whitney transmission line would cross only one major waterbody, the Paluxy River, and several small tributaries of the Brazos River and Lake Whitney (Figure 2-14).

The potential for transmission lines and water pipelines to affect aquatic resources principally is associated with procedures for management of vegetation and maintenance of service roads in ROWs adjacent to waterbodies. The same management practices currently employed by Oncor

Electric Delivery for the existing CPNPP Units 1 and 2 transmission line ROWs are expected to be employed for the proposed DeCordova and Whitney transmission line ROWs. These practices include procedures to prevent impacts on surface waters and wetlands. For example, service roads near water would be maintained to prevent erosion and its potential to affect aquatic and wetland communities through increased turbidity and sedimentation, and vegetated buffers would be maintained between roads and waterbodies/wetlands. Vegetation within ROWs near water would be managed through hand cutting, mowing, and application of herbicides. Herbicides would be applied selectively by qualified personnel in accordance with manufacturer recommendations and regulatory guidance in order to prevent the possibility of herbicide runoff into surface water. Similar procedures are expected to be employed in maintaining the pipeline ROW.

Effects from transmission line and pipeline ROW maintenance and vegetation management activities on floodplains and wetlands were evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437 (NRC 1996). Effects of these activities in wetland and floodplain areas were found to be minimal at operating nuclear power plants. Control of trees and large shrubs is normally required only in forested areas where trees grow tall enough to physically interfere with operation of the powerlines. Ponds, marshes, and other types of wetlands lacking trees generally are not subjected to vegetation control and would not be affected. Wetlands occur on only 2.5 percent or less of the area of the transmission line ROWs (Tables 2-9 and 2-10) and no wetlands are present on the proposed pipeline ROW.

As a result of these management practices and other lines of evidence described above, the operation and maintenance of the proposed transmission lines and pipelines would be unlikely to adversely affect aquatic or wetland ecosystems. The review team concludes that the impacts of transmission line and pipeline ROW maintenance activities on aquatic and wetland resources would be minimal and that additional mitigation beyond the practices described above would not be warranted.

5.3.2.8 Impacts on Important Aquatic Species and Habitats

This section describes the potential impacts to important aquatic species, including recreationally important fishes and Federally and State-listed threatened or endangered aquatic species, and their habitats that may result from operation of the proposed CPNPP Units 3 and 4 and associated new transmission lines and pipelines. The biology and life histories of representative important species are presented in Section 2.4.2. The potential impacts from operation of the proposed facilities on these species are described in the following sections.

Recreational Fishery Species

As discussed in Section 5.3.2.2, there would be negligible impacts on the aquatic ecosystem of SCR, including fishery species, as a result of the operation of CPNPP Units 3 and 4. (See Section 5.9.5 for discussion of radiological dose and lack of impacts to aquatic biota of SCR.) Lake Granbury, however, would be affected by the intake that would provide makeup water to Units 3 and 4 and the discharge of blowdown from the facility. Water-based recreation is among the uses for which Lake Granbury is operated by the BRA. Current fishing opportunities provided by Lake Granbury are rated by TPWD as good for largemouth bass, striped bass, white bass, catfish, and sunfish, and fair for crappie (TPWD 2009d). Although game fish populations in Lake Granbury have been reduced annually since 2001 by toxic blooms of golden alga, stocking has been used to mitigate the losses of striped bass and largemouth bass (Baird and Tibbs 2006). However, recent TPWD inventories indicate that most species surveyed are increasing in numbers. There appear to be less recent impacts attributable to the algae as compared to historic trends (TPWD 2010b). As discussed above, populations of these recreational fishery species in Lake Granbury are unlikely to be noticeably affected by operations, including intake-related entrainment or impingement or discharge-related increases in water temperature and chemical effluents or reductions in water quality. Based on the evaluations described above, the review team concludes that impacts from operation of the proposed CPNPP Units 3 and 4 on recreational fishery species in Lake Granbury, and the forage species on which they feed, would be minimal, and mitigation would not be warranted.

Fishes that inhabit the Brazos River below Lake Granbury and are likely to be pursued by recreational anglers include largemouth bass, white bass, sunfish, channel catfish, and blue catfish (*Ictalurus furcatus*). Based on the evaluations described in Sections 5.2 and 5.3.2.3, populations of recreational fishery species in the Brazos River downstream of Lake Granbury would be unlikely to be adversely affected by changes in temperature or water chemistry resulting from operation of the CPNPP Units 3 and 4 intake and discharge in the lake. Changes in hydrology in this river reach due to modifications to water management practices and releases from Lake Granbury likely would result in some reduction in base flows. As discussed in Section 5.3.2.3, there is uncertainty about the magnitude of the impacts on riverine biota, including game fish that may result from the relatively limited alterations in river flow associated with the operation of CPNPP Units 3 and 4. Such impacts may range from negligible to noticeable depending on the species and the degree to which their habitat is affected.

PKL is similar to Lake Granbury in that it is used for recreational fishing for the same species, fish populations have been reduced by golden alga toxicity since 2001, and stocking is used to mitigate the losses of some species. The fishing opportunities provided by PKL currently are rated by TPWD as fair for largemouth bass, crappie, striped bass, and sunfish; good for catfish; and excellent for white bass (TPWD 2009c). Operation of CPNPP Units 3 and 4 potentially could affect fishery species in PKL as a result of changes in water management by the BRA that would affect water levels in this lake upstream of Lake Granbury. As described above, the water levels in PKL would typically be lower than in the past. The likelihood that PKL water levels would be lower more frequently increases the potential for adverse effects on the reproductive success of fishes that spawn in shallow littoral habitats. Declines in water levels of several feet, particularly in spring or early summer, could expose fish nests or eggs adhering to surfaces. As shown by the information in Table 5-4, the majority of fishes inhabiting Lake Granbury, and which also occur in PKL, have demersal, adhesive eggs that are deposited in nests or attached to other surfaces. Thus, these eggs remain in place and would die if located where they are exposed by a decline in water levels, and lower water levels during spawning may reduce the area of bottom habitat suitable for spawning. As discussed above, the potential for populations of fish to be measurably affected by reductions in reproductive success would be dependent on the timing and duration of low water levels, the characteristics of the species, and the proportion of their spawning habitats affected. Given these uncertainties, the effects of water level changes on individual fish populations may vary from negligible to noticeable.

WBR was first stocked to establish a recreational fishery in 2007. Largemouth bass, smallmouth bass, bluegill, and channel catfish fingerlings were released that year and again in 2008; then in 2009 smallmouth bass fingerlings and walleye fry were stocked (TPWD 2010e). The Paluxy River from the low dam at Glen Rose to the Brazos River, a reach of approximately 2 mi, potentially supports a recreational fishery similar to that described above for the Brazos River. As described in Section 5.3.2.5, the Paluxy River at Glen Rose, which supplies water to WBR from an impoundment behind a low channel dam, would experience only a very minor reduction in flow (0.8 percent of the mean annual flow) as a result of the use of the allocation of water from WBR for operation of CPNPP Units 3 and 4. Diversion of water from the Paluxy to supply WBR would not occur during periods of minimal streamflow, so there would be no adverse effects from low flows. The dam on the Paluxy River at Glen Rose is approximately 2.5 mi upstream of the confluence of the Paluxy River with the Brazos River, so only this short segment of the river would be affected. Thus, impacts on recreational fishery species, and forage species on which they feed, in WBR or the Paluxy River as a result of water supply withdrawals associated with the operation of CPNPP Units 3 and 4 would be negligible.

Non-Native and Nuisance Species

With the exception of golden alga in some years, non-native and nuisance species of aquatic plants are not currently a problem in Lake Granbury (Baird and Tibbs 2006), SCR, PKL, or the Brazos River in the vicinity of the CPNPP site (Luminant 2009a). As discussed in Section 2.4.2.1, golden alga is a nuisance species, and possibly non-native, that can develop toxic blooms and has caused extensive fish kills in Lake Granbury and PKL. The conditions that promote fish kills by golden alga are not well understood and are the subject of ongoing research. Certain conditions that are stressful to golden alga are associated with increased toxicity, such as low temperatures, low nutrient levels, low salinity, and high pH (TWRI 2009, Wythe 2008). It is an apparent paradox that golden alga grows optimally at warm temperatures of 25 to 30 °C (77 to 86 °F), yet in Texas it blooms mainly in winter. Thus, the majority of fish kills due to golden alga take place during winter when the water is cold. This may be because cold conditions are not favorable for (1) the growth of green algae, resulting in reduced competition for golden alga (TPWD 2009c), and/or (2) the growth of cyanobacteria (blue-green algae), which produce a variety of cyanotoxins that impair competitors and may suppress the growth of golden alga (TWRI 2009, Wythe 2008). The discharge of warm, blowdown water into Lake Granbury would not result in colder conditions or otherwise inhibit the growth of green algae or cyanobacteria that may suppress golden alga growth. Therefore, toxic blooms of golden alga would not be expected to be promoted in Lake Granbury as a result of the operation of CPNPP Units 3 and 4, and the occurrence of toxic blooms of golden alga also would not be promoted in the other water bodies in the region. The characteristics of the other nuisance species that occur in at least some of these water bodies, the Asian clam (*Corbicula fluminea*) and estuarine mud crab (*Rhithropanopeus harrisii*), were described in Section 2.4.2.4 and provide no indication that their growth would be promoted by effects from the operation of CPNPP Units 3 and 4.

Aquatic Threatened and Endangered Species

As discussed in Section 2.4.2.4 and shown in Table 2-18, there are no Federally listed aquatic species within the three counties in which the CPNPP Units 3 and 4 facilities and new transmission line and pipeline ROWs would operate (Hood, Somervell, and Bosque Counties), or the two counties upstream of Lake Granbury (Palo Pinto and Parker Counties). However, there are two Federally designated candidate species potentially occurring in these counties in the vicinity of the proposed CPNPP Units 3 and 4: the sharpnose shiner (*Notropis oxyrhynchus*) and smalleye shiner (*N. buccula*). Candidate species are under consideration for listing but are not currently legally protected under the Endangered Species Act. Based on their habitat requirements, the sharpnose shiner and smalleye shiner would not occur in area reservoirs such as Lake Granbury, SCR, PKL, WBR, or Lake Whitney. Due to their current distributions within the Brazos River drainage, these shiners are unlikely to occur in the river downstream of Lake Granbury, in the Brazos River between Lake Granbury and PKL, in Squaw Creek, in the Paluxy River, or in other streams in the vicinity of the proposed facilities. Consequently, operation of CPNPP Units 3 and 4 would not affect any Federally listed threatened or endangered species and would have a negligible potential to affect these two candidate species.

Also as discussed in Section 2.4.2.4 and shown in Table 2-19, there are four aquatic species that are State-listed as threatened and three State species of concern that potentially may occur in the vicinity of or be affected by operation of the proposed CPNPP Units 3 and 4. The Brazos water snake (*Nerodia harteri*), which has a State listing status of threatened, historically has occurred in Somervell, Hood, and Bosque Counties. Scott et al. (1989) identified the species in Lake Granbury, typically within 3 m of the shoreline and in about 1-m-deep water. Adults were swimming or basking on tree limbs while juveniles were typically found under flat rocks. Recent surveys completed by McBride (2009) identified the presence of the water snake upstream and downstream of Lake Granbury within the Brazos River; however, the species was not observed in Lake Granbury although that could be a sampling artifact as a result of high lake levels and sampling technique. The most critical variable that was identified within this study that could be affecting the occurrence of the snake was the amount of juvenile habitat (McBride 2009). Juveniles require moderate to large flat rocks along shoreline from which to hide and forage. The operation of the intake and discharge structures in Lake Granbury would not be expected to substantially alter the shallow, shoreline habitat potentially utilized by the Brazos water snake or reduce the populations of small forage fishes on which the snake potentially would feed. The Brazos water snake also has occurred historically in Palo Pinto County (TPWD 2010e) and Parker County (TPWD 2010f), so there is a potential that this species could occur along the shoreline of PKL or the Brazos River between PKL and Lake Granbury. Hydrological changes, such as lower reservoir levels in PKL, could reduce the amount of available habitat for the Brazos water snake. However, if suitable submerged rocks are present, the snake could shift its habitat use corresponding to the change in water levels. If suitable submerged rocks are not present near the shoreline after water levels shift, the habitat loss for juvenile Brazos water snakes could noticeably affect the population.

Three species of freshwater mussels that are State-listed as threatened are designated by TPWD as potentially occurring or having been recorded in at least one of the three counties in which proposed facilities would be located: the Texas fawnsfoot (*Truncilla macrodon*) in Hood, Somervell, and Bosque Counties; and the false spike (*Quincuncina mitchelli*) and smooth pimpleback (*Quadrula houstonensis*) in Bosque County(TPWD 2011). Two other mussels, the pistolgrip (*Tritogonia verrucosa*) and rock pocketbook (*Arcidens confragosus*), are State species of concern designated by TPWD as potentially occurring or having been recorded in all three of the counties in which proposed facilities would be located (TPWD 2010c, 2010d, and 2010g). In 2006, the fawnsfoot was observed in a range of areas with low to moderate levels of disturbance along shoreline habitats within Sandy Beach Park/Pecan Plantation of the Brazos River. TPWD 2007 surveys for the fawnsfoot downstream of Lake Granbury yielded no detected individuals (TPWD 2011). The Texas fawnsfoot, pistolgrip, and rock pocketbook also have been recorded in Palo Pinto County (TPWD 2010e) and Parker County (TPWD 2010f), where hydrological alterations would occur in conjunction with the operation of CPNPP Units 3 and 4.

The stretch of the Brazos River from the PKL dam to Tin Top Road is a Texas Mussel Sanctuary (TPWD 2011). However, the Texas Natural Diversity Database includes no reported observations of any of these mussels within 10 mi of the proposed CPNPP Units 3 and 4 or the proposed new transmission line ROWs (TPWD 2009d). The false spike possibly has been extirpated in Texas (TPWD 2010d). Although habitats supportive of all five species potentially could be present in the Brazos River between Lake Granbury and Lake Whitney, these mussels are not known to occur in this river segment and were not found in recent biological surveys at a location downstream of the DeCordova Bend Dam (Bio-West 2008a). Although the smooth pimpleback and rock pocketbook may occur in reservoirs, they have not been reported in recent surveys of invertebrate organisms in Lake Granbury and SCR. Thus, none of the five species of mussels is likely to occur in Lake Granbury, where they would have the greatest potential to be affected by the operation of the proposed intake and discharge. Of the three species in Palo Pinto and Parker Counties, only the rock pocketbook potentially may occur in a reservoir environment such as PKL. Given the existing and historical variability in reservoir levels, the mussel species that can occur in reservoirs would be unlikely to be adversely affected by the relatively limited changes in water levels that may result from water management alterations associated with the operation of CPNPP Units 3 and 4. The Texas fawnsfoot, pistolgrip, and rock pocketbook potentially could occur in the Brazos River between PKL and Lake Granbury but are unlikely to be adversely affected by the reduced variability of the flow regime that would occur in this reach.

An additional species designated as a State species of concern with the potential to occur in Bosque and Palo Pinto Counties is the Guadalupe bass (*Micropterus treculii*) (TPWD 2010c). The Guadalupe bass utilizes habitats with flowing water, preferring downstream segments of small streams, and it would not occur in reservoirs such as Lake Granbury, SCR, PKL, or WBR. The range of the Guadalupe bass is limited to the northern and eastern parts of the Edwards Plateau region of south-central Texas, including portions of the Brazos River drainage well downstream of Lake Whitney, such as the Lampasas, Leon, and Little Rivers (Lee et al. 1980, TPWD 2009b). Thus, the Guadalupe bass is unlikely to occur in the Brazos River drainage in Hood, Somervell, or Palo Pinto Counties, and review of available records in the Texas Natural Diversity Database indicates that its last reported observation within 10 mi of the proposed new CPNPP Units 3 and 4 transmission line ROWs in Bosque County was in 1979 (TPWD 2009f). Consequently, the Guadalupe bass would not be likely to occur in these reservoirs or the Brazos River above Lake Whitney and would not be affected by operation of the proposed CPNPP Units 3 and 4.

Based on threatened and endangered species surveys, historical records, life history information, known species occurrence locations, and information provided by Luminant in its ER (Luminant 2009a) and request for additional information (RAI) responses, the review team concludes that the impacts on aquatic Federally or State-listed threatened and endangered species from operation of the proposed CPNPP Units 3 and 4 would be minimal, with the possible exception of the Brazos water snake for which impacts could be noticeable if there are substantial changes in water levels causing juvenile habitat loss.

5.3.2.9 Aquatic Monitoring during Operation

Luminant does not plan to perform formal monitoring of aquatic ecosystems or wetlands during operations. Its basis for this decision is that operational impacts are expected to be minimal. Accordingly, Luminant (Luminant 2009a) states that “No additional preoperational or operational monitoring is warranted or planned, with the possible exception of specific locations along the new transmission line ROWs, unless the need for monitoring arises during the course of obtaining the necessary regulatory permits or approvals required to construct and operate the proposed additional units at CPNPP.” Thus, USACE or TCEQ may require aquatic monitoring in conjunction with their permitting requirements.

5.3.2.10 Potential Mitigation Measures for Operation-related Aquatic and Wetland Impacts

Luminant does not plan to perform mitigation measures for operation-related impacts to aquatic resources beyond those discussed above. Mitigation for project impacts to wetlands, including potential operational impacts, would be considered during the USACE permitting process.

5.3.2.11 Summary of Operational Impacts on Aquatic and Wetland Resources

Operation of the proposed CPNPP Units 3 and 4 potentially could affect the aquatic ecosystems of Lake Granbury, SCR, the Brazos River, PKL, WBR, the Paluxy River below the City of Glen Rose, and waterbodies crossed by the proposed new transmission line and pipeline ROWs. Evaluation of these ecosystems identified Lake Granbury and the Brazos River as the waterbodies with the greatest potential to be affected.

Lake Granbury would be the source of makeup water for the proposed CPNPP Units 3 and 4 cooling water system and also would receive blowdown effluent from the cooling system. Consequently, impacts on the aquatic resources of Lake Granbury from operation of the intake and discharge were assessed. Evaluation of the use of a closed-cycle cooling system in conjunction with the proposed design and construction of the intake, the location of the intake within the reservoir, and the relatively small proportion of water that would be withdrawn from the reservoir supported the conclusion that impacts of the intake due to impingement and entrainment of aquatic organisms would be minimal. In order to provide the additional water needed for CPNPP Units 3 and 4, the BRA would alter its operation of the Brazos River system, including Lake Granbury and PKL. These operational changes would include increases in the release of water from PKL to Lake Granbury.

Liquid effluent from the proposed CPNPP Units 3 and 4 predominantly would be cooling system blowdown that would be discharged into Lake Granbury. Much smaller amounts of effluent would be discharged into SCR, including sanitary wastewater and radioactive and other effluents from the liquid waste management system, which would be discharged via the CPNPP Units 1and 2 circulating water return line. Impacts on aquatic organisms in Lake Granbury due to the discharge could result from thermal effects, chemical effects, physical effects on the substrate, and hydrological changes. Modeling of the thermal plume predicted it to be small, to dissipate within a limited area near the dam, and to have negligible ecological effects on populations of fish or other organisms in the reservoir. Evaluation of predicted and permitted chemical concentrations in the lake that may result from the discharge indicated adverse effects on biota would be unlikely. Physical impacts such as scouring, siltation, and increased turbidity also would be unlikely. Hydrological changes would include water levels in the lake 2 ft or more below full pool an additional 15 percent of the time and an average water level 0.6 ft lower than under current conditions. The effects of these changes on the aquatic resources in Lake Granbury are somewhat uncertain but likely would range from negligible to noticeable.

The evaluation determined that the Brazos River would not be substantially affected by thermal or chemical effects of the discharge to Lake Granbury. Operation of the Unit 3 and 4 cooling systems would result in a net consumptive loss of water from the Brazos River system due to withdrawal and subsequent evaporation. The BRA would alter its operation of the Brazos River system, including Lake Granbury and PKL, in order to provide the additional water needed for CPNPP Units 3 and 4. These operational changes would include increases in the release of water from PKL to the river upstream of Lake Granbury and smaller releases from Lake Granbury to the river downstream. There is uncertainty about the magnitude of the impacts on riverine biota that may result from these relatively limited alterations in river flow. Such impacts may range from negligible to substantial depending on the species and the degree to which its habitat is affected.

Impacts to wetlands from fogging, precipitation, and icing from cooling tower operation would likely be similar to those from occasional natural icing events in the region in winter and would occur when vegetation is dormant. Impacts to wetlands from vegetation maintenance on power transmission line and pipeline ROWs would be minimized or prevented by management practices that reduce or eliminate erosion, provide vegetated buffers, and prescribe selective cutting, mowing, and herbicide use. Accordingly, impacts to wetlands from operation of CPNPP Units 3 and 4 are expected to be minor.

The review team examined the potential aquatic ecological impacts of operating new generation facilities at the CPNPP site, including Units 3 and 4 at the facility on SCR, cooling water intake and effluent discharge structures on Lake Granbury, and new transmission lines and pipelines. Potential indirect impacts from the operation of CPNPP Units 3 and 4 also were evaluated, including (1) impacts from hydrological changes in PKL due to alterations in water management in the Brazos River Basin to accommodate cooling system losses, (2) impacts in the Brazos River from hydrological changes due to alterations in water management, and (3) impacts in the Paluxy River and WBR from withdrawals to supply water for potable and other uses at CPNPP. There is substantial uncertainty associated with the magnitude of ecological effects that may result from the hydrological changes in the Brazos River as well as Lake Granbury and PKL. Given the information provided in Luminant's ER (Luminant 2009a), their responses to RAI, interactions with the Texas Parks and Wildlife Department (TPWD) and the USFWS, the public scoping process, and NRC's own independent review, the review team concludes that impacts from operation of the new facilities on aquatic resources may range from SMALL to MODERATE. Additional mitigation may be warranted to help reduce adverse effects of flow alterations on the Brazos River. Such measures could include managing water releases from PKL and Lake Granbury to maintain higher base flows and to periodically provide episodic high flows that would better simulate the natural instream flow regime of the river.

5.4 Socioeconomic Impacts

Operations activities at CPNPP Units 3 and 4 could affect individual residents and communities in the surrounding region. Although the review team considered the entire 50-mi CPNPP region when assessing socioeconomic impacts, the primary Economic Impact Area (EIA) is the six-county area in which over 96 percent of the current CPNPP work force resides. These six counties are Somervell, Hood, Bosque, Erath, Johnson, and Tarrant Counties in Texas. Section 2.5 of this EIS provides additional details regarding the socioeconomic baseline in the vicinity of the CPNPP site.

The review team reviewed the ER prepared by Luminant and verified the data sources used in its preparation by examining cited references (Luminant 2009a). The review team requested clarifications and additional information from Luminant where needed to verify data in the ER. Unless otherwise specified in the following sections, the review team has drawn upon verified data from Luminant's ER and responses to RAI. Where the review team used different analytical methods or additional information for its own analysis, the following sections include explanatory discussions and citations for additional sources.

5.4.1 Physical Impacts

This section identifies and assesses the potential direct physical impacts of operations-related activities on the community, including disturbances from noise, odors, exhausts, thermal emissions, and visual intrusions. The review team believes that these direct physical impacts would be avoided or minimized by operating CPNPP Units 3 and 4 in accordance with all applicable Federal, State, and local regulations and therefore would not significantly affect the surrounding region. The following subsections assess the potential operations-related physical impacts of CPNPP Units 3 and 4 on specific segments of the population, the existing CPNPP plant, and nearby communities.

5.4.1.1 Workers and the Local Public

There are no residential areas located within the CPNPP site boundary. The nearest residence is located 0.8 mi southwest of the center point between CPNPP Units 3 and 4, to the east of Farm-to-Market Road (FM) 56 and adjacent to the CPNPP site boundary. As discussed in Section 2.5.1.1, the area near the CPNPP site is rural, with a relatively low population density. The 2007 estimated population within 5.0 mi of the CPNPP site was only 3530 individuals, with a population density of 45 people per square mile. There are no large industrial or commercial facilities in the immediate vicinity of the CPNPP site.

5.4.1.2 Buildings

Operations activities would not affect any offsite buildings, primarily due to distance. The nearest residence is 0.8 mi southwest of the CPNPP Units 3 and 4 center point. Because of their distance from the CPNPP site, no offsite industrial or commercial facilities would be affected by operations activities.

Many existing onsite buildings related to the safety of CPNPP Units 1 and 2 were constructed to meet seismic qualification criteria, which makes them resistant to the effects of vibration and shock. Other onsite facilities were constructed to the appropriate building codes and standards, which included consideration of seismic loads. Regardless of the applicable design standard, operations activities would be planned, reviewed, and conducted in a manner that would ensure no adverse effect on CPNPP Units 1 and 2 and the other buildings on site.

The distance of the nearest offsite structures would minimize the interaction of the buildings with operations activities, while the design of onsite buildings would ensure no adverse effects on CPNPP Units 1 and 2. Thus, the impact of plant operations on buildings would be SMALL, and no mitigation would be required.

5.4.1.3 Roads

Operations activities at CPNPP Units 3 and 4 would increase vehicular traffic on local roads and highways because additional workers would drive to and from the CPNPP site each day and in-migrating workers and their families would drive on local roads and highways for personal travel. There would also be additional trucks related to the removal of solid/salt waste from the proposed BDTF, unless rail cars are used to remove the BDTF solid/salt waste. Section 2.5.2.3 describes the local transportation network around the CPNPP site, and Figure 2-21 illustrates the road and highway systems in Somervell and Hood Counties.

Given that the overall traffic increase that would occur during operations would be much smaller than during the peak building period (Section 4.4.4.1), the review team concludes that operating Units 3 and 4 would have only a SMALL physical impact on roads in the six-county study area because potential impacts would be reduced by mitigation measures implemented during the building phase. Section 5.4.4.1 discusses the impacts of the additional vehicular traffic on local roads and highways in the context of existing traffic volumes, road capacities, and level of service (LOS).

5.4.1.4 Aesthetics

Operations activities at CPNPP Units 3 and 4 would be visible primarily to workers on site and to residents across SCR because visibility from other areas off site would be obstructed by the hilly topography of the area. Federal regulations require that any temporary or permanent structure, including all accompaniments, that exceeds an overall height of 200 ft above ground level be appropriately marked with lighting.

The tallest structures associated with CPNPP Units 3 and 4 would be smaller than the existing reactor domes for CPNPP Units 1 and 2, which are 266 ft tall. Thus, because CPNPP Units 1 and 2 have been in operation since the early 1990s, it is likely that the most severe impacts to local viewsheds have already occurred. The Units 1 and 2 reactor domes are visible from Dinosaur Valley State Park and Oakdale Park. Because visual effects are inversely related to distance, the effects of the CPNPP reactor domes on most other parks in the region are minimal. Most of the parks in the region are located more than 14 mi from the CPNPP site. Although structures associated with Units 3 and 4 may be visible at that distance, they would occupy less than 1 degree of vision. Further, visual impacts from the additional lighting required for Units 3 and 4 would be minimized by using low sodium lighting, as has been done at Units 1 and 2. Thus, the visual impact of the tallest structures associated with Units 3 and 4 at the CPNPP site would be SMALL and would require no mitigation beyond the measures proposed by Luminant in its ER (Luminant 2009a).

Operating CPNPP Units 3 and 4 could affect aesthetics on Lake Granbury and PKL by decreasing water level elevations and exposing more denuded shoreline. These aesthetic impacts could, in turn, have adverse affects on recreation and tourism (Section 5.4.4.2) and on shoreline property values (Section 5.4.4.3).

PKL was completed in 1941 and Lake Granbury was completed in 1969. Both lakes were constructed, and continued to be maintained and operated by the BRA, as water supply reservoirs. As such, both lakes have been subject to water level fluctuations since they were filled, due to natural variations in flows in the Brazos River, evaporation, and the variable demand for water associated with power generation, municipal water supply, irrigation, and other uses. In fact, BRA's *Regulations for Governance of Brazos River Authority Lakes and Associated Lands* (BRA 2010c) state the following:

> "The water level in the Lakes will not be constant. Authority Lakes are water conservation projects. While it is the desire of the Brazos River Authority to keep the Lakes as full as possible, the level of the water will vary, depending on the amount of water used from the Lakes, evaporation rates, generation of hydroelectric power, amounts of rainfall and runoff in the Brazos Basin upstream, and other factors. The level in any lake may drop substantially below the full lake level." (BRA 2010c).

Despite a history of water level fluctuations, including severe water level decreases such as those experienced during droughts, both Lake Granbury and PKL have an aesthetic appeal that attracts local recreational users and tourists from throughout the region, as well as significant residential development along the lakes' shorelines.

As discussed in Section 5.2.2.1, modeling indicates that under current conditions Lake Granbury would be at full pool (approximately 693 ft MSL) about 57 percent of the time. Additional water use by CPNPP Units 3 and 4 would result in a full pool at Lake Granbury just 46 percent of the time. Operation of CPNPP Units 3 and 4 would reduce the average water level by about 0.6 ft in Lake Granbury. The water level in Lake Granbury is estimated to fall 2 ft or more below full pool about 10 percent of the time under current conditions, and about 25 percent of the time with CPNPP Units 3 and 4 operating. For Lake Granbury, water levels 5 ft or more below full pool are estimated to occur about 3 percent of the time under current conditions, and 5 percent of the time with Units 3 and 4 operating. The largest drops in lake water levels predicted by the modeling are associated with the conditions encountered during the drought of record in 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions, without CPNPP Units 3 and 4 , Lake

Granbury's water level is estimated to drop down to 6.5 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 9.4 ft below full pool.

The review team concludes that these additional water level decreases in Lake Granbury during non-drought conditions would have only a SMALL aesthetic impact because such decreases would be temporary and within the normal range of the lake's fluctuations. The review team concludes that the additional water level decreases during drought conditions would have a MODERATE impact because they would noticeably alter the aesthetic environment of Lake Granbury. However, the impact would not be sufficient to destabilize important attributes of the aesthetic environment on Lake Granbury.

The modeling discussed in Section 5.2.2.1 indicates that PKL would be at full pool about 34 percent of the time under current conditions, but only about 26 percent of the time with CPNPP Units 3 and 4 operating. Operation of CPNPP Units 3 and 4 would reduce the average water level by 1.5 ft in PKL. The water level in PKL is estimated to be 5 ft or more below full pool about 10 percent of the time under current conditions, and about 25 percent of the time with CPNPP Units 3 and 4 operating. For PKL, the frequency of lake levels 20 ft or more below full pool is estimated to be well below 1 percent under current conditions, but over 1 percent with Units 3 and 4 operating. The largest drops in lake water levels predicted by the modeling are associated with the conditions encountered during the drought of record in 1953. During these drought conditions, without CPNPP Units 3 and 4, PKL's water level is estimated to drop down to 22.6 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 37.4 ft below full pool.

The review team concludes that these additional water level decreases in PKL during non-drought conditions would have only a SMALL aesthetic impact because such a decrease would be temporary and within the normal range of the lake's fluctuations. The review team concludes that the additional water level decreases during drought conditions would have a MODERATE impact because they would noticeably alter the aesthetic environment of PKL. However, the impact would not be sufficient to destabilize important attributes of the aesthetic environment on PKL.

5.4.1.5 Noise

As discussed in more detail in Section 5.8.2, CPNPP Units 3 and 4 would produce noise from the operation of pumps, transformers, turbines, generators, and switch yard equipment. While there are no applicable local noise ordinances, noise levels below 60 to 65 decibels adjusted[1] (dBA) are considered to be of small significance (HUD 1996). Most equipment would be located inside structures, reducing the outdoor noise level. Luminant would use a mechanical draft (wet) cooling tower for each unit to remove excess heat; these cooling towers are expected to be the primary source of noise during operation. Luminant expects noise levels of 55 decibels adjusted 1000 ft from the towers, while the receptors of concern are more than 4400 ft away. Luminant calculates that the noise levels from Units 3 and 4 would be less than those recorded at the same locations in 2006 (Luminant 2009a), which includes the operational noise from Units 1 and 2. The day-night noise levels from the CPNPP plant operations (specifically the cooling towers) would be less than 65 decibels adjusted at the site boundary, which the review team believes would have only a SMALL impact on the public.

The high-voltage transmission lines are not expected to be a source of noise, as line voltages would be no higher than 345 kV (Luminant 2009a). The one uncertainty in noise levels would

[1] "Decibel adjusted" is a unit used to show the relationship between the interfering effect of a noise frequency, or band of noise frequencies, and a reference noise power level.

be the noise from the pumps moving cooling water from Lake Granbury to the cooling towers. Noise reflects off water and could increase the pump noise levels; however, Luminant has identified mitigation measures to reduce the pumping noise (Luminant 2009a). With this qualification, the maximum sound level generated by the operation of Units 3 and 4 at the site boundary would not affect the usage of nearby recreational and residential areas and would not require mitigation. Therefore, the review team determined that the noise related effect on workers, residents, and recreational users of nearby areas would be SMALL and that no mitigation would be required (Section 5.8.2).

5.4.1.6 Air Quality

Once CPNPP Units 3 and 4 have begun operation, the facility would produce air emissions due to the periodic testing and operation of standby diesel generators and auxiliary power systems and to commuter vehicle dust and exhaust (see Section 5.7). The generators and power systems would be used on an infrequent basis and pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides) would be permitted in accordance with the facility's TCEQ air permit. Therefore, the review team expects that the impact of these systems on air quality would be SMALL.

Emissions associated with commuter vehicles would also be generated as a result of the proposed project. As discussed in Section 5.4.4.1, vehicular traffic on local roads would increase during operation of Units 3 and 4, so air emissions would increase in proportion to the increase in traffic. In addition, many measures taken by Luminant to mitigate traffic impacts during project building, including staggering shift times and encouraging car-pooling, would similarly reduce vehicle-related emissions during operations. Because the CPNPP area is in attainment for all criteria air pollutants with respect to the National Ambient Air Quality Standards and is subject to State Implementation Plan requirements, the increase in vehicle traffic-related emissions would not change the air quality status of the local area. Therefore, the addition of Units 3 and 4 at the CPNPP site would have only a SMALL impact on air quality and would not require mitigation. Air quality impacts of plant operation are discussed in more detail in Section 5.7 of this document.

5.4.1.7 Summary of Physical Impacts

Overall, the physical impacts of operating CPNPP Units 3 and 4 on workers and the local public, buildings, roads, aesthetics, noise, and air quality would be SMALL and would require no mitigation beyond that proposed by Luminant (Luminant 2009a).

5.4.2 Demography

Section 2.5.1 provides population estimates and projections for the 50-mi CPNPP region and the EIA. Section 2.5.2.1 provides data on the labor force, employment, and unemployment in the EIA.

During 2018, the peak operating year at CPNPP Units 3 and 4, Luminant estimates that there would be a total of 1494 operations workers on site, with 1000 workers at Units 1 and 2 and 494 workers at Units 3 and 4. Of the 494 workers at Units 3 and 4, 248 would be on site during project building and the remaining 246 would arrive after project building. The number of operations workers at Units 3 and 4 would decrease slightly after the initial start-up period, and then remain relatively constant for the term of the license. The review team's analysis focuses on the peak ("start-up") operations period because it serves as the upper bound to the expected socioeconomic impacts of operations. The impacts of the 248 operations workers who would be on site during project building are included in the discussion of impacts in Section 4.4.

Therefore, in most cases this section focuses on the additional 246 operations workers at Units 3 and 4. For impacts that cannot be characterized by the peak period alone because they would continue to accrue over time (e.g., economic impacts related to employment, income, and taxes), this analysis uses the full operations workforce of 494 workers.

During the operations period there would be 800 to 1200 additional workers onsite for outages, which would occur every 18 months for Units 1 and 2 and every 24 months for Units 3 and 4. However, this analysis of population growth does not include these outage workers because they are part of the existing baseline. This analysis also does not include any population growth related to the creation of indirect jobs during the operations period because the review team assumes that all the indirect jobs would be filled by existing residents of the EIA (Section 5.4.3.1).

Luminant expects that 50 percent of the 246 operations workers (123 workers) would come from inside the CPNPP region, and that the other half would in-migrate from outside the region (Table 5-5). Because operations jobs such as those on CPNPP Units 3 and 4 provide permanent employment, the review team expects that all of the in-migrating operations workers with families would relocate their families to the CPNPP region. In 2000, the average household size in Texas was 2.74 persons (USCB 2009a). However, the state average includes households that do not typically have children (e.g., elderly people). Therefore, the review team assumes an average household size of 3.0 as a more reasonable estimate of the family size that would be associated with the operations workforce. Multiplying this household size (3.0) by the 123 operations workers expected to in-migrate with a family after the building period results in an additional 369 people in the CPNPP region (Table 5-5).

Based on the residential pattern of current CPNPP workers (Table 2-21), the review team assumes that 23 percent of the total in-migrants (84 persons) would reside in Somervell County, 44 percent (162 persons) in Hood County, 11 percent (42 persons) in Johnson County, 9 percent (33 persons) in Tarrant County, 5 percent (18 persons) in Erath County, and 4 percent (15 persons) in Bosque County. Table 5-5 presents the calculations behind these assumptions.

This influx of operations workers and their families after building would represent about 1.0 percent and 0.3 percent increases in the projected 2020 populations (Table 2-18) of Somervell and Hood Counties, respectively. The percentage increases in the projected 2020 populations for the other study area counties would be much smaller, as follows: Johnson County (0.02 percent); Tarrant County (0.002 percent); Erath County (0.04 percent); and Bosque County (0.07 percent). Thus, the in-migrating workers and their families would represent a SMALL population increase for each of the counties in the EIA.

Table 5-5. Potential Population Growth in the EIA Due to Peak Operations Employment at CPNPP Units 3 and 4

	Total	County						
		Somervell	**Hood**	**Bosque**	**Erath**	**Johnson**	**Tarrant**	**Other**
Operations workers[(a)]	246							
In-migrants (50% of total)	123	28	54	5	6	14	11	5
With family (100%)	123	28	54	5	6	14	11	5
Ave. household size = 3.0								
Total including family	369	84	162	15	18	42	33	15
Without family (0%)	0							
Total operations in-migrants	369	84	162	15	18	42	33	5
Total in-migrants	369	84	162	15	18	42	33	15

(a) Does not include the 248 operations workers at CPNPP Units 3 and 4 during peak building, existing operations workers at CPNPP Units 1 and 2, or outage workers.

Source: The review team, based on Luminant 2009a

The review team discusses the impacts of this population growth on transportation, recreation, housing, public services, and education in the EIA in Sections 5.4.4.1 through 5.4.4.5. However, most of the impacts of this relatively small population growth would be more than offset by the large population decrease that would occur when building is completed and most of the in-migrating construction workers and their families leave the EIA. Although it is likely that some of the in-migrating construction workers would find permanent jobs and choose to remain in the area, as many as 5201 residents (the total population increase due to construction workers during peak building) (Table 4-4) could leave the area. Such a population decrease would be over 14 times as large as the population increase associated with the operations workers that would arrive after building. Sections 5.4.4.1 through 5.4.4.5 also discuss the impacts of this population decrease on transportation, recreation, housing, public services, and education.

5.4.3 Economic Impacts to the Community

This section evaluates the economic impacts on the area within 50 mi of the CPNPP site as a result of operating CPNPP Units 3 and 4. The evaluation focuses on the impacts of operations that would occur because of the presence of the operations workforce.

5.4.3.1 Economy

The impacts of operations on the local and regional economy depend on the region's current and projected population and economy. Section 2.5.1 provides population estimates and projections for the 50-mi CPNPP region and the EIA. Section 2.5.2.1 describes the economic characteristics of the EIA, including the labor force, employment by industry type, unemployment, total personal income, and per capita income. This section discusses economic impacts in the EIA from direct and indirect jobs and incomes and increased purchases of goods and services. Section 5.4.3.2 discusses tax revenues separately.

The review team assumes that 50 percent of the 246 operations workers would in-migrate from outside the region or the state. Thus, the project would provide 123 operations jobs for workers who already reside in the EIA. These direct jobs would help reduce unemployment in the study area, which had a total of 49,062 unemployed workers in 2008 (Table 2-21).

In addition, the 123 in-migrating operations workers would create new indirect jobs in the study area through a process called the multiplier effect (Section 4.4.3.1). The U.S. Department of Commerce Bureau of Economic Analysis provides regional multipliers ("RIMS II Multipliers") for industry jobs and earnings. Luminant used RIMS II multipliers to estimate the number of indirect jobs and expenditures of money that would result from operations at CPNPP Units 3 and 4. For the in-migrating operations workers, Luminant used the power generation and supply multiplier from the RIMS II Multipliers, resulting in a multiplier value of 2.1. This means that for every new operations worker in the project area, 1.1 indirect jobs would be created. Thus, the 123 in-migrating operations workers would result in 135 indirect jobs (in addition to the 136 indirect jobs that would be created by the 124 in-migrating operations workers during the building peak). Because most of these indirect jobs would be service-related and not highly specialized, the review team assumes that all of the indirect jobs would be filled by existing residents of the EIA. Therefore, these indirect jobs would help reduce unemployment in the EIA.

The employment of a large operations work force at CPNPP Units 3 and 4 (494 workers total) would have long-term positive effects on income in the EIA. Luminant has stated that operations at Units 3 and 4 would require 150 reactor operators and 344 support personnel, including security, administration, and technicians (Luminant 2009a). To estimate income effects, the review team assumes that these 344 support personnel would include 250 technicians, 64 administrative personnel, and 30 security personnel. Table 5-6 shows the average annual wages of all operations period workers based on national averages in 2007. Based on these average annual wages, the Units 3 and 4 operations workforce could earn over $31 million annually.

The review team estimates that the average annual wage (based on 2000 hours) associated with the indirect jobs created during operations would be about $26,000 (CPPP 2007). Based on 135 indirect jobs created, total annual indirect income would be about $3.5 million.

Annual direct and indirect earnings of over $35 million would have a positive effect on the total and per capita income of the EIA (Table 2-22). Based on information found in *Update of the MIT 2003 Future of Nuclear Power* (MIT 2009), the review team estimates that the combined annual expenditures for operating and maintaining CPNPP Units 3 and 4 would be about $175 million (excluding fuel costs). Operation of CPNPP Units 3 and 4 would have a beneficial effect on the economy of the EIA and, to a lesser extent, the entire 50-mi CPNPP region, by creating direct jobs, incomes, and expenditures that would generate indirect jobs, incomes, and expenditures. However, this beneficial effect would be offset by the loss of jobs, incomes, and expenditures (as well as indirect jobs and expenditures) that would occur when project building is completed. With the exception of the 494 direct jobs and the 271 indirect jobs created by operations, unemployment in the EIA could return to near current levels. Although this economic downturn would have adverse short-term consequences for the local economy, the economic benefits of the two new units at CPNPP would last for at least 40 years. Therefore, the overall long-term economic benefits of operating CPNPP Units 3 and 4 are likely to be MODERATE to LARGE in Somervell and Hood Counties but SMALL in the rest of the EIA and the 50-mi CPNPP region.

Table 5-6. Average Annual Salary for Operations Workforce at CPNPP Units 3 and 4

Specialty	Number of Workers	Average Annual Salary (2007 $)	Total Annual Salary (Million 2007 $)
Mechanical technician	50	66,581	3.3
Electrical technician	50	67,517	3.4
Instrumentation and control technician	50	72,238	3.6
Chemistry technician	50	70,990	3.5
Radiation protection technician	50	69,056	3.4
Non-licensed operator	50	70,793	3.5
Reactor operator	50	77,782	3.9
Senior reactor operator	50	85,426	4.3
Administrative	64	28,000	1.8
Security	30	35,000	1.1
Total	494		31.8

Sources: The review team, based on Luminant 2009a and CTEC 2005

Operating CPNPP Units 3 and 4 could have an adverse effect on the economy by decreasing water level elevations on Lake Granbury and PKL. Decreased water level elevations could reduce access to public and private boat docks and boat ramps, make some shallow areas of the lakes inaccessible by boat, and increase the potential for boating accidents due to underwater hazards. These impacts could have an adverse affect on tourism in the region, because both Lake Granbury and PKL are popular tourist destinations. However, as discussed in Section 5.4.4.2, the review team concluded that project-related water level decreases in Lake Granbury and PKL during non-drought conditions would have only a SMALL impact on recreational use of the lakes. During drought conditions, those impacts would increase to MODERATE. For Lake Granbury, the review team determined MODERATE impacts occur about 3 percent of the time under current conditions, and would occur about 5 percent of the time with Units 3 and 4 operating. For PKL, the frequency of MODERATE impacts is estimated to be well below 1 percent under current conditions, but between 1 and 2 percent with Units 3 and 4 operating (Section 5.2.2.1). Therefore, the review team concludes that the limited increase in impacts attributable to CPNPP Units 3 and 4 would represent only a SMALL impact on the local economy.

5.4.3.2 Taxes

Section 2.5.2.2 discusses current tax revenues within the EIA. Operations activities and purchases at CPNPP Units 3 and 4 and personal expenditures made by operations workers would generate several types of taxes, including income taxes on corporate profits, wages, and salaries; sales and use taxes on corporate and employee purchases; real property ad valorem taxes related to the CPNPP facilities; and personal property taxes.

While the State of Texas has no personal income tax, the wages paid to the operations workers would generate Federal income tax revenue. As discussed in Section 5.4.3.1, the Units 3 and 4 operations work force and associated indirect workers could earn a total of over $35 million annually during operations. The workers' wages would also generate state and local revenues through sales and use taxes because it is likely that a large amount of the workers' discretionary income would be spent in the EIA.

As discussed in Section 2.5.2.2, the sales and use tax rate in most of the study area is 8.25 percent including local and state taxes. The review team's experience indicates that about 10 percent of annual operations expenditures are spent locally. Annual expenditures are estimated in Section 5.4.3.1 at $175 million (MIT 2009). Therefore, the review team expects that about $17.5 million in operations expenditures (not including workers' personal expenditures) would occur in the study area.

Luminant currently pays ad valorem taxes on CPNPP Units 1 and 2 to Somervell and Hood Counties and to several taxing jurisdictions within those counties (Section 2.5.2.2), and the review team assumes that Luminant would pay ad valorem taxes on Units 3 and 4. Although the tax rates for Units 3 and 4 have not been finalized, Section 4.4.3.2 provides an estimate of the potential tax revenues for affected jurisdictions assuming that Luminant pays the same ad valorem taxes on Units 3 and 4 as on Units 1 and 2. As with Units 1 and 2, the review team expects that most of the ad valorem tax revenue from Units 3 and 4 would go to Glen Rose Independent School District (ISD) and Somervell County. Table 5-7 shows that Glen Rose ISD could receive over $17.4 million annually and that Somervell County could receive over $5.1 million annually.

Table 5-7. Potential Total Annual Ad Valorem Taxes Paid on CPNPP Units 3 and 4 During Operations

Somervell County	5,124,604
Glen Rose	35
Somervell County Water District	1,882,099
Glen Rose ISD[(a)]	17,355,171
Hood County	5595
Tolar	37
Granbury ISD[(a)]	18,734
Tolar ISD[(a)]	15,073
Hood County Library District	255

(a) ISD = Independent School District

Source: The review team, based on Luminant 2009a

During the operations period, local tax revenues, especially from ad valorem taxes and sales and use taxes, would remain high in the study area. The relatively large tax revenues would be of particular benefit to the local jurisdictions in Somervell and Hood Counties. However, some of this beneficial effect would be offset by the loss of sales and use and property tax revenues that would occur when building is completed and most of the in-migrating construction workers and their families leave the EIA. Although this decrease in tax revenues would have short-term adverse consequences for local governments, the long-term tax revenue benefits of operating CPNPP Units 3 and 4 are likely to remain LARGE in Somervell County and, to a lesser extent, Hood County. Tax revenue benefits would be SMALL elsewhere in the EIA and the 50-mi CPNPP region.

5.4.3.3 Summary of Economic Impacts to the Community

In terms of employment and income, the long-term economic benefits of operating CPNPP Units 3 and 4 are likely to be MODERATE to LARGE in Somervell and Hood Counties, but SMALL in the rest of the EIA and the 50-mi CPNPP region. With regard to tax revenues, the long-term economic benefits of operating CPNPP Units 3 and 4 are likely to be LARGE in Somervell County and, to a lesser extent, Hood County, but SMALL elsewhere in the EIA and the 50-mi CPNPP region.

5.4.4 Infrastructure and Community Services

The local infrastructure and community services that would be affected by operation of CPNPP Units 3 and 4 include transportation, recreation, housing, public services (including water and wastewater, solid waste, police, fire, and medical services, and social services), and education.

5.4.4.1 Transportation

Operation of CPNPP Units 3 and 4 would increase vehicular traffic on local roads and highways compared to current conditions because additional workers would drive to and from the CPNPP site each day and in-migrating workers and their families would drive on local roads and highways for personal travel. There would also be additional traffic from trucks removing solid/salt waste from the proposed blow down treatment facility (BDTF), unless rail cars are used to remove the BDTF solid/salt waste. As discussed in Section 3.3.4, Luminant estimates that removing solid/salt waste from the BDTF could generate up to 65 truck trips per day.

Overall, however, the total increase in traffic during operations would be much smaller than the increase experienced during the building of CPNPP Units 3 and 4. Section 4.4.4.1 describes the expected traffic increases associated with project building, focusing primarily on FM 56. These building-period impacts become the new baseline for the operations-period impacts discussed in this section, which focuses on the 246 operations workers who would arrive after project building and the additional 65 trucks per day related to the BDTF. To estimate the potential impacts of this additional traffic (311 vehicles per day), the review team considered the following factors:

- The traffic associated with the 246 operations workers and the 65 BDTF-related trucks (a total of 311 vehicles) represents less than 15 percent of the peak traffic volume associated with the Units 3 and 4 construction workers;
- Units 3 and 4 operations workers would be divided among various shifts, so no more than about one-third of the workers (82 workers) would enter or exit the site at any one time. Assuming no carpooling, these 82 vehicle trips would represent less than 9 percent of the peak project building volume assessed in Section 4.4.4.1.
- Operations-related traffic impacts could be further reduced by road improvements implemented by Luminant or the Texas Department of Transportation to facilitate peak building traffic.

Therefore, the review team concludes that the traffic-related impacts of the 246 operations workers who would arrive after project building and the additional 65 trucks per day related to the BDTF would be minimal compared to the traffic-related impacts of the construction workers. Given that building-period traffic impacts would be SMALL to MODERATE, operations-period traffic impacts would be SMALL.

If rail cars are used to remove solid/salt waste from the BDTF, Luminant estimates that about 13 rail cars per day would be needed (Section 3.3.4). As discussed in Section 2.5.2.3, the CPNPP rail spur connects to the Ft. Worth Western Railroad Company line that runs through Tolar approximately 10 mi northwest of the CPNPP site. Currently, an average of two trains use this railway each day, with four to five cars of hazardous materials from various sources transported each month. Given this existing use of the rail line, the review team concludes that the increase in rail traffic associated with the BDTF (about 13 rail cars per day) would not have significant adverse impacts on the local rail system.

5.4.4.2 Recreation

Section 5.4.2 discusses the population growth that could occur in the EIA as a result of operations at CPNPP Units 3 and 4. The review team expects that the population growth associated with the in-migrating operations workers arriving after project building (i.e., 369 new residents) would slightly increase the use of existing recreational facilities and the demand for additional facilities. However, this additional demand would be offset by the large out-migration of construction workers and their families after project building. Also, it is likely that the potential effects of any increased use and demand, such as the cost to repair or replace existing recreational facilities or provide new ones, would be offset by increased funding related to local and State tax revenues associated with CPNPP Units 3 and 4. Thus, the impacts of operations-related population growth on recreation are expected to be SMALL and would require no mitigation.

Luminant's proposal to reopen SCR to members of the public via controlled access would likely have a positive effect on recreation by providing local residents with additional opportunities for boating, fishing, and shoreline activities. Luminant plans to allow a maximum of 100 boats on SCR at any given time, but more than 100 boats may be allowed for special events (Luminant 2010c).

Operating CPNPP Units 3 and 4 could affect recreation on Lake Granbury and PKL by decreasing water level elevations. Decreased water level elevations could reduce access to public and private boat docks and boat ramps, make some shallow areas of the lakes inaccessible by boat, and increase the potential for boating accidents due to underwater hazards. These impacts to recreation could, in turn, have an adverse affect on tourism in the region, because both Lake Granbury and PKL are popular tourist destinations.

PKL was completed in 1941 and Lake Granbury was completed in 1969. Both lakes were constructed, and continue to be maintained and operated by the BRA, as water supply reservoirs. As such, both lakes have been subject to water level fluctuations since they were filled, due to natural variations in flows in the Brazos River, evaporation, and the variable demand for water associated with power generation, municipal water supply, irrigation, and other uses. In fact, BRA's *Regulations for Governance of Brazos River Authority Lakes and Associated Lands* (BRA 2010c) state the following:

> "The water level in the Lakes will not be constant. Authority Lakes are water conservation projects. While it is the desire of the Brazos River Authority to keep the Lakes as full as possible, the level of the water will vary, depending on the amount of water used from the Lakes, evaporation rates, generation of hydroelectric power, amounts of rainfall and runoff in the Brazos Basin upstream, and other factors. The level in any lake may drop substantially below the full lake level." (BRA. 2010c).

The text of BRA's *Permit and Agreement for On-Water Facility* (BRA 2010b) (the permit issued to construct boat docks on BRA lakes) is even more specific, mentioning the possibility of a 33-foot drop in lake levels:

> "The level in any lake will drop as much as 33 feet below the full lake level. The Authority will not credit, pro-rate, refund, or provide any form of compensation for the inability of permittee to utilize on-water permitted facilities." (BRA. 2010b).

Despite a history of water level fluctuations, including severe water level decreases such as those experienced during droughts, both Lake Granbury and PKL support a variety of water-based recreational activities. And despite BRA's warnings about fluctuating lake levels, both lakes have attracted significant residential development along their shorelines, complete with public and private boat ramps and boat docks.

As discussed in Section 5.2.2.1, modeling indicates that under current conditions Lake Granbury would be at full pool (approximately 693 ft MSL) about 57 percent of the time. Additional water use by CPNPP Units 3 and 4 would result in a full pool at Lake Granbury just 46 percent of the time. Operation of CPNPP Units 3 and 4 would reduce the average water level by about 0.6 ft in Lake Granbury. The water level in Lake Granbury is estimated to fall 2 ft or more below full pool about 10 percent of the time under current conditions, and about 25 percent of the time with CPNPP Units 3 and 4 operating. For Lake Granbury, water levels 5 ft or more below full pool are estimated to occur about 3 percent of the time under current conditions, and 5 percent of the time with Units 3 and 4 operating. The largest drops in lake water levels predicted by the modeling are associated with the conditions encountered during the drought of record in 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions, without CPNPP Units 3 and 4, Lake Granbury's water level is estimated to drop down to 6.5 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 9.4 ft below full pool.

During the 2009 drought, Lake Granbury's water level dropped by 3.5 ft to an elevation of 688.83 MSL in September (BRA 2009), the lake's lowest elevation since 1984 (Luminant 2010j). With this 3.5-ft decrease in 2009, three of the six public boat ramps (Luminant 2010j) and many of the private boat ramps and fixed boat docks (BRA 2009) on Lake Granbury were out of the water and could not be used.

The review team concludes that if the two proposed units were to go on line, the projected marginal water level decreases in Lake Granbury during normalconditions would have only a SMALL impact on recreational use of the lake because such decreases would be temporary and within the normal range of the lake's fluctuations. The review team concludes that the marginal water level decreases during drought conditions would have a MODERATE impact on recreational use of the lake, especially on the ability to use fixed boat docks and boat ramps. This impact would be especially noticeable given that most of the 3137 residential boat docks on Lake Granbury are fixed docks (Luminant 2010j) that cannot adjust to changes in the water level. However, the impact would not be sufficient to destabilize important attributes of recreational resources and tourism on Lake Granbury because large water level decreases would still be relatively rare and temporary. Further, BRA warns recreational users and shoreline residents of the potential for significant decreases in water level elevations.

The modeling discussed in Section 5.2.2.1 indicates that PKL would be at full pool about 34 percent of the time under current conditions, but only about 26 percent of the time with CPNPP Units 3 and 4 operating. Operation of CPNPP Units 3 and 4 would reduce the average water level by 1.5 ft in PKL. The water level in PKL is estimated to be 5 ft or more below full pool about 10 percent of the time under current conditions, and about 25 percent of the time with CPNPP Units 3 and 4 operating. For PKL, the frequency of lake levels 20 ft or more below full pool is estimated to be below 1 percent under current conditions, but over 1 percent with Units 3 and 4 operating. The largest drops in lake water levels predicted by the modeling are associated with the conditions encountered during the drought of record in 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions, without CPNPP Units 3 and 4, PKL's water level is estimated to drop down to 22.6 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 37.4 ft below full pool.

The review team concludes that these additional water level decreases in PKL during non-drought conditions would have only a SMALL impact on recreational use of the lake because such decreases would be temporary and within the normal range of the lake's fluctuations. The review team concludes that the additional water level decreases during drought conditions would have a MODERATE impact on recreational use of PKL, especially on the ability to use boat docks and boat ramps. This impact to recreation on Possum Kingdom Lake would be somewhat less noticeable than on Lake Granbury, however, because most of the 1995 residential boat docks on Possum Kingdom Lake are floating docks (rather than fixed docks) that can adjust somewhat to changes in the water level (Luminant 2010j). Overall, the impact would not be sufficient to destabilize important attributes of recreational resources and tourism on PKL because large water level decreases would still be relatively rare and temporary. Further, BRA warns recreational users and shoreline residents of the potential for significant decreases in water level elevations.

5.4.4.3 Housing

Operation of CPNPP Units 3 and 4 would increase the demand for both short-term and long-term housing in the EIA due to the in-migration of operations workers and their families. Section 2.5.2.5 provides data on existing housing in the study area, including the total number of units, the total number and types of occupied units, the total number of vacant units, and vacancy rates. As discussed in Section 2.5.2.5, most of the current CPNPP employees (over 66 percent) live in Hood and Somervell Counties, and over 96 percent live in the EIA. This analysis assumes that the operations workers for Units 3 and 4 would follow this same residential pattern.

The in-migration of operations workers and their families after the building period would result in a population increase of 369 people in the CPNPP region (Section 5.4.2). This analysis assumes that each of the 123 operations workers in-migrating would represent one household. Given this assumption, the operations period at CPNPP Units 3 and 4 would create 123 new households in the EIA. Thus, the total demand for short-term and long-term housing units for the in-migrating operations workers would be 123 units. Table 5-8 shows the distribution of these households in the EIA. The data in Table 5-8 indicate that each of the six counties has an adequate number of existing vacant housing units to accommodate projected worker demand.

Table 5-8. Vacant Housing Units[(a)] and Projected Housing Demand from In-Migrating CPNPP Operations Workers in the EIA

County	Vacant Units	Projected Demand	Surplus (or Shortage)
Somervell	312	28	284
Hood	2880	54	2826
Bosque	1918	5	1913
Erath	2473	6	2467
Johnson	4708	14	4694
Tarrant	65,514	11	65,503

(a) Data are for 2007 except for 2000 data used for Somervell and Bosque Counties.

Sources: The review team, based on USCB 2007; USCB 2009b; Luminant 2009a

With the number housing units available in the EIA, the review team expects that the in-migrating operations workers would be able to find sufficient housing within a relatively short commuting distance. This is especially true given the large population decrease that would occur when project building is completed and the construction workers and their families leave the EIA. Although it is likely that some of the in-migrating construction workers would find permanent jobs and choose to remain in the area, as many as 5201 residents (Table 4-4) could leave the area. Although this decrease in housing demand could have short-term adverse consequences for the local economy, the overall impact on long-term housing availability and price is likely to be SMALL.

Operating CPNPP Units 3 and 4 could affect recreation and aesthetics on Lake Granbury and PKL by decreasing water level elevations (Sections 5.4.1.4 and 5.4.4.2). These impacts could, in turn, have an adverse affect on property values along the shorelines of both lakes.

As discussed in Section 5.4.4.2, both Lake Granbury and PKL were constructed, and continue to be maintained and operated by the BRA, as water supply reservoirs. As such, both lakes have been subject to water level fluctuations since they were filled, due to natural variations in flows in the Brazos River, evaporation, and the variable demand for water associated with power generation, municipal water supply, irrigation, and other uses. In fact, BRA's *Regulations for Governance of Brazos River Authority Lakes and Associated Lands* c) *Permit and Agreement for On-Water Facility* (BRA 2010b) (the permit issued to construct boat docks on BRA lakes) warn recreational users and residents about the potential for lake level fluctuations (Section 5.4.4.2).

Despite a history of water level fluctuations at both Lake Granbury and PKL, including severe water level decreases such as those experienced during droughts, both lakes support a variety of water-based recreational activities and have a high aesthetic value. And despite BRA's warnings about fluctuating lake levels, the recreational opportunities and aesthetic values that Lake Granbury and PKL offer have attracted significant residential development along their shorelines, complete with private boat ramps and boat docks and property values that have continued to increase through the years.

As discussed in Section 5.2.2.1, modeling indicates that under current conditions Lake Granbury would be at full pool (approximately 693 ft MSL) about 57 percent of the time. Additional water use by CPNPP Units 3 and 4 would result in a full pool at Lake Granbury just 46 percent of the time. Operation of CPNPP Units 3 and 4 would reduce the average water level by about 0.6 ft in Lake Granbury. The water level in Lake Granbury is estimated to fall 2 ft or more below full pool about 10 percent of the time under current conditions, and about 25 percent of the time with CPNPP Units 3 and 4 operating. For Lake Granbury, water levels 5 ft or more below full pool are estimated to occur about 3 percent of the time under current conditions, and 5 percent of the time with Units 3 and 4 operating. The largest drops in lake water levels predicted by the modeling are associated with the conditions encountered during the drought of record in 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions, without CPNPP Units 3 and 4, Lake Granbury's water level is estimated to drop down to 6.5 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 9.4 ft below full pool.

During the 2009 drought, Lake Granbury's water level dropped by 3.5 ft to an elevation of 688.83 MSL in September (BRA 2009b), the lake's lowest elevation since 1984 (Luminant 2010j). With this 3.5-ft decrease in 2009, many of the private boat ramps and fixed boat docks (BRA 2009b) on Lake Granbury were out of the water and could not be used.

The modeling discussed in Section 5.2.2.1 indicates that PKL would be at full pool about 34 percent of the time under current conditions, but only about 26 percent of the time with CPNPP Units 3 and 4 operating. Operation of CPNPP Units 3 and 4 would reduce the average water level by 1.5 ft in PKL. The water level in PKL is estimated to be 5 ft or more below full pool about 10 percent of the time under current conditions, and about 25 percent of the time with CPNPP Units 3 and 4 operating. For PKL, the frequency of lake levels 20 ft or more below full pool is estimated to be well below 1 percent under current conditions, but over 1 percent with Units 3 and 4 operating. The largest drops in lake water levels predicted by the modeling are associated with the conditions encountered during the drought of record in 1953. A drought of record is the worst recorded drought since compilation of meteorologic and hydrologic data began and is , therefore, an extreme and unusual event. During these drought conditions, without CPNPP Units 3 and 4, PKL's water level is estimated to drop down to 22.6 ft below full pool; operation of Units 3 and 4 would increase the maximum drawdown to 37.4 ft below full pool.

The review team concludes that the projected additional water level decrease in Lake Granbury and PKL during non-drought conditions would have, at most, only a SMALL impact on property values around the lakes because such decreases would be temporary and within the normal range of the lakes' fluctuations. The review team concludes that the additional water level decreases at Lake Granbury and PKL during drought conditions would also have a SMALL impact on property values around the lakes because: (1) such decreases would still be relatively rare and temporary; (2) property values along the lakes' shorelines have continued to increase since the lakes were completed despite water level fluctuations, and; (3) property values are influenced by a number of factors in addition to water levels, including local, regional, and national economic conditions and the demand for housing and property. Further, to the extent that any impacts to property values would occur on either lake, BRA warns shoreline residents (especially those seeking a permit to construct a boat dock) of the potential for significant decreases in water level elevations.

Operation of CPNPP Units 3 and 4 is not expected to have an adverse affect on housing values in the EIA away from Lake Granbury and PKL. In a review of previous studies on the effect of seven nuclear power facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling (2006) concluded that assessed valuations and median housing prices have tended to increase at rates above national and State averages. Clark et al. (1997) similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative imagery of the facilities. These findings differ from studies that looked at undesirable facilities, largely related to hazardous waste sites and landfills, but also including several studies on power facilities (Farber 1998), in which property values were negatively affected in the short-term but these effects were moderated over time. Bezdek and Wendling (2006) attribute the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area. Therefore, the review team concludes that the general impacts to property values attributable to CPNPP Units 3 and 4 would be SMALL.

5.4.4.4 Public Services

Operation of CPNPP Units 3 and 4 would increase the demand for a variety of public services in the EIA due to the in-migration of operations workers and their families. Section 2.5.2.6 provides data on existing public services in the study area, including water and wastewater, solid waste, police, fire, and medical services, and social services (educational services are discussed separately in Sections 2.5.2.7 and 5.4.4.5). This analysis of public service impacts assumes that over 66 percent of the onsite workers during CPNPP operations would live in Hood and Somervell Counties, and that over 96 percent would live in the EIA (Section 2.5.2).

As discussed in Section 5.4.2, the in-migration of 123 operations workers and their families after the project building period would result in a population increase of 369 people in 123 households in the CPNPP region. Table 5-8 shows the distribution of these households in the EIA. The following sub-sections discuss the impacts of this population growth on existing and planned public services.

Water and Wastewater

Operation of CPNPP Units 3 and 4 would increase the demand for water and wastewater services in the EIA due to the projected in-migration of 369 new residents (Sections 3.3.1 and 5.2 discuss the increased demand for water and wastewater due to onsite operations activities). In 2006, municipal water use [defined as "city-owned, districts, water supply corporations, or private utilities supplying residential, commercial (non-goods-producing businesses), and institutional (schools, governmental operations)"] in the EIA averaged 148 gallons per person per day (TWDB 2009).

Based on the population growth patterns discussed in Section 5.4.2 and a projected demand of 148 gallons of water per person per day, the review team estimates that 12,432 additional gallons per day (gpd) would be used each year in Somervell County and that 23,976 additional gpd would be used each year in Hood County. Annual increases in the other counties would be 6216 gpd in Johnson County, 4884 gpd in Tarrant County, 2664 gpd in Erath County, and 2220 gpd in Bosque County.

The data in Table 4-9 indicate that all of the counties in the EIA have adequate water treatment capacity to accommodate the additional demand that would result from population growth during the operations period. Somervell, Hood, and Johnson Counties are planning expansions of their existing water supply and treatment systems (Section 2.5.2.6), so the available capacity in those counties should be even larger in 2016.

Given the excess capacities of the existing and planned water treatment facilities in the EIA, the increased demand for water associated with operations-related population growth would have only a SMALL impact.

Conventional wastewater planning assumes that all of the water consumed by residents is disposed of through wastewater treatment facilities. The data in Table 4-9 indicate that all of the counties in the EIA have adequate wastewater treatment capacity to accommodate the additional demand during the operations period. Hood and Johnson Counties are planning expansions of their existing wastewater treatment systems (Section 2.5.2.6), so the available capacity in those counties should be even larger in 2016.

Given the excess capacities of the existing and planned wastewater treatment facilities in the EIA, the increased demand for wastewater treatment associated with operations-related population growth would have only a SMALL impact.

Solid Waste

Operation of CPNPP Units 3 and 4 would increase the generation of solid waste in the EIA due to the projected in-migration of 369 new residents after the building period (Section 3.3.1 discusses the increased generation of solid waste due to onsite operations activities). In 2007, per capita solid waste generation in the United States was over 4.6 lb per day (or 1679 lb/yr) (EPA 2008a).

Based on the population growth patterns discussed in Section 5.4.2 and a per capita generation rate of 1679 lb of solid waste per year, the review team estimates that 71 additional tons of solid waste per year would be generated in Somervell County, 136 tons in Hood County, 35 tons in Johnson County, 28 tons in Tarrant County, 15 tons in Erath County, and 13 tons in Bosque County.

As discussed in Section 2.5.2.6, there are no active landfills in Somervell or Hood Counties. In 2005, the IESI, Inc. Somervell County Transfer Station handled 14,284 tons of waste, and the IESI, Inc. Granbury Transfer Station handled 16,153 tons. Thus, the additional solid waste generated annually by the in-migrating residents of Somervell and Hood Counties during the operations period would represent a 0.5 percent increase for the IESI, Inc. Somervell County Transfer Station and a 0.8 percent increase for the IESI, Inc. Granbury Transfer Station.

The total amount of additional solid waste from these two stations (207 tons) would be transported to the IESI, Inc. Weatherford Landfill in Parker County. The Weatherford Landfill has an estimated 1.1 million tons of space remaining, so the total amount of solid waste generated annually by the new residents of Somervell and Hood Counties would represent only 0.02 percent of that excess capacity. Even considering the additional solid waste that would be generated annually in Bosque, Erath, Johnson, and Tarrant Counties, the review team expects that the overall impact on solid waste management and landfill capacity in the study area would be SMALL. This is especially true given the large population decrease that would occur when project building is completed in 2016 and most of the in-migrating construction workers and their families leave the EIA.

Police, Fire, and Medical Services

Operation of CPNPP Units 3 and 4 would increase the need for police, fire, and medical services in the EIA due to the projected in-migration of 369 new residents after the building period (Section 3.3.1 discusses CPNPP onsite security, fire, and medical services during project operations).

The projected population of Somervell County in 2020 is 8659 (TSDC 2009). Assuming the county's current number of full-time police officers (19), the county would have 2.2 police officers per 1000 residents without the CPNPP in-migrating workers. With the operations workers that would in-migrate after project building, the number of police officers per 1000 residents in Somervell County would remain at 2.2.

The projected population of Hood County in 2020 is 56,847 (TSDC 2009). Assuming the county's current number of full-time police officers (67), the county would have 1.2 police officers per 1000 residents without the CPNPP in-migrating workers. With the operations workers that would in-migrate after project building, the number of police officers per 1000 residents in Hood County would remain at 1.2.

Because the number of police officers per 1000 residents in Somervell and Hood Counties would not change due to the in-migration of operations workers and their families, the review team expects that the operations-related impact on police services would be SMALL. Given the existing police resources that are available in Bosque, Erath, Johnson, and Tarrant Counties, and the relatively small proportion of the CPNPP in-migrating workers that would settle in those counties, the increased demand for police services would also have only a SMALL impact.

Assuming Somervell County's projected population in 2020 and current number of firefighters (40), the county would have 4.6 firefighters per 1000 residents without the CPNPP in-migrating workers. With the operations workers that would in-migrate after project building, the number of firefighters per 1000 residents in Somervell County would remain at 4.6.

Assuming Hood County's projected population in 2020 and current number of firefighters (250), the county would have 4.4 firefighters per 1000 residents without the CPNPP in-migrating workers. With the operations workers that would in-migrate after project building, the number of firefighters per 1000 residents in Hood County would remain at 4.4.

Given the existing fire department resources that are available in Somervell and Hood Counties, and the relatively small proportion of the CPNPP in-migrating workers that would settle in Bosque, Erath, Johnson, and Tarrant Counties, the review team expects that the increased demand for fire protection would have only a SMALL impact.

Currently, the combined daily load at Glen Rose Medical Center and Lake Granbury Medical Center is 23 beds. When planned expansions are complete, the two medical centers would have a combined capacity of 142 beds, well above the current demand. The population growth associated with onsite workers during operations would increase the populations of Somervell and Hood Counties by only 1.0 percent and 0.3 percent, respectively (Section 5.4.2). Therefore, the review team expects that the existing and planned medical facilities would be more than adequate to accommodate the demands of this in-migrating population. Thus, the impacts of CPNPP operations on local medical services would be SMALL and require no mitigation.

Social Services

Social services in the EIA are provided by the Texas Department of Family and Protective Services and local nongovernmental organizations (NGOs) and religious groups. To the extent that Luminant and its contractors would hire individuals who would otherwise rely on these social services, operation of CPNPP Units 3 and 4 would help reduce demands on the service providers. Therefore, the review team concludes that the overall impact of CPNPP operations on social services would be SMALL and would not warrant mitigation.

5.4.4.5 Education

Section 2.5.2.7 contains information about current enrollments and capacities of the school districts most likely to be affected by CPNPP worker in-migration in Somervell and Hood Counties. As discussed in Sections 2.5 and 4.4, the review team assumes that 123 operations workers would in-migrate with families after the building period (Section 5.4.2) and that the average operations worker household size would be 3.0. Further, the review team assumes that the CPNPP worker households would average one child (aged between 0 and 18 yr), for a total of 123 new children in the EIA. Of these 123 new children, the review team estimates that 73.5 percent (90 children) would be school-aged (i.e., 5 to 18 yr old) based on an even distribution of children aged 0 to 18 yr. Thus, this analysis assumes that the operations workers that in-migrate after project building would bring 90 new K-12 students to the EIA.

Based on the residential pattern of current CPNPP workers (Table 2-21), the review team estimates that 21 new K–12 students would reside in Somervell County, 40 students in Hood County, ten students in Johnson County, eight students in Tarrant County, five students in Erath County, and three students in Bosque County. The remaining three students would reside in Hamilton and Parker Counties.

In Somervell County, Glen Rose ISD has a maximum capacity of 2862 students with enrollment for the 2007–2008 school year at 1657 students. Thus, the addition of 21 new students after CPNPP building would not put Glen Rose ISD at capacity. Officials with Glen Rose ISD have indicated that the school system is capable of handling the influx of students generated by the anticipated construction and operations workers (Luminant 2009a).

In Hood County, Granbury ISD has a maximum capacity of 8556 students and a September 2007 enrollment of 6882 students. Thus, the addition of 40 new students after CPNPP building would not put Granbury ISD at capacity.

Given the existing enrollments and capacities of the school districts in the EIA, and the relatively small proportion of the CPNPP in-migrating workers that would settle in Bosque, Erath, Johnson, and Tarrant Counties, the review team expects that any potential adverse impacts to the school districts would be SMALL.

5.4.4.6 Summary of Impacts to Public Services

Overall, the population growth associated with the in-migrating operations workers at CPNPP Units 3 and 4 would have only a SMALL impact on public services in the EIA, including water and wastewater, solid waste, police, fire, and medical services, social services, and education.

5.4.5 Potential Mitigation Measures for Operation-Related Socioeconomic Impacts

All of the adverse socioeconomic impacts of operating CPNPP Units 3 and 4 would be SMALL and would not require additional mitigation, with one exception. For recreation, the review team concludes that the maximum water level decreases in Lake Granbury (2.9 ft) and PKL (14.8 ft) associated with operating CPNPP Units 3 and 4 would have a MODERATE impact on recreational use of the lakes during drought periods (Section 5.4.4.2). Potential mitigation measures related to reservoir water use for plant operations are discussed in Section 5.2.5.

5.4.6 Summary of Socioeconomic Impacts

Overall, operation of CPNPP Units 3 and 4 would have both adverse and beneficial impacts on socioeconomic resources in the EIA. Population growth resulting from the in-migration of CPNPP operations workers after the building period would create additional traffic, demand for recreation, housing, public services, and education. However, the impacts of this increased demand would be SMALL given existing and planned resources and facilities. The only MODERATE adverse impacts of operating Units 3 and 4 would occur in recreation, where maximum water level decreases in Lake Granbury and PKL could have a MODERATE impact on recreational use of the lakes during drought periods.

5.5 Environmental Justice Impacts

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.6 discusses the locations of minority and low-income populations around the CPNPP site and within the 50-mi radius.

The scope of the review as defined in NRC guidance should include an analysis of the impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The descriptions to be provided should state whether the impacts are likely to be disproportionately high and adverse. The review should also evaluate the significance of such impacts.

The review team evaluated whether the health and welfare of minority or low-income populations at those Census blocks identified in Section 2.6 and along downstream pathways from the CPNPP site could be disproportionately affected by the potential impacts of operating two new reactors. To perform this assessment, the review team used the same process employed in Section 4.5.

5.5.1 Health and Environmental Impacts

The review team evaluated whether the health or welfare of minority and low-income populations in those Census blocks identified in Section 2.6 of this EIS could be disproportionately affected by operating the proposed Units 3 and 4 at the CPNPP site. To perform this assessment, the review team followed the methodology described in Section 2.6.1. In the context of operations at the CPNPP site, the review team considered the questions outlined in Section 2.6.1.

As discussed in Section 2.6.3, the review team did not find any evidence of unique characteristics or practices in the region that could lead to a disproportionate impact on any minority or low-income population.

For all three health-related considerations described in Section 2.6.1, the review team determined through consultations with NRC staff health physics experts that the expected operations-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and cannot impose a disproportionately high and adverse radiological health effect on any identified minority or low-income populations. The results of the normal operations dose assessments (Section 5.9) indicate that the maximum individual dose from all identified exposure pathways would be insignificant—well below the regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20.

NRC staff's evaluation of postulated accidents (Section 5.11) demonstrates that the radiological consequences of these accidents would meet the site acceptance criteria of 10 CFR 50.34 and 10 CFR Part 100 for the exclusion boundary area and the low population zone boundary. In demonstrating compliance with these criteria, NRC staff determined that the US-APWR design offers an adequate level of protection from design basis accidents. In addition, the review team found no long-term health conditions in local minority or low-income populations that would make them exceptionally vulnerable to radiological doses. There would be no significant adverse health impacts on the most exposed members of the public, and there would be no disproportionate and adverse health impacts on minority or low-income members of the public.

In terms of the health and environmental effects of operating a nuclear power plant, there are three primary exposure media: soil, water, and air. The following subsections discuss the potential impacts of project operations through each of these pathways.

5.5.1.1 Soil Pathway

As discussed in Section 5.8, the review team believes that there would be no operations-related environmental effects to soils at the CPNPP site that would extend beyond the site boundary. Therefore, the review team concludes that there would be no disproportionate and adverse soil-related impact on any minority or low-income populations.

5.5.1.2 Water Pathway

As discussed in Sections 5.2.2 and 5.2.3, the review team concludes that the water use and water quality impacts of operating CPNPP Units 3 and 4 would be MODERATE and SMALL to MODERATE respectively. However, there are no identified unique characteristics among the minority or low-income populations in the CPNPP area that would make these groups significantly more vulnerable than the rest of the population to the water use or water quality impacts identified (Section 2.6.3). Therefore, the review team concludes that water use and water quality impacts from operating Units 3 and 4 would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

5.5.1.3 Air Pathway

The review team determined that the total liquid and gaseous effluent doses from all four units (existing Units 1 and 2 plus proposed Units 3 and 4) would be well within the regulatory limits of 40 CFR 190. As described in Section 5.7, the review team determined that Luminant's findings were reasonable and that the potential impacts from all air medium sources would be small. Furthermore, there are no identified unique characteristics among the minority or low-income populations in the CPNPP area that would make these groups significantly more vulnerable than the rest of the population to air quality impacts (Section 2.6.3). Therefore, the review team concludes that the impacts from operating Units 3 and 4 on air quality would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

5.5.1.4 Noise

As discussed in Section 5.4.1.5, the review team concluded that noise impacts on workers, residents, and recreational users of nearby areas of operating CPNPP Units 3 and 4 would be SMALL. There are no identified unique characteristics among the minority or low-income populations in the CPNPP area that would make these groups significantly more vulnerable than the rest of the population to the noise impacts identified (Section 2.6.3). Therefore, the review team concludes that noise impacts from operating Units 3 and 4 would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

5.5.2 Socioeconomic Impacts

The review team assessed the socioeconomic impacts of operating CPNPP Units 3 and 4 (Section 5.4) to determine if there would be any human health or environmental effects on minority or low-income populations. The adverse socioeconomic impacts from operation of the proposed CPNPP Units 3 and 4 will be similar in nature to the building-related impacts, except on a smaller scale. Based on the evaluations in Section 4.5, the review team believes there would be no disproportionate and adverse impact from operations because all impacts from operation would be smaller than the impacts of construction and pre-construction activities due to the smaller size of the workforce. Because the review team did not find any potential building-related environmental justice issues , the review team determined that there would be no disproportionately high and adverse effects from operations.

5.5.3 Subsistence and Special Conditions

As discussed in Section 2.6.3, the review team's scoping and outreach did not identify any unique socioeconomic characteristics or potential pathways for disproportionate health and environmental impacts. Regarding subsistence populations, the review team did not identify any unique characteristics that could result in disproportionate impacts to minority or low-income populations. Specifically, based on U.S. Census data, the review team identified no low-income populations within the immediate vicinity of the CPNPP site, where potential CPNPP-related impacts would be expected to be most significant. Moreover, the low-income populations identified in the larger 50-mi CPNPP region are located principally within urban areas near the

City of Fort Worth where subsistence type dependence on natural resources (e.g., fish, game, agricultural products, and natural water sources) is less likely.

5.5.4 Summary of Environmental Justice Impacts

The review team concludes that operating CPNPP Units 3 and 4 would not have any disproportionately high and adverse human health or environmental effects on minority or low-income populations through the pathways of soil, water, and air. Similarly, the impacts of operations on socioeconomic resources would not have any disproportionately high and adverse effects on minority or low-income populations. Therefore, the review team concludes that the environmental justice impacts of operating CPNPP Units 3 and 4 would be SMALL.

5.6 Historic and Cultural Resource Impacts from Operation

The National Environmental Policy Act of 1969, as amended, (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended, (NHPA), also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (NRHP) (such resources are referred to as “historic properties” in the NHPA) (National Park Service 2009). As outlined in 36 CFR 800.8, “Coordination with the National Environmental Policy Act of 1969,” the NRC coordinated compliance with Section 106 of the NHPA in meeting the requirements of NEPA. For specific historic and cultural information on the CPNPP site, see section 2.7.

Building, operating, and decommissioning new nuclear power units is an undertaking that could affect either known or potential historic properties that may be located at the CPNPP site. Therefore, in accordance with the provisions of NHPA and NEPA, the review team is required to make a reasonable and good faith effort to identify historic properties in the Area of Potential Effect (APE) and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing on the NRHP) are present or affected, the review team is required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC staff is required to assess and resolve adverse effects of the undertaking.

For the purposes of NHPA 106 consultation, the review team does not expect any significant impacts on cultural and historic resources during the operation of proposed Units 3 and 4. Therefore, the review team concludes with a finding of no historic properties affected [36 CFR 800.4(d)(1)].

For the purposes of the NEPA analysis, the review team does not expect any significant impacts on cultural and historic resources during operation of Units 3 and 4. Luminant plans to monitor land disturbing activities that may occur during operation of CPNPP Units 3 and 4 to identify potential cultural resources that may not have been identified during the Section 106 review process (Luminant 2009a). In the event of an inadvertent find Luminant plans to stop work and notify the appropriate county authority, SHPO, and Tribal Historic Preservation Office (THPO). Therefore, the review team concludes that with procedures in place the impacts from operations would be SMALL. Mitigation may be warranted in the event of an inadvertent find. Any necessary mitigative measures would be determined by Luminant in consultation with the Texas SHPO.

5.7 Meteorological and Air Quality Impacts

The primary impacts of operation of two new units on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system (mechanical draft cooling towers), operation of auxiliary equipment (generators and boilers), and emissions from workers' vehicles. The potential impacts of releases from operation of the cooling system are discussed in Section 5.7.2. Section 5.7.1 covers potential air-quality impacts from nonradioactive effluent releases at the CPNPP site, and Section 5.7.1 covers the potential air-quality impacts of transmission line corridors during plant operation.

5.7.1 Air Quality Impacts

Standby diesel generators and auxiliary power systems would be used for emergency power and auxiliary steam purposes. These systems would be used on an infrequent basis and pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides) would be permitted in accordance with the facility's TCEQ Air Permit Number 19225. The air emissions sources, and their estimated annual emissions, are provided in Table 5-9. These air emissions would be regulated under the facility's TCEQ Air Permit. This permit is currently held by the facility for operations associated with CPNPP Units 1 and 2, and could be modified 12 months prior to the beginning of operations to add the new emissions sources, and associated emissions limits, associated with Units 3 and 4. A modified permit could regulate emissions from the existing sources associated with Units 1 and 2 as well as the newly added sources associated with Units 3 and 4.

Table 5-9. Air Emissions Associated with CPNPP Units 3 and 4 (lb/yr)

	NO_x	CO	SO_2	Particulate Matter	Hydrocarbons
Gas Turbine Generators (GTGs)	24,283	1719	1095	260	87
Fuel Tanks for GTGs	-	-	-	-	433
Diesel Fire Pump	88[a]	16	-	4	-
Fuel Tank for Fire Pump	-	-	-	-	0.29
Auxiliary Boilers	3564	2288	9208	1486	148
Fuel Tank for Auxiliary Boilers	-	-	-	-	67
Totals	27,935	4023	10,303	1750	735

(a) Value reported as NOx and non-methane hydrocarbons, assumed to be primarily NOx

Source: Luminant 2009a, Tables 3.6-2 through 3.6-7, and Luminant 2010j, the revision to Table 3.6-6, p. 44

Operation of proposed CPNPP Units 3 and 4 would also result in impacts to local air quality as a result of emissions associated with increased vehicle use, including transportation of workers to and from the site. These emissions would occur simultaneously with the emissions from the onsite sources and would continue for the entire duration of site operations. As discussed in Section 5.4.4.1, operation of the new units would result in a maximum increase of 246 vehicles per day.

Because Somervell County is in attainment or unclassified for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR 81.344), a conformity analysis on direct and indirect emissions is not required (58 FR 63214).

Impacts of existing transmission lines on air quality are addressed in NUREG-1437 (NRC 1996). Small amounts of ozone and smaller amounts of NO_x are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1200-kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted. The five new 345-kV transmission lines constructed to accommodate the new power generating capacity would be well within the range of transmission lines provided in NUREG-1437, and the review team therefore concludes that air quality impacts from transmission lines would not be noticeable.

Finally, the operation of a nuclear power plant involves the emission of some greenhouse gases, primarily carbon dioxide (CO_2). The review team has estimated that the annual carbon footprint for actual plant operations of Units 3 and 4 for 40 years is of the order of 650,000 metric tons (the sum of about 190,000 metric tons from plant operations and about 130,000 metric tons from operations workforce transportation for each unit) of CO_2 equivalent (an emission rate of about 16,000 metric tons annually, averaged over the period of operation), as compared to a total United States annual CO_2 emissions rate of 6,000,000,000 metric tons (EPA 2010). Periodic testing of diesel generators accounts for about 60 percent of the total. Workforce transportation accounts for most of the rest. These estimates are based on carbon footprint estimates in Appendix J. Based on its assessment of the relatively small plant operations carbon footprint as compared to the United States annual CO_s emissions, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable and additional mitigation would not be warranted.

The review team has considered the timing and magnitude of atmospheric releases related to operation of proposed Units 3 and 4, the existing air quality at the CPNPP site and the distance to the closest Class I Federal Area, and the Luminant commitment to manage and mitigate emissions in accordance with applicable regulations. On these bases, the review team concludes that the air quality impacts of operation of proposed Units 3 and 4 would not be noticeable. Based on its assessment of the carbon footprint of plant operations, the review team concludes that the atmospheric impacts of greenhouse gases from plant operations would not be noticeable.

5.7.2 Cooling System Impacts

The operation of the cooling system is described in Section 3.4 of the ER (Luminant 2009a). The proposed cooling system for the proposed Units 3 and 4 at the CPNPP site is mechanical draft cooling towers. A total of four cooling towers would be constructed—two for each new nuclear unit. Mechanical draft cooling towers remove excess heat by evaporating water. Upon exiting the cooling tower, water vapor mixes with the surrounding air and this process can lead to condensation and the formation of a visible plume. Aesthetic impacts from the visible plume as well as land-use impacts from cloud shadowing, fogging, icing, increased humidity, and drift from dissolved salts and chemicals found in the cooling water can result.

The Seasonal and Annual Cooling Tower Impacts Prediction Code (SACTI) computer model was used by Luminant to estimate impacts associated with operating the cooling towers. Meteorological data used as input into the SACTI model included seasonal mixing height data from the Stephenville meteorological station and 6 years of meteorological data (2001 through 2006) from the Mineral Wells airport station. Cooling towers were simulated using a discharge height of 55.4 ft (Luminant 2009a).

Results from the SACTI analysis, as reported in the ER (Luminant 2009a), indicate that on average the longest plume lengths would occur during the winter and the shortest plume lengths would occur during the summer. The longest plumes in all seasons would move from the towers towards the west and northwest. The longest plume length is projected to be 3.86 mi. Ground-level fogging or icing is predicted to occur to the north and the south, on the shoreline and on the lake surface within 1.5 mi of the towers. Deposition of salts from cooling tower drift would occur in all directions from the towers. Deposition of solids would occur within 100 m north of the towers, at a maximum rate of 137.3 kg/km^2/month. Based on experience with cooling towers reported in NUREG-1437 (NRC 1996), Luminant concluded that the impacts of salt deposition from cooling towers would be minimal and would not require mitigation.

On the basis of the analysis presented by Luminant in the ER and the review team's independent evaluation of that analysis, the review team concludes that atmospheric impacts of the cooling tower operation would be minimal.

5.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and greenhouse gas emissions from operating proposed Units 3 and 4. The review team also evaluated potential impacts of cooling system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operation of proposed Units 3 and 4 on air quality from emissions of criteria pollutants, CO_2 emissions, and cooling system emissions are SMALL and that no further mitigation is warranted.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological human health impacts of operating the proposed new units at the Comanche Peak. Health impacts to the public from the cooling system, noise generated by operations, EMFs, and transporting operations are discussed. Health impacts from the same sources are also evaluated for workers at the new units. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiologic Agents

Etiologic agents consist of all microorganisms that can cause infectious disease in humans. One class of etiologic agents is thermophilic; these microorganisms thrive in hot water generally well above 40ºC. Operation of Comanche Peak Units 3 and 4 would result in a thermal discharge to Lake Granbury. The thermal discharge to Lake Granbury is expected to result in a temperature increase of 1ºC or less.

Thermal discharges have the potential to increase the growth of microorganisms, including *Salmonella* species, *Shigella* species, and *Pseudomonas* species, as well as thermophilic organisms, including fungi, bacteria such as *Legionella* species, and free-living amoeba such as *Naegleria fowleri* and *Acanthamoeba* species. These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels.

Salmonella and *Shigella* species are mostly associated with areas of poor sanitation, but they can also be transmitted by the common house fly. Although the organisms can live for several weeks in water, they do not multiply there. *Pseudomonas* can be found in soil, humidifiers, on the skin of healthy individuals, and anywhere *Salmonella* and *Shigella* are found (NRC 1996, Appendix D). While *Pseudomonas* could be found in Lake Granbury (and other waterbodies), there is no known sanitation pathway for large numbers of these organisms to enter the reservoir.

Legionnaires' disease can be very serious and can cause death in up to 5 to 30 percent of cases. Each year, between 8000 and 18,000 people are hospitalized with Legionnaires' disease in the U.S. However, many infections are not diagnosed or reported, so this number may be higher. More illness is usually found in the summer and early fall, but it can occur any time of year (CDC 2009). Most cases can be treated successfully with antibiotics (drugs that kill bacteria in the body), and healthy people usually recover from infection. Mild forms of the disease go away on their own without treatment (CDC 2009). One population-based study estimated that more than three-quarters of cases are currently undiagnosed or unreported. Incidence rates per 100,000 persons vary from 1.8 in Delaware to less than 0.3 in Texas (Neil and Berkelman 2008).

The *Legionella* bacteria are found naturally in the environment, usually in water. The bacteria grow best in warm water, like the kind found in hot tubs, cooling towers, hot water tanks, large plumbing systems, or parts of the air-conditioning systems of large buildings. They do not seem to grow in car or window air-conditioners. People get Legionnaires' disease when they breathe in a mist or vapor (small droplets of water in the air) that has been contaminated with the bacteria. For example, one might breathe in the mist from a whirlpool spa that has not been properly cleaned and disinfected (NRC 1996, Appendix D).

People most at risk of getting sick from the bacteria are older people (usually 65 yr of age or older), as well as people who are smokers, or those who have a chronic lung disease (such as emphysema). People who have weak immune systems from diseases such as cancer, diabetes, or kidney failure are also more likely to get sick from *Legionella* bacteria. Patients who take drugs to suppress (weaken) the immune system (often after a transplant operation or chemotherapy) are also at higher risk (CDC 2009).

Primary amebic meningoencephalitis (PAM) is a rare but nearly always fatal disease caused by infection with *Naegleria fowleri*. In 2007, six cases of PAM in the United States were reported to Centers for Disease Control and Prevention (CDC); all six patients died (CDC 2008). Two of the six were in Texas. In response to the six PAM cases reported in 2007, CDC and the Council of State and Territorial Epidemiologists formed the *Naegleria* Workgroup to review future actions related to *N. fowleri* and to determine whether the six cases represented an increase in the annual number of cases. The workgroup used multiple resources to conduct a review of all PAM cases reported in the United States from 1937 to 2007 (CDC 2008). Analyses of the data are still being conducted. Preliminary results indicate that a total of 121 cases (range: 0–8 cases per yr) occurred in the United States from 1937 to 2007. The six cases of PAM reported in 2007 were among the six highest annual totals of cases reported during the study period; the other five highest totals were 1980 (eight cases), 2002 (seven cases), and 1978, 1986, and 1995 (six cases each). During 1937–2007, the median age of the patients was 12 yr (range: 8 months–66 yr). Among the 119 cases for which sex of the patient was known, males accounted for 93 (78 percent) of the cases. Only one reported survivor met the case criteria.

Exposure to PAM primarily occurred in untreated, warm, freshwater lakes or rivers in 15 southern tier states (Arizona, Arkansas, California, Florida, Georgia, Louisiana, Mississippi, Missouri, Nevada, New Mexico, North Carolina, Oklahoma, South Carolina, Texas, and Virginia); the state of exposure for four cases was unknown. Among the 112 cases for which month of exposure was known, 95 (85 percent) occurred from July through September (CDC 2008).

The new units at Comanche Peak will use two banks of mechanical-draft cooling towers with a closed-loop cooling system to reduce the temperature of water discharged to Lake Granbury. The maximum temperature of the discharged water is 93°F; it begins to mix and cool immediately after discharge (Luminant 2009a). The temperature of the lake will be well below the optimal temperatures for the thermophillic bacteria to grow and reproduce.

The BDTF will also be a source of heated water. Water in the cooling tower basin has a maximum design temperature of 88.5°F and a high salt concentration. Most infectious agents, including the salt-tolerant *Acanthamoeba* amoeba, cannot thrive under these conditions. The bacteria responsible for cholera (*Vibrio cholerae*) could theoretically grow under these conditions. *V. cholerae* has not been found in source water for Lake Granbury, and there are no known naturally occurring populations of the bacteria near Comanche Peak. Luminant has stated that it will monitor for *V. cholerae* if the State authorities require it (Luminant 2010j).

In or downstream of Lake Granbury, any increases in water temperature should be extremely small, and most organisms cannot survive the salinity of the cooling tower basin. Any temperature increase resulting from operating the new nuclear units would not significantly increase the abundance of the organisms discussed above. The review team concludes that the impacts on human health from thermophilic organisms in Lake Granbury and the cooling towers would be SMALL and that mitigation would not be warranted.

5.8.2 Noise

In NUREG-1437 (NRC 1996), the NRC staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, and transformers, with intermittent contributions from loud speakers and auxiliary equipment such as diesel generators. These noise sources are discussed in this section.

The existing units at the CPNPP site use water from the SCR to remove waste heat with once-through condenser units. No cooling towers are used for CPNPP Units 1 and 2. Units 3 and 4 would have a secondary-side cooling water system with a closed-loop system with mechanical draft (wet) cooling towers. Cooling water would be pumped from Lake Granbury by an intake pipeline, and blowdown from the cooling tower basins would be returned to the lake through a discharge pipeline, with part of the blowdown passing through a treatment facility.

The U.S. Department of Housing and Urban Development (HUD) has established noise impact guidelines for residential areas based on day-night average sound levels (DNL) (HUD 1996). A sound level in DNL is valid for a 24-hr period and is computed the same as a 24-hr Leq except that the prevailing sound level in the calculation has a 10-dB penalty added between 2 a.m. and 7 a.m. Neither the State of Texas nor Hood and Somervell Counties have developed noise regulations specifying acceptable community noise levels.

Luminant assessed noise against the HUD DNL of 60–65 dBA, below which the noise would be considered acceptable for residential and outdoor recreational uses. HUD's goal is to have the exterior noise level not exceed a day-night average of 55 dB (HUD 2006). However, when considering cost and feasibility, HUD says a day-night sound level of 65 dB is acceptable and allowable (HUD 2006). According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in the Final *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NUREG-0586, Supplement 1) (NRC 2002). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1 (NRC 2002), is stated as follows:

> The noise impacts are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal

human activities, or if the behavior or breeding of a threatened and endangered species is affected.

The main source of continuous noise is anticipated to be the mechanical draft cooling towers. Per NUREG-1817 (NRC 2006), cooling towers generate approximately 85 dBA in close proximity and approximately 55 dBA at a distance of 1000 feet during operation (Luminant 2009a). Luminant identified heating, ventilation, and air conditioning (HVAC) systems, vents, transformers and electrical equipment, transmission lines, water pumps, material-handling equipment, motors, public address systems, cooling towers, trucks and vehicular traffic as additional noise sources from plant operation. A firearms shooting range on site is a source of sporadic noise. Many of the noise sources are expected to be confined indoors or underground or used infrequently (Luminant 2009a). The nearest offsite receptors are all more than 4400 ft from the cooling tower. The calculated noise levels from Units 3 and 4 are less than the noise levels recorded at those locations in 2006 (see Table 5-10), so the impact of the cooling towers would not significantly affect the noise background.

The waterlines from the Lake Granbury are underground, but the pumps for cooling water for Units 3 and 4 would be located next to those for Units 1 and 2. The noise levels generated by the new pumps are not yet known. Pump noise may reflect off the water and increase the noise from current levels. Therefore, the operation of the water pumps could have an impact on the areas around the lake (Luminant 2009a).

Until further information is available on noise of the water pumps, it is possible that some mitigation would be warranted. Possible mitigation measures could include installing low-noise-producing pump motors, mounting the motors on sound-dampening material, relocating the motors away from the water, or enclosing the pump motors in a sound-absorbing structure (Luminant 2009a).

Luminant plans to construct an evaporation pond as part of the BDTF complex. The exact location of this pond has not been determined. Figure 1 in the Luminant response (Luminant 2010f) shows the evaporation pond only for the purpose of indicating that there is adequate space in the designated parcel of land. The evaporation pond will be divided into sections by berms. Luminant calculates that 182 misters would be required. Each mister has 30 nozzles. The manufacturer has provided noise data for one mister (Slimline 1999). Given the noise versus distance profile provided by Slimline (1999), residents beyond 250 to 300 ft from the closest mister should experience less than the DNL of 65 dB that would require special approval or requirements by HUD (24 CFR Part 51). Consequently, no mitigation would be necessary.

The review team concludes that the impact of noise from the operation of Comanche Peak 3 and 4 could range from SMALL to MODERATE, depending on the final pump design and equipment choices and their proximity to residences.

Table 5-10. Predicted Noise Levels (DbA) Expected Due to Plant Operations

Receptor Position[a]	Approximate Distance from nearest cooling Tower (ft)	Recorded Ambient Leq dBA Day-Night Average 2006	CPNPP Units 3 and 4 Calculated Noise Emissions dBA[b]	Projected Average Noise Level [b]
1 – Approximate Southwest fence line along access road	4746	57	42	57
2 – Approximate east fence line between cooling tower and residential property located across SCR	14,794	56	33	56
3 – Approximate nearest western fence line	4693	56	43	56
15 Swim beach north of site	4482	56	42	56
23 Nearest residential neighborhood south-southwest of site	4746	44–65[c]	42	44–65
25 Nearest Church and Cemetery	8591	44–68[c]	36	44–68

(a) Locations obtained from Figure 2.5–20 in Luminant 2009a.

(b) Calculations were made using a noise level of 55 dBA at 1000 ft. The combination of cooling towers for units 3 and 4 would not have a significant impact due to distance and shielding from each cooling tower and other structures. Noise attenuation calculation. Secondary noise level (SPL_2, dBA) = Initial noise level (SPL_1, dBA) – 20 log (d^1 / d^2) where d^1 is the original distance from the source and d^2 is the measured distance from the source.

(c) Area noise levels were collected at these locations utilizing a Quest Type 2 sound level meter with octave band analysis.

Source: Luminant 2009a

5.8.3 Acute Effects of Electromagnetic Fields

Electric shock resulting from either direct access to energized conductors or induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1999). Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and adherence to the standards for transmission systems regulated by the Public Utility Commission of Texas (PUCT).

In its ER, Luminant suggests that additional transmission capacity might be constructed by Oncor Electric Delivery to service new generation at the CPNPP site (see Section 5.6.3.1 in the ER [Luminant 2009a]). Luminant commits to design any new transmission lines to ensure that all lines would be in compliance with the 5-milliamp standard in the present NESC. Luminant states that

> Adding circuitry to existing transmission lines high enough to comply with the 5-ma standard eliminates the possibility of dangerous electrical shocks and continues Oncor Electric Delivery's long-standing commitment to operate and maintain facilities that ensure public and worker safety (see Section 5.8.3.1 in the ER [Luminant 2009a]).

With Luminant's, and Oncor Electric Delivery's commitment to design new transmission lines to meet the present NESC criteria when transmission lines are combined and the review team's assumption that new transmission lines constructed for the additional generation at the CPNPP site would be constructed to the NESC standards in effect at the time of construction, the review team concludes that the impact to the public from acute effects of EMFs would be SMALL and that additional mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Research on the potential for chronic effects from 60-Hz EMFs from energized transmission lines was reviewed and addressed by the NRC in the NUREG-1437 (NRC 1996). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directed related research on this topic through the U.S. Department of Energy. An NIEHS report (1999) contains the following conclusion.

> The NIEHS concludes that extremely low frequency (ELF)-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

The staff reviewed recently available scientific literature on chronic effects to human health from ELF-EMF published since the NIEHS report, and found that several other organizations reached the same conclusions (AGNIR 2006; WHO 2007). The report by the World Health Organization (WHO) updated the assessments of a number of scientific groups reflecting the potential for transmission line EMF to cause adverse health impacts in humans. The report summarized the potential for ELF-EMF to cause disease such as cancers in children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications, and neurological disease. The results of the review by WHO (2007) found that the extent of scientific evidence linking these diseases to EMF exposure is not conclusive.

The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding potential chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts.

5.8.5 Occupational Health

In general, occupational health risks for new units are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and plant modifications. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. In 2007, the incidence rate of nonfatal injuries and illnesses for the nuclear electric power generation industry was 0.9 total recordable cases per 100 full-time-equivalent employees, with 0.4 cases per 100 full-time-equivalent employees involving days away from work, job transfer, or restriction (BLS 2008a).

Luminant (2009a) states that workers at Units 3 and 4 may be vulnerable to accidents such as falls, electric shock, burns, occupational injury due to noise exposure, and exposure to toxic or oxygen-replacing gases. At Units 1 and 2, the total recordable case rate for the CPNPP workforce for 2003–2006 was 1.06 cases per 100 workers. This rate is similar to the national rate for nuclear generation and lower than the total recordable case rate for electric power generation, transmission and distribution (3.1 per 100 full-time employees) in Texas (BLS 2008b). Nationally, the reportable case rate for nuclear electrical power generation is lower than for other forms of electrical generation (BLS 2008a). Luminant would use the same safety program to guide operations at CPNPP Units 3 and 4. Table 5-11 shows the expected cases in the 2018 Unit 3 and 4 workforce.

Table 5-11. Expected Annual Total Recordable Cases of Injuries and Illnesses

	Luminant (Units 1 and 2)	**National Nuclear Power Generation**	**Texas Electric Power Generation**
Incidence Per 100 Workers	1.06[(a)]	0.9[(b)]	3.1[(c)]
Workforce 2018	494[(d)]	494[(d)]	494[(d)]
Expected Cases	5.2	4.4	15.3

Sources:

(a) Comanche Peak Nuclear Power Plant, Units 3 and 4 COL Application, Part 3, Environmental Report, Luminant 2009a, p. 5.13-1.

(b) Table 1. Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2007," BLS 2008a.

(c) Table 6. Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2007," BLS 2008b.

(d) Luminant 2009a, p. 5.8-1.

Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards (29 CFR Part 1910), practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks for new nuclear unit operation. The review team assumes adherence to NRC, OSHA, and State safety standards, practices, and procedures during new nuclear unit operations.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, etologic microorganisms, as discussed in Section 5.8.1, in the condenser bays, and caustic agents. Luminant's current safety and health programs promote safe work practices and respond to occupational injuries and illnesses. The Personal Safety Program includes procedures to provide workers a means of preventing accidents due to unsafe conditions and unsafe acts. These procedures address hearing protection, confined space entry, personal protective equipment, heat stress, electrical safety, ladders, chemical handling, storage, and use, and other industrial hazards. The Senior Safety Committee and the Safety and Training Departments oversee Luminant safety procedures and training. Luminant states that the same program would be used to guide operations at CPNPP Units 3 and 4 (Luminant 2009a). Because health impacts to workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations, the review team concludes that the impacts would be SMALL.

5.8.6 Impacts of Transporting Operations Personnel and Waste Salt

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the CPNPP site. However, preliminary estimates are the only data available to estimate these impacts. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

The April 24, 2009 update to the ERs estimates 474 workers for Units 3 and 4, 1000 workers at Units 1 and 2 (Luminant 2009a), and 800-1200 refueling workers every 18 months (Luminant 2009a). NRC staff assumed that the average commute distance for operators and outage workers would be 20 mi one way, 250 days a yr for the permanent workers, and 24 days for outage workers. Incident rates for 2007 were taken from the National Highway Transportation Safety Administration, *Traffic Safety Facts 2007* (NHTSA 2009).

The estimated impacts of transporting operations and outage workers to/from the CPNPP site are shown in Table 5-12. The total annual traffic fatalities during operations, including both operations and outage personnel, are expected to be less than 0.5. There may be 13–22 injuries from traffic accidents each year in both the permanent and outage workforces. The addition of the operational personnel at Units 3 and 4 is expected to result in a small, if not imperceptible, increase relative to the current traffic fatality risk in the area surrounding the CPNPP site. Therefore the review team concludes the impacts of transporting operations and outage workers to and from the CPNPP site would be SMALL

Luminant (2010d) provided estimates of the annual number of rail or truck shipments that would be necessary to transport waste salt. These estimates included both the expected number of shipments and a maximum number of shipments each year. The waste salt is expected to be classified as a non-hazardous waste. The average distance to candidate landfills is 64 mi by rail and 46 mi by truck. The estimated health effects of transportation of waste salt are shown in Table 5-13.

If all the salt were shipped by rail, the number of accidents, injuries, or fatalities expected from the shipments in a given year would be negligible. Using 2007 large truck (gross vehicle weight rating greater than 10,000 pounds) risk data, fatalities from a truck accident would be unlikely. A few truck accidents could occur, with a low number of injuries each year. These numbers represent small increases relative to the current traffic fatality risks in this area. Therefore, the review team concludes the health effects from transporting the waste salt would be SMALL.

5.8.7 Summary of Nonradiological Health Impacts

The review team evaluated health impacts to the public and the workers from the cooling systems, noise generated by unit operations, and acute and chronic impacts of EMFs, and transporting operations and outage workers to/from the two additional units. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from etiologic microorganisms, noise generated by unit operations, and acute impacts of EMFs would be minimal. Based on the information provided by Luminant's and the review team's independent review, the review team concludes that the potential impacts of nonradiological effects resulting from the operation of Units 3 and 4 would be SMALL to MODERATE, depending on the noise from the final pump design and equipment choices.

Table 5-12. Annual Expected Impacts of Transporting Operations Personnel to the Comanche Peak Site

Workforce	Miles Driven Annually	Expected Fatalities (a)	Expected Injuries (a)	Expected Fatalities (Texas rate) (b)
Units 1 and 2	10,000,000(c)	0.14	8.2	0.14
Units 3 and 4	4,940,000(d)	0.07	4.0	0.07
Permanent Workforce	14,940,000(e)	0.20	12.2	0.21
Outage Workforce	768,000(f)–11,520,000(g)	0.01–0.16	0.63–9.4	0.16–0.21

(a) NHTSA 2009, Table 2. U.S. fatality rate: 1.36 per 100 million mi driven; U.S. injury rate: 82 per 100 million mi driven
(b) NHTSA 2009, Table 122. Texas fatality rate: 1.38 per million mi driven.
(c) 1000 employees × 40 mi/day × 250 days/yr
(d) 494 employees × 40 mi/day × 250 days/yr
(e) 1494 employees × 40 mi/day × 250 days/yr
(f) 800 outage workers × 40 mi/day × 24 days/yr
(g) 1200 outage workers × 40 mi/day × 24 days/yr

Table 5-13. Annual Expected Impacts of Transporting Salt Waste from CPNPP Units 3 and 4

	Rail transportation				
	Loads/yr	Distance Traveled (km/yr)(c)	Expected Accidents(e)	Expected Injuries (e)	Expected Fatalities (e)
Expected	1773(a)	365,000	0.022	0.016	0.008
Worst case	4711(b)	970,000	0.059	0.041	0.022
	Truck transportation				
	Loads/yr	Distance Traveled (mi/yr)(d)	Expected Accidents (f)	Expected Injuries (f)	Expected Fatalities (f)
Expected	8866(a)	816,000	2.53	0.58	0.028
Worst case	23,555(b)	2,170,000	6.73	1.6	0.074

(a) Luminant 2010f.
(b) This figure assumes a 25% increase in the worst case in (a) due to a 20% moisture content in the salt.
(c) Assumes average distance of 64 mi by rail to landfill.
(d) Assumes average distance of 46 mi by truck to landfill.
(e) Incident rates per 100,100 km traveled: accident rate: 6.10; injury rate: 4.26; fatality rate: 2.27. Table 6, Saricks and Tompkins 1999 (ANL/ESD/TM-150).
(f) Incident rates per 100,000 mi traveled: accident rate 193; injury rate: 44.5; fatality rate 2.12. Federal Motor Carrier Safety Administration (FMCSA) 2009.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the proposed new units 3 and 4 on the CPNPP site, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the site. Radiological impacts were determined using the Mitsubishi Heavy Industries (MHI) US-APWR reactor design (MHI 2009) with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation.

5.9.1 Exposure Pathways

The public and biota would be exposed to increased ambient background radiation from a nuclear reactor unit via the liquid effluent, gaseous effluent, and direct radiation pathways. In the ER (Luminant 2009a), Luminant estimated the potential exposures to the public and biota by evaluating exposure pathways typical of the area surrounding a nuclear reactor site. They considered pathways that could cause the highest calculated radiological dose based on the use of the environment by residents of the area. For example, factors such as the location of homes in the area, consumption of meat from the area, and consumption of vegetables grown in area gardens were considered. An illustration of the pathways leading to exposure to members of the public is shown in Figure 5-2.

For the liquid effluent release pathway, Luminant (2009a) considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., fish), ingestion of water, and direct radiation exposure from shoreline activities. Liquid effluents were assumed to be released into SCR. Water from SCR is not used as a source of drinking water. Access to SCR for recreational activity is controlled by Luminant. Boating, fishing and shoreline activities are allowed (Luminant 2010g).

To limit the concentration of tritium (H-3) in SCR the liquid effluents of the proposed units may be diverted to an evaporation pond from which the tritium and other volatile materials become airborne emissions. The analysis for population (or collective) dose considered the following exposure pathways: ingestion of aquatic food and direct radiation exposure from shoreline, swimming, and boating activities. The exposure pathways associated with airborne emission, discussed below, are applicable to the emissions from the evaporation pond. Drinking water was evaluated although the current land-use census information indicates no drinking water use of the river within 50 mi downstream of the site. Luminant noted a potential future water diversion about 49 mi south of the Squaw Creek Dam and considered in the ER (Luminant 2009a).

As discussed in the Final Safety Analysis Report (FSAR) (Luminant 2009b), the design of proposed CPNPP Units 3 and 4 includes a number of features to prevent and mitigate leakage from system components that may contain radioactive material, such as pipes and tanks. In addition, Luminant committed to use the guidance of NEI 08-08,"Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination," to minimize contamination during construction, operation, and decommissioning (Luminant 2010b). However, the potential still exists for leaks of radioactive material, such as tritium, into the ground, similar to leaks that have been reported at currently operating power plants. Based on the discussion above, the NRC staff expects that the impacts from such potential leakage for proposed CPNPP Units 3 and 4 would be SMALL.

For the gaseous effluent release pathway, the ER (Luminant 2009a) considered the following exposure pathways in evaluating the dose to the MEI: submersion in the radioactive plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, and ingestion of milk and beef. There is no milk production within 5 mi of the site. For population doses from the gaseous effluents, Luminant used the same exposure pathways in assessing the dose to individuals and included the cow milk ingestion pathway. In some counties within 50-mi of the site the current land-use census information indicates no milk cows are present. If an earlier land-use census indicated the presence of milk cows in the region then Luminant (2009a) elected to use the earlier information. All agricultural products grown within 50 mi of the CPNPP site were assumed to be consumed by the population within 50 mi of the site.

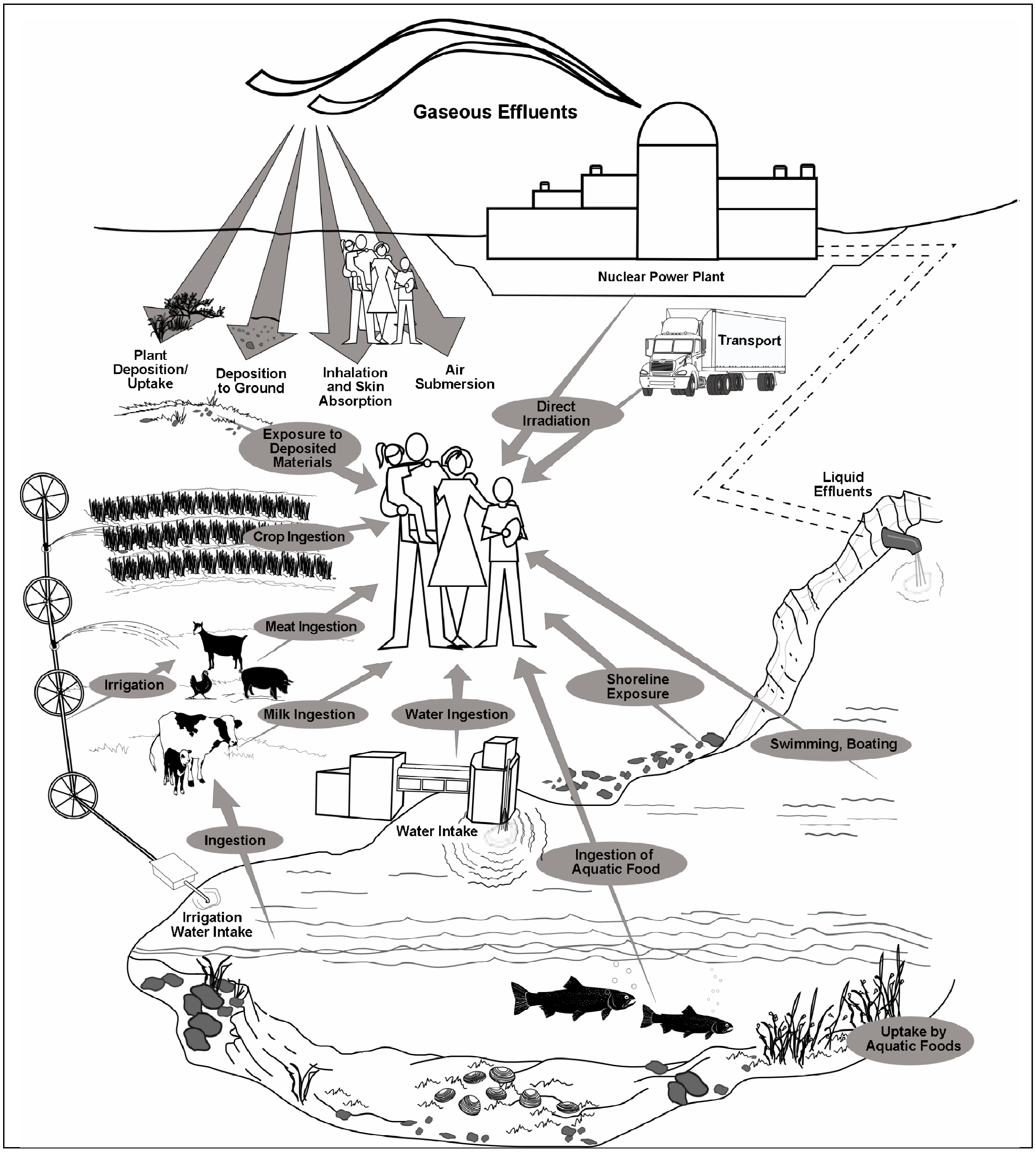

Figure 5-2. Exposure Pathways to Man (Adapted from Soldat et al. 1974).

Luminant (2009a) stated that direct radiation from the reactor buildings for Units 3 and 4 and the planned Independent Spent Fuel Storage Installation (ISFSI) would be a source of radiation exposure to the public from the CPNPP site. However, Luminant assumes that the contained sources of radiation would be shielded and would not contribute to the external dose to the MEI or to the population.

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-3 and include:

- Ingestion of aquatic foods
- Ingestion of water
- External exposure from water immersion and shoreline sediments
- Inhalation of airborne radionuclides
- External exposure to submersion in gaseous effluent plumes, and
- Surface exposure from deposition of iodine and particulates from gaseous effluents.

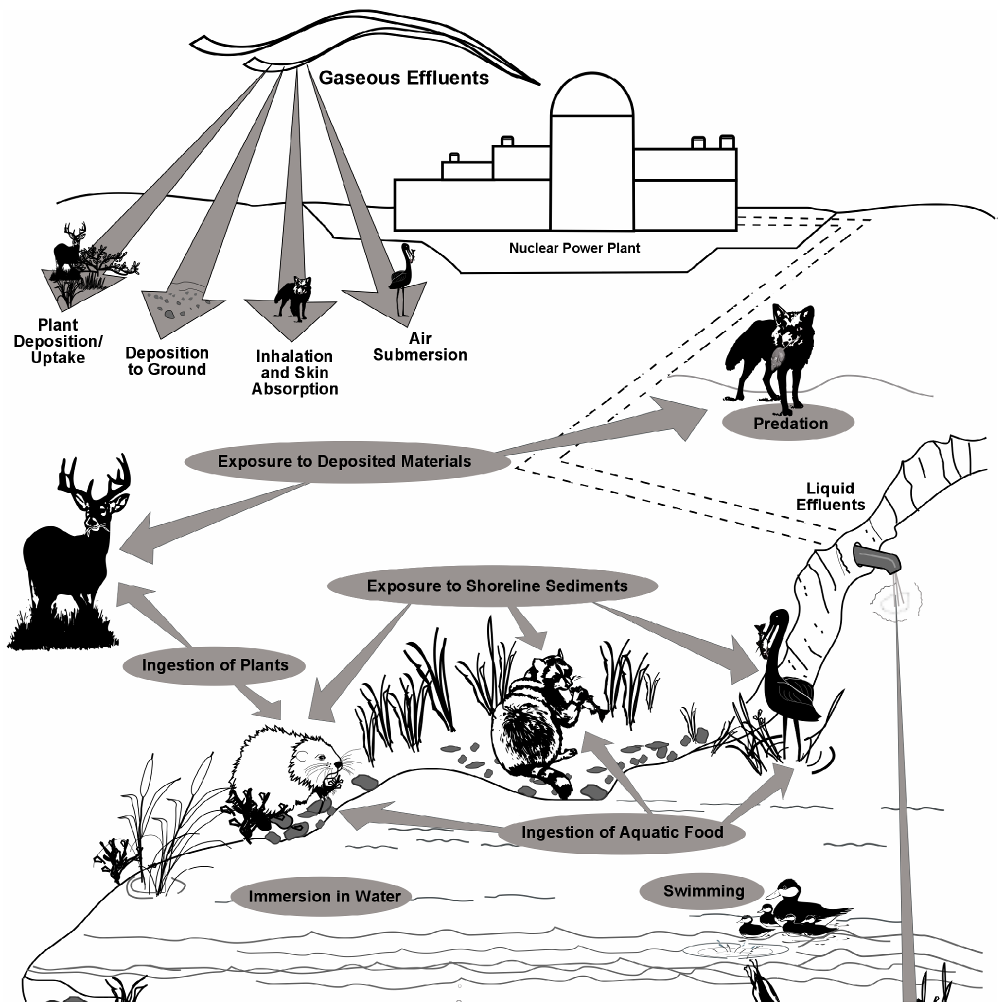

Figure 5-3. Exposure Pathways to Biota Other than Man (Adapted from Soldat et al. 1974).

The NRC staff reviewed the exposure pathways for the public and non-human biota identified by Luminant (Luminant 2009a) and found them to be appropriate, based on a documentation review and a tour of the environs with Luminant staff and contractors during the site visit in February 2009.

5.9.2 Radiation Doses to Members of the Public

Luminant calculated the dose to the MEI and to the population living within a 50-mi radius of the site from both the liquid and gaseous effluent release pathways (Luminant 2009a). As discussed in the previous sections, direct radiation exposure to the MEI from sources of radiation at CPNPP Units 3 and 4 was considered to be negligible.

5.9.2.1 Liquid Effluent Pathway

Liquid effluents would be released into the SCR via the circulating water return line from CPNPP Units 1 and 2. The highest concentration of the radiological material would be in the SCR. Liquid pathway doses to the MEI were calculated for the SCR by Luminant (2009a) using the LADTAP II computer program (Strenge et al. 1986).

The liquid effluent releases used in the estimates of dose are found in Table 5.4-8 of the ER (Luminant 2009a). Other parameters used as inputs to the LADTAP II program, including effluent discharge rate, dilution factor for discharge, transit time to receptor, and liquid pathway consumption and usage factors (i.e., fish consumption and drinking water consumption), can be found in Table 5.4-1 of the ER (Luminant 2009a).

Luminant (2009a, 2010j) calculated liquid pathway doses to the MEI as shown in ER Table 5.4-4 and the LADTAP output files (Luminant 2009c) which assumed all liquid effluents would be released to SCR. Table 5-14 is derived from those output files. The MEI was an adult (total body dose) ingesting fresh water sport fish and receiving shoreline exposure from SCR. The highest organ dose would be to the liver of a teenager (Luminant 2009a).

Table 5-14. Annual Doses to the MEI for Liquid Effluent Releases from a New Unit[(a)]

Pathway	Age Group	Annual Dose (mrem/yr)		
		Total Body[(b)]	Maximum Organ (Liver)[(c)]	Thyroid
Shoreline Use	Adult	0.0020	0.0013	0.0013
	Teenager	0.011	0.0073	0.0073
	Child	0.0023	0.0015	0.0015
Water Ingestion	Adult	0.0064	0.0064	0.0064
	Teenager	0.0045	0.0045	0.0045
	Child	0.0086	0.0086	0.0086
Fish Ingestion	Adult	0.88	1.2	0.14
	Teenager	0.52	1.3	0.10
	Child	0.25	1.1	0.086

(a) Bounding values based on liquid effluent release to SCR.

(b) An adult receives the maximum individual total body dose.

(c) A teenager received the maximum individual organ dose.

Luminant (2009a, 2010j) also calculated the doses to the MEI and the population assuming one-half the liquid effluents of ER Table 5.4-8 would be diverted to an evaporation pond. The resultant airborne emissions were evaluated using the GASPAR II computer program (Strenge et al. 1987). The fish ingestion pathway is the dominant dose contributor for liquid effluents, and radionuclides released to the air from the evaporation pond do not contribute to the fish ingestion pathway. Assuming no diversion of liquid effluents to the evaporation pond results in a higher dose to the MEI compared to the combination of some liquid effluent going to the SCR and some going into the air through evaporation. As discussed in Section 3.4.3.1, discharges from the pond during extreme weather conditions would be released to the SCR via a transfer pump and a discharge line to the circulating water return line from CPNPP Units 1 and 2. Therefore, the doses for the liquid effluent calculated assuming no diversion to the evaporation pond are bounding.

The NRC staff's evaluation of the doses from the liquid effluent releases includes the doses due to airborne emissions from the evaporation pond. However, the dose to the MEI for the liquid effluent releases is bounded by the direct release to SCR. The dose contribution from the airborne emissions from the evaporation pond is negligible.

The NRC staff recognizes the LADTAP II and GASPAR II computer programs as appropriate methods for calculating dose to the MEI for liquid effluent releases and atmospheric emission, respectively. All input parameters used in Luminant's calculations were judged by the NRC staff to be appropriate. The NRC staff performed an independent evaluation of liquid pathway doses using input parameters from the ER (Luminant 2009a) and found similar results. Further discussion of the NRC staff's independent evaluation is found in Appendix G.

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the MEI were calculated by Luminant (2009a) using the GASPAR II computer program (Strenge et al. 1987) at the nearest residence, the exclusion area boundary (EAB), the nearest garden, nearest meat cow, and nearest milk cow. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground; (2) inhalation of gases and particulates; (3) ingestion of meat from animals eating contaminated grass; and (4) ingestion of garden vegetables contaminated by gases and particulates. Luminant (2009a) stated that no milk cows or milk goats are located within 5 mi of the proposed site. However, Luminant did provide individual dose results for the milk pathway in its ER (Luminant 2009a) for information purposes, but those results are not included in the total doses reported here. Luminant (2009a) did include the milk pathway in the calculation of population dose based on an earlier agricultural census.

Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in Tables 5.4-3, 5.4-4, and 5.4-5 of the ER (Luminant 2009a). Gaseous pathway doses to the MEI calculated by Luminant are found in Table 5.4-13 of the ER (Luminant 2009a) and summarized in Table 5-15.

These doses include releases of radioactive material to the air from the plant vents and the evaporation pond (see ER Table 5.4-7) (Luminant 2009a). These are bounding calculations because the same radioactive materials in the liquid effluents cannot be released to both the SCR and the atmosphere. The doses presented in Table 5-7 for the liquid pathways already included all the radioactive material in the liquid release. The doses presented in Table 5-16 include some of the same radioactive material already addressed in Table 5-7.

The NRC staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The NRC staff reviewed the input parameters and values used by Luminant and concluded that the parameters were appropriate. The NRC staff performed an independent evaluation of the gaseous pathway doses and obtained similar results for the MEI. Further discussion of the NRC staff's independent review is found in Appendix G.

Table 5-15. Annual Doses to MEI from Gaseous Effluent Releases from a New Unit[(a)]

Pathway	Age Group	Annual Dose (mrem)			
		Total Body	**Max. Organ (GI Tract)**	**Skin**	**Thyroid**
Plume (0.37 mi SSE)	All	0.054	0.054	0.50	0.054
Ground (0.37 mi SSE)	All	0.12	0.12	0.15	0.12
Inhalation (0.79 mi SSW)	Adult	0.065	0.067	0.064	0.086
	Teen	0.065	0.067	0.065	0.076
	Child	0.058	0.058	0.057	0.071
	infant	0.033	0.033	0.033	0.045
Vegetation (0.79 mi SSW)	Adult	0.014	0.32	0.12	0.17
	Teen	0.017	0.39	0.15	0.20
	Child	0.029	0.44	0.26	0.36
Meat (0.79 mi SSW)	Adult	0.028	1.9	0.022	0.024
	Teen	0.019	1.2	0.015	0.016
	Child	0.029	0.74	0.022	0.024
Milk (0.79 mi SSW)	Adult	0.061	0.049	0.043	0.098
	Teen	0.081	0.068	0.061	0.15
	Child	0.13	0.11	0.11	0.28
	Infant	0.21	0.19	0.18	0.61

(a) Based on gaseous effluent release and one-half of liquid effluents being diverted to evaporation pond.

Source: ER Table 5.4-12 (Luminant 2009a, 2010h)

Table 5-16. Comparison of Annual MEI Dose for Single Unit with 10 CFR 50, Appendix I Dose Design Objectives

Pathway / Type of Dose	Luminant [(a)]	Appendix I Dose Design Objectives
Liquid Effluents		
Total Body	0.90 mrem/yr	3 mrem/yr
Maximum Organ	0.15 mrem/yr	10 mrem/yr
Gaseous Effluent (Noble Gases)		
Gamma Air	0.08 mrad/yr	10 mrad/yr
Beta Air	0.61 mrad/yr	20 mrad/yr
Total Body	0.05 mrem/yr	5 mrem/yr
Skin	0.50 mrem/yr	15 mrem/yr
Gaseous Effluent (Radioiodine and Particulates)		
Maximum Organ	2.6 mrem/yr	15 mrem/yr

(a) Luminant (2009a, 2010h)

Luminant has opened SCR for recreational use (Luminant 2010c) and has evaluated the doses from the gaseous effluent releases of the new units, including the emissions from the evaporation pond, to members of the public using SCR for recreational activities (Luminant 2010h). Luminant evaluated gaseous pathways doses for recreational activities at a location about 0.1 mi NNW of the proposed new units (0.41 mi NNW of the evaporation pond) and added those doses to the plume, ground, and inhalation pathway doses estimated for the MEI. The NRC staff performed an independent evaluation of these gaseous pathway doses and obtained similar results. Further discussion of the NRC staff's independent review is found in Appendix G. The doses presented in Table 5-15, 5-16, and 5-17 include the doses from recreational use of SCR.

5.9.3 Impacts to Members of the Public

This section (1) compares the estimated doses from operation of CPNPP Units 3 and 4 to the dose design criteria of Appendix I to 10 CFR Part 50, (2) compares the doses from CPNPP site (Units 1, 2, 3, and 4) to the dose standards of 40 CFR Part 190, and (3) estimates the population dose from operation of CPNPP Units 3 and 4.

5.9.3.1 Maximally Exposed Individual

Luminant states that total body and organ dose estimates to the MEI from liquid and gaseous effluents for each new unit would be within the dose design objectives of 10 CFR Part 50, Appendix I. Luminant determined the annual total body and maximum organ doses at SCR from liquid effluents were well within the respective 3 mrem and 10 mrem Appendix I dose design objectives. Annual doses at the EAB from gaseous effluents were well within the Appendix I dose design objectives of 10 mrad air dose from gamma radiation, 20 mrad air dose from beta radiation, 5 mrem to the total body, and 15 mrem to the skin. In addition, the annual dose to bone was within the 15 mrem Appendix I dose design objective. A comparison of dose estimates for each of two new units to the Appendix I dose design objectives is found in Table 5-16.

Table 5-17 compares the combined dose estimates from direct radiation and gaseous and liquid effluents from existing Units 1 and 2 and the proposed Units 3 and 4 against the 40 CFR Part 190 standards. Information for Units 1 and 2 presented in Table 5-17 was developed by the

NRC staff using the 2008 effluent monitoring report for Units 1 and 2 (Luminant 2009e, 2009f). The table shows that the total doses to the MEI at the CPNPP site would be below the 40 CFR Part 190 standards. As noted in Section 5.9.1, Luminant indicated no offsite dose contribution from direct radiation from Units 3 and 4 and the ISFSI.

5.9.3.2 Population Dose

Luminant (2009a) estimates the annual collective total body dose within a 50-mi radius of the CPNPP site to be 8.0 person-rem from the proposed Units 3 and 4 from gaseous and liquid effluent pathways. The estimated annual collective dose to the same population from natural background radiation is estimated to be 985,000 person-rem. The dose from natural background radiation was calculated by multiplying the 50-mi population estimate for 2058 of approximately 3,490,000 people by the annual U.S. average background dose of 311 mrem (NCRP 2009).

Collective population doses from gaseous and liquid effluent pathways were estimated by Luminant using GASPAR II and LADTAP II computer codes, respectively. The NRC staff performed an independent evaluation of population doses and obtained similar results (see Appendix G).

Table 5-17. Comparison of MEI Annual Doses (mrem/yr) with 40 CFR Part 190 Standards

	CPNPP Units 1 and 2[a]				CPNPP Units 3 and 4[b]			Site Total	Regulatory Standard
	Liquid	Gaseous	Direct[c]	Total	Liquid	Gaseous	Total		
Total Body	0.087	0.088	0.13	0.31	1.8	1.6	3.4	3.7	25
Thyroid	0.13	0.41	0.13	0.67	0.3	2.1	2.4	3.1	75
Other[d]	<0.001	0.0028	0.13	0.13	2.6	5.1	7.7	7.8	25

(a) Liquid and gaseous dose values reported by Luminant (2009a, 2010j).

(b) Derived from ER Table 5.4-12 (Luminant 2009a).

(c) Direct radiation values from ER Section 5.4.1.3 (Luminant 2009c).

(d) The maximum organ dose was to the GI Tract.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect, and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from International Commission on Radiological Protection (ICRP) Publication 103 (ICRP 2007). The estimated annual collective whole body dose to the population living within 50 mi of the proposed two new units at CPNPP site is 8.0 person-rem, which is less than the 1754 person-rem value that ICRP and National Council on Radiation Protection and Measurements (NCRP) suggest, would most likely result in zero excess health effects (NCRP 1995; ICRP 2007).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published in 1990 a report entitled, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The health impacts from routine gaseous and liquid radiological effluent releases from the two proposed units have been calculated by both Luminant and NRC staff. Based on the information provided by Luminant and NRC's evaluation, the NRC staff concludes there would be no observable health impacts to the public from normal operation of the proposed units. Therefore, the health impacts would be SMALL, and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

Luminant (2009a) reported an annual average occupational dose of 73 person-rem per unit for existing CPNPP Units 1 and 2. Based on available data for the MHI US-APWR design, the projected annual occupational dose, including outages, is estimated to be 79 person-rem for each unit or 160 person-rem for both units (Luminant 2009a). The occupational doses for APWR designs are estimated to be less than the annual average occupational doses for current light-water reactors.

The licensee of a new plant would need to maintain individual doses to workers within 5 rem annually as specified in 10 CFR 20.1201 and incorporate provisions to maintain doses As Low As Reasonably Achievable (ALARA).

The NRC staff concludes that the health impacts from occupational radiation exposure would be SMALL based on individual worker doses being maintained within 10 CFR 20.1201 limits and collective occupational doses being typical of doses found in current operating light-water reactors. Additional mitigation would not be warranted because the operating plant would be required to maintain doses ALARA.

5.9.5 Dose to Biota Other Than Humans

Luminant (2009a) estimated doses to biota in the site environs; in many cases using surrogate species. Surrogate species used in the ER are well defined and provide an acceptable method for evaluating doses to biota (Soldat et al. 1974). Surrogate species analysis was performed for aquatic species such as fishes, invertebrates, and algae; and for terrestrial species such as muskrats, raccoons, herons, and ducks. Important biota species for the CPNPP site and the corresponding surrogate species are as follows: (1) pistol grip mussel – invertebrates, (2) channel catfish, largemouth bass, striped bass – fish, (3) white-tailed deer, turkey, rabbit, squirrel, and raccoon – raccoon and muskrat, (4) ducks (various species) – duck, and (5) sandpipers and heron – heron. Exposure pathways considered in evaluating dose to the biota were discussed in Section 5.9.1 and shown in Figure 5-3.

5.9.5.1 Liquid Effluent Pathway

Liquid effluents are released into the SCR; therefore, the highest concentration of radiological material would be in the SCR. Luminant (2009a) used the LADTAP II computer code to calculate doses to the biota from liquid effluent pathways. Liquid pathway doses were higher for biota compared to humans because of consideration of bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in water and along the shoreline compared to humans. The liquid effluent releases used in estimating biota dose are found in Table 5.4-6 of the ER (Luminant 2009a). Table 5-18 presents Luminant's estimates of the doses to biota from liquid and gaseous pathway from proposed Units 3 and 4. As discussed in Appendix G, the NRC staff obtained similar results in confirmatory calculations for the liquid pathway.

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents (Figure 5-3). The dose calculated to the MEI from gaseous effluent releases in Table 5-19 would also be applicable to terrestrial surrogate species with two modifications. One modification defined by Luminant was increasing the ground deposition parameter by a factor of two as terrestrial animals would be closer to the ground than the MEI. The second modification was to assume no vegetation intake pathway for muskrat and heron because they are not known to consume vegetation. The gaseous effluent releases used in estimating dose are found in Table 5.4-7 of the ER (Luminant 2009a). The ER used doses at the EAB (0.37 mi NNW) in estimating terrestrial species doses. Luminant's dose estimates to the surrogate species from gaseous and liquid pathways are shown in Table 5-19. As discussed in Appendix G, the NRC staff reviewed Luminant's estimates and concluded that they are reasonable.

Table 5-18. Biota Annual Doses for Proposed Units 3 and 4

Biota	Luminant's Annual Absorbed Dose Estimate (mrad)		
	Liquid Pathway[(a)]	Gaseous Pathway[(b)]	Total
Fish	19.0	NA	19.0
Invertebrate	32.0	NA	32.0
Algae	41.0	NA	41.0
Muskrat	67.0	2.6	70.0
Raccoon	20.3	1.8	22.0
Heron	200.0	1.7	202.0
Duck	68.0	2.4	70.0

(a) ER Table 5.4-21 (Luminant 2009a).

(b) ER Table 5.4-22 (Luminant 2009a).

Table 5-19. Comparison of Biota Doses from the Proposed Units 3 and 4 at the CPNPP Site to Relevant Guidelines for Biota Protection

Biota	Absorbed Dose Rate (mrad/d)	
	Luminant Estimate[(a)]	IAEA/NCRP Guidelines[(b)]
Fish	0.052	1000
Invertebrates	0.088	1000
Algae	0.11	1000
Muskrat	0.19	100
Raccoon	0.060	100
Heron	0.55	100
Duck	0.19	100

(a) ER Tables 5.4-21 and 5.4-22 (Luminant 2009a).

(b) Published guidelines reported in mGy/d (1 mGy equals 100 mrad).

5.9.5.3 Impact of Estimated Non-Human Biota Doses

Radiation doses to non-human biota are evaluated using the absorbed dose (mrad) because dose equivalent (mrem) only applies to humans. The biota dose estimates for the new units are conservative because they are based on the maximum exposure conditions.

The ICRP (1977, 1991, 2007) states that if humans are adequately protected, other living things are also likely to be sufficiently protected. The International Atomic Energy Agency (IAEA 1992) and the NCRP (1991) reported that a chronic absorbed dose rate of no greater than 1000 mrad/d to the MEI in a population of aquatic organisms would ensure protection of the population. IAEA (1992) also concluded that a chronic absorbed dose rate of 100 mrad/d or less does not appear to cause observable changes in terrestrial animal populations. Table 5-19 compares Luminant's estimated total body dose to the biota from the proposed Units 3 and 4 to the IAEA chronic dose rate values for aquatic and terrestrial biota. The dose rates are far less than the NCRP and IAEA guidelines.

Based on the information provided by Luminant and NRC's review, the NRC staff concludes that the radiological impact on biota from the routine operation of the proposed Units 3 and 4 at the CPNPP site would be SMALL, and additional mitigation would not be warranted.

5.9.6 Radiological Monitoring

A radiological environmental monitoring program (REMP) has been in place for the CPNPP site since 1981 to include preoperational sample collection began before the construction and operation of CPNPP Units 1 and 2 (Luminant 2009a). The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway from the SCR, and the ingestion exposure pathway within a 5-mi-radius of the station, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi. Milk is not currently sampled because there is no known production within 5 mi of the site. An annual land use census is conducted for the area surrounding the site to verify the accuracy of assumptions used in the analyses, including the occurrence of milk production. The preoperational REMP sampled various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once the units began operation. The preoperational program included collection and analysis of samples of air particulates, precipitation, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation. After operation of CPNPP Unit 1 began in April 1990 (Unit 2 in 1993), the monitoring program continued to assess the radiological impacts on the public and the environment. Radiological releases and the results of the REMP are summarized in the two annual reports: the Annual Radiological Environmental Operating Report (Luminant 2009d) and Annual Radioactive Effluent Release Report (Luminant 2009e).

No additional monitoring program has been established for the new units. To the greatest extent practical, REMP for the COL program would use the procedures and sampling locations used by the existing CPNPP site. The NRC staff reviewed the documentation for the existing REMP, the Offsite Dose Calculation Manual, and recent monitoring reports from Luminant, and determined that the current operational monitoring program is adequate to establish the radiological baseline for comparisons with the expected impacts on the environment related to the construction and operation of the proposed new units at the CPNPP site.

The year 2008 monitoring data for the waters of the SCR shows a tritium concentration ranging from 11,800 to 14,300 picocuries per liter (pCi/L) (Luminant 2009e). The trend in the SCR tritium levels indicates that SCR is in equilibrium with the tritium release rate of the existing CPNPP Units 1 and 2. The equilibrium value is less than Luminant's administrative action level of 30,000 pCi/L. The tritium content of SCR is the only consistent detectable indicator of CPNPP operations found in the site environment.

5.10 Nonradioactive Waste Impacts

This section describes the potential impacts to the environment that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during the operation of proposed Units 3 and 4 at the CPNPP site.

Section 3.4.4 describes the nonradioactive waste systems for CPNPP Units 3 and 4. The potential types of nonradioactive waste that would be generated, handled, and disposed of during operational activities at proposed Units 3 and 4 include solid wastes, liquid effluents, and air emissions. Solid wastes include municipal waste, sewage treatment sludge, and industrial wastes. Liquid waste includes TPDES-permitted discharges such as effluents containing chemicals or biocides, wastewater effluents, site stormwater runoff, and other liquid wastes such as used oils, paints, and solvents that require offsite disposal. Air emissions would primarily be generated by vehicles, diesel generators, and combustion generators. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

5.10.1 Impacts to Land

Operation of proposed Units 3 and 4 would generate solid and liquid wastes similar to those already generated by current operations of CPNPP Units 1 and 2. These wastes would consist of typical industrial wastes (metal, wood, and paper), as well as process wastes such as nonradioactive resins, filters, and sludge. The principal hazardous waste generated is expected to be Freon-contaminated waste oil. Petroleum wastes may include fuels such as gasoline and diesel oil along with used oil and greases from equipment maintenance (Luminant 2009a).

Operation of Units 3 and 4 would generate one type of waste not associated with Units 1 and 2: salt wastes from the BDTF. Between 195,610 tons and 519,375 tons of salt would be removed from the BDTF evaporation ponds each year for disposal in licensed industrial landfills. The impacts of this waste stream are discussed in Section 5.1.1 of this EIS.

Non-hazardous solid wastes resulting from operations of Units 3 and 4 would be collected at the site by private, municipal, or county solid waste transporters for disposal in a landfill licensed by the TCEQ. Based on information regarding the capacity of non-hazardous solid waste landfills in the region (TCEQ 2008), disposal of the wastes from Units 3 and 4 would result in the conversion of additional land for waste disposal use. Water treatment and purification waste reverse-osmosis filters would be containerized before disposal at a non-hazardous waste landfill. It is expected that used liquid petroleum materials will be recycled for fuel blending, while petroleum residue wastes (such as oil rags) will be disposed of at an off-site industrial waste facility licensed by TCEQ (Luminant 2009a).

Hazardous wastes generated by the operation of Units 3 and 4 would be collected and stored on-site in the same enclosed hazardous-waste storage building currently serving Units 1 and 2. These wastes would be removed from the storage building within 90 days of generation, manifested, and transported for disposal at an off-site, RCRA-permitted Treatment, Storage, and Disposal Facility. Luminant expects that operations at Units 3 and 4 will generate about the same amount of hazardous waste as current operations at Units 1 and 2, which is less than 220 pounds per month. With this additional amount, the CPNPP site would continue to be classified as a Small Quantity Generator of hazardous waste under TCEQ criteria (Luminant 2009a).

Current operations on the CPNPP site follow a waste minimization plan that has proved successful in significantly reducing the amount of hazardous and non-hazardous waste. Luminant proposes to apply this plan to operations at Units 3 and 4. Luminant also intends to train operations employees in chemical awareness and in the appropriate implementation of waste-handling procedures and regulations (Luminant 2009a).

Based on the effective practices for recycling and minimizing waste already in place for CPNPP Units 1 and 2 and the plans to manage solid and liquid wastes in a similar manner in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts to land from nonradioactive wastes generated during the operation of proposed Units 3 and 4 would be minimal, and no further mitigation would be warranted.

5.10.2 Impacts to Water

Operation of proposed CPNPP Units 3 and 4 would result in discharge to surface water of effluents containing various chemical and biological constituents.

Treated sanitary wastewater effluent, site stormwater runoff, and effluents from nonradioactive floor drains would be discharged to SCR. As discussed in Section 5.2.3.1, nonradioactive wastewater streams from the CPNPP Units 3 and 4 would include cooling tower blowdown, auxiliary boiler blowdown, water treatment waste, floor and equipment drains, and nonradioactive laboratory waste.

The new sanitary wastewater treatment plant that would be installed as part of the Units 3 and 4 construction project would treat sanitary wastewater and effluents from floor and equipment drains, laboratories, and sanitary waste. The treated effluent would be discharged to SCR. SCR would also receive uncontaminated site stormwater runoff. As discussed in Section 5.2.3.1, discharges to SCR would be required to comply with water quality limitations specified in a TPDES discharge permit, and impacts to SCR would be minor.

Effluents from cooling systems and the BDTF would be directed to Lake Granbury. Potential surface water impacts to Lake Granbury are discussed in Section 5.2.3.1. Based on the TPDES permit conditions, operation of the BDTF to reduce the concentrations of dissolved substances, surface water quality impacts to Lake Granbury and the Brazos River would be minor.

As discussed in Section 5.2.3.2, impacts to groundwater are expected to be minor, but in view of various uncertainties and the potential impacts of overflows from the BDTF evaporation pond, noticeableimpacts cannot be ruled out. As discussed in Section 5.2.5, additional monitoring of groundwater could further reduce potential impacts by providing early detection of impacts to groundwater quality.

Based on the regulated practices for managing liquid discharges containing chemicals or biocide, and other wastewater, and the plans for managing stormwater, the review team expects that impacts to water from nonradioactive effluents during the operation of Units 3 and 4 would be minimal.

5.10.3 Impacts to Air

Operation of proposed Units 3 and 4 would result in gaseous emissions from the intermittent operation of gas turbine generators, auxiliary boilers, and diesel fire pumps. In addition, increased vehicular traffic associated with personnel necessary to operate Units 3 and 4 would increase vehicle emissions in the area. Impacts to air quality are discussed in detail in Section 5.7. Increases in air emissions from operation of Units 3 and 4 would be in accordance with permits issued by TCEQ that would ensure compliance with the Federal Clean Air Act.

Based on the regulated practices for managing air emissions from stationary sources, the review team expects that impacts to air from nonradioactive emissions during the operation of proposed Units 3 and 4 would be minimal, and no further mitigation would be warranted.

5.10.4 Mixed Waste Impacts

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, or disposal of mixed waste is regulated by Atomic Energy Act of 1954, the Solid Waste Disposal Act of 1965, as amended by the Resource, Conservation, and Recovery Act (RCRA) in 1976, and the Hazardous and Solid Waste Amendments (which amended RCRA in 1984). The EPA Mixed Waste Rule finalized on May 16, 2001 provides increased flexibility to generators and facilities that manage low-level mixed waste (LLMW). Luminant has put in place programs to minimize the generation of mixed waste; the two new units are expected to produce on the order of 1 m^3 per year of mixed waste. Mixed waste from the existing CPNPP Units 1 and 2 is maintained in a designated storage area and is monitored on a regular inspection schedule (Luminant 2009a). Mixed waste can be reduced through decay, stabilization, neutralization, or filtration. Mixed waste may be shipped to an approved offsite treatment or disposal facility, using a licensed hazardous/mixed waste carrier.

Based on the effective practices for minimizing waste already in place for CPNPP Units 1 and 2, and the plans to manage mixed wastes in a similar manner in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts from the generation of mixed waste at CPNPP Units 3 and 4 would be minimal, and no further mitigation would be warranted.

5.10.5 Summary of Waste Impacts

Solid, liquid, gaseous, and mixed wastes generated during operation of proposed Units 3 and 4 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste. Wastewater discharge would be compliant with TPDES limitations. Air emissions from Units 3 and 4 operations would be compliant with air quality standards as permitted by TCEQ. Mixed waste generation, storage, and disposal impacts during operation of proposed Units 3 and 4 would be compliant with requirements and standards.

Based on the information provided by Luminant, the effective practices for recycling, minimizing, managing, and disposing of wastes already in use at the CPNPP site, the review team's expectation that regulatory approvals would be obtained to regulate the additional waste that would be generated from proposed Units 3 and 4, and the review team's independent evaluation, the review team concludes that the potential impacts from nonradioactive waste resulting from the operation of the proposed two additional units at the CPNPP site would be SMALL, and mitigation would not be warranted.

Cumulative impacts to water and air from nonradioactive emissions and effluents are discussed in Sections 7.2 and 7.6, respectively. For the purposes of Chapter 9 (alternatives), the review team expects that there would be no substantive differences between the impacts of nonradioactive waste for the CPNPP site and the alternative sites and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences on the environment of potential accidents at the proposed new units at the CPNPP site. Consequence estimates are based on the MHI US-APWR standard design, which is being evaluated for design certification by the NRC staff. The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which comprise the first line of defense, are intended to prevent the release of radioactive materials from the plant. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas ALARA are specified in 10 CFR Part 50, Appendix I. There are additional measures that are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor siting criteria in 10 CFR Part 100, which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident, and emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47, 10 CFR Part 50, Appendix E, and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

This section discusses (1) the types of radioactive materials; (2) the potential paths for their release to the environment; (3) the relationship between radiation dose and health effects; and (4) the environmental impacts of reactor accidents, both design-basis accidents (DBA) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. The majority of the material in the fuel is in the form of nonvolatile solids. However, after operation, a significant fraction of the material is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and, therefore, have lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water; (2) inhalation of radioactive material; and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Radiation protection experts conservatively assume that any amount of radiation exposure may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Physiological effects are clinically detectable should individuals receive radiation exposure resulting in a dose greater than about 25 rem over a short period of time (hours). Untreated doses of about 250 to 500 rem received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

Luminant evaluated the potential consequences of postulated accidents to demonstrate that two US-APWRs could be constructed and operated at the CPNPP site without undue risk to the health and safety of the public (Luminant 2009a). These evaluations used the US-APWR reactor design being considered for the CPNPP site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The bases for analyses of postulated accidents for this design are well established because the reactors are pressurized water type reactors that are being reviewed in the NRC's reactor design certification process. Potential consequences of DBAs are evaluated following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the US-APWR and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000a).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as relative concentration (χ/Q), which has units of s/m^3. Smaller χ/Q values are associated with greater dilution capability. Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

5-20 lists χ/Q values pertinent to the environmental review of DBAs for the CPNPP site (Luminant 2009a). The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the EAB, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term (i.e., 2 hours); for the low-population zone, they are calculated for the course of the accident in four time increments totaling 30 days (720 hours). The second column in Table 5-20 lists the χ/Q values presented in Table 7.1-11 of Luminant's ER. Luminant calculated the χ/Q values listed in Table 5-20 using six years of onsite meteorological data (2001 to 2006) for the CPNPP site, assuming that the release point was located at ground level.

Table 5-20. Atmospheric Dispersion Factors for Comanche Peak Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, or worst 2 hr period Exclusion Area Boundary	5.75×10^{-5}
0 to 8 hr, Low Population Zone	3.32×10^{-6}
8 to 24 hr, Low Population Zone	2.75×10^{-6}
1 to 4 d, Low Population Zone	1.83×10^{-6}
4 to 30 d, Low Population Zone	1.01×10^{-6}

The NRC staff reviewed the meteorological data used by Luminant and the Luminant atmospheric dispersion factors. Based on these reviews, the NRC staff concludes that the atmospheric dispersion factors for the CPNPP site are acceptable for use in evaluating potential environmental consequences of postulated DBAs for the US-APWR design at the CPNPP site.

Table 5-21 lists the set of DBAs considered by Luminant and presents estimates of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). In these analyses, TEDE is the sum of the committed effective dose equivalent from inhalation and the effective dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the effective dose equivalent.

Table 5-21. DBA Doses for a US-APWR for Proposed CPNPP Units 3 and 4

Accident	Standard Review Plan Section[b]	TEDE in rem[a]		
		EAB[c]	LPZ[d]	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		3×10^{-2}	1×10^{-2}	$2.5 \times 10^{+1}$[e]
Accident-initiated iodine spike		4×10^{-2}	1×10^{-2}	$2.5 \times 10^{+0}$[f]
Steam generator rupture	15.6.3			
Pre-existing iodine spike		4.2×10^{-1}	3×10^{-2}	$2.5 \times 10^{+1}$[e]
Accident-initiated iodine spike		1.1×10^{-1}	1×10^{-2}	$2.5 \times 10^{+0}$[f]
Loss-of-coolant accident	15.6.5	1.5×10^{0}	2.6×10^{-1}	$2.5 \times 10^{+1}$[e]
Rod ejection	15.4.8	5.9×10^{-1}	9.0×10^{-2}	$6.25 \times 10^{+0}$[f]
Reactor coolant pump rotor seizure (locked rotor)	15.3.3	6×10^{-2}	2×10^{-2}	$2.5 \times 10^{+0}$[f]
Failure of small lines carrying primary coolant outside containment	15.6.2	1.8×10^{-1}	1×10^{-2}	$2.5 \times 10^{+0}$[f]
Fuel handling	15.7.4	3.84×10^{-1}	3×10^{-2}	$6.25 \times 10^{+0}$[f]

(a) To convert rem to Sv, divide by 100.

(b) NUREG-0800 (NRC 2007).

(c) Exclusion area boundary.

(d) Low population zone.

(e) 10 CFR 52.79(a)(1) and 10 CFR 100.21 criteria.

(f) Standard Review Plan criterion.

The NRC staff reviewed Luminant's selection of DBAs by comparing the accidents listed in the application with the DBAs considered in the US-APWR Design Control Document (MHI 2009) and the pressurized water reactor (PWR) DBAs listed in NUREG-0800 (NRC 2007) and NUREG-1555 (NRC 2000b). The DBAs in the ER are the same as those considered in the design certification; therefore, the NRC staff concludes that the set of DBAs is appropriate. In addition, the NRC staff reviewed the calculation of the site-specific consequences of the DBAs and found the results of the calculations to be reasonable for use in its evaluation of environmental consequences of DBAs.

There are no environmental criteria related to the potential consequences of DBAs. Consequently, the review criteria used in the NRC staff's safety review of DBA doses are included in Table 5-21 to illustrate the magnitude of the calculated environmental consequences (TEDE doses). In all cases, the calculated TEDE values are considerably smaller than the TEDE doses used as safety review criteria.

Summary of DBA Impacts. The NRC staff reviewed the Luminant DBA analysis in the ER, which is based on analyses performed for design certification of the US-APWR design with adjustment for CPNPP site-specific characteristics. The results of the Luminant analyses indicate that the environmental risks associated with DBAs if two US-APWRs were to be located at the CPNPP site would be small. The NRC staff performed an independent assessment of the environmental consequences of DBAs at the CPNPP site and concludes that the environmental consequences of DBAs if two US-APWRs were to be located at the CPNPP site would be SMALL.

5.11.2 Severe Accidents

In its ER (Luminant 2009a), Luminant considers the potential consequences of severe accidents for a US-APWR at the CPNPP site. Three pathways are considered: (1) the atmospheric pathway, in which radioactive material is released to the air; (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water; and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

Luminant bases its evaluation of the potential environmental consequences for the atmospheric and surface water ingestion pathways on the results of the MACCS2 computer code (Chanin et al. 1990; Jow et al. 1990) run using US-APWR source term information and site-specific meteorological, population, and land-use data. The NRC staff has reviewed Luminant's input and output files, has run confirmatory calculations, and finds the Luminant results reasonable.

The MACCS computer code was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990). MACCS2 (Chanin and Young 1998) is the current version of MACCS. The MACCS and MACCS2 codes evaluate the consequences of atmospheric releases of material following a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water.

Three types of severe accident consequences were assessed: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early cancer fatalities and latent fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990). Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within a 50-mi radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident. Farmland decontamination is an estimate of the area that has an average whole body dose rate for the 4-yr period following the release that would be greater than 0.005 Sv/yr if not reduced by decontamination and that would have a dose rate following decontamination of less than 0.005 Sv/yr. Decontaminated land is not necessarily suitable for farming.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident (also called core damage frequency [CDF]) without loss of containment for a US-APWR is estimated to be 1.1×10^{-6} per reactor year (Ryr) for internal events. The cumulative population dose associated with a severe accident without loss of containment at the CPNPP site is calculated to be 9 person-Sv. The population dose risk for this release class is the product of 1.1×10^{-6} Ryr^{-1} and 9 person-Sv, which equals 1.0×10^{-5} person-Sv Ryr^{-1}.

The following sections discuss the estimated risks associated with each pathway. The risks presented in Tables 5-22 through 5-23 are risks per year of reactor operation. Luminant plans to build two US-APWR reactors on the CPNPP site. The consequences of a severe accident would be the same regardless of whether one or two US-APWR reactors were built at the CPNPP site. However, if two reactors were built, the risks would apply to each reactor, and the total risk for the two new reactors at the site would be double the risk for a single reactor.

5.11.2.1 Air Pathway

The MACCS2 code directly estimates consequences associated with releases to the air pathway. Luminant used the MACCS2 code to estimate consequences to the population in 2056 based on meteorological data for 2001, 2003 and 2006. The results of the MACCS2 runs (Luminant 2009a) based on 2006 meteorological data are presented in Table 5-23. These values are based on 2006 meteorological data, and have the highest dose risk for the three years of meteorological data. The CDFs given in these tables include internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. The health effects resulting from internal fire, internal flood, and low-power and shutdown events were determined using the ratio of the CDF values for these events and the CDF value for the internal events. Core damage frequencies for other at power events, including tornadoes, hurricanes, and external floods were evaluated by Luminant on a plant-specific basis and determined to be negligible (Luminant 2009a). The total CDF for events occurring while the reactor is at low power or shutdown is estimated to be about an order of magnitude less than the total CDF at power (Luminant 2009a). Table 5-24 shows the total health effects for internal events, internal flood events, fire events, and low power and shutdown events

In Table 5-24, the health risks estimated for a US-APWR for 2006 meteorological data, at the CPNPP site, are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-23. The health risks shown for a US-APWR at the CPNPP site exclude external events as these were shown to be negligible compared to internal events (Luminant 2009a). Even with the addition of the externally initiated events for a US-APWR reactor the resulting health risks for Comanche Peak are significantly lower than the risks associated with current-generation reactors presented in NUREG-1150.

Table 5-22. Environmental Risks from a US-APWR Severe Accident at the Comanche Peak Site (2006 Meteorological Data)

Release Category (Accident Class)	Description[b]	Environmental Risk[a] Core Damage Frequency (Ryr^{-1})[a]	Population Dose (person-Sv Ryr^{-1})[c]	Fatalities (Ryr^{-1}) Early[d]	Fatalities (Ryr^{-1}) Latent[e]	Cost[f] (\$ Ryr^{-1})	Farm Land Decontamination[g] (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})[c]
RC1	Containment bypass which includes both core damage after steam generator tube rupture (SGTR) and thermal induced SGTR after core damage	7.5×10^{-9}	2.9×10^{-4}	2.0×10^{-09}	2.0×10^{-5}	99	1.5×10^{-11}	1.9×10^{-5}
RC2	Containment isolation failure	2.1×10^{-9}	6.1×10^{-5}	2.5×10^{-10}	4.4×10^{-6}	17	1.5×10^{-12}	1.3×10^{-6}
RC3	Containment overpressure failure before core damage due to loss of heat removal	2.0×10^{-8}	9.0×10^{-4}	6.5×10^{-8}	1.3×10^{-4}	338	1.1×10^{-10}	1.2×10^{-4}
RC4	Early containment failure due to dynamic loads which includes hydrogen combustion before or just after reactor vessel failure, in-vessel and ex-vessel steam explosion, rocket-mode reactor vessel failure, and direct containment heating	1.1×10^{-8}	2.7×10^{-4}	4.7×10^{-10}	1.6×10^{-5}	57	2.7×10^{-11}	6.9×10^{-6}
RC5	Late containment failure which includes containment overpressure failure after core damage, hydrogen combustion long after reactor vessel failure, and basemat melt through	6.5×10^{-8}	1.5×10^{-3}	0.0×10^{-0}	7.1×10^{-5}	195	1.1×10^{-9}	1.5×10^{-5}
RC6	Intact containment in which fission products are released at design leak rate	1.1×10^{-6}	1.0×10^{-5}	0.0×10^{-0}	5.3×10^{-7}	8	8.5×10^{-12}	2.4×10^{-8}
	Total	1.2×10^{-6}	3.0×10^{-3}	6.8×10^{-8}	2.4×10^{-4}	714	3.2×10^{-8}	1.6×10^{-4}

(a) All values in the table are based on data supplied by Luminant (2009b).

(b) Release categories contributing less than 1 percent of the risk in all categories are not shown. Totals include all release categories. In all cases, the risks shown exceed 98 percent of the total risk.

(c) To convert person-Sv to person-rem, multiply by 100.

(d) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).

(e) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.

(f) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).

(g) Land risk is area where the average whole body dose rate for the 4-yr period following the accident exceeds 0.005 Sv/yr but can be reduced to less than 0.005 Sv/yr by decontamination.

Table 5-23. Total Severe Accident Health Effects (Based on 2006 Meteorological Data)

Accident Type	Core Damage Frequency (per Ryr^{-1})	Scaling Factor	Dose-Risk (person-Sv Ryr^{-1})	Number of Early Fatalities (Ryr^{-1})	Number of Latent Fatalities (Ryr^{-1})	Water Ingestion Pathway (person-Sv Ryr^{-1})
Internal Events	1.2×10^{-6}	1	3.0×10^{-3}	6.7×10^{-8}	2.4×10^{-4}	1.6×10^{-4}
Internal Fire	1.8×10^{-6}	1.50	4.5×10^{-3}	1.0×10^{-7}	3.6×10^{-4}	2.5×10^{-4}
Internal Flood	1.4×10^{-6}	1.17	3.5×10^{-3}	7.9×10^{-8}	2.8×10^{-4}	1.9×10^{-4}
LPSD	2.0×10^{-7}	0.167	5.0×10^{-4}	1.1×10^{-8}	4.0×10^{-5}	2.7×10^{-5}
Total	4.6×10^{-6}	-	1.2×10^{-2}	2.6×10^{-7}	9.2×10^{-4}	6.3×10^{-4}

Table 5-24. Comparison of Environmental Risks for a US-APWR at the Comanche Peak Site Using 2006 Meteorological Data with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150 (NRC 1990)

	Core Damage Frequency (Ryr^{-1})	50-mi Population Dose Risk (person-Sv Ryr^{-1})(a)	Fatalities Ryr^{-1}		Average Individual Fatality Risk Ryr^{-1}	
			Early	Latent	Early	Latent Cancer
Grand Gulf(b)	4.0×10^{-6}	5×10^{-1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom(b)	4.5×10^{-6}	$7 \times 10^{+0}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah(b)	5.7×10^{-5}	$1 \times 10^{+1}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry(b)	4.0×10^{-5}	$5 \times 10^{+0}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion(b)	3.4×10^{-4}	$5 \times 10^{+1}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
US-APWR(c) at the Comanche Peak site	1.2×10^{-6}	3.0×10^{-3}	6.8×10^{-8}	2.4×10^{-4}	1.6×10^{-9}(d)	3.3×10^{-10}(e)

(a) To convert person-Sv to person-rem, multiply by 100.

(b) Risks were calculated using the MACCS code and are presented in NUREG-1150 (NRC 1990).

(c) Calculated with MACCS2 code using Comanche Peak site-specific input for internal and external at power initiating events (Luminant 2009a).

(d) See Section 7.2.4 of ER. Calculated based on the highest early fatality per year from the 3 yr of meteorological data for the population living within 2 km from the site (rather than 1 mi as per safety goal).

(e) See Section 7.2.4 of ER. Calculated based on the highest latent fatality per year from the 3 yr of meteorological data and for the year 2056 population estimate that is expected to be living within 50 mi radius around the site.

The last two columns of Table 5-24 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the NRC staff compares these estimates to the safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the *Safety Goal Policy Statement* (51 FR 30028). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health
- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all “other accidents to which members of the U.S. population are generally exposed,” is about 4.0×10^{-4} per yr, including a 1.6×10^{-4} per yr risk associated with transportation accidents (NSC 2006); one-tenth of 1 percent of these figures imply that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7} per Ryr.
- “The sum of cancer fatality risks resulting from all other causes” for an individual is taken to be the cancer fatality rate in the U.S., which is about 1 in 500 or 2×10^{-3} per yr (Reed 2007); one-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to 2×10^{-6} per Ryr.

MACCS2 calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission’s safety goals (NRC 1990).

The NRC staff compared the CDF and population dose risk estimate for a US-APWR at the CPNPP site with statistics summarizing the results of contemporary severe accident analyses performed for 76 reactors at 44 sites. The results of these analyses are included in the final site-specific Supplements 1 through 37 to NUREG-1437 (NRC 1996) and in the ERs included with license renewal applications for those plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990); the analyses for 72 of the reactors used MACCS2, which was released in 1997. Table 5-25 shows that the CDF estimated for the US-APWR is significantly lower than those of current-generation reactors. Similarly, the 50-mi population dose risk estimated for a US-APWR at the CPNPP site is well below the mean and median values for current-generation reactors that have undergone or are undergoing license renewal.

Finally, the population dose risk from a severe accident for a new US-APWR at the CPNPP site (3.0×10^{-3} person-Sv/Ryr) would be smaller than the dose risk for normal operation of a US-APWR at the CPNPP site. Section 5.9.3.2 of this EIS indicates that the population dose from normal operation of proposed Units 3 and 4 would be approximately 8.0 person-rem/yr (8.0×10^{2} person-Sv/yr).

In developing a probabilistic risk assessment for a nuclear power plant, criteria are included to “screen out” information that is insignificant. Regulatory Guide 1.200 (NRC 2009a) discusses methods and criteria for determining if the contribution to risk from an initiating event is insignificant. For example, the risk potential of a severe accident at a co-located nuclear unit as an initiating event is insignificant compared to other initiating events because the event frequency is very low. First, the frequency of a severe accident that results in an early large release of radioactive material to the environment is on the order of 1×10^{-6} per reactor year for current operating nuclear power plants such as CPNPP Units 1 and 2 (even lower for new reactors such as CPNPP Units 3 and 4). Then that accident or the radioactive release from that accident has to create a problem that leads to the initiation of a severe accident at a co-located nuclear power plant. The radioactive release from the accident does not initiate an accident at the co-located reactor; however, it may set up conditions that could eventually lead to a severe accident at the co-located reactor. The wind direction must move the accident release toward the co-located units; the release must overwhelm the habitability systems such that operators on the co-located units have to be evacuated because of high dose rates; and the lack of continuous operator attention and action must eventually result in multiple system failures that lead to a loss of reactor cooling and containment failure. There is no detailed estimate of the combined probability of this sequence of events; however, the overall probability of a severe accident initiating a severe accident at a co-located reactor is expected to be several orders of magnitude less than the frequency of large early release (i.e., several orders of magnitude less than 1 x 10^{-6} per reactor year). Based on this explanation, the NRC staff concludes that the potential environmental impact of this accident scenario does not need to be evaluated because it is remote and speculative.

Table 5-25. Comparison of Environmental Risks from Severe Accidents for a US-APWR at the Comanche Peak Site with Risks for Current Plants from Operating License Renewal Reviews, Including CPNPP Units 1 and 2

	Core Damage Frequency (Ryr^{-1})	**50-mi Population Dose Risk (person-Sv Ryr^{-1})[(a)]**
Current Reactor Maximum[(b)]	2.4×10^{-4}	6.9×10^{-1}
Comanche Peak Unit 1 and 2[(c)]	9.6×10^{-6} and 9.8×10^{-6}	not available [(d)]
Current Reactor Mean[(b)]	2.7×10^{-5}	1.6×10^{-1}
Current Reactor Median[(b)]	1.6×10^{-5}	1.3×10^{-1}
Current Reactor Minimum[(b)]	1.9×10^{-6}	3.4×10^{-3}
US-APWR[(e)(f)] at Comanche Peak	5.3×10^{-7}	4.1×10^{-3}

(a) To convert person-Sv to person-rem, multiply by 100.

(b) Based on MACCS and MACCS2 calculations for 76 current plants at 44 sites.

(c) (Westinghouse 2007).

(d) No license renewal has been submitted for Comanche Peak Units 1 and 2; hence, no data are available.

(e) Population dose risk includes risk associated with internal and externally initiated events with the reactor at power.

(f) Calculated with MACCS2 code using Comanche Peak site-specific input (Luminant 2009a).

Even though this accident scenario is remote and speculative, Luminant made a bounding estimate of the population dose risk by postulating that a severe accident at one CPNPP unit could cause a severe accident at the remaining units. Luminant estimated the population dose risk for one PWR at the CPNPP site to be about 3 x 10^{-1} person-rem per Ryr^{-1} and further indicated that the cumulative dose risk from all four units would be about 1.2 person-rem/yr

(Luminant 2010d). The NRC staff reviewed Luminant's bounding analysis and concludes that the corresponding environmental risks would still be small based on comparisons with the environmental risks shown in Table 5-22.

The ER does address the risk from internal flood, internal fire, and low power shutdown (LPSD) as a part of the site specific severe accident mitigation alternative (SAMA) analysis. The CDF and LRF associated with fire, flood, and LPSD were estimated in the US-APWR PRA and the results have been reported in US-APWR Design Control Document (DCD), Chapter 19. Table 5-26 presents the mean estimates for CDF and Large Release Frequency (LRF) for each of these contributors. Furthermore, the US-APWR DCD evaluated the uncertainties associated with these estimates and provided the 95 percent upper confidence bounds. The seismic risk was addressed in Chapter 19 of US-APWR DCD via Seismic Margin Analysis (SMA). SMA demonstrated that sufficient margin in seismic design exists by showing that the high confidence of low probability of failures (HCLPFs) of the plant structures and components are greater than the review-level earthquake (RLE). The RLE of US-APWR is 0.5g. Considering the safe shutdown earthquake for Comanche Peak Steam Electric Station Units 1 and 2 is conservatively set at 0.12g in the FSAR for Units 1 and 2 (CPSES 2001), the seismic risk contribution is judged to be negligible.

Table 5-26. The Mean CDF and LRF Estimated Contributions for US-APWR at CPNPP

Contributions	Mean estimated value CDF (Ryr^{-1})	Mean estimated value LRF (Ryr^{-1})
Internal	1.2×10^{-6}	1.0×10^{-7}
Fire	1.7×10^{-6}	1.2×10^{-7}
Internal Flood	1.5×10^{-6}	4.0×10^{-7}
External Flood	Negligible	Negligible
Seismic	Negligible	Negligible
Hurricane	Negligible	Negligible
High Wind/Tornado	7×10^{-8}	Negligible
Low Power Shutdown	2.5×10^{-7}	2.5×10^{-7}

The contributions from high winds/tornadoes and external floods are site specific, and were evaluated by Luminant in support of the COL application. For high winds/tornadoes, Luminant assumed that the plant switchyard and selected turbine building related equipment will be damaged on a tornado strike. However, all systems and components essential for safe shutdown are located within seismic category 1 buildings and have substantial resistance to failure for all but the largest tornado strikes. The Luminant analysis finds that the total CDF caused by a tornado strike is less than 7×10^{-8} per reactor year. For external flood, Luminant found this contribution to be insignificant as the design basis flood elevation provides 14 ft of freeboard under the worst potential flood considerations (Luminant 2009a). Based on this explanation, the NRC staff concludes that the treatment of high winds/tornadoes and external floods is reasonably addressed.

5.11.2.2 Surface-Water Pathways

Surface-water pathways are an extension of the air pathway. These pathways consider the effects of radioactive material deposited on open bodies of water. The surface water pathways of interest include external radiation from submersion in water and activities near the water, ingestion of water, and ingestion of fish and other aquatic creatures. Of these pathways, the

MACCS2 code evaluates only the ingestion of contaminated water. The risks associated with this surface water pathway calculated for the CPNPP site are included in the last column of Table 5-23.

Doses from other surface water pathways are not modeled in MACCS2. However, NUREG-1437 (NRC 1996) contains a bounding estimate of the risk associated with uninterdicted consumption of aquatic foods for the current units based on the Fermi 2 site located on Lake Erie (NRC 1981). This risk is 14 person-Sv/ Ryr^{-1}. The Fermi site has similar annual precipitation and wind data to other sites analyzed within the scope of NUREG-1437, and has surface-water areas of the same order of magnitude or greater than all other sites evaluated. The Fermi analysis of water-related exposure pathways also suggests that population exposures from swimming are significantly lower than exposures from the aquatic food ingestion pathway. Considering the estimated population of about 2.7 millions within 50 mi radius of CPNPP site by the year 2056, the individual dose from aquatic food consumption around the CPNPP site would be about 6×10^{-6} person-Sv/ Ryr^{-1}. Comparing this dose risk with the average individual dose risk from water ingestion from Table 5-23 (i.e., 1.6×10^{-4} person-SV/ Ryr^{-1}) confirms the position taken by both NUREG-1437 (NRC 1996), and the ER is correct, and in fact for the CPNPP site, the dose risk from aquatic food ingestion is negligible. Further, should a severe accident occur at a US-APWR located at the CPNPP site, it is likely that Federal, State, and local officials would restrict access to SCR near the site. These actions would further reduce aquatic food ingestion pathway risk. At sites such as the CPNPP site, interdiction could reduce the risk by a factor of 2 to 10 (NRC 1996). Thus, the dose risk for the aquatic food path is expected to be significantly smaller than other pathway dose risk estimates.

5.11.2.3 Groundwater Pathway

MACCS2 does not evaluate the environmental risks associated with severe accident releases of radioactive material to groundwater. However, this pathway has been addressed by NUREG-1437 for current generation reactors (NRC 1996). In NUREG-1437, the NRC staff assumes a 1×10^{-4} Ryr^{-1} probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination. The NRC staff concluded that groundwater contribution to risk is generally a small fraction of the risk attributable to the atmospheric pathway.

The NRC staff has re-evaluated its assumption of a 1×10^{-4} Ryr^{-1} probability of a basemat melt-through. The NRC staff believes that the 1×10^{-4} probability is too large for new plants because the probability of core melt with basemat melt-through should be no larger than the total CDF estimate for the reactor.

Table 5-26 gives a total CDF estimate of 4.7×10^{-6} Ryr^{-1} for the US-APWR. NUREG-1150 indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. New designs include features to reduce the probability of basemat melt-through in the event of a core melt accident. On this basis, the NRC staff believes that a basemat melt-through probability of less than 1.7×10^{-7} Ryr^{-1} (MHI 2008) is reasonable and still conservative. Further, if the CDF for US-APWR severe accidents in which containment remains intact are subtracted from the total US-APWR CDF to get the CDF for severe accidents in which basemat melt-through is a possibility, the remaining CDF is on the order of 1.0×10^{-7} $Ryr^{-1}$for internal event initiators and 8.0×10^{-7} $Ryr^{-1}$for all initiators including internal events and low-power and shutdown events. Considering that the US-APWR provides a highly reliable reactor cavity flooding system, and coolant water is continuously supplied during a severe accident the likelihood of the basemat melt-through is expected to be reasonably low.

The groundwater pathway is more tortuous and affords more time for implementing protective and remedial actions than the atmospheric pathway and, therefore, results in a lower risk to the public. As a result, the NRC staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on overall risk of a severe accident for the two US-APWRs at the CPNPP site.

5.11.2.4 Summary of Severe Accident Impacts

The NRC staff has reviewed the analysis in the ER, FSAR, and DCD for the purpose of determining the potential environmental impacts of severe accidents. Based on this review, the NRC staff concludes that the overall severe accident risk for proposed Comanche Peak Units 3 and 4 is low. The NRC staff is currently reviewing the risk analyses presented in the FSAR to confirm this conclusion and determine compliance with the NRC's safety regulations (10 CFR 52.79) and the Commission's safety goals. The results of that review will be presented in the Safety Evaluation Report prepared by the NRC staff regarding the COL application. The NRC staff also conducted a confirmatory analysis of the probability-weighted consequences of severe accidents for proposed Comanche Peak Units 3 and 4 using the MACCS2 code, The results of the Luminant analysis and the NRC analysis indicate that the environmental risks associated with severe accidents if two US-APWRs were to be located at Comanche Peak site would be small compared to risks associated with operation of the current-generation reactors at the Comanche Peak site and other sites. On these bases, the NRC staff concludes that the environmental impact of the probability-weighted consequences of severe accidents at the Comanche Peak site would be SMALL for the proposed US-APWR reactors.

5.11.3 Severe Accident Mitigation Alternatives

Luminant references a US-APWR design that incorporates many features intended to reduce severe accident CDFs and risks associated with severe accidents. The expected effectiveness of the US-APWR reactor design features in reducing risk is evident in Tables 5-25 and 5-26, which compare CDFs and severe accident risks for the design with CDFs and risks for current-generation reactors including CPNPP Units 1 and 2. Core damage frequencies and risks have generally been reduced by a factor of 2 or more when compared to the existing units.

The purpose of the evaluation of SAMAs is to determine whether there are severe accident design mitigation alternatives (SAMDAs) or procedural modifications or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000b). Consistent with direction from the Commission to consider the SAMDAs at the time of certification, the US-APWR vendor has considered 156 design alternatives for a US-APWR at a generic site (MHI 2009).

The US-APWR design already has numerous plant features intended to reduce CDF and risk; as a result, the benefits and risk reduction potential of any additional plant improvements are significantly reduced from those of existing reactors. This reduction is true for both internally and externally initiated events. Moreover, with the features already incorporated in the US-APWR design, the ability to estimate CDFs and risk is approaching the limits of probabilistic techniques. Specifically, when estimated CDFs are on the order of 1 in 1,000,000 years, areas of the probabilistic risk assessment where modeling is least complete, or supporting data are sparse or even nonexistent, may include important contributors to the remaining risk. However, the NRC staff does not expect that either improvements in modeling or data would change its conclusions.

In its ER (Luminant 2009a), Luminant assesses 156 SAMDAs that were considered in the US-APWR DCD (MHI 2009) using the CPNPP site-specific information. Using procedures set forth in NUREG/BR-0184 (NRC 1997), Luminant determined that the maximum averted cost risk for a single US-APWR at the CPNPP site is so low that none of the SAMDAs is cost beneficial. A more realistic assessment would show that the potential reductions in cost risk are substantially less than the maximum averted cost risk because no SAMDA can reduce the remaining risk to zero.

SAMDAs are a subset of the SAMA review. The other portion of the SAMA review includes procedural modifications and training activities. Alternatives in these areas were not addressed in the generic SAMDA analysis conducted by MHI for design certification (MHI 2009). Luminant has stated that administrative SAMAs would not be appropriate to evaluate until the plant design is finalized, and that the appropriate administrative controls on plant operations would be incorporated into the plant's managements systems as part of its baseline configuration (Luminant FSAR 2009, Chapter 19 [Luminant 2009b]).

Appendix I contains a detailed review of the MHI and Luminant SAMA analyses and presents the NRC staff conclusions related to the Luminant Comanche Peak site-specific analysis. After reviewing the Luminant analysis, the NRC staff concludes that there are no US-APWR SAMDAs that would be cost beneficial at the Comanche Peak site.

As discussed in Appendix I, because the maximum attainable benefit is so low, a SAMA based on procedures or training for an US-APWR at the Comanche Peak site would have to reduce the CDF or risk by 20 percent to become cost beneficial. Based on its evaluation, the NRC staff concludes that it is unlikely that any of the SAMAs based on procedures or training would reduce the CDF or risk that much. Therefore, the NRC staff further concludes it is unlikely that these SAMAs would be cost effective. In addition, based on statements by Luminant in the ER (Luminant 2009a), the NRC staff expects that Luminant will consider risk insights in the development of procedures and training. However, this expectation is not crucial to the NRC staff's conclusions because the NRC staff already concluded procedural and training SAMAs would be unlikely to be cost effective. Therefore, the NRC staff concludes that SAMAs have been appropriately considered.

5.11.4 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from DBAs and severe accidents for a US-APWR reactor at the CPNPP site. Based on the information provided by Luminant and the NRC's own independent review, the NRC staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed CPNPP Units 2 and 3 would be SMALL, and no further mitigation would be warranted.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of the proposed Units 3 and 4, the review team relied on Luminant's compliance with the following measures and controls that would limit adverse environmental impacts:

- Compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, storm-water management, spill response and cleanup, hazardous material management);
- Compliance with applicable requirements of permits or licenses required for operation of the new units (e.g., Corps' Section 404 Permit, National Pollutant Discharge Elimination System [NPDES]);
- Compliance with existing CPNPP Unit 1 and 2 processes and/or procedures applicable to environmental compliance activities during operation of proposed Units 3 and 4 at the CPNPP site (e.g., solid waste management, hazardous waste management, and spill prevention and response);
- Incorporation of environmental requirements into construction contracts; and
- Implementation of BMPs.

Table 5-27, which is the review team's adaptation from sections of Luminant's Table 5.10-1 in Luminant's ER (Luminant 2009a), lists a summary of measures and controls to limit adverse impacts during operation proposed by Luminant. The review team considered these measures and controls in its evaluation of the impacts of plant operation.

5.13 Summary of Operational Impacts

The review team's evaluation of the environmental impacts of operations of proposed Units 3 and 4 is summarized in Table 5-28. Impact category levels are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts. Some impacts, such as the addition of tax revenue from Luminant for the local economies, are likely to be beneficial and are noted as such in the Impact Level column.

Table 5-27. Summary of Measures and Controls Proposed by Luminant to Limit Adverse Impacts During Operation

Resource Area	Specific Measures and Controls
Land-Use Impacts	
The Site and Vicinity	• Limit continued disturbance of vegetation to the area within the site designated for CPNPP construction
Transmission Line ROW and Offsite Areas	• Unknown – Pending transmission line study
Water-Related Impacts	
Hydrologic Alterations and Plant Water Supply	• Avoid usage of groundwater sources. • Implement Storm Water Pollution Prevention Plan (SWPPP) as part of the proposed Units 3 and 4 NPDES permit to minimize releases. • Install multi-port diffuser pipes to maximize thermal and chemical dissolution. • Install erosional control devices to stabilize the banks, if needed.
Water-Use Impacts	• Cooling and Plant Water Systems are designed to minimize the amount of water needed, SCR spillage for Brazos, and use of Luminant contracted water. • Effluent discharges are limited, compliance with Clean Water Act regulations (40 CFR Part 423), compliance with the sites amended TPDES regulations and blowdown is treated to minimize discharge of residual chemicals. • Compliance with Wheeler Branch Reservoir and supply water from the Paluxy River, tributary to the Brazos River, SCR spillage for BRA use, and use of Luminant contracted water
Cooling System Impacts	
Intake Structure	
Hydrodynamic Descriptions and Physical Impacts	• To limit impact of noise associated with operations of water makeup pumps protective hearing equipment will be used, as appropriate, by employees working near the pumps and cooling towers. • Stabilize banks of the embayment and shoreline with erosion controls, as needed. • Water intake design to avoid buildup of sediment deposits and littoral debris

Table 5-27. (contd)

Resource Area	Specific Measures and Controls
Aquatic Ecosystems	• Utilization of closed-cycle cooling and cooling towers using the best technology available. • Design of intake structures to ensure minimum water velocity through screens that are designed to prevent fish from being drawn into the intake structure. • Makeup water is expected to be supplied by the low-flow reservoir during low flow conditions to minimize impact resulting from Lake Granbury water consumption.
Discharge System	
Aquatic Ecosystems	• To the extent practical, equipment is employed and positioned so as to reduce scouring and turbidity effects. • Blowdown is treated to minimize discharge of residual chemicals. • Intake structure constructed using Best Available Technology. • Reduction of thermal plume effects on aquatic organisms through use of cooling towers and closed-loop cooling cycle. Hazardous effluents are treated according to RCRA, CWA, and TPDES permit requirements.
Heat Discharge System	
Heat Dissipation to the Atmosphere	• Drift eliminators are used in cooling towers to minimize the amount of water lost for the towers via drift. • Blowdown is treated to minimize total dissolved content of circulating water.
Terrestrial Ecosystems	• Cooling towers are designed to minimize noise levels and drift. • Use a salt fence around the perimeter of the BDTF to reduce salt drift in adjoining terrestrial habitats.

Table 5-27. (contd)

Resource Area	Specific Measures and Controls
Impacts to Members of the Public	• As applicable, workers are trained in compliance with Noise Control Act (NCA), 42 USC 4901 et seq. and Occupational Safety and Health Act (OSHA) • To limit impact of noise associated with operations of water makeup pumps protective hearing equipment will be used, as appropriate, by employees working near the pumps and cooling towers • Water is periodically monitored and tested for thermophilic microorganisms according to the Centers for Disease Control's Surveillance for Waterborne-Disease Outbreaks-United States. • Workers are trained on safe work procedures including, as appropriate, the use of air respirators.
Radiological Impacts of Normal Operation	
Exposure Pathways	• Calculated doses for all exposure pathways less than guidelines established in 10 CFR Part 50, Appendix I, and regulatory limits set in 40 CFR Part 190. • Effluent discharges must comply with requirements specified in 10 CFR Part 20. • Comply with requirements and design to maintain dose ALARA. • Implement radiological monitoring program.
Radiation doses to Members of the Public	• Calculated doses for all exposure pathways less than guidelines established in 10 CFR Part 50, Appendix I, and regulatory limits set in 40 CFR Part 190. • Comply with requirements and design to maintain dose ALARA. • Implement radiological monitoring program.
Impact to Members of the Public	• Calculated doses for all exposure pathways less than guidelines established in 10 CFR Part 50, Appendix I, and regulatory limits set in 40 CFR Part 190. • Comply with requirements and design to maintain dose ALARA. • Implement radiological monitoring program.

Table 5-27. (contd)

Resource Area	Specific Measures and Controls
Impacts to Biota Other than Members of the Public	• Use of exposure guidelines, such as 40 CFR Part 190, which apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. The international Council on Radiation Protection states that "… if man is adequately protected then other living things are also likely to be sufficiently protected," and uses human protection to infer environmental protection from the effects of ionizing radiation.
Occupational Radiation Doses	• Based on the available data on the US-APWR design, the maximum annual occupational dose is estimated to be 0.7 person-Sv. Impacts to workers from occupational radiation doses are SMALL and do not warrant additional mitigation.
Accidents	
Design Basis Accidents	• Calculated dose consequences of design basis accidents for the US-APWR at the CPNPP site were found to be within regulatory limits.
Severe Accidents	• Calculated probability-weighted consequences of severe accidents for the US-APWR at the CPNPP site were found to be lower than the probability- weighted consequences for current operating reactors.

Table 5-27. (contd)

Resource Area	Specific Measures and Controls
Environmental Impacts of Waste	
Nonradioactive Waste System Impacts	• All discharges will comply with TCEQ NPDES permit and applicable water quality standards. • Hazardous waste is carefully monitored. • Approved transporters and approved offsite disposal facilities for disposal of solid wastes are used. A waste program for waste minimization through reuse, recycling and product selection will be created. • Sanitary waste is treated at an approved sewage treatment plant by licensed operators. • Non-hazardous non-radioactive waste is generated and disposed of according to applicable local, state, and federal regulations, including the Solid Waste Disposal Act, as amended, 42 USC 6901 et seq. • Inspections are performed to ensure that all waste is managed according to applicable laws and regulations • Employees are trained to follow applicable procedures, waste regulations, and chemical awareness information. • Discharges from the sediment retention pond are monitored in accordance with the SWPPP. • Minor air emissions sources are operated in accordance with applicable federal state, and local regulations.
Mixed Waste Impacts	• The inventory of mixed waste is maintained in a designated storage area and monitored prior to offsite disposal. • Transport of mixed waste is done by licensed hazardous/mixed waste carriers. • Mixed waste is limited though source reduction, recycling and treatment options. • Inspections are performed to ensure that all waste is managed according to applicable laws and regulations. • Mixed-waste storage assures that chemical and radiological exposures are minimized both by ALARA and chemical awareness training programs.
Waste Minimization	• Comply with current Waste Minimization Plan developed for existing Units 1 and 2 to address hazardous waste management, treatment (decay in storage), work planning, waste tracking, and awareness training.

Table 5-27. (contd)

Resource Area	Specific Measures and Controls
Transmission and Pipeline ROW Impacts	
Terrestrial Ecosystems	• Employees are trained on how to perform work in a manner that reduces adverse environmental impacts. • Minimize potential impacts through compliance with permitting requirements and best management practices. • To the extent feasible, avoid any additional disturbances on critical or sensitive terrestrial habitats/species. • As practical, machinery use, noise suppression//mufflers, and vehicles are maintained to reduce emissions. • Readily available spill response materials and personnel trained to respond to, clean-up and report spills. • Employees are trained in hazardous materials/waste procedures to minimize the risk of spills. • Herbicides are applied by trained employees licensed to apply herbicides.
Aquatic Ecosystems	• Minimize potential impacts through compliance with permitting requirements and best management practices. • To the extent feasible, avoid any additional disturbances on critical or sensitive aquatic habitats/species. • As practical, cleared areas are reseeded to limit erosion, • Apply appropriate erosion control (grassed or wooded buffer strips, board roads, and removable mats). Obtain a permit before dredge or fill activities • Herbicides are applied by using proper management practices by trained employees who possess an application permit • Employees are trained in hazardous materials/waste procedures to minimize the risk of spills. • Perform routine over-flights to prevent unauthorized encroachment.

Table 5-27. (contd)

Resource Area	Specific Measures and Controls
Impacts to Members of the Public	• Transmission lines built to standards. • Natural vegetation is retained at road and river crossings during construction to help minimize ground-level visual impacts unless engineering requirements dictate otherwise. • Transmission towers would be designed to reduce any impact to important scenic view areas. • No towers along the new transmission lines are expected to exceed 200 ft in height, nor are there any airports, airstrips, or heliports within 20,000 ft of the transmission line corridors currently under review.
Uranium Fuel Cycle Impacts	• Comparison of the US-APWR reactor, which was normalized for a reference 1000 MWe LWR, to Table S–3 values, as shown in Table 5.7-1 in Luminant's ER, show that the impacts evaluated (land use, water use, fossil fuels, chemical effluents, radioactive effluents and wastes, occupational exposure, and transportation), would all be minor and require no action to warrant mitigation. • Possible use of centrifuge uranium enrichment process in lieu of gaseous diffusion process, which significantly reduces energy use and resultant environmental effects
Socioeconomic Impacts	
Physical Impacts of Proposed Units	• Improvement of SH 144 and FM 56 and the potential additional entrance to the site. • Zoning and land-use restriction may be used to help manage development. • Train and appropriately protect CPNPP employees to reduce the risk or potential exposure to noise. • Monitor release of waste emissions and effluents. • Train workers on procedures and regulations involving waste emissions and effluents

Table 5-27. (contd)

Impact Category	Specific Measures and Controls
Social and Economic Impacts of Proposed Units	• Based on vacancy data from the 2000 Census, sufficient housing units are available. • Diversify settlement of new workers into several communities. • Increased property and worker-related taxes can help offset some of the problems related to increased population such as community facilities and infrastructure, police, fire protection, and schools. • Local land zoning and ordinances can help mitigate potential socioeconomic growth problems. • Optimization study completed to design the cooling towers to economically limit the amount of water potentially consumed. • Provide appropriate job-training to workers. • Community relation group to manage concerns from adjacent residents or visitors on a case-by-case basis through an employee-concerns resolution program. • Provide onsite services for emergency first aid, and conduct regular health and safety monitoring.
Air Quality	• Obtain air permits and operate systems within permit limits, and monitor emissions as required.
Historic and Cultural Resources	• Consult with SHPO if a cultural resource is discovered. • Follow established procedures to halt work if a potential unanticipated historic, cultural, or paleontological resource is discovered.
Nonradiological Health Impacts	• Implement site-wide Safety and Medical Program, including safety policies, safe work practices, as well as general and topic-specific training. • Take measures that could include monitoring workers, providing radiation worker training, and developing work plans that minimize worker radiation exposure.

Source: Adapted from Luminant 2009a

Table 5-28. Summary of Operational Impacts at the Proposed Unit 3 and 4 Comanche Peak Site

Resource Area	Comments	Impact Category Level
Land-Use Impacts		
The Site and Vicinity	Without more case history data on the misters and salt fence, the review team cannot rule out possible vegetation injury on private property located south of the BDTF due to salt drift.	SMALL to MODERATE
Transmission Line and Pipeline Corridors	No substantial impacts expected.	SMALL
Water-Related Impacts		
Water Use		
Surface Water	Withdrawal and use of water from Lake Granbury for use by CPNPP Units 3 and 4 would result in lower water levels in the lake and decreased flows in the Brazos River downstream of the DeCordova Dam. In addition, Brazos River system operations would be altered to accommodate the additional withdrawals. These operational changes would include changes in the timing of water releases from Possum Kingdom Lake, resulting in lower water levels in that lake. Seasonal distribution of streamflow downstream from Possum Kingdom Lake would be altered, with lower flows during the wetter months (typically May and June) and higher flows during the drier months of the year.	MODERATE
Groundwater	There would be no increase in the use of groundwater at the CPNPP site due to operation of CPNPP Units 3 and 4.	SMALL

Table 5-28. (contd)

Resource Area	Comments	Impact Category Level
Water Quality		
Surface Water	The increased inflows from Possum Kingdom Lake to Lake Granbury will increase the ambient concentrations of naturally-occurring TDS and chlorides in Lake Granbury. During low-flow conditions, the blowdown discharge diffuser may operate less effectively than during high-flow periods, and although the effluent concentrations are designed to be within water quality criteria, they may be above ambient concentrations in Lake Granbury and result in locally elevated concentrations in the vicinity of the diffuser due to less-effective mixing.	SMALL to MODERATE
Groundwater	Implementation of the SWPPP would reduce the potential for leaks and spills such that any impacts to groundwater quality from leaks and spills would be minor. Some release and deposition of salts would occur during operation of the cooling towers and/or the salt spray discharged by the misters at the BDTF. Impacts to groundwater quality from salt deposition would be minor because shallow groundwater in the vicinity of the evaporation pond site is not used for water supply.	SMALL to MODERATE
Ecological Impacts		
Terrestrial Ecosystems	Without more case history data on the misters and salt fence, the review team cannot rule out possible vegetation injury due to salt drift from the BDTF. Impacts due to cooling system operation to shoreline vegetation on Lake Granbury and Possum Kingdom Reservoir would be noticeable, but not drastic enough to destabilize important attributes of the resource. Operation of transmission line across BDTF could cause bird collision mortality.	MODERATE

Table 5-28. (contd)

Resource Area	Comments	Impact Category Level
Aquatic Ecosystems and Wetlands	The effects on water levels in Lake Granbury and PKLdue to withdrawals to support the operation of Units 3 and 4 would result in potential impacts to aquatic resources in the lakes, possibly including the State-listed Brazos water snake; while these impacts are somewhat uncertain, they likely would range from negligible to noticeable. Impacts to wetlands during operations would be minor.	SMALL to MODERATE
Socioeconomic Impacts		
Physical Impacts	No significant physical impacts on workers and the local public, buildings, roads, aesthetics, noise, or air quality.	SMALL
Demography	Population growth would be small and more than offset by the large population decrease when operations begin and most of the in-migrating construction workers leave the area.	SMALL
Impacts to Community – Social and Economic		
Economy	Significant employment and income benefits in Somervell and Hood Counties, but much less significant in the rest of the six-county study area.	MODERATE to LARGE (Beneficial)
Taxes	Significant tax benefits to Somervell County and, to a lesser extent, Hood County. Much less significant in the rest of the six-county study area.	LARGE (Beneficial) in Somervell County to SMALL elsewhere
Infrastructure and Community Services		
Transportation	Minimal traffic impacts compared to those expected during project development, especially given possible mitigation measures implemented during project development.	SMALL

Table 5-28. (contd)

Resource Area	Comments	Impact Category Level
Recreation	No significant impacts to most recreational resources; noticeable adverse impacts to recreational use of Lake Granbury and Possum Kingdom Lake due to decreased water levels during drought periods.	SMALL to MODERATE
Housing	No significant impacts; possible short-term, minor impact on housing prices as more units become available when operations begin and some in-migrating construction workers leave the area.	SMALL
Public Services	No significant impacts on water and wastewater, solid waste, police, fire, and medical services, or social services	SMALL
Education	No significant impacts on educational services.	SMALL
Environmental Justice	The operation of CPNPP Units 3 and 4 would not have any disproportionately high and adverse human health or environmental effects on minority or low-income populations through the pathways of soil, water, and air. Similarly, the impacts of operations on socioeconomic resources would not have any disproportionately high and adverse effects on minority or low-income populations.	SMALL
Historic and Cultural Resources	There are no known historic or cultural impacts at this site. Luminant has agreed to follow procedures if historic or cultural resources are discovered during ground-disturbing activities.	SMALL
Air Quality	Operation of the cooling towers and intermittent operation of various diesel generators would be the primary emissions sources for air pollutants.	SMALL

Table 5-28. (contd)

Resource Area	Comments	Impact Category Level
Nonradiological Health Impacts	Traffic accident impacts during operations would increase local traffic impacts by a small, if not imperceptible, amount. The impact of noise from the operation of water pumps could be noticeable, depending on the final pump design and equipment choices.	SMALL to MODERATE
Radiological Impacts		
Members of the Public	Doses to members of the public would be below NRC and EPA standards and there would be no observable health impacts (10 CFR Part 20, Appendix I to 10 CFR Part 50, 40 CFR Part 190).	SMALL
Plant Workers	Occupational doses to plant workers would be below NRC standards and program to maintain doses ALARA would be implemented.	SMALL
Biota other than Humans	Doses to biota other than humans would be well below NCRP and IAEA guidelines.	SMALL
Nonradioactive Waste	Current Luminant practices and procedures would help minimize waste generation at Units 3 and 4. Solid, liquid, gaseous and mixed wastes generated during the operation of Units 3 and 4 would be handled according to county, State and Federal regulations.	SMALL
Impacts of Postulated Accidents		
Design-Basis Accidents	Impacts of design basis accidents would be well below regulatory criteria.	SMALL
Severe Accidents	Probability-weighted consequences of severe accidents would be lower than the Commission's safety goals and probability-weighted consequences for currently operating reactors.	SMALL

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29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

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6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle (UFC) and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of proposed Units 3 and 4 at the Comanche Peak Nuclear Power Plant (CPNPP) site.

In its evaluation of UFC impacts from the proposed CPNPP Units 3 and 4, Luminant Power Generation Company LLC (Luminant) used the design for the U.S. Advanced Pressurized-Water Reactor (US-APWR), an advanced light-water reactor (LWR), by Mitsubishi Heavy Industries Ltd. (MHI) (MHI 2009). The capacity factor reported by Luminant for the US-APWR is 95 percent. The results reported here assume two units with a capacity factor of 95 percent.

6.1 Fuel Cycle Impacts and Solid Waste Management

This section discusses the environmental impacts from the UFC and solid waste management for the US-APWR design. The environmental impacts of this design are evaluated against specific criteria for LWR designs at Title 10 of the Code of Federal Regulations (CFR) 51.51.

The regulations in 10 CFR 51.51(a) state that:

> Under §51.50 every environmental report (ER) prepared for the construction permit stage or early site permit or combined license (COL) stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data in 10 CFR Part 51.51, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low level wastes and high level wastes related to UFC activities to the environmental costs of licensing the nuclear power reactor. Table S-3 shall be included in the ER and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The US-APWRs proposed for Units 3 and 4 at the CPNPP site are LWRs that will use uranium dioxide (UO2) fuel; therefore, Table S-3 (10 CFR 51.51[b]) can be used to assess environmental impacts of the UFC. Table S-3 values are normalized for a reference 1000-MW(e) LWR at an 80 percent capacity factor. The 10 CFR 51.51(a) Table S-3 values are reproduced in Table 6-1. Each US-APWR unit is rated at 4451 MW(t) (MHI 2009). For the two US-APWR units to be located on the CPNPP site, the combined power rating for both units is 8902 MW(t). Each US-APWR reactor unit is rated at 1700 MW(e), of which 100 MW(e) is used for station and auxiliary loads, leaving 1600 MW(e) net electrical output when the reactor is operating (MHI 2009). With a capacity factor of 95 percent (Luminant 2009a), each US-APWR unit produces an average of 1520 MW(e). For two US-APWR units, this corresponds to 3040 MW(e).

Table 6-1. Uranium Fuel Cycle Environmental Data as Provided in Table S-3 of 10 CFR 51.51(b)[a]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[b]	100	
Undisturbed area	79	
Disturbed area	22	*Equivalent to a 100-MW(e) coal-fired power plant.*
Permanently committed	13	
Overburden moved (millions of MT)	2.8	*Equivalent to a 95-MW(e) coal-fired power plant.*
Water (millions of gallons):		
Discharged to air	160	*= 2 percent of model 1000-MW(e) LWR with cooling tower.*
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	*<4 percent of model 1000 MW(e) with once-through cooling.*
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	*<5 percent of model 1000 MW(e) LWR output.*
Equivalent coal (thousands of MT)	118	*Equivalent to the consumption of a 45-MW(e) coal-fired power plant.*
Natural gas (millions of standard cubic feet)	135	*<0.4 percent of model 1000 MW(e) energy output.*
Effluents--Chemical (MT)		
Gases (including entrainment):[c]		
SO_x	4400	
NO_x[d]	1190	*Equivalent to emissions from 45 MW(e) coal-fired plant for a year.*
Hydrocarbons	14	
CO	29.6	
Particulates	1154	
Other gases:		
F	0.67	*Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. The concentration is within the range of state standard-below level that has effects on human health.*
HCl	0.014	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Liquids:		
SO_4^-	9.9	*From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs, NO_3—20 cfs, Fluoride—70 cfs.*
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10	
Fe	0.4	
Tailings solutions (thousands of MT)	240	*From mills only–no significant effluents to environment.*
Solids	91,000	*Principally from mills–no significant effluents to environment.*
Effluents–Radiological (curies)		
Gases (including entrainment):		
Rn-222		*Presently under reconsideration by the Commission.*
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	0.14	*Principally from fuel reprocessing plants.*
I-129	1.3	
I-131	0.83	
Tc-99		*Presently under consideration by the Commission.*
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	*Principally from milling–included tailings liquor and returned to ground–no effluents; therefore, no effect on environment.*
Ra-226	0.0034	*From UF_6 production.*
Th-230	0.0015	
Th-234	0.01	*From fuel fabrication plants–concentration 10 percent of 10 CFR Part 20 for total processing 26 annual fuel requirements for model LWR.*
Fission and activation products	5.9×10^{-6}	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
Solids (buried onsite):		
Other than high level (shallow)	11,300	9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^7	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4063	<5 percent of model1000-MW(e) LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

(a) In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the table. Table S-3 does not include health effects from the effluents described in the table, or estimates of releases of radon-222 from the uranium fuel cycle, or estimates of technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the *Environmental Survey of the Uranium Fuel Cycle*, WASH-1248 (AEC 1974); the *Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle*, NUREG-0116 (Supp.1 to WASH-1248) (NRC 1976); the *Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle*, NUREG-0216 (Supp. 2 to WASH-1248) (NRC 1977b); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S-4 of Sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

(b) The contributions to temporarily committed land from reprocessing are not prorated over 30 years, because the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2 percent from natural gas use and process.

Source: Adapted from Table S-3 in 10 CFR 51.51(b). Some minor changes have been made to format and wording but not to the data as it appears in Table S-3.

Specific categories of environmental considerations are included in Table S-3 (see Table 6-1). These categories relate to land use; water consumption and thermal effluents; radioactive releases; burial of transuranic waste, high-level waste (HLW), and low-level waste (LLW); and radiation doses from transportation and occupational exposures. In developing Table S-3, the U. S. Nuclear Regulatory Commission (NRC) staff considered two UFC options that differed in the treatment of spent fuel removed from a reactor. The "no-recycle" option treats all spent fuel as waste to be stored at a Federal waste repository, whereas the "uranium-only recycle" option involves reprocessing spent fuel torecover unused uranium and returning it to the system.

Neither cycle involves the recovery of plutonium or the use of mixed-oxide (MOX) fuel derived from recycle. The contributions in Table S-3 resulting from reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium only and no-recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The UFC is defined as the total of those operations and processes associated with provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

The Nuclear Non-Proliferation Act of 1978 (22 USC 3201, et seq.), significantly impacted the disposition of spent nuclear fuel by deferring indefinitely the commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power program. While the ban on the reprocessing of spent fuel was lifted during the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the nuclear power industry in the United States stagnated, providing little incentive for the industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005 (Public Law 109-58) was enacted. It authorized the U.S. Department of Energy (DOE) to conduct an advanced fuel-recycling technology research and development program to evaluate proliferation-resistant fuel recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional DOE efforts would be necessary before commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power plants could commence.

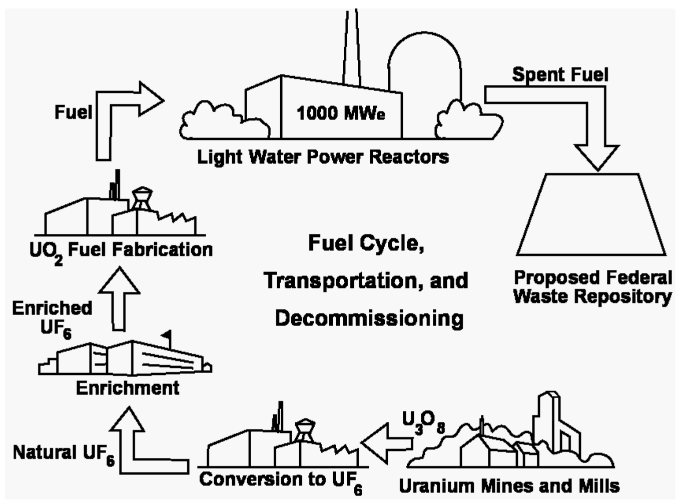

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (Derived from NRC 1999)

The no-recycle option is presented schematically in Figure 6-1. Natural uranium is mined in either open-pit or underground mines or by an *in situ* leach solution mining process. *In situ* leach mining, presently the primary form of uranium mining in the United States, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or *in situ* leach solution is transferred to mills where it is processed to produce “yellowcake” (U_3O_8). A conversion facility accepts the uranium oxide as feed and then converts it to uranium hexafluoride (UF_6), which is then processed by an enrichment facility to increase the percentage of the more-fissile isotope uranium-235 and to decrease the percentage of the nonfissile isotope uranium-238. At a fuel fabrication facility, the enriched UF_6, which is approximately 5 percent uranium-235, is converted to UO_2. The UO_2 is milled, pelletized, sintered, and inserted into tubes to form fuel assemblies, which are placed in a reactor to produce power. When the content of the uranium-235 reaches a point at which the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor as spent fuel. After onsite storage for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies would be transferred to a waste repository for geologic interment. Disposal of spent fuel elements in a repository constitutes the final step in the no-recycle option.

The following assessment of the environmental impacts of the UFC as related to the operation of the proposed CPNPP Units 3 and 4 project is based on the values given in Table S-3 (Table 6-1) and on the NRC staff's analysis of the radiological impact from radon-222 and technetium-99. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, NRC 1999)[(a)], the NRC staff provides a detailed analysis of the environmental impacts from the UFC. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR design considered here uses the same type of fuel. The NRC staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and provided below.

The UFC impacts in Table S-3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). As explained above, the total net electric output for the proposed two new units at the CPNPP site is 3040MW(e) ; this is about 3.8 times the impact values in Table S-3 (Table 6-1) [i.e., 3040 MW(e) divided by 800 MW(e) yields 3.8]. In the following review and evaluation of the environmental impacts of the UFC, the NRC staff multiplied the values in Table S-3 by a factor of 4 rather than 3.8, scaling the impact upward to account for the increased electric generation of the two proposed US-APWRs. Throughout this chapter, this will be referred to as the 1000-MW(e) LWR-scaled model reflecting 3040 MW(e) for the site.

Recent changes in the UFC may have some bearing on environmental impacts; however, as discussed below, the NRC staff is confident that the contemporary normalized UFC impacts are below those identified in Table S-3. This assertion is true in light of the following recent UFC trends in the United States:

- Increasing use of *in situ* leach uranium mining, which does not produce mine tailings.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifugation. The latter process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion.
- Current LWRs use nuclear fuel more efficiently due to higher fuel burnup. Therefore, less uranium fuel per reactor-year of reactor operation is required than in the past to generate the same amount of electricity.
- Fewer spent fuel assemblies per reactor-year are discharged; hence the waste storage/repository impact is lessened.

The values in Table S-3 were calculated from industry averages for the performance of each type of facility or operation within the UFC. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the NRC staff followed the policy of choosing the assumptions or factors to be applied so that the calculated CPNPP Units 3 and 4 values would not be underestimated. This approach was intended to ensure that the actual environmental impacts would be less than the quantities shown in Table S-3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle UFC parameters and interactions were recognized by the NRC staff as being less precise than the estimates and

(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

were not considered or were considered but had no effect on the Table S-3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S-3, the NRC staff defined the model reactor as a 1000-MW(e) LWR reactor operating at 80 percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 megawatt days per metric ton of uranium (MWd/MTU). This is a "reactor reference year" or "reference reactor year," depending on the source (either Table S-3 or NUREG-1437), but it has the same meaning. If approved, the COLs for the proposed Units 3 and 4 would allow 40 years of operation. In NUREG-1437, the sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This was the approach followed by the NRC staff in NUREG-1437 for both boiling water reactors (BWRs) and pressurized water reactors (PWRs); the higher annual requirement, 35 metric tons (MT) of uranium made into fuel for a BWR, was chosen in NUREG-1437 as the basis for the reference reactor year (NRC 1996). The average annual fuel requirement presented in NUREG-1437 would only be increased by 2 percent if a 40-year lifetime were evaluated. However, a number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements per reactor-year. Since the time when Table S-3 was promulgated, these improvements have reduced the annual fuel requirement, which means the Table S-3 assumptions remain bounding as applied to the proposed Units 3 and 4.

Another change is the elimination of the U.S. restrictions on the importation of foreign uranium. Until recently, the economic conditions of the uranium market favored utilization of foreign uranium at the expense of the domestic uranium industry. From the mid-1980s to 2004, the price of U_3O_8 remained below $20/lb. These market conditions forced the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, more recently the spot price of uranium has increased dramatically (from $24/lb in April 2005 to $135/lb in July 2007) and has remained in the range of $45 to $65/lb range as of June 2009 (Platts 2009). As a result, there is a renewed interest in uranium mining and milling in the United States, and the NRC anticipates receiving multiple license applications for uranium mining and milling in the next several years. Most of the applications are expected to be for in situ leach-solution mining, which does not produce tailings. Factoring in changes to the UFC suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S-3; however, Table S-3 estimates have not been reduced for these analyses.

In sum, these reasons highlight why Table S-3 is likely to overestimate impacts from the proposed Units 3 and 4 and therefore remains a bounding approach for this analysis.

Section 6.2 of NUREG-1437 discusses the sensitivity to changes in the UFC on the environmental impacts in greater detail (NRC 1996).

6.1.1 Land Use

The total annual land requirement for the UFC supporting the 1000-MW(e) LWR-scaled model for the proposed two 1600 MW(e) (net) units is about 452 acres (ac). Approximately 52 ac are permanently committed land, and 400 ac are temporarily committed. A "temporary" land commitment is a commitment for the life of the specific UFC plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. "Permanent" commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E, for release of that area for unrestricted use. Of the 400 ac of temporarily committed land, 316 ac are undisturbed and 84 ac are disturbed. In comparison, a coal-fired power plant producing the same megawatt-electric-adjusted output (3200 MWe) as the LWR-scaled model and using strip-mined coal requires the disturbance of about 2500 ac/yr for fuel alone (Fthenakis and Kim 2009). The NRC staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the UFC supporting a 1000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of the UFC, which for Table S-3 is assumed to be based on energy-intensive gaseous diffusion technology. By scaling values found in Table S-3, the NRC staff determined that, of the total annual water use of 4.55×10^{10} gal, about 4.44×10^{10} gallons (gal) are required for the removal of waste heat. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 6.40×10^{8} gal/yr and water discharged to the ground (e.g., mine drainage) of about 5.13×10^{8} gal/yr.

On a thermal effluent basis, annual discharges from the UFC are about 4 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The consumptive water use is about 2 percent of the 1000-MW(e) LWR-scaled model using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the UFC use cooling towers) would be about 6 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. As uranium enrichment technology evolves more toward the gas centrifuge method, water use effects will decrease significantly. The NRC staff concludes that the impacts on water use for those combinations of thermal loadings and water consumption would be SMALL.

6.1.3 Fossil Fuel Impacts

Electric energy and process heat are required during various phases of the UFC process. Most of the electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the UFC represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. This assumes that domestic gaseous diffusion is the sole method of uranium enrichment. Process heat for UFC facilities is primarily generated by the combustion of natural gas. Gas consumption, if used to generate electricity, would represent less than 0.4 percent of the electrical output from the model plant.

The largest source of carbon dioxide (CO_2) emissions associated with nuclear power is from the fuel cycle, not the operation of the plant, as indicated in the previous paragraph and in Table S-3. The CO_2 emissions from the fuel cycle are about 5 percent of the CO_2 emissions from an equivalent fossil fuel-fired plant.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gaseous centrifuge technology is likely to eventually replace gaseous diffusion technology for uranium enrichment in the United States. The same amount of enrichment from a gaseous centrifuge facility uses less electricity and therefore results in lower amounts of air emissions such as CO_2 than a gaseous diffusion facility. The transition toward centrifuge enrichment and the availability of foreign UFC services will continue to decrease the domestic fossil fuel effects of the UFC. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S-3 continue to be appropriately bounding values.

In Appendix J, the NRC staff estimates that the carbon footprint of the fuel cycle to support a reference 1000-MW(e) LWR for a 40-year plant life is on the order of 17,000,000 MT of CO_2 including a very small contribution from other greenhouse gases. Scaling this footprint to the

3040-MW(e) power level of the two US-APWR reactors, the NRC staff estimates the carbon footprint for 40 years of fuel cycle emissions to be 68,000,000 MT (an emission rate of about 1,700,000 MT annually, averaged over the period of operations) of CO_2, as compared to a total United States annual emissions rate of 6,000,000,000 MT (EPA 2010).

On this basis, the NRC staff concludes that the fossil fuel impacts including greenhouse gas emissions from the direct and indirect consumption of electric energy for UFC operations would be SMALL relative to the net power production of the proposed project.

6.1.4 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents with UFC processes are given in Table S-3 (Table 6-1) for the reference 1000-MW(e) LWR and, according to WASH-1248 (AEC 1974), result from the generation of electricity for UFC operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table S-3 states that the UFC for the reference 1000-MW(e) LWR requires 323,000 MW-hr of electricity annually. The UFC for the 1000-MW(e)-scaled model would therefore require four times that annually (1.29 million MW-hr/yr), or 0.031 percent of the 4.1 billion MW-hr of electricity generated in the United States in 2008 (DOE/EIA 2009). Therefore, the gaseous and particulate emissions would add about 0.031 percent to the national emissions for electricity generation. Improvements in enrichment technology and increasing use of foreign UFC services will result in fewer domestic impacts from chemical effluent related to the UFC.

Liquid chemical effluents produced in UFC processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations, and only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S-3 (Table 6-1) specifies the amount of dilution water required for specific constituents. In addition, all liquid discharges into the navigable waters of the United States from plants associated with UFC operations would be subject to requirements and limitations set by appropriate Federal, State, Tribal, and local agencies.

Tailings solutions and solids are generated during the milling process and are not released in quantities sufficient to have a significant impact on the environment.

Based on the discussions above, the NRC staff concludes that the impacts of chemical effluents would be SMALL.

6.1.5 Radiological Effluents

Radioactive effluents estimated to be released to the environment from waste management activities and certain other phases of the UFC process are set forth in Table S-3 (Table 6-1). Using these effluents in NUREG-1437 (NRC 1996), the NRC staff calculated the 100-year environmental dose commitment to the U.S. population from the UFC for 1 year of operation of the model 1000-MW(e) LWR. The total overall whole body gaseous dose commitment and whole body liquid dose commitment from the UFC (excluding reactor releases and dose commitments because of exposure to radon-222 and technetium-99) were calculated to be approximately 400 person-rem and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 4 for the 1000-MW(e) LWR-scaled model results in whole body dose commitment estimates of 1600 person-rem for gaseous releases and 800 person-rem for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 2400 person-rem for the 1000-MW(e) LWR-scaled model.

Currently, the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S-3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. Luminant provided an assessment of radon-222 and technetium-99 in its ER (Luminant 2009a). This evaluation relied on the information discussed in NUREG-1437 (NRC 1996).

In Section 6.2 of NUREG-1437 (NRC 1996), the NRC staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operation of the reference 1000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor year for the 1000-MW(e) LWR-scaled model, or for the total electric power rating for proposed Units 3 and 4 for a year, are approximately 20,800 curies (Ci). Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tails before stabilization. For radon releases from stabilized tailings, the NRC staff assumed that the LWR-scaled model would result in an emission of 4 Ci per site year, [i.e., about four times the estimate found for the reference reactor year in NUREG-1437 (NRC 1996)]. The major risks from radon-222 are from exposure to bone and lung, although there is a small risk from exposure to the whole body. The organ-specific dose-weighting factors from 10 CFR Part 20 were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from mining, milling, and tailings before stabilization for each site year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 3680 person-rem to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 70 person-rem to the whole body. Additional insights regarding Federal policy and resource perspectives concerning institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG-1437 (NRC 1996).

Also, as discussed in NUREG-1437, the NRC staff considered the potential health effects associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor year for the 1000-MW(e) LWR-scaled model are 28 mCi from chemical processing of recycled UF_6 before it enters the isotope enrichment cascade and 20 mCi into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. When organ-specific dose-weighting factors from 10 CFR Part 20 are applied to the doses to the gastrointestinal tract and kidneys, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 400 person-rem for the 1000-MW(e) LWR-scaled model.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. The nominal probability coefficient for total detriment is a factor for the incidence of cancer and other health effects. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem, equal to 0.00057 effects per person-rem. The coefficient is taken from International Commission on Radiological Protection's (ICRP) Publication 103 (ICRP 2007).

The nominal probability coefficient was multiplied by the sum of the estimated whole body population doses from gaseous effluents, liquid effluents, radon-222, and technetium-99 discussed above (approximately 6550 person-rem/yr) to calculate that the U.S. population would incur a total of approximately four fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Radon-222 releases from tailings are indistinguishable from background radiation levels at a few miles from the tailings pile (at less than 0.6 mi in some cases) (NRC 1996). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR Part 190, is 25 mrem/yr to the whole body from the entire UFC, but most NRC licensees have airborne effluents resulting in doses of less than 1 mrem/yr (61 FR 65120).

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

	Source	Dose (mrem/yr)[(a)]	Percent of Total
Ubiquitous background	Radon & Thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Total background sources	**311**	**50**
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Total medical sources	**300**	**48**
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[(b)]	0.1
	Nuclear fuel cycle	0.05[(c)]	0.01
Total		**624**	

(a) NCRP Report 160 table expressed doses in mSv/yr (1 mSv/yr equals 100 mrem/yr).
(b) Occupational dose is regulated separately from public dose and is provided here for informational purposes.
(c) Estimated using 153 person-Sv/yr from Table 6.1 of NCRP 160 and a 2006 US population of 300 million.

Source: NCRP 2009. Report 160, Ionizing Radiation Exposure of the Population of the United States

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (NCI 1990). The report included an evaluation of health statistics around all nuclear power plants and several other UFC facilities in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990). The contribution to the annual average dose received by an individual from UFC -related radiation and other sources as reported in a report published by the National Council on Radiation Protection and Measurements (NCRP 2009) is listed in Table 6-2. The UFC contribution to an individual's annual average radiation dose is extremely small (less than

0.01 mrem per year) compared to the annual average background radiation dose (about 311 mrem/yr). Based on the analyses presented above, the NRC staff concludes that the environmental impacts of radioactive effluents from the UFC are SMALL.

6.1.6 Radiological Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S-3 (Table 6-1).

For LLW disposal at land burial facilities, the Commission notes in Table S-3 that there would be no significant radioactive releases to the environment. CPNPP Units 1 and 2 can no longer dispose of Class B and C LLW at the Energy Solutions site in Barnwell, South Carolina. Proposed Units 3 and 4, if in operation, would also not be able to dispose of these wastes at Barnwell. However, Class A LLW can be shipped to the Energy Solutions site in Clive, Utah. Other disposal sites may be available by the time the two new units would become operational. For example, on September 10, 2009, the Texas Commission on Environmental Quality (TCEQ) (TCEQ 2009) issued Radioactive Material License R04100 to Waste Control Specialists, LLC (WCS) for the construction of a LLW facility in Andrews County, Texas. The facility will accept Class A, B, and C LLW. Once WCS completes construction and satisfies any operational-related conditions imposed by the TCEQ, the facility may begin to receive and dispose of LLW (TCEQ 2009). Construction activities have begun, and disposal activities are estimated to begin in late 2011 (Valhi 2011). Thus, it is likely that this facility would be available to the CPNPP for disposal of LLW. In addition, the industry is investigating alternate disposal pathways for Class B and C LLW, including (1) compaction and storage at offsite vendor locations until disposal is secured, and (2) blending of waste types with subsequent disposal at available disposal sites.

The NRC staff anticipates that licensees would temporarily store Class B and C LLW onsite until offsite storage locations are available. Several operating nuclear power plants have successfully increased onsite storage capacity in the past in accordance with existing NRC regulations. This extended waste storage onsite resulted in no significant increase in dose to the public. In addition, the NRC issued Regulatory Issue Summary 2008-12 (NRC 2008), which included guidance for the extended onsite interim storage of LLW. This guidance addressed the storage of waste in a manner that minimizes potential exposure to workers which may require adding shielding and storing waste in packaging compatible with the waste composition (e.g., chemical and thermal properties).

The NRC staff concluded in NUREG-1437 (NRC 1996) that the radiological impacts from LLW storage would be small and fall within current regulatory requirements. Although NUREG-1437 is for license renewal activities, the staff concludes that the evaluation can be applied to new reactors because radwaste technology and operations will be similar to those for existing operating reactors. In NUREG-1437 (Section 6.4.4.2), the NRC staff concluded that there should be no significant issues or environmental impacts associated with interim storage of LLW generated by nuclear power plants. Interim storage facilities would be used until these wastes could be safely shipped to licensed disposal facilities. Luminant's resolution of LLW disposal issues for the existing CPNPP Units 1 and 2 could also be implemented for the proposed Units 3 and 4.

Current national policy, as found in the Nuclear Waste Policy Act (42 USC 10101, et seq.) mandates that high-level and transuranic wastes are to be buried at a deep geologic repository, such as the proposed repository at Yucca Mountain, Nevada. No release to the environment is expected to be associated with deep geologic disposal because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976), which provides background and context for the high-level and transuranic Table S-3 values established by the Commission, the NRC staff indicates that these high-level and transuranic wastes will be buried and will not be released to the environment.

As a part of the Table S-3 rulemaking the NRC staff evaluated, along with more conservative assumptions, the zero release assumption associated with waste burial in a repository, and the NRC reached an overall generic determination that fuel cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC's position that the zero release assumption was reasonable in the context of the Table S-3 rulemaking to address generically the impacts of the UFC in individual reactor licensing proceedings (*Baltimore Gas & Electric v. Natural Resources Defense Council*, 462 U.S. 87 (1983)).

Further, in the Commission's Waste Confidence Decision and Rule (10 CFR 51.23(a)) (75 FR 81032), the Commission has made the generic determination that "if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in a combination of storage in its spent fuel storage basin and at either onsite or offsite independent spent fuel storage installations. Further, the Commission believes there is reasonable assurance that sufficient mined geologic repository capacity will be available to dispose of the commercial high-level radioactive waste and spent fuel generated in any reactor when necessary." In addition, 10 CFR 51.23(b) applies the generic determination in Section 51.23(a) to provide that "no discussion of any environmental impact of spent fuel storage in reactor facility storage pools or independent spent fuel storage installations (ISFSI) for the period following the term of the . . . reactor combined license or amendment. . .is required in any . . . environmental impact statement . . . prepared in connection with . . . the issuance or amendment of a combined license for a nuclear power reactors under parts 52 or 54 of this chapter."

In the context of operating license renewal, Sections 6.2 and 6.4 of NUREG-1437 (NRC 1996) provide additional description of the generation, storage, and ultimate disposal of LLW, mixed waste, and HLW, including spent fuel from power reactors. These sections conclude that environmental impacts from these activities are small. For the reasons stated above, the NRC staff concludes that the environmental impacts of radioactive waste storage and disposal associated with Units 3 and 4 are SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the UFC for the 1000-MW(e) LWR-scaled model is about 2400 person-rem. This quantity is based on a 600 person-rem occupational dose estimate attributable to all phases of the UFC for the model 1000-MW(e) LWR (NRC 1996). (Most of the dose arises from reprocessing and waste management.) The NRC staff concludes that the environmental impact from this occupational dose would be SMALL because the dose to any individual worker is maintained within the limits of 10 CFR Part 20, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public totals about 2.5 person-rem annually for the reference 1000-MW(e) LWR per Table S-3 (Table 6-1). This quantity corresponds to a dose of 10 person-rem for the 1000-MW(e) LWR-scaled model. The NRC staff concludes that environmental impacts of UFC transportation would be SMALL.

6.1.9 Conclusions

The NRC staff evaluated the environmental impacts of the UFC, as given in Table S-3 from 10 CFR 51.51(b) (Table 6.1), considered the effects of radon-222 and technicium-99, and appropriately scaled the impacts for the proposed CPNPP 3040-MWe (net) system (total for Units 3 and 4) from the Table S-3 model, which is for a single 1000-MW(e) unit. The NRC staff also evaluated the environmental impacts of greenhouse gas emissions from the UFC and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on that evaluation, the NRC staff concludes that the impacts would be SMALL.

6.2 Transportation Impacts

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to the CPNPP site and alternative sites, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of LLW and mixed waste to offsite disposal facilities. The sites evaluated in this EIS include the existing CPNPP site (preferred) near Glen Rose, Texas, and alternative sites identified in Luminant's ER as the Coastal site (Site A, near Victoria, Texas), the Pineland site (Site B, near Lufkin, Texas), and the Tradinghouse site (Site C, near Waco, Texas) (Luminant 2009a). Additional details, including the location of these three alternative sites, can be found in Section 9.3 of this EIS.

The NRC performed a generic analysis of the environmental effects of transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants*, WASH-1238 (AEC 1972) and in a supplement to WASH-1238, NUREG-75/038 (NRC 1975) and found the impact to be minimal. These documents provided the basis for Table S-4 in 10 CFR 51.52, which summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) [1000 to 1500 MW(e)]. Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR. The transportation impacts associated with the CPNPP site were normalized for a reference 1100-MW(e) LWR at an 80 percent capacity factor for comparisons to Table S–4.[(c)] Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor year. The combined dose to the public along the route and dose to onlookers were estimated to result in a collective dose of 3 person-rem per reference reactor year.

Environmental risks of radiological effects during accident conditions, as stated in Table S-4, are minimal. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reactor years and one nonfatal injury in 10 reference reactor years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977a) and NUREG/CR-6672 (Sprung et al. 2000) concluded that impacts were bounded by Table S-4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts are not required when licensing an LWR (i.e., impacts are bounded by Table S-4) if the reactor meets the following criteria.

- The reactor has a core thermal power level not exceeding 3800 MW(t).
- Fuel is in the form of sintered UO_2 pellets having a uranium-235 enrichment not exceeding 4 percent by weight, and the pellets are encapsulated in zircalloy-clad fuel rods.

(c) The basis for Table S-4 is an 1100 MW(e) LWR at an 80% capacity factor (AEC, 1972, NRC 1975). The basis for Table S-3 in 10 CFR 51.51(b) that was discussed in Section 6.1 of this EIS is a 1000 MW(e) LWR with an 80% capacity factor (NRC 1976). However, since the fuel cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

- Average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MTU, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.
- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.
- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (i.e., in Table S-4) are met; if not, then a full description and detailed analysis is required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis; for example, higher burnups (above 33,000 MWd/MTU), enrichments (above 4 percent uranium-235), or thermal power levels (above 3800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) must be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing of new reactors.

In its application, Luminant requested COLs for two additional reactors at its CPNPP site in Somervell and Hood Counties, Texas. The design of the proposed new reactor would be an US-APWR. Each US-APWR reactor has a thermal power rating of 4451 MW(t) and a design net electrical output of 1600 MW(e). The thermal power rating exceeds the 3800 MW(t) condition given in 10 CFR 51.52(a). The US-APWR reactors are expected to operate with a 93 percent capacity factor, so the net electrical output (annualized) is about 1488 MW(e)(Luminant 2009a). Fuel for the plants would be enriched up to about 4.55 weight-percent uranium-235, which exceeds the 10 CFR 51.52(a) condition. In addition, the expected irradiation level of about 46,200 MWd/MTU exceeds the 10 CFR 51.52(a) condition. Therefore, a full description and detailed analysis of transportation impacts is required.

In its ER (Luminant 2009a), Luminant provided a full description and detailed analyses of transportation impacts. In these analyses, radiological impacts of transporting fuel and waste to/from the CPNPP site were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2008). RADTRAN 5.6 was used in this EIS and is the most commonly used transportation impact analysis software in the nuclear industry.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the CPNPP site and to the alternative sites. Radiological impacts of normal operating conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts to populations and maximally exposed individuals (MEIs) are presented. Because the specific fuel fabrication plant for CPNPP Units 3 and 4 are not known at this time, the NRC staff's analysis assumes a "representative" route between the fuel fabrication facility and CPNPP site and the alternative sites. This means that one analysis was done using a "representative" route with one set of route characteristics (distances and population distributions), and that analysis was used to conclude that the impact from radiation dose would be small for the CPNPP site and for each of the alternative sites. Once the location of the fuel fabrication plant is known, there would likely be small differences in the route and dose estimates for the CPNPP site and the alternative sites. However, the radiation doses from transporting unirradiated fuel to the CPNPP site and the alternative sites would still be small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without releasing any radioactive material to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated-fuel shipping containers. Radiation exposures at some level would occur to (1) persons residing along the transportation corridors between the fuel fabrication facility and the CPNPP site or the alternative sites; (2) persons in vehicles traveling on the same route as an unirradiated fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Truck Shipments

Table 6-3 provides the NRC staff's estimate of the number of truck shipments of unirradiated fuel for the US-APWR design compared with those for the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972) operating at 80 percent capacity [880 MW(e)]. After normalization, the number of truck shipments of unirradiated fuel to the proposed CPNPP site and alternative sites would be fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238.

Table 6-3. Numbers of Truck Shipments of Unirradiated Fuel for the Reference LWR and the US-APWR

Reactor Type	Number of Shipments per Reactor Total[(a)]	Unit Electric Generation, MW(e)[(b)]	Capacity Factor[(b)]	Normalized, Shipments per 1100 MW(e)[(c)]
Reference LWR (WASH-1238)	252	1100	0.8	252
CPNPP US-APWR	100	1600	0.93	60

(a) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(b) Unit capacities and capacity factors were taken from WASH-1238 (AEC 1972) for the reference LWR and the ER (Luminant 2009a) for the US-APWR reactor.
(c) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW(e) plant at 80 percent or net electrical output of 880 MW(e) (AEC 1972).

Shipping Mode and Weight Limits

In 10 CFR 51.52 (a)(5), a condition is identified that states all unirradiated fuel is shipped to the reactor by truck. Luminant specifies that unirradiated fuel would be shipped to the reactor site by truck (Luminant 2009a). Table S-4 in 10 CFR 51.52 includes a condition that the truck shipments not exceed 73,000 lb as governed by Federal or State gross vehicle weight restrictions. Luminant states in its ER (Luminant 2009a) that the unirradiated fuel shipments to the proposed CPNPP site would comply with applicable weight restrictions.

Radiological Doses to Transport Workers and the Public

Table S-4 in 10 CFR 51.52, Table S-4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. The doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and number of shipments to which the individuals are exposed. For this EIS, the NRC staff calculated the radiological dose impacts of the transportation of unirradiated fuel for the worker and the public using the RADTRAN 5.6 computer code (Weiner et al.2008).

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 3.3 feet (ft) from the transport vehicle is about 0.1 mrem/hr, which is one percent of the U.S. Department of Transportation (DOT) regulatory limit (49 CFR 173.441). This assumption was also used in the NRC staff's analysis of the US-APWR reactor unirradiated fuel shipments. This assumption is reasonable because the US-APWR reactor fuel materials would be low-dose-rate uranium radionuclides and would be packaged similarly to that described in WASH-1238 (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table 6-3 by 40 years of operation. Other key input parameters (listed in metric units) used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

The RADTRAN 5.6 results for this "generic" unirradiated fuel shipment are as follows:

- Worker dose: 1.85×10^{-3} person-rem/shipment;
- General public dose (onlookers/persons at stops and sharing the highway): 3.79×10^{-3} person-rem/shipment); and
- General public dose (along route/persons living near a highway or truck stop): 5.02×10^{-5} person-rem/shipment.

These values were combined with the average annual shipments of unirradiated fuel for the US-APWR reactor to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts calculated by the NRC staff to workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 0.5 mi of the highway) for transporting unirradiated fuel to the CPNPP site. The cumulative annual dose estimates in Table 6-5 were normalized to 1100 MW(e) [880 MW(e) net electrical output]. The NRC staff performed an independent review and determined that all dose estimates calculated by the staff are bounded by the Table S-4 conditions of 4 person-rem/yr to transportation workers, 3 person-rem/yr to onlookers, and 3 person-rem/yr to members of the public along the route.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological BEIR VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on the method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. The coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from Publication 103 of the International Commission of Radiological Protection (ICRP 2007).

Table 6-4. RADTRAN 5.6 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5 Input Value	Source
Shipping distance, km	3200	AEC 1972[(a)]
Travel fraction—rural	0.90	
Travel fraction—suburban	0.05	NRC 1977a
Travel fraction—urban	0.05	
Population density—rural, persons/km^2	10	
Population density—suburban, persons/km^2	349	DOE 2002a
Population density—urban, persons/km^2	2260	
Vehicle speed—km/hr	88.49	Conservative in transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count—rural, vehicles/hr	530	
Traffic count—suburban, vehicles/hr	760	DOE 2002a
Traffic count—urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC 1972
Packaging length, m	9.1	Approximate length of two US-APWR fuel assemblies placed on end (INEEL 2003)
Number of truck crew	2	AEC 1972, NRC 1977a, and DOE 2002a
Stop time, hr/trip	4	Based on 1 30-minute stop per 400 km (Johnson and Michelhaugh 2003)
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters	

(a) WASH 1238 (AEC 1972) provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for fresh fuel shipments. A 3200-km (2000-mi) “representative” shipping distance was assumed here.

Table 6-5. Radiological Impacts under Normal Conditions of Transporting Unirradiated Fuel to the CPNPP Site and Alternative Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-rem/yr per 1100 MW(e)[(a)] [880 MW(e) net]		
		Workers	Public - Onlookers	Public - Along Route
Reference LWR [WASH-1238 (AEC 1972)]	6.3	1.1×10^{-2}	2.3×10^{-2}	3.2×10^{-4}
US-APWR, CPNPP and Alternative Sites	1.5	4.1×10^{-3}	7.1×10^{-3}	4.3×10^{-5}
10 CFR 51.52, Table S-4 Condition	< 1 per day	4	3	3

(a) Multiply person-rem/yr times 0.01 to obtain doses in person-Sv/yr.

Both NCRP and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995, ICRP 2007). The largest annual collective dose estimate for transporting unirradiated fuel to the CPNPP site and alternative sites was 1.7×10^{-2} person-rem, which is less than the 1754 person-rem value that ICRP and NCRP suggest would most likely result in zero excess health effects.

To place these impacts in perspective, the average U.S. resident receives about 311 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices) (NCRP 2009). Using this average effective dose, the collective population dose from natural background radiation to the population along this representative route would be about 1.4×10^{5} person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the CPNPP and alternative sites are small compared to the collective population dose to the same population from exposure to natural sources of radiation.

MEIs under Normal Transport Conditions

A scenario-based analysis was conducted by the NRC staff to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the CPNPP site and alternative sites. The following discussion applies to unirradiated fuel shipments to, and spent fuel and radioactive shipments from, any of the alternative sites. The analysis is based on information from DOE (DOE 2002b) and incorporates data about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the normalized fuel and waste shipments addressed in this EIS. In all cases, the NRC staff assumed that the dose rate emitted from the shipping containers is 10 mrem/hr at 2 m (6.6 ft) from the side of the transport vehicle. This assumption is conservative, in that the assumed dose rate is the maximum dose rate allowed by DOT regulations (49 CFR 173.441). Most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972, DOE 2002a). An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the CPNPP site and alternative sites. The analysis is described below.

Truck crew member. Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period of time. The analysis assumed that crew member doses are limited to 2 rem per year, which is the DOE administrative control level presented in Chapter 2, Article 211, of *DOE Standard, Radiological Control*, DOE-STD-1098-99 (DOE 2005). This limit is anticipated to apply to spent nuclear fuel shipments to a disposal facility because DOE would take title to the spent fuel at the reactor site. There will be more shipments of spent nuclear fuel from the CPNPP site and alternative sites than there will be shipments of unirradiated fuel and radioactive waste other than spent fuel from these sites. This is because the capacities of spent fuel shipping casks are limited due to their substantial radiation shielding and accident resistance requirements. Spent fuel shipments also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002b). As a result, crew doses from unirradiated fuel and radioactive waste shipments would be lower than the doses from the spent nuclear fuel shipments. The DOE administrative limit of 2 rem/yr (see DOE 2005) is less than the NRC limit for occupational exposures of 5 rem/yr (see 10 CFR Part 20).

The DOT does not regulate annual occupational exposures. It does recognize that air crews are exposed to elevated cosmic radiation levels and recommends dose limits to air crew members from cosmic radiation (DOT 2003). Air passengers are less of a concern because passengers do not fly as frequently as air crew members. The recommended limits are a 5-year effective dose of 2 rem/yr with no more than 5 rem in a single year (DOT 2003). As a result, a 2 rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of spent fuel and waste from the CPNPP site and alternative sites.

Inspectors. Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. The Yucca Mountain Final EIS (DOE 2002b) assumed that inspectors would be exposed for 1 hr at a distance of 1 m (3.3 ft) from the shipping containers. The dose rate at 1 m (3.3 ft) is about 14 mrem/hr; therefore, the dose per shipment is about 14 mrem. This is independent of the location of the reactor site. Based on this conservative value and the assumption that the same person inspects all shipments of fuel and waste to and from the CPNPP site and the alternative sites, the annual doses to vehicle inspectors were calculated by the NRC staff to be about 0.8 rem/yr, based on a combined total of all shipments of unirradiated fuel, spent fuel and radioactive waste to and from the CPNPP site and alternative sites This value is less than the DOE administrative control level (DOE 2005) on individual doses and is also less than the 5 rem/yr NRC occupational dose limit.

Resident. The NRC staff's analysis assumed that a resident lives adjacent to a highway where a shipment would pass and that the resident would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were obtained from the NRC staff's RADTRAN 5.6 output files. These dose estimates are based on an individual located 100 ft from the shipments that are traveling 15 mph. The potential radiation dose to the maximally exposed resident is about 0.3 mrem/yr for shipments of fuel and waste to/from the CPNPP site and alternative sites

Individual stuck in traffic. This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for 1 hr at a distance of 4 ft. The NRC staff's analysis assumed this exposure scenario would occur only one time to any individual and that the dose rate was at the regulatory limit of 10 mrem/hr at 2m (6.6 ft) from the shipment, so the dose will be higher at the assumed exposed distance of 4 ft. The dose to the MEI was calculated to be 16 mrem in DOE's Yucca Mountain Final EIS (DOE 2002b).

Person at a truck service station. This scenario estimates doses to an employee at a service station where all truck shipments to and from the CPNPP site and alternative sites are assumed to stop. It is assumed that this person is exposed for 49 min at a distance of 52 ft from the loaded shipping container (DOE 2002b). The exposure time and distance were based on the observations discussed by Griego et al. (1996). This results in a dose of about 0.55 mrem/shipment and an annual dose of about 48 mrem/yr for the CPNPP site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the CPNPP site and alternative sites.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Accident frequencies for transportation of unirradiated fuel to the CPNPP site or any of the alternative sites are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for Table S-4 in 10 CFR 51.52, because of improvements in highway safety and security, and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published. There is no significant difference in consequences of transportation accidents severe enough to result in a release of unirradiated fuel particles to the environment between the US-APWR and current-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, consistent with the conclusions of

WASH-1238 (AEC 1972), the impacts of accidents during transport of unirradiated fuel for the US-APWR at the CPNPP site and alternative sites are expected to be negligible.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the CPNPP site and alternative sites (that is, the analysis does not consider radiological or hazardous characteristics of the cargo). Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources. The rates (i.e., impacts per vehicle-km traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is as follows:

Impacts = (*unit rate*) × (*round-trip shipping distance*) × (*annual number of shipments*)

In this formula, impacts are presented in units of the number of accidents, number of injuries, and number of fatalities per year. Corresponding unit rates (i.e., impacts per vehicle-km traveled) are used in the calculations.

Accident, injury, and fatality rates were taken from Table 4 in ANL/ESD/TM-150 *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Nation-wide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport unirradiated fuel to the CPNPP site and alternative sites. In addition, the DOE Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System (MCMIS 2009), and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting.

The nonradiological accident impacts calculated by the NRC staff for transporting unirradiated fuel to (and empty shipping containers from) the CPNPP site and alternative sites are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 reference LWR (AEC 1972) are also shown for comparison purposes. Note that there are only small differences between the impacts calculated for an US-APWR at the CPNPP site and alternative sites and the reference LWR in WASH-1238 due entirely to the estimated annual number of shipments.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the CPNPP Site and Alternative Sites, Normalized to Reference LWR[(a)]

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance, km	Round-trip Distance, km per Year	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238)	6.3	3200	4.0×10^{4}	1.8×10^{-2}	9.3×10^{-3}	6.1×10^{-4}
CPNPP and Alternative Sites US-APWR	1.5	3200	5.8×10^{3}	2.6×10^{-3}	1.3×10^{-3}	8.7×10^{-5}

(a) The WASH-1238 reference LWR (AEC 1972)

6.2.2 Transportation of Spent Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting spent fuel from the proposed CPNPP site and alternative sites to a spent fuel disposal repository. For the purposes of those analyses, the staff considered the proposed geologic HLW repository at the Yucca Mountain site in Nevada, site as a surrogate destination. Currently, NRC has not made a decision on the proposed geologic repository at Yucca Mountain. However, the NRC staff considers that an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts to a storage or disposal facility because of the distances involved and the representativeness of the distribution of members of the public in urban, suburban, and rural areas (i.e., population distributions) along the shipping routes. Radiological environmental impacts of normal operating conditions and transportation accidents, as well as nonradiological impacts, are discussed in this section.

The NRC's staff analysis is based on shipment of spent fuel by legal-weight trucks in shipping casks with characteristics similar to currently available casks (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Due to the large size and weight of spent fuel shipping casks, each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with those made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999). Because the alternative transportation methods involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999), thereby reducing impacts, these assumptions are conservative. Also, the use of current shipping cask designs for this analysis results in conservative impact estimates because the current designs are based on transporting short-cooled spent fuel (approximately 120 days out of the reactor). Future shipping casks would be designed to transport longer-cooled fuel (greater than 5 years out of the reactor) and would require much less shielding to meet external dose limitations. Therefore, future shipping casks are expected to have higher cargo capacities, thus reducing the numbers of shipments and associated impacts.

Radiological impacts of transportation of spent fuel were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2008). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from Transportation Routing Analysis Geographic Information System (TRAGIS) code (Johnson and Michelhaugh 2003). The population data in the TRAGIS code are based on the 2000 census. Nonradiological impacts were calculated using published traffic accident, injury, and fatality data (Saricks and Tompkins 1999) in addition to route information from TRAGIS (Johnson and Michelhaugh 2003). Traffic accident rates input to RADTRAN 5.6 and nonradiological impact calculation were adjusted to account for under-reporting, as discussed in Section 6.2.1.3

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" conditions, are transportation activities in which shipments reach their destination without an accident occurring en route. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation exposures would occur to the following populations: (1) persons residing along the transportation corridors between the CPNPP site or any of the alternative sites and the proposed repository location; (2) persons in vehicles traveling on the same route as a spent fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers (drivers). For the purposes of this analysis, it was assumed that the destination for the spent fuel shipments would be the proposed Yucca Mountain disposal facility in Nevada. This assumption is conservative because it tends to maximize the shipping distance from the CPNPP site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the US-APWR. Information in Early Site Permit Environmental Report Sections and Supporting Documentation (INEEL 2003) indicated that advanced LWR fuel designs would not be significantly different from existing LWR fuel designs; therefore, current shipping cask designs were used for the analysis of US-APWR spent fuel shipments. The NRC staff assumed that the capacity of a truck shipment of US-APWR spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972). This assumption results in conservative estimates for future shipments because shipping casks designed for 10-year-cooled fuel would have three or more times this capacity, resulting in fewer shipments and lower impacts.

Input to RADTRAN 5.6 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2003) for highway routes from the proposed CPNPP site and alternative sites to the proposed geologic HLW repository at Yucca Mountain. The resulting route characteristics information generated by the NRC staff is shown in Table 6-7. Note that for truck shipments, all the spent fuel is assumed to be shipped to the Yucca Mountain site over designated highway-route controlled-quantity routes. In addition, TRAGIS data was loaded into RADTRAN 5.6 on a state-by-state basis. This increases precision and could allow the results to be presented for each state along the route between the CPNPP site and alternative sites and the proposed geologic HLW repository at Yucca Mountain, if desired.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, the number in the truck crew, stop time, and population density at stops. A listing of the values for these and other parameters that were used in the NRC staff's analysis and the sources of the information is provided in Table 6-8.

Table 6-7. Transportation Route Information for Shipments from the CPNPP Site and Alternative Sites to the Proposed Geologic Repository at Yucca Mountain, Nevada (Johnson and Michelhaugh 2003) Spent Fuel Disposal Facility

Advance Reactor Site	One-way Shipping Distance, km				Population Density, persons/km^2			Stop time per trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
CPNPP Site	2568	2198	317	53	8.1	344.6	2268	4
Site A (Coastal)	2848	2480	316	53	7.3	346.5	2363	4
Site B (Pineland)	3095	2501	489	105	8.5	380.3	2393	5
Site C (Tradinghouse)	2605	2227	324	54	8.1	341.7	2242	4

Note: This table presents aggregated route characteristics provided by TRAGIS (Johnson and Michelhaugh 2003), including estimated distances from the alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

For purposes of this analysis, the transportation crew for spent fuel shipments delivered by truck is assumed to consist of two drivers. Escort vehicles and drivers were considered, but they were not included because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers and would be negligible. Stop times for refueling and rest were assumed to accrue at the rate of 30 min per 4 hr driving time. TRAGIS outputs were used to estimate the number of stops (Johnson and Michelhaugh 2003). Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5.6 analyses. For this analysis, doses to the public at refueling and rest stops ("stop doses") are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure 6-2. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is similar to that used by Sprung et al. (2000). Population densities and shielding factors were also taken from Sprung et al. (2000), which were based on the observations of Griego et al. (1996).

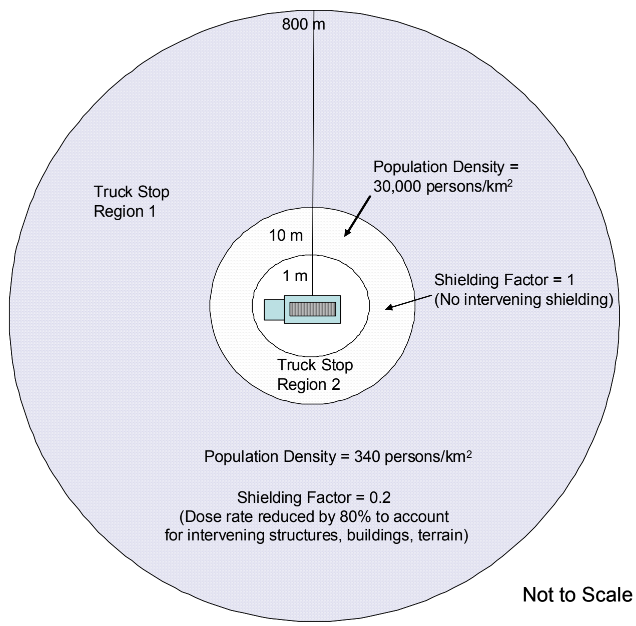

Figure 6-2. Illustration of Truck Stop Model

Table 6-8. RADTRAN 5.6 Normal (Incident-Free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count—Rural, vehicles/hr Traffic count—Suburban, vehicles/hr Traffic count—Urban, vehicles/hr	State-specific	Weiner et al. (2008)
Vehicle occupancy, persons/vehicle	1.5	DOE (2002a)
Dose rate at 1 m from vehicle, mrem/hr	14	DOE (2002a, 2002b)—approximate dose rate at 1 m that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle.
Packaging dimensions, m	Length—5.2 Diameter—1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a, 2002b)
Stop time, hr/trip	4	See Table 6-5
Population Density at Stops, persons/km^2	30,000	Sprung et al. (2000). Nine persons within 10 m of vehicle. See Figure 6-2.
Min/Max Radii of Annular Area Around Vehicle at Stops, m	1 to 10	Sprung et al. (2000)
Dimensionless Shielding Factor Applied to Annular Area Surrounding Vehicle at Stops	1 (no shielding)	Sprung et al. (2000)
Population Density Surrounding Truck Stops, persons/km^2	340	Sprung et al. (2000)
Min/Max Radius of Annular Area Surrounding Truck Stop, m	10 to 800	Sprung et al. (2000)
Dimensionless Shielding Factor Applied to Annular Area Surrounding Truck Stop	0.2	Sprung et al. (2000)

The results calculated by the NRC staff for these normal (incident-free) exposure calculations are shown in Table 6-9 for the proposed CPNPP site and alternative sites. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and persons on highways exposed to the spent fuel shipment), and persons along the route (persons living near the highway). Shipping schedules for spent fuel generated by the proposed new unit have not been determined. It was judged by the NRC staff to be reasonable to calculate the annual doses assuming the annual number of spent fuel shipments is equivalent to the annual refueling requirements. Population doses were normalized to the reference LWR in WASH-1238 (880 net MW[e]) (AEC 1972). This corresponds to an 1100-MW(e) LWR operating at 80 percent capacity.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the CPNPP Site and Alternative Sites to the Proposed High-Level Waste Repository at Yucca Mountain

	Worker (Crew)	Along Route	Onlookers
Reference LWR,[(a)] Person-rem/yr[(b)]	1.3×10^{1}	7.1×10^{-1}	2.5×10^{1}
CPNPP COLs Normalized Impacts, person-rem/yr	2.0×10^{0}	1.1×10^{-1}	3.7×10^{-1}
Alternate Site A (Coastal)	2.4×10^{0}	9.1×10^{-2}	3.9×10^{-1}
Alternate Site B (Pineland)	2.5×10^{0}	9.5×10^{-2}	3.9×10^{-1}
Alternate Site C (Tradinghouse)	2.0×10^{0}	1.1×10^{-1}	3.7×10^{-1}
Table S-4 Condition	4×10^{0}	3×10^{0}	3×10^{0}

(a) WASH-1238 reference reactor (AEC 1972).
(b) To convert person-rem to person-Sv, divide by 100.

There are only small differences in transportation impacts among the four sites evaluated. In general, the CPNPP site and the Alternate Site C have slightly lower impacts than the Alternate Site A and Alternate Site B because of the shorter shipping distance to the proposed geologic HLW repository at Yucca Mountain. However, the differences among sites are relatively minor and all less than the uncertainty in the analytical results.

The bounding cumulative doses to the exposed population given in Table S-4 (10 CFR 51.52) are as follows:

- 4 person-rem/yr to transport workers
- 3 person-rem/yr) to general public (onlookers), and members of the public along the route.

The calculated population doses to the crew and onlookers for the reference LWR and the CPNPP site and alternative site shipments exceed Table S-4 values (10 CFR 51.52). A key reason for the higher population doses relative to Table S-4 is the longer shipping distances assumed for this COL analysis (i.e., to a possible repository in Nevada) than were used in WASH-1238. WASH-1238 assumed that each spent fuel shipment would travel a distance of 1000 mi, whereas the shipping distances used in this assessment were about 1500 to 1900 mi (AEC 1972). Other important differences are the model related to vehicle stops described above and the additional precision that results from incorporating state-specific route characteristics and vehicle densities (vehicles per hour).

Where necessary, the NRC staff made conservative assumptions to calculate impacts. Some of the key conservative assumptions are:

- Use of the Regulatory Maximum Dose Rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 Calculations.

  The shipping casks assumed in the EIS prepared by DOE in support of the application for the proposed geologic HLW repository at Yucca Mountain (DOE 2002b) were designed to transport spent fuel that has cooled for 5 years (see 10 CFR 961, Subpart B). Most spent fuel would have cooled for much longer than 5 years before it would be shipped to a possible geologic repository. Based on this assumption, shipments from the CPNPP site or from any of the alternative sites are also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 could be further reduced if more realistic dose rate projections and shipping cask capacities are used.

- <u>Use of 30 Min as the Average Time at a Truck Stop in the Calculations</u>.

  Many stops made for spent fuel shipments, for example, for brief visual inspections of the cargo (e.g., checking the cask tie-downs), are of short duration (i.e., 10 min). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided in Griego et al. (1996) indicate that a 30-min duration is toward the high end of the stop time distribution. Average stop times observed by Griego et al (1996) are on the order of 18 min.

A sensitivity study was performed to demonstrate the effects of using more realistic dose rates and stop times on the incident-free population doses. For the study, the dose rate was reduced to 5 mrem/hr, the approximate 50 percent confidence interval of the dose rate distribution estimated by Sprung et al. (2000) for future spent fuel shipments. The stop time was reduced to 18 min per stop. All other RADTRAN 5.6 input values were unchanged. The result is that the annual crew doses were reduced to about 35 percent of the annual dose shown in Table 6-9, about 0.7 person-rem/yr. The annual onlooker doses were reduced to 1.1 person-rem/yr (28 percent) and the annual doses to persons along the route were reduced to 0.04 person-rem/yr (36 percent).

In its ER (Luminant 2009a) Luminant described the results of a RADTRAN 5.6 analysis of the impacts of incident-free transport of spent fuel to the proposed geologic HLW repository at Yucca Mountain. Although the overall approaches are the same (e.g., use of TRAGIS and RADTRAN 5.6), there are some differences in the modeling details. For example, the NRC staff's analysis used state-by-state route characteristics and a shipment capacity of 0.5 MTU whereas Luminant elected to use aggregated route information The NRC staff concluded that the results produced by Luminant are similar to those calculated by the NRC staff in this EIS.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the staff estimated the annual collective public dose impacts for transporting spent fuel from the CPNPP site and alternative sites to Yucca Mountain to be about 18 person-rem/yr, which is less than the 1754 person-rem value that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most likely result in zero excess health effects. This dose is very small compared to the estimated 2.8×10^5 person-rem that the same population along the route from the proposed CPNPP site to Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population doses along the Comanche Peak-to-Yucca Mountain route from natural background radiation are different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS because the route characteristics are different. A generic route was used in Section 6.2.1.1 for unirradiated fuel shipments and the actual highway route was used in this section for spent fuel shipments.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and wastes under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Accidents

As discussed previously, the NRC staff used the RADTRAN 5.6 computer code to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN 5.6 considers a spectrum of postulated transportation accidents, ranging from those with high frequencies and low consequences (e.g., "fender benders") to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were taken from Luminant's ER (Luminant 2009a).

Spent fuel inventories used in the NRC staff's analysis are presented in Table 6-10. Table 6-10 lists all of the radionuclides that were included in the analysis conducted by Sprung et al. (2000). The NRC staff's analysis also included the estimated inventory of crud (radioactive material deposited on the external surfaces of LWR spent fuel rods). Because crud is deposited from corrosion products generated elsewhere in the reactor cooling system and the complete reactor design and operating parameters are uncertain, the quantities and characteristics of crud deposited on US-APWR reactor spent fuel are not available at this time. The CPNPP US-APWR spent fuel transportation accident impacts were calculated in this EIS and in Luminant's ER (Luminant 2009a), assuming the cobalt-60 inventory in the form of crud is 76 Ci/MTU, based on information in Sprung et al. (2000).

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for the US-APWR[(a)(b)]

Radionuclide	Ci/MTU	Bq/MTU	Physical-Chemical Group
Am-241	2.12E+03	7.9E+13	Particulate
Am-242m	2.39E+01	8.8E+11	Particulate
Am-243	8.74E+01	3.2E+12	Particulate
Ce-144	1.63E+04	6.0E+14	Particulate
Cm-242	7.13E+01	2.6E+12	Particulate
Cm-243	6.76E+01	2.5E+12	Particulate
Cm-244	1.47E+03	5.4E+14	Particulate
Co-60	1.01E+02	3.7E+12	Crud
Cs-134	7.52E+04	2.8E+15	Cesium
Cs-137	2.07E+05	7.6E+15	Cesium
Eu-154	1.21E+04	4.5E+14	Particulate
Eu-155	3.22E+03	1.2E+14	Particulate
Kr-85	1.28E+04	4.7E+14	Gas
Pm-147	6.07E+04	2.2E+15	Particulate
Pu-238	1.12E+03	4.1E+14	Particulate
Pu-239	4.78E+02	1.8E+13	Particulate
Pu-240	8.17E+02	3.0E+13	Particulate
Pu-241	1.97E+05	7.3E+15	Particulate
Ru-106	2.89E+04	1.1E+15	Ruthenium
Sb-125	3.98E+03	1.5E+14	Particulate
Sr-90	1.40E+05	5.2E+15	Particulate
Y-90	1.40E+05	5.2E+15	Particulate

(a) Divide Becquerel per Metric Ton Uranium (Bq/MTU) by 3.7×10^{10} to obtain curies per MTU (Ci/MTU).

(b) The source of the spent fuel inventories is Table 7.4-1 in the Comanche Peak ER (Luminant 2009a).

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe postulated hypothetical accident conditions with essentially no loss of containment or shielding capability.

These casks are also designed with fissile material controls to ensure that the spent fuel remains subcritical under normal and accident conditions. According to Sprung et al. (2000), the probability of encountering accident conditions during transport that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The NRC staff assumed that shipping casks approved for transportation of spent fuel from a US-APWR would provide equivalent mechanical and thermal protection of the spent fuel cargo.

Accident frequencies are calculated in RADTRAN 5.6 using user-specified accident rates and conditional shipping cask failure probabilities. State-specific accident rates were taken from Saricks and Tompkins (1999) and used in the RADTRAN 5.6 calculations. The State-specific accident rates were then adjusted to account for underreporting, as described in Section 6.2.1.3. Conditional shipping cask failure probabilities (i.e., the probability of cask failure as a function of the mechanical and thermal conditions applied in an accident) were taken from Sprung et al. (2000).

The RADTRAN 5.6 accident risk calculations were performed using the radionuclide inventories given in Table 6-10. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments to derive estimates of the annual accident risks associated with spent fuel shipments from the CPNPP site and alternative sites to the proposed geologic HLW repository at Yucca Mountain in Nevada. As was done for normal transport exposures, the NRC staff assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000) were used to approximate the impacts from the US-APWR spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions.

The NRC staff used RADTRAN 5.6 to calculate the population dose from the released radioactive material from four of five possible exposure pathways. The fifth pathway, ingestion of contaminated food, was not considered because the staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident. The four pathways are as follows.

- External dose from exposure to the passing cloud of radioactive material (cloudshine).
- External dose from the radionuclides deposited on the ground by the passing plume (groundshine). The NRC staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.
- Internal dose from inhalation of airborne radioactive contaminants (inhalation).
- Internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The NRC staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

Table 6-11 presents the environmental consequences calculated by the NRC staff for transportation accidents when shipping spent fuel from the CPNPP site and the alternative sites to the proposed geologic HLW repository at Yucca Mountain repository. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (see Section 6.2.2.1). The results are normalized to the WASH-1238 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80-percent capacity) (AEC 1972) to provide a common basis for comparison to the impacts listed in Table S-4. Although there are slight differences in impacts among the alternative sites, none of the alternative sites would be clearly favored over the CPNPP site

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual collective public dose estimate for transporting unirradiated fuel to the CPNPP site or any of the alternative sites to the proposed geologic HLW repository at Yucca Mountain is about 1×10^{-4} person-rem/yr, which is less than the 1754 person-rem value that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most likely result in zero excess health effects. This risk is very small compared with the estimated 1.2×10^{5} person-rem/yr that the same population along the route from the proposed CPNPP site to the proposed geologic HLW repository at Yucca Mountain would incur from exposure to natural sources of radiation.

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for an US-APWR Reactor at the CPNPP Site and Alternative Sites Normalized to Reference 1100-MW(e) LWR Net Electrical Generation

	Normalized Population Impacts, Person-rem/yr[(a)]
Reference LWR, Person-rem/yr (AEC 1972)	3.8×10^{-4}
CPNPP Site Normalized Impacts, person-rem/yr	5.9×10^{-5}
Alternate Site A (Coastal)	5.2×10^{-5}
Alternate Site B (Pineland)	5.3×10^{-5}
Alternate Site C (Tradinghouse)	6.3×10^{-5}

(a) Divide person-rem/yr by 100 to obtain person-Sv/yr.

The NRC staff performed a confirmatory evaluation of Luminant's spent fuel transportation accident risk analysis. Luminant used a different, though valid, methodology for the ER calculations (Luminant 2009a). The primary difference was that Luminant assumed aggregated route parameters whereas this EIS used state-by-state shipping distances and population densities. The NRC staff concluded that Luminant's analysis was reasonable and comprehensive and thus was considered to meet the intent of 10 CFR 51.52(b).

6.2.2.3 Nonradiological Impact of Spent Fuel Shipments

The general approach used to calculate nonradiological impacts of spent fuel shipments is the same as that used for unirradiated fuel shipments. The main difference is that the spent fuel shipping route characteristics are better defined, so the state-level accident statistics in Saricks and Tompkins (1999) may be used. State-by-state shipping distances were obtained from the TRAGIS output file (Johnson and Michelhaugh 2003) and were combined with the annual number of shipments and accident, injury, and fatality rates by state from Saricks and Tompkins (1999) to calculate nonradiological impacts. In addition, the accident, injury, and fatality rates from Saricks and Tompkins (1999) were adjusted to account for under-reporting (see Section 6.2.1.3). The results calculated by the NRC staff are shown in Table 6-12.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the CPNPP Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain, Nevada, Normalized to Reference LWR

Site	One-way Shipping Distance, km	Nonradiological Impacts, per year		
		Accidents/yr	Injuries/yr	Fatalities/yr
CPNPP (preferred site)	2568	1.1×10^{-2}	6.2×10^{-2}	4.2×10^{-3}
Alternate Site A (Coastal)	2848	1.3×10^{-2}	6.3×10^{-2}	4.3×10^{-3}
Alternate Site B (Pineland)	3095	1.3×10^{-2}	6.3×10^{-2}	4.3×10^{-3}
Alternate Site C (Tradinghouse)	2605	1.1×10^{-2}	6.2×10^{-2}	4.2×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 9.5 shipments/yr after normalizing to the reference LWR (AEC 1972).

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste other than spent fuel from the CPNPP site and alternative sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows.

- Radioactive waste (except spent fuel) would be packaged and in solid form.
- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or rail.
- The weight limitation of 73,000 lb per truck and 100 tons per cask per railcar would be met.
- Traffic density would be less than the one truck shipment per day or three railcars per month condition.

Radioactive waste other than spent fuel from the US-APWR reactor is expected to be capable of being shipped in compliance with Federal or State weight restrictions. Table 6-13 presents the NRC staff's estimates of annual waste volumes and annual waste shipment numbers for a US-APWR reactor normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). The expected annual waste volume for the US-APWR reactor is estimated at 15,278 ft^3/yr, and the annual number of waste shipments is estimated at 109 shipments per year (Luminant 2009a) after normalization to the reference LWR in WASH-1238. The annual waste volume exceeds that for the 1100-MW(e) reference reactor that was the basis for Table S-4 in 10 CFR 51.52. However, the number of radioactive waste shipments for the US-APWR is somewhat larger than the number that was assumed in WASH-1238 for the reference LWR. The staff reviewed the shipment capacities assumed by Luminant (Luminant 2009a) and concluded that the assumptions are reasonable, based on current LWR operating experience. Therefore, the estimated annual waste volumes for the US-APWR exceed those for the reference LWR, and the number of shipments of radioactive waste to disposal facilities is anticipated to be roughly double those for the reference LWR in WASH-1238.

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste for a US-APWR reactor located at the CPNPP site and alternative sites is well below the one-truck-shipment-per-day condition given in 10 CFR 51.52, Table S-4.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

Table 6-13. Summary of Radioactive Waste Shipments from the CPNPP Site and Alternative Sites

Reactor Type	Waste Generation Information	Annual Waste Volume, m^3/yr per Unit	Electrical Output, MW(e) per Unit	Normalized Rate, m^3/1100 MW(e) Unit (880 MW(e) Net)[(a)]	Shipments/ 1100 MW(e) (880 MW(e) Net) Electrical Output[(b)]
Reference LWR (WASH-1238)	3800 ft^3/yr per unit	108	1100	108	46[(b)]
CPNPP US-APWR	15,278 ft^3/yr per unit[(c)]	433	1600[(c)]	256	109[(d)]

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are 80 percent for the reference LWR (AEC 1972) and 93 percent for the US-APWR (Luminant 2009a). Waste generation for the US-APWR is normalized to 880 MW(e) net electrical output (1100-MW(e) unit with an 80 percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m3 per shipment (AEC 1972).

(c) These values were taken from the ER (Luminant 2009a).

(d) This value was obtained from the Luminant (Luminant 2009a) estimate (109 shipments/yr) to the reference LWR electrical generation output. If the WASH-1238 shipment capacity is used (2.34 m^3 per shipment) in lieu of the Luminant (Luminant 2009a) annual shipment estimate, the normalized shipments from the US-APWR would be about 109 shipments per year.

Nonradiological impacts of radioactive waste shipments were calculated using the same general approach as unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 500 mi one way (AEC 1972). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999). These rates were adjusted to account for under-reporting, as described in Section 6.2.1.3. The results calculated by the NRC staff are presented in Table 6-14. As shown, the calculated non-radiological impacts for transportation of radioactive waste other than spent fuel from the CPNPP site and alternative sites to waste disposal facilities are roughly double the impacts calculated for the reference LWR in WASH-1238.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the CPNPP Site

	Normalized Shipments per Year	One-Way Distance, km	Accidents per Year	Injuries per Year	Fatalities per Year
WASH-1238 (AEC 1972)	46	800	3.3×10^{-2}	1.7×10^{-2}	1.1×10^{-3}
CCNPP US-APWR	109	800	7.7×10^{-2}	4.0×10^{-2}	2.6×10^{-3}

Note: The shipments and impacts have been normalized to the reference LWR; the expected waste volumes and shipments from the Luminant ER were used (Luminant 2009a).

6.2.4 Conclusions

The NRC staff conducted confirmatory analyses and performed independent calculations of potential impacts under normal operating and accident conditions of transporting fuel and wastes to and from an US-APWR reactor proposed to be located at the proposed CPNPP site and alternative sites. To make comparisons to Table S-4 in 10 CFR 51.52, the environmental impacts were adjusted (that is, were normalized) to the environmental impacts associated with the reference LWR in WASH-1238 (AEC 1972) by multiplying the normalized impacts by the ratio of the total electric output for the reference reactor to electrical output for the proposed US-APWR reactor at the CPNPP site and alternative sites.

Because of the conservative approaches and data used to calculate impacts, the actual environmental effects are not likely to exceed those calculated in this EIS. Thus the NRC staff concludes that the environmental impacts of transportation of fuel and radioactive wastes to and from the CPNPP site and alternative sites would be SMALL and that they would be consistent with the environmental impacts associated with transportation of fuel and radioactive wastes from the current-generation reactors presented in Table S-4 of 10 CFR 51.52.

The NRC staff notes on March 3, 2010 (DOE 2010) DOE submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca, Mountain, Nevada. Regardless of the outcome of this motion, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case Texas to Nevada. The distance from the CPNPP site or any of the alternative sites to any new planned repository in the contiguous United States would be no more than double the distance from the CPNPP site to Yucca Mountain. Doubling the environmental impact estimates from the transportation of spent fuel, as presented in this section, would provide a reasonable bounding estimate of the impacts for National Environmental Policy Act (NEPA 1969) purposes. The NRC staff concludes that the environmental impacts of these doubled estimates would still be SMALL.

6.3 Decommissioning Impacts

At the end of the operating life of a nuclear power reactor, NRC regulations require that the facility be decommissioned. The NRC defines decommissioning as the safe removal of a facility from service and the reduction of residual radioactivity to a level permitting termination of the NRC license. Sections 10 CFR 50.75 and 50.82 provide the NRC regulations governing the decommissioning nuclear power reactors. The radiological criteria for termination of the NRC license are in 10 CFR Part 20, Subpart E.

An applicant for a COL is required to certify that sufficient funds will be available to ensure radiological decommissioning at the end of power operations. Luminant included a Decommissioning Funding Assurance Report as Attachment 9 to Part 1 of its COL application for the proposed CPNPP Units 3 and 4 on the CPNPP site near Glen Rose, Texas (Luminant 2009b). Luminant will establish an external sinking funds account to accumulate funds for decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in NUREG-0586, the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, *Supplement 1* (GEIS-DECOM) (NRC 2002). Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the NUREG-0586, Supplement 1. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The NRC staff's evaluation of the environmental impacts of decommissioning presented in NUREG-0586, Supplement 1, identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the US-APWR are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the US-APWR.

The GEIS-DECOM does not specifically address the carbon footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, it discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the CO_2 footprint of decommissioning to be of the order of 70,000 MT without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix J. A 40-yr SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the UFC.

The NRC staff relies upon the bases established in the GEIS-DECOM and concludes the following:

- Doses to the public would be well below applicable regulatory standards regardless of which decommissioning method considered in NUREG-0586, Supplement 1, is used.
- Occupational doses would be well below applicable regulatory standards during the license term.
- The quantities of Class C or greater than Class C wastes generated would be comparable or less than the amounts of solid waste generated by reactors licensed before 2002.
- Air quality impacts of decommissioning are expected to be negligible at the end of the operating term.
- Measures are readily available to avoid potential significant water quality impacts from erosion or spills. The liquid radioactive waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.
- Ecological impacts of decommissioning are expected to be negligible.
- Socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM and the evaluation of air quality impacts from greenhouse gas emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

6.4 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

10 CFR Part 961. Code of Federal Regulations, Title 10, *Energy*. Part 961, “Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Waste.”

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

49 CFR Part 173. Code of Federal Regulations, Title 49, *Protection of Environment*, Part 173, "Shippers-General Requirements for Shipments and Packagings."

61 FR 65120. December 10, 1996. “10 CFR Part 20. Resolution of Dual Regulation of Airborne Effluents of Radioactive Materials; Clean Air Act.” *Federal Register*. Nuclear Regulatory Commission.

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7.0 Cumulative Impacts

The National Environmental Policy Act of 1969, as amended (NEPA), requires a Federal agency to consider the cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

Luminant Generation Company (Luminant) submitted an application for combined licenses (COLs), which included an Environmental Report (ER) (Luminant ER 2009), to construct and operate two Mitsubishi Heavy Industries, Inc., (MHI) U.S. Advanced Pressurized Water Reactor (US-APWR) reactors at the Comanche Peak Nuclear Power Plant (CPNPP) site. When evaluating the potential of building and operating two new units, the U.S. Nuclear Regulatory Commission (NRC) and U.S. Army Corps of Engineers (Corps or USACE) (collectively, review team) considered potential cumulative impacts to resources that could be affected by the construction, preconstruction, operation, and decommissioning of two MHI, US-APWR reactors at the CPNPP site. Cumulative impacts result when the effects of an action are added to or interact with other past, present, and reasonably foreseeable future effects on the same resources. For purposes of this analysis, past actions are those prior to the receipt of the COL application. Present actions are those related to resources from the time of the COL application until the start of NRC-authorized construction of the proposed new units. Future actions are those that are reasonably foreseeable through building and operating the proposed Units 3 and 4, including decommissioning. The geographic area over which past, present, and reasonably foreseeable future actions could contribute to cumulative impacts is dependent on the type of resource considered and is described below for each resource area. The review team considered, among other things, cumulative effects of the proposed Units 3 and 4 with current operations at the existing CPNPP Units 1 and 2.

The approach for this environmental impact statement (EIS) is outlined in the following discussion. To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on guidance developed by the Council on Environmental Quality (CEQ) [Title 40 of the Code of Federal Regulations (CFR) 1508.27]. The three significance levels established by the NRC – SMALL, MODERATE, or LARGE – are defined as follows:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions in the general area surrounding the CPNPP site that would affect the same resources impacted by the proposed new units, regardless of what agency (Federal or non-Federal) or person undertakes such actions. These combined impacts are defined as “cumulative” in 40 CFR 1508.7 and include individually minor but collectively potentially significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impacts analysis, including the effects of past actions. The incremental impacts related to the construction activities requiring NRC authorization [10 CFR 50.10(a)] are described and characterized in Chapter 4, and those related to operations are described and characterized in Chapter 5. These impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area.

This chapter includes an overall cumulative impact assessment for each resource area. NRC staff performed the cumulative impact analysis according to guidance provided in NUREG-1555 and NRC Staff Memorandum *Addressing Construction and Preconstruction, Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011). The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. This assessment includes the impacts of construction and operations for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning impacts described in Chapter 6; and impacts of past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed actions.

The review team visited the CPNPP site in February 2009. The team then used the information provided in the ER, Luminant's responses to Requests for Additional Information (RAIs) issued by the NRC and Corps staff, information from other Federal and State agencies, and information gathered at the CPNPP site visit to evaluate the cumulative impacts of building and operating two new nuclear power plants at the site. To inform the cumulative analysis, the review team researched U.S. Environmental Protection Agency (EPA) databases for recent EISs within Texas, used databases for permits for water discharges in the geographic area, and used the www.recovery.gov website to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Other actions and projects that were identified during this review and considered in the review team's independent analysis of the cumulative effects are described in Table 7-1.

7.1 Land Use

The description of the affected environment in Section 2.2 serves as the baseline for the cumulative impact assessment for land use. As described in Section 4.1, the NRC staff concludes that the impacts of NRC-authorized construction on land use would be SMALL and no further mitigation would be warranted. The combined impacts from construction and preconstruction are also described in Section 4.1 and have been determined by the review team to be SMALL for the project site and vicinity and MODERATE for transmission lines and pipelines. As described in Section 5.1, the review team concludes that the impacts of operations on land use would be SMALL to MODERATE and mitigation could be warranted.

Table 7-1. Projects and Other Actions Considered in the Cumulative Analysis at the CPNPP Site

Project Name	Summary of Project/Activity	Location	Status
Energy Projects			
Operation of CPNPP Units 1 and 2	The CPNPP consists of two existing nuclear generating units (i.e., Units 1 and 2), which began commercial operation in 1991 and 1993, respectively	About 0.5 mi southeast	Operational.[a]
License renewal for CPNPP Units 1 and 2	Extend the operating license of CPNPP Units 1 and 2 for up to an additional 20 years	About 0.5 mi southeast	The operating licenses for existing Units 1 and 2 expire in 2030 and 2033, respectively.[a]
DeCordova Steam Electric Station	A four-turbine, 1084-MW conventional steam generating plant	3.6 mi northeast	Operational.[a]
Wolf Hollow 1	A gas-fired, 730-MW power plant	4.9 mi northeast	Operational.[a]
Transportation Projects			
Highway 121 construction	Highway construction, I-30 to Farm-to-Market Road 1187	35 mi northeast	Proposed.[b]
Southwest to Northeast Rail Corridor	Transportation improvements via light rail to the cities of Fort Worth, Haltom City, North Richland Hills, Colleyville and Grapevine	50 mi northeast	Proposed.[c]
River and Watershed Projects			
Lake Granbury Surface Water and Treatment System (SWATS)	Supplies water to the City of Granbury and the Acton Municipal Utility district. Treatment capacity is 10.5 million gallons per day	10 mi northeast	Operational.[a]
Somervell County Water Supply Project	Construction and operation of two dams (concrete channel dam on the Paluxy River and earthen dam on Wheeler Branch), pump station and pipeline from Paluxy River to Wheeler Branch reservoir, water treatment plant, and water supply distribution systems[d]	Potentially within 5 mi	Dams, reservoir, pumping station and pipeline are complete. Development of water treatment and distribution systems is ongoing as of 2010. Additional expansion of distribution systems is planned in the future.[e]

Table 7-1. (contd)

Project Name	Summary of Project/Activity	Location	Status
New water treatment facility for City of Granbury	New 1.5 million gallon per day water treatment plant	12 mi north	Proposed.[(a)]
Mining Projects and Oil/Gas Industry			
DeCordova Compressor Station	Compressor for the oil and gas industry	3.1 mi northeast	Operational.[(a)]
Various oil and gas exploration and extraction operations	Numerous oil and gas exploration and extraction operations throughout a 50-mi radius of CPNPP Unit 3 and 4 site	Throughout the region	Facilities are in operation but more could be developed as demand increases.[(a)]
Parks			
Dinosaur Valley State Park	Scenic 1500-ac State park that straddles the Paluxy River	About 3 mi southwest	Operational.[(f)]
Squaw Creek Reservoir	Currently closed to public access; however, reopening for limited public access for recreational opportunities is being considered	Immediately adjacent to and east of site	Reopening the reservoir is proposed.[(g)]
Other parks, forests, and reserves	Numerous State and National parks, forests, reserves, and other recreational areas are located within a 50-mi region	Throughout 50-mi region	Parks are currently being managed by National, State, and/or local agencies.

Table 7-1. (contd)

Project Name	Summary of Project/Activity	Location	Status
Other Actions/Projects			
Naval Air Station Forth Worth Joint Reserve Base	Provides training to reservists in preparation for mobilization readiness. Trains and equips air crews and aviation ground support personnel in preparation for deployment.	About 35 mi northwest, in Carswell, Texas	Operational.[h]
Various hospitals and industries that use radioactive materials	Medical and other isotopes	Within 50 mi	Operational in nearby cities and towns.
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and rail; construction of water- and/or wastewater treatment and distribution facilities and associated pipelines, as described in local land use planning documents	Throughout the region	Construction would occur in the future, as described in state and local land use planning documents.

(a) Source: Luminant 2009a.
(b) Source: TxDOT 2010.
(c) Source: FWTA 2010.
(d) Source: Freese and Nichols 2001.
(e) Source: SCWD 2008.
(f) Source: TPWD 2009.
(g) Source: Luminant 2010a.
(h) Source: U.S. Navy 2010.

In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers past, present, and reasonably foreseeable future actions that could impact land use. For this cumulative analysis, the geographic area of interest is defined as Somervell, Hood, and Bosque Counties. Direct and indirect impacts on land use due to construction and operation of CPNPP Units 3 and 4 would be confined to this three-county area. The anticipated routes for development of transmission lines, pipelines, and other offsite ancillary facilities are also confined to these three counties. In addition, impacts due to interactions between the proposed project and other foreseeable activities would not be expected to extend beyond this three-county area.

Historically, land in the three-county area of interest has been used predominantly for ranching and agricultural purposes since the first European settlers arrived in the early- to mid-1800s, with cattle ranches and farms dominating the landscape. Increases in population and urban development began after World War II and accelerated in the period between 1960 and 1980 due partly to the completion of Lake Granbury and CPNPP Units 1 and 2. Even with this increase in urban development, most land in the three counties is still devoted to ranching and farming, with pastureland being the prevalent land use, followed by cropland (TSHA 2010).

Table 7-1 lists projects that, in combination with the proposed development and operation of CPNPP Units 3 and 4, could contribute to cumulative impacts in the region. None of these other projects or actions would contribute to fogging, icing, or salt drift.

Cumulative land-use impacts on the CPNPP site would consist of the additional commitment of land for the proposed Units 3 and 4 to the land already used for Units 1 and 2. Units 1 and 2 together with their supporting facilities presently occupy approximately 203 ac, and it is not anticipated that any additional land would be dedicated to their operation, even if their licenses were renewed. Following post-development revegetation and landscaping, Units 3 and 4 plus their supporting facilities [e.g., cooling towers and blowdown treatment facility (BDTF)] would permanently occupy approximately an additional 550 ac. The result would be a combined total of 753 ac of land dedicated to energy production use on the 7950 ac site, occupying approximately 9 percent of the site. The remainder of the site would continue to be occupied by Squaw Creek Reservoir (SCR) and naturally vegetated buffer lands. Construction, preconstruction, and operational impacts of the new units and associated transmission line and pipeline rights-of-way (ROWs) are addressed in Sections 4.1 and 5.1 of this EIS.

In June 2010, Luminant opened the SCR for limited public use. Outside a security area established around CPNPP (including the existing and proposed units and associated support facilities), members of the public are able to engage in activities such as fishing, boating, and shoreline activities. Development and operation of Units 3 and 4 should not interfere with the recreational opportunities on SCR or otherwise result in adverse effects on recreational land use, since Luminant would control access to the new and existing reactor support facilities and would not allow uses incompatible with the site's primary function for energy production. The opening of SCR could have the beneficial effect of increasing the amount of recreational land in the area of interest.

Other recent and ongoing development actions in the three-county geographic area of interest include the development of Wheeler Branch Reservoir (WBR), located approximately 1 mi south of the site, and Ham Creek Park (HCP), approximately 18 mi southeast. Major development was recently completed at WBR, with installation of the associated water distribution system scheduled to begin in 2010 (SCWD 2010). Before development began, the WBR site was covered by grassland and evergreen and deciduous forest, including a stream valley, all of which are characteristic of the region and the CPNPP site. Construction at HCP is largely complete, with final trail construction scheduled for 2010. This park occupies vacant wooded and open land that had been previously used as a public recreation area until the 1970s. No other major Federal, State, or local actions are foreseen in the area.

Expanded natural gas exploration and extraction activities by private parties could occupy more land and therefore could affect availability of land near the CPNPP site. Natural gas wells are scattered throughout the region, especially in Hood County. Drilling permits are concentrated in eastern Hood County but are also found in other parts of the county and in Somervell County. Following a decade of decline, natural gas production in the area of interest has increased dramatically since 2004. In 2008 wells in Hood County produced approximately 65,411,773 million cubic feet (mcf) of natural gas, more than 83 times the county's production in 2004. Somervell County wells produced approximately 4,915,171 mcf in 2008, or 395 times as much as in 2004. On a smaller scale, production has also increased in Bosque County, rising from 0 mcf in 2004 to 230,463 mcf in 2008 (Railroad Commission of Texas 2010). Although there are a number of the wells in the region, each one occupies only a small area on the land surface, resulting in a limited impact on land use. Natural gas exploration and production wells generally can be operated in a manner compatible with concurrent agricultural use of land, and land supporting wells can typically be used for most other land uses once the wells are removed from service.

New workers would be attracted both by the construction and operation of CPNPP Units 3 and 4 and by the exploration and extraction of natural gas. However, in both cases, workers would be drawn from a region substantially larger than Somervell, Hood, and Bosque Counties. Thus, the impacts of induced land use changes (such as new residential areas and retail and service developments) would be dispersed over that wider region. The review team does not expect this induced urban development to be extensive or concentrated enough to substantially alter land use trends or the general character of the landscape over the three counties.

Texas State Data Center (TSDC) projects that the population in a six-county area surrounding the CPNPP site (including Bosque, Erath, Hood, Johnson, Somervell, and Tarrant Counties) will increase by 41.5 percent by the year 2040 (TSDC 2009). The highest growth in the six-county area is projected to occur in areas close to Fort Worth; however, the more outlying counties are still expected to experience substantial growth. Even with the anticipated growth, the area around the CPNPP site is likely to continue to be predominantly rural in character with the majority of land continuing to be covered by grassland and evergreen and deciduous forest. Recent urbanization in this area has occurred primarily in and around the cities of Granbury and Glen Rose. This trend is likely to continue, with most of the growth occurring in Hood County around and northeast of Lake Granbury, due primarily to recreation home development and commuting patterns associated with Fort Worth. The construction and operations workforce for CPNPP Units 3 and 4 would make a minor contribution to this increase in the urban growth of the region. The cumulative urbanization in the geographic area of interest could alter attributes of land use by reducing natural vegetation and open space in localized areas. However, this would not be expected to substantially affect the overall availability of land for various uses or substantially alter the extent and connectivity of wetlands, forests, and wildlife habitat near the CPNPP site.

The report on Global Climate Change (GCC) Impacts in the United States, provided by the U.S. Global Change Research Program (GCRP), summarizes the projected impacts of future climate changes in the U.S. (Karl et al. 2009). The report divides the U.S. into nine regions. The CPNPP site is located in the Great Plains region. The GCRP climate models for this region project continued warming in all seasons and an increase of as much as 12°F from 2000 to 2090. Additionally, climate models project that there will tend to be less rainfall in this area. The GCRP states that the precipitation decrease projected for the Great Plains could result in a potential reduction in crop yields and livestock productivity, which may change distribution of agricultural and ranching land, as well as reductions in forests and wetlands.

Based on its evaluation, the review team concludes that the cumulative land-use impacts associated with proposed Units 3 and 4 and other projects in the three-county area of interest would be MODERATE. The land-use impacts from development of the transmission lines and pipelines serving CPNPP Units 3 and 4, combined with other ongoing and anticipated offsite land uses in the three-county geographic area of interest, would be sufficient to alter noticeably, but not destabilize, important attributes of land use. The NRC staff concludes that the incremental impacts of NRC-authorized activities (which includes NRC-authorized construction and operations activities but not preconstruction) would be SMALL, and would not contribute substantially to the MODERATE impact characterization. The incremental contribution of the overall CPNPP Units 3 and 4 project, including preconstruction, however, would substantially contribute to the MODERATE impact characterization.

7.2 Water Use and Quality

This section analyzes the cumulative impacts of the proposed new units, the existing CPNPP Units 1 and 2, and other past, present, and reasonably foreseeable projects on water use and water quality.

7.2.1 Water-Use Impacts

This section describes cumulative water use impacts resulting from construction and operation of the proposed CPNPP Units 3 and 4, and their interactions with the surrounding environment. The geographic area of interest for this cumulative analysis of water use and quality is the Brazos G Regional Water Planning Area. This is the region of interest because it encompasses the water resources potentially affected by the proposed project.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impact assessments in this resource area. As described in Section 4.2, the review team concludes that the impacts of NRC-authorized construction activities on water use (including both surface water and groundwater) would be SMALL and that no further mitigation would be warranted. Section 5.2 provides the review team conclusion that the impacts of operations on surface water use would be MODERATE, but no further potential mitigation has been identified. Additionally, in Section 5.2, the review team concluded that the operational effects of the proposed new nuclear units would have a SMALL to MODERATE impact on water quality, but no further potential mitigation has been identified. Also as described in Section 5.2, the review team concludes that impacts to groundwater quantity from operations would be SMALL and no further mitigation would be warranted.

Other past, present, and reasonably foreseeable future actions in the region of interest with a potential to affect water use include the construction of WBR and associated expansion of the Somervell County Water District (SCWD) water supply system, the continued operation of reservoirs (Lake Granbury, SCR, Lake Palo Pinto, Possum Kingdom Lake [PKL], and Lake Whitney), consumptive use by existing steam electric power plants (CPNPP Units 1 and 2 and the DeCordova Power Company LLC natural gas-fired steam electric plant), expanded development of natural gas production from the Barnett Shale, the future operation of WBR, and ongoing and future water use by population growth in the region. Anticipated changes in the Brazos River Authority's (BRA) policies for Brazos River System water management under the pending System Operation Permit (SOP) are intended to accommodate these existing and future uses of Brazos River water. The continuing buildup of sediment in Brazos River System reservoirs may affect future water supply as well.

Climate Change

On a larger spatial and longer time scale, GCC is a subject of national and international interest. The recent compilation of the state of knowledge by the GCRP, a Federal Advisory Committee, has been considered in preparation of this EIS (Karl et al. 2009). Based on a review of multiple sets of global climate model predictions, that report indicates that climate change is projected to result in less spring rainfall in the southern Great Plains region, where the CPNPP site is located. It also indicates that median annual runoff in the subregion that includes the Brazos River basin is estimated to be 2 to 5 percent lower in the years 2041-2060 than it was during the years 1901–1970. Ward (2009) incorporated global climate modeling results into water budgets for four regions of Texas to estimate the potential cumulative impacts on each region's water resources from future climate change and future increases in water demand. His analysis assumes that climate change would increase Texas' statewide air temperatures by 3.6°F and reduce precipitation by 5 percent. Ward's findings also have been considered in preparing this EIS.

7.2.1.1 Surface-Water-Use Impacts

The water availability model (WAM) sanctioned by the Texas Commission on Environmental Quality (TCEQ) to assess the feasibility of new water rights and deliveries is discussed in Section 5.2. Additional WAM results provided by Luminant in support of the BRA SOP are based on water demand growth assumptions defined in the 2060 Brazos Region G Water Plan. Thus, the modeling includes the effects of the past, present, and reasonable foreseeable future actions that may contribute to cumulative impacts. In the Brazos G Region as a whole, water demand is projected to increase 38 percent between 2010 and 2060, from 835,691 ac-ft/yr to 1,150,973 ac-ft/yr (TWDB 2007). Due almost entirely to projected increases in population resulting in increased municipal water use, local water demand from PKL is projected to grow from 12,867 ac-ft/yr in 2020 to 17,283 ac-ft/yr in 2060, and local water demand from Lake Granbury (exclusive of CPNPP Units 3 and 4) is projected to grow from 85,138 ac-ft/yr in 2020 to 107,302 ac-ft/yr in 2060. The model also estimates that reservoir sedimentation will continue to reduce the surface area and capacity of both reservoirs, so that by 2060 PKL holds 79 percent of the volume it held in 2020 (73 percent of its volume in 2005) and Lake Granbury holds only 75 percent of the volume it held in 2020 (68 percent of its volume in 2003) (Freese and Nichols 2008).

These increased water demands and other cumulative changes are expected to result in more frequent occurrence of low water levels in Lakes Granbury and Possum Kingdom, lower average streamflows in the Brazos River, and additional reduction in seasonal variation in streamflow. Water management under the SOP and other Texas Water Development Board (TWDB)-approved strategies would, however, minimize adverse impact on water availability for users with valid water rights under the Texas Water Code.

If GCC results in decreased precipitation and increased temperatures in the Brazos River Basin as many predictions suggest, the resulting reduction in surface runoff and increase in evapotranspiration would contribute to cumulative impacts on surface water quantity by reducing streamflows. Ward (2009) analyzed the effect of climate change on water budgets for the Central Region of Texas, which includes the Brazos River basin. Considering climate conditions and increases in water demand projected for the year 2050, and assuming that new water supplies are developed to meet increased demand, Ward's analysis found that in "normal" years streamflow to the Gulf of Mexico from the Central Region would be 36 percent less than in normal years under baseline conditions for the year 2000. Increased water demand accounts for only a 6 percent reduction in streamflow, with the remainder of the reduction attributed to climate change. Under drought conditions comparable to those of the years 1950 to 1956 (the period that includes the drought of record), the analysis indicates that streamflow to the Gulf would be 24 percent of normal under year 2000 baseline conditions, 18 percent of normal baseline with year 2050 water demand but no change in climate, and just 3 percent of normal if the effect of GCC and the effect of year 2050 water demand are combined.

Based on this analysis, the review team concludes that cumulative impacts on surface-water quantity would be MODERATE to LARGE. Considering non-drought conditions, cumulative impacts would be MODERATE because there would be noticeable alterations in the Brazos River System to accommodate increased water demand and the effects of climate change. Under extreme drought conditions, however, the combined effects of past, present, and reasonably foreseeable stresses on the surface water resource could destabilize the resource, resulting in LARGE impacts. Because CPNPP Unit 3 and 4 withdrawals would be a major new determinant of Brazos River System water management policy but would be a small contributor to cumulative impacts when compared with the impacts of climate change, the review team concludes that the incremental impacts from NRC-authorized activities at proposed CPNPP Units 3 and 4 would be MODERATE.

7.2.1.2 Groundwater-Use Impacts

Construction of the WBR and resulting expansion of surface water supplies in the SCWD service area can be expected to result in some reversal of the groundwater level declines that have occurred historically in the local area, resulting in a positive cumulative impact on groundwater quantity. The planned use of WBR water for potable supply at the CPNPP site would contribute to this positive impact. Additionally, Luminant has indicated that no groundwater would be used during construction or operation of Units 3 and 4.

In the region, use of hydrofracturing to develop natural gas wells in the Barnett Shale is expected to increase water demand in the region, with the majority of the additional water use to be supplied from groundwater sources. Development of one gas well requires 4 to 11 ac-ft of water over a period of about one month (Bené et al. 2007). In 2005, development of gas wells in the Barnett Shale is estimated to have used 7200 ac-ft of water in Texas, including 4300 ac-ft of groundwater. There was no use of groundwater for gas well development in Hood and Somervell Counties during the period 2000-2005, but an analysis done for the TWDB (Bené et al. 2007) projected increased demand in subsequent years. In Hood County, gas well development was estimated to account for 8 to 11 percent of groundwater use in 2006-2010, rising to 15 to 18 percent in 2011-2015, and dropping to 7 to 8 percent in 2016-2020 and 8 to 11 percent in 2021-2025. Corresponding estimates for Somervell County are 19 to 26 percent of groundwater use in 2006-2010, 32 to 40 percent in 2011-2015, 17 to 21 percent in 2016-2020, and 18 to 28 percent in 2021-2025. Modeling of the effect of this and other projected groundwater uses on groundwater levels in the Hosston and Hensell layers (approximately equivalent to the Twin Mountains Formation) of the Trinity aquifer found that groundwater levels in Hood and Somervell Counties would remain the same or rise, depending on the specific layer and the assumed level of water demand for gas well development. Significant declines are projected for these and other aquifers in other parts of the Barnett Shale region (such as the Dallas-Fort Worth area), but these would not interact with any effects from CPNPP Units 3 and 4, so they would not contribute to cumulative impacts.

Based on this analysis, the review team concludes that the cumulative impact on groundwater quantity would be SMALL.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts from construction, preconstruction, and operations of proposed Units 3 and 4, and other past, present, and reasonably foreseeable projects.

In Section 5.2, the review team concluded that the operational effects of the proposed new nuclear units would have a SMALL to MODERATE impact on water quality, but no further potential mitigation has been identified. Impacts to groundwater quality from operations are expected to be SMALL, but possibly could be MODERATE, and could be mitigated through additional monitoring.

Other actions and activities in the region of interest that have a potential to affect water quality include future urbanization, permitted discharges of effluents to the Brazos River and its tributaries, oil and gas exploration and extraction in the region, residential development near the reservoirs, and various construction projects, including the construction of WBR and associated expansion of the SCWD's water supply system and the construction of Ham Creek Park (HCP; a campground at Whitney Lake, about 40 river mi downstream from Lake Granbury). Changes in water quantity, as discussed in Section 7.2.1, also can indirectly affect water quality. Reductions in surface water quantity can affect surface water quality by changing the volume of water available to assimilate contaminants delivered to streams from natural sources and effluent discharges. Changes in groundwater use that affect groundwater levels in an aquifer can affect groundwater quality by increasing or reducing the aquifer's vulnerability to vertical contaminant migration.

7.2.2.1 Surface-Water Quality Impacts

When multiple construction projects occur in a watershed during the same time period, they can have cumulative impacts on surface-water quality that are much larger than the impacts of any one project. Besides WBR and the HCP, the review team has identified no other existing or planned water resources development or control projects that would impact Lake Granbury or the Brazos River downstream. HCP is an existing public park that was closed 20 years ago, but it will be renovated and reopened. HCP is located 18 mi to the south of Lake Granbury (40 Brazos river miles). The construction of the WBR project is likely to be completed before major construction of CPNPP Units 3 and 4 would begin. These activities will all employ best management practices (BMPs) to reduce the impacts of construction on water quality. Because of planned mitigation measures and the separation in distance (HCP) or time (WBR) from the construction of the proposed CPNPP Units 3 and 4, the cumulative impacts to water quality resulting from construction of all three of these projects would be minor.

The review team evaluated information on other sources that could contribute water pollutants to the same surface water bodies that would receive discharges from CPNPP Units 3 and 4. Thirteen sanitary wastewater treatment facilities (including the facility that serves CPNPP Units 1 and 2) discharge effluent to Lake Granbury, Squaw Creek, the Paluxy River, or the Brazos River between Lake Granbury and Lake Whitney (Mitsubishi and Enercon 2009 and Luminant 2010a). These types of discharges can adversely affect water quality by introducing nutrients into the receiving waters and contributing to depletion of dissolved oxygen. Future urbanization would add to these types of impacts. Most of the existing wastewater treatment facilities are small; based on their permit limits, the combined discharge from these facilities could average more than 4.3 million gallon(s) per day (MGD), but their combined total discharge in 2008 was well below 3 MGD, or less than 10% of the volume that Units 3 and 4 would discharge to Lake Granbury. The potential from cumulative impact of these sources is limited by their small size and their geographic dispersal. Because the contaminants they introduce are different in kind from those that would be introduced by the principal discharges from proposed Units 3 and 4, there is little potential for operation of these units to add to their effects on water quality.

Four existing effluent discharges in the area are similar in kind to the effluents from proposed Units 3 and 4, and thus could combine with those effluents to cumulatively affect the water quality of affected surface waters:

- The Luminant DeCordova Power Plant is a substantial source of thermal impacts to Lake Granbury. It is permitted to discharge heated effluent at a rate of 1041.8 MGD at a location about 7 mi upstream from the proposed discharge location for Units 3 and 4. This discharge permit for this source allows a maximum permitted effluent temperature of 110°F and a maximum chlorine concentration of 0.2 mg/L. Discharge at the permitted volume and concentration can create a substantial thermal plume, while introducing 3 tons/day of chlorine into the lake. During 2008, this facility discharged effluent during only six months of the year, at a maximum flow of 612 MGD, peak temperature of 103°F, and maximum chlorine concentration of just half of its permit limit Luminant 2010a). The steam-electric unit of the DeCordova Power Plant that is responsible for this heated effluent was reportedly mothballed in 2009, while four natural gas-fired combustion turbine units are still operating (Luminant 2010b).
- The Lake Granbury Surface Water and Treatment Systems (SWATS) facility discharges water with high concentrations of dissolved solids (similar to the proposed BDTF effluent) to Lake Granbury under a permit that allows discharge of up to 2.5 MGD and daily average concentrations of sulfate and chloride of 4700 and 9900 mg/L, respectively. The permitted concentration of chloride in the SWATS effluent is well above the 1000-mg/L water-quality criterion for the lake. Operating at its permit limits, the SWATS facility could return almost 950 tons/day of chloride to Lake Granbury. However, during 2008 this plant consistently discharged at levels well below its permit limits. At the peak daily flow (710,000 gpd) and the highest daily chloride concentration (1612 mg/L) reported in 2008, this plant would discharge 18 tons/day of chloride to the lake (Luminant 2010a).
- Wolf Hollow Power Plant, which withdraws water from Lake Granbury, discharges its effluent to the Brazos River several miles downstream from DeCordova Dam. This plant is permitted to discharge at an average rate of 1.1 MGD and a maximum of 1.65 MGD, but discharged no more than 517,000 gpd in 2008. The discharge is monitored for parameters typically associated with sanitary wastewater (such as biochemical oxygen demand [BOD] and nitrogen) as well as parameters associated with power plant cooling (such as temperature, dissolved solids concentrations, and chlorine). During 2008, Wolf Hollow discharges had total dissolved solids (TDS) concentrations as high as 6670 mg/L, chloride as high as 2280 mg/L, sulfate as high as 2450. At the peak flow rate and chloride concentration reported in 2008, the plant would discharge 18 tons/day of chloride to the river. Monthly average discharge temperatures ranged from 68 to 88°F, with monthly maximums of 90°F and above year-round (Luminant 2010a).
- CPNPP Units 1 and 2 discharge cooling water, sanitary wastewater treatment effluent, site runoff, and other plant wastewaters to SCR. The cooling water discharge has the most potential for cumulative impacts. Discharge occurred at the full permitted rate of 3168 MGD during most of 2008, and monthly average discharge temperatures ranged from 83 to 110°F, with monthly maximums of 86 to 111°F (Luminant 2010a).

Releases of cooling water from DeCordova Power Plant, Wolf Hollow Power Plant, and the existing CPNPP units cumulatively affect the thermal condition of the Brazos River system by the addition of heat. Effluent from operation of the proposed CPNPP Units 3 and 4 would not increase the temperature of Lake Granbury or releases from Lake Granbury significantly. The proposed operation of Units 3 and 4 would not add significant cumulative impact to the temperature of Lake Granbury.

Under low flow conditions, the proposed operation of Units 3 and 4 would result in effluent discharges with TDS and chloride concentrations greater than ambient concentrations (see Section 5.2.3.2). Such effluent would combine with the impact of the Lake Granbury SWATS and Wolf Hollow Power Plant, also contributors to higher salt concentrations in Lake Granbury, to increase TDS and chloride concentrations in Lake Granbury and the Brazos River downstream.

If GCC results in decreased precipitation and increased temperatures in the Brazos River Basin, as many predictions suggest, the resulting reduction in surface runoff and increase in evapotranspiration would contribute to cumulative impacts on surface water quality. By reducing streamflows, these changes could reduce the ability of Lake Granbury and the Brazos River downstream to dilute natural salt concentrations and waste heat and other constituents in the effluent from Units 3 and 4.

These changes would increase salt concentrations in Lake Granbury and downstream during reduced streamflow conditions, but would not significantly change the existing thermal and chemical profiles of Lake Granbury. Additionally, because operation of the proposed CPNPP Units 3 and 4 would be among the larger contributors to cumulative impacts, the review team concludes that cumulative impacts to surface-water quality resulting from the operation of the proposed CPNPP Units 3 and 4 would be SMALL to MODERATE. The MODERATE level is based on the potential impacts to ambient water conditions and downstream users from increased dissolved solids, particularly during low flow conditions. Current and future water users would still be required to implement water treatment mechanisms to address salinity regardless of the increase in salt concentrations attributable to CPNPP Units 3 and 4.

7.2.2.2 Groundwater-Quality Impacts

Oil and gas exploration and extraction in the region are a potential source of cumulative adverse impacts to groundwater quality throughout the region. The significant vertical separation between the main oil and gas production target (the Barnett Shale) at depth and the water supply aquifer (the Twin Mountains Formation) nearer the land surface (Figure 2-21) limits the potential for impact, but if leakage occurs along inadequately cased drillholes and wells, the aquifer could be contaminated by drilling fluids and naturally occurring salts and other contaminants from the hydrocarbon production zone. Any such impact would typically be localized to the immediate vicinity of the affected drillhole or well.

At the CPNPP site, groundwater quality may be affected by spills and leaks during construction and operation and by salt drift from cooling towers and the BDTF. Similarly, there is a potential for contamination due to spills and leaks at other construction and industrial sites in the region. Effects of all of these activities would generally be localized, and (as discussed in Section 5.2.3.2) any contaminant releases at the CPNPP site would likely be limited to the shallow groundwater on site and would not impact offsite users.

Over time, the past, present, and future discharge to SCR of effluents from CPNPP operations could adversely affect groundwater quality in the Twin Mountains Formation aquifer if SCR water migrates downward through the Glen Rose Formation to the Twin Mountains Formation. The low vertical permeability of the Glen Rose Formation impedes such fluid migration in spite of the downward hydraulic gradient between SCR and the Twin Mountains Formation, but vertical migration is possible, particularly in fractures or other preferential flow paths that may be present but undetected in the Glen Rose Formation. Any migration would be slow, however, and radioactive decay would likely reduce tritium concentrations to background levels before the water reached the Twin Mountains Formation. The reversal of past groundwater level declines noted in Section 7.2.1.2 could slightly reduce the potential for downward migration of contaminants from SCR and other surface sources, but would not eliminate the potential for impact.

In summary, there are several potential sources of cumulative adverse impacts to groundwater quality in the region. However, all potential impacts would be localized, and implementation of good engineering practices could avoid or reduce the potential impacts. Accordingly, the review team concludes that cumulative impacts to groundwater quality from construction, preconstruction and operation of Units 3 and 4, when combined with other present and reasonably foreseeable future actions, would be SMALL to MODERATE. The potential for a MODERATE level of impact is related to the potential infiltration of salt from the BDTF ponds, as discussed in Section 5.2.3.2.

7.3 Ecology

This section addresses the cumulative impacts on terrestrial resources, and aquatic and wetlands resources. It considers activities associated with the proposed new units at the CPNPP site combined with other past, present, and reasonably foreseeable future activities within a geographic area of interest defined for each resource.

7.3.1 Terrestrial Ecology

The description of the affected environment in Section 2.4.1 provides the baseline for the cumulative impacts assessments for terrestrial ecological resources. As described in Section 4.3.1, the review team concluded that the impacts from NRC-authorized construction on terrestrial resources would be SMALL, and no further mitigation would be warranted. However, the combined impacts of construction and preconstruction were described in Section 4.3.1 and determined to be SMALL to MODERATE. As described in Section 5.3.1, the review team concluded that the impacts of operations on terrestrial ecology would be MODERATE, and further monitoring and mitigation may be warranted.

In addition to impacts from construction, preconstruction, and operation, the following cumulative analysis also considers other past, present, and reasonably foreseeable projects that could affect the same terrestrial ecological resources affected by the CPNPP Units 3 and 4 project. For purposes of this cumulative analysis, the geographic area of interest is defined as Somervell, Hood, and Bosque Counties. These counties encompass the CPNPP site, anticipated transmission line and pipeline ROWs, and the surrounding ecological landscape. These counties lie almost completely in the Limestone Cut Plain of the Western Cross Timbers ecoregion (Griffith et al. 2004) (for purposes of the following analysis, the counties are assumed to be completely in that ecoregion). These counties are expected to encompass those other projects capable of interacting with the CPNNP Units 3 and 4 project to affect terrestrial ecological resources.

7.3.1.1 Wildlife and Plant Communities

As described in Section 2.4.1, most of the region existed prior to European settlement as grassland or open live oak savanna that supported herds of bison (*Bison bison*) and other herbivores. The introduction of domestic livestock, farming, and wildfire control in the nineteenth century dramatically altered the landscape. At the time CPNNP Units 1 and 2 were developed, the geographic area of interest consisted primarily of a mosaic of forest, woodland, savanna, and prairie. The transitional natural vegetation of little bluestem grassland with scattered blackjack oak and post oak trees was used mostly for rangeland and pastureland, with some areas of woody plant invasion and closed forest.

Since establishment of Units 1 and 2, development in the three counties has continued and additional acreage of terrestrial habitat has been lost or modified by farming, ranching, residential development, river and watershed projects, and transportation projects (see Table 7-1). Oil production has been a major activity in the three counties for over eighty years (Griffith et al. 2004), and oil and natural gas exploration and production continue throughout the region. These trends will likely continue over the operating life of proposed Units 3 and 4. Indeed, the power produced by these units would contribute to this further development.

As noted in Section 2.4.1, building of the proposed Units 3 and 4 at CPNPP would affect several areas of habitat types and associated wildlife including the permanent or temporary loss of approximately 675 ac, consisting mostly of mostly Ashe juniper woodland - savanna habitat, with some grassland and mixed hardwood forest, as well as some land previously disturbed during development and operation of Units 1 and 2. Overall, 675 ac would be disturbed during preconstruction and construction, which represents about 8.5 percent of the total site. Expansion of power transmission and cooling water pipeline ROWs required for CPNPP Units 3 and 4 would occupy additional offsite acreage of similar wildlife habitat types. No old growth timber, unique or sensitive plants, or unique or sensitive plant communities would be affected by work on the site. In order to obtain approval from Electric Reliability Council of Texas (ERCOT) and Public Utility Commission of Texas (PUCT) to build the transmission lines, Oncor would be expected to perform surveys for threatened and endangered species on transmission and pipeline ROWs once the final routes are determined. Impacts on terrestrial resources from expansion of the ROWs could be minimized by placement of structures to avoid sensitive resources such as wetlands and habitats favorable for threatened and endangered species.

Proposed future and other current actions within the geographic area of interest that could adversely affect terrestrial resources in a similar way to development of the CPNPP Units 3 and 4 project include the proposed development and building of transportation projects, future urbanization, and continued oil and gas exploration and development (Table 7-1). Other future actions or conditions that would contribute to cumulative effects on terrestrial resources would include creation and/or upgrading transmission lines independent of Units 3 and 4, new road development and expansion, continued industrial and urban development throughout the geographic region of interest, increased outdoor recreation, and continued nonpoint source runoff from activities such as agriculture and ranching.

TSDC projects that the population in a six-county area surrounding the CPNPP site (including Bosque, Erath, Hood, Johnson, Somervell, and Tarrant Counties) will increase by 41.5 percent by the year 2040 (TSDC 2009). The highest growth in the six-county area is projected to occur in areas close to Fort Worth; however, the more outlying counties are still expected to experience substantial growth. Even with the anticipated growth, the area around the CPNPP site is likely to continue to be predominantly rural in character with the majority of land covered by grassland and evergreen and deciduous forest. Recent urbanization in this area has occurred primarily in and around the cities of Granbury and Glen Rose. This trend is likely to continue, with most of the growth occurring in Hood County around and northeast of Lake Granbury, due primarily to recreation home development and commuting patterns associated with Fort Worth. The preconstruction, construction, and operations workforce for CPNPP Units 3 and 4 would make only a minor contribution to this increase in the urban growth of the region. The cumulative urbanization in the geographic area of interest could alter attributes of land use by reducing wildlife habitat in localized areas. However, this would not be expected to substantially affect the overall availability of wildlife habitat or wildlife migration corridors near the CPNPP site or the general extent of forests or other specific habitat types near the CPNPP site.

Continued development of other projects is expected to further contribute to the loss of wildlife habitat. Activities associated with highway projects and continued urban and industrial development that would cumulatively affect terrestrial ecological resources include land clearing and grading (temporary and permanent), residential growth due to building and operation, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. Site preparation and building activities for proposed projects would likely displace or destroy wildlife that inhabits areas where activities take place. Some wildlife, including some important species, would perish or be displaced during land clearing as a consequence of direct mortality, habitat loss, habitat fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals such as birds, many of which would be displaced to adjacent natural habitats. Undisturbed land adjacent to areas of activity could provide habitat to support displaced wildlife, but increased competition for available space and resources could reduce population levels. Such land disturbing activities are not expected to destabilize terrestrial resources; however, site preparation and building activities for other projects could alter key attributes of terrestrial resources. Wildlife would also be subjected to impacts from increased noise and traffic, and birds could be injured or suffer mortality through collisions with tall structures or equipment.

Development of power transmission line and cooling water pipeline ROWs required for CPNPP Units 3 and 4, as well as other ROW development expected as the geographic area continues to develop, would impact additional land areas and may increase the fragmentation of remaining forested areas. This trend could be beneficial for some species, including those that inhabit early successional habitat or use edge environments. However, the increased fragmentation would adversely affect species that require continuous expanses of uninterrupted forested habitat, including many neotropical migratory birds. New transmission lines are not anticipated to cause any increases in bird collisions and electrocutions, if proper mitigation were employed, and thus, would not be expected to increase and contribute to cumulative effects.

As described in Section 5.3.1, impacts to terrestrial ecosystems associated with salt deposition stemming from mechanical draft cooling tower deposition for Units 3 and 4 would be below levels expected to adversely affect terrestrial habitats. Salt drift from the BDTF as described in Section 5.3.1, however, could affect adjoining terrestrial habitats both on and off of the CPNPP site. The review team concluded that the effects of salt drift from the BDTF could be enough to injure vegetation. No noticeable impacts to vegetation associated with fogging, precipitation and icing from cooling tower and BDTF operation are expected. No other projects anticipated in the geographic area of interest have the potential for fogging or salt drift impacts. Any impacts to birds from collisions with power lines over the BDTF might be successfully mitigated with appropriate bird deterrents.

Additionally, Section 5.3.1 describes impacts to shoreline habitat as a result of operations of the proposed new nuclear units. The increased drawdown from operations of Units 3 and 4 would constitute an added fluctuation that may noticeably further stress plant communities by lessening availability of water to vegetation on the existing shoreline. The increased drawdown, and hence stress to shoreline plant communities, could be further exacerbated by the increased municipal and local water demands from those lakes outlined in Section 7.2.1.1. The review team concludes the cumulatively increased drawdown of Lake Granbury and PKL would noticeably alter shoreline habitat; however, it would not destabilize the important attributes of the resource. No other projects identified in the geographic area of interest have the potential affect shoreline habitat in a similar manner.

The habitats that would be disturbed at the 7950 ac CPNPP site, and additional acreage for new transmission and pipeline ROWs, are common in the area of geographical interest. The majority of the Limestone Cut Plain of the Western Cross Timbers ecoregion has been subject to continued and additional loss of acreage of terrestrial habitat due to farming, ranching, gas exploration, residential development, river and watershed projects, and transportation projects. This project, in addition to future development and other proposed actions would likely further reduce these types of habitats. These impacts may be sufficient to alter noticeably important attributes of wildlife habitat

The report on GCC impacts in the United States, provided by the GCRP, summarizes the projected impacts of future climate changes in the U.S. (Karl et al. 2009). The report divides the U.S. into nine regions. The CPNPP site is located in the Great Plains region. The GCRP climate models for this region project continued warming in all seasons and an increase of as much as 12°F from 2000 to 2090. Additionally, climate models project that there will tend to be less rainfall in this area. The GCRP states that the precipitation could possibly alter the character of terrestrial habitats. This could further stress terrestrial resources affected by the activities described above. Reduced precipitation could contribute to drawdowns on PKL and Lake Granbury, and hence contribute to impacts on shoreline habitats fringing those lakes.

7.3.1.2 Important Species

The discussion of important species, as defined by the NRC in NUREG 1555, for the CPNPP site and vicinity in Section 2.4.1.3 is applicable to the geographic area of interest defined for cumulative impact assessment. Future urban and industrial development, new transmission corridors, and the effects of other projects may potentially affect important species in the geographic area of interest primarily by decreasing or degrading the available habitat for these species. Impacts from development, new transmission corridors, and potential effects of other projects would noticeably alter, but not destabilize, important species in the geographic area of interest.

Populations of three bird species listed under the Endangered Species Act (ESA) occur in the geographic area of interest for cumulative effects. These are the Federally endangered black-capped vireo (*Vireo atricapillus*), golden-cheeked warbler (*Dendroica chrysoparia*), and whooping crane (*Grus americana*). Each is also listed as endangered by the State of Texas.

The major threats to the black-capped vireo and golden-cheeked warbler are habitat modification, habitat loss, and habitat fragmentation due to range management practices and continued development in the region. Depending on the final route ultimately selected, the Whitney transmission line ROW might pass through habitat occupied by one or both of these species. In addition, habitat potentially suitable for the golden-cheeked warbler (but not black-capped vireo) could be altered by salt drift from the BDTF. Habitat loss and alteration due to other projects, including non-Federal projects, in the geographical area of interest could be sufficient to alter noticeably populations of both species. In order to obtain approval from ERCOT and PUCT to build the transmission lines, Oncor is expected to have to perform surveys for threatened and endangered species on the transmission and pipeline ROWs once the final routes are determined. As a result of these consultations the consulted agencies would likely issue recommendations that would prevent impacts capable of destabilizing affected populations.

The geographic area of interest lies within the 200-mi wide migratory flyway for the Aransas-Wood Buffalo population of the whooping crane. Whooping cranes do not breed or winter anywhere near the geographic area of interest, but they do transiently stop in wetlands and croplands within the migratory flyway for brief periods during their annual fall and spring migrations. However, as noted in Sections 4.3.1 and 5.3.1, there are no recorded observations of whooping crane near the geographic area of interest, and the losses of habitat favored by the whooping crane for transient stopovers during migration would be minimal.

The three species noted above are also listed as endangered by the State of Texas. Three additional species are listed as threatened or endangered by the State of Texas that could be cumulatively affected by the CPNPP Units 3 and 4 and other projects in the geographic area of interest. These consist of one bird, the bald eagle (*Haliaeetus leucocephalus*); and two reptiles: Texas horned lizard (*Phrynosoma cornutum*), and timber (canebreak) rattlesnake (*Crotalus horridus*). In addition, three species listed by the State of Texas as rare, but with no official regulatory status, could be cumulatively affected. These consist of one reptile, the Texas garter snake (*Thamnophis sirtalis annectens*); and two plants: Comanche Peak prairie clover (*Dalea reverchonii*), and Glen Rose yucca (*Yucca necopina*). All of these species are potentially affected by habitat loss from projects in the geographic area of interest and direct mortality from clearing and grading associated with those projects. Where distributions of these species overlap areas required for CPNPP Units 3 and 4 and associated structures, development and operation of the project could contribute to locally noticeable environmental effects. Other important species in Somervell, Hood, and Bosque Counties, such as the recreationally important white-tailed deer and wild turkey, are sufficiently abundant and have sufficient favorable habitat that environmental effects should be minimal.

Summary. Cumulative impacts to terrestrial ecological resources are estimated based on the information provided by Luminant and the review team’s independent evaluation. Past, present, and reasonably foreseeable future activities exist in the geographic area of interest that could affect terrestrial ecological resources. Development of new transmission corridors and infrastructure to support future projects, when combined with this project, could adversely affect wildlife and may be detrimental to surrounding terrestrial habitats. Loss of vegetation, wildlife habitat, and increased habitat fragmentation from continued development and GCC are unavoidable and would continue to occur. The extents of available habitats are ultimately limited, and direct loss of habitat through continuing development, as well as habitat modifications caused by increasing scarcity of water could noticeably contribute to cumulative impacts. Based on this analysis, the review team concludes that cumulative impacts from past, present, and reasonably foreseeable future actions on important species and habitat wildlife habitat in Somervell, Hood, and Bosque Counties near the CPNPP site and associated structures would be noticeable. The review team concludes that the cumulative impacts to terrestrial resources from construction, preconstruction, and operations of Units 3 and 4—when combined with other present and reasonably foreseeable future actions and viewed in the context of past impacts—would be MODERATE. The MODERATE level of impact is associated primarily with the operation of the cooling system on shoreline vegetation on Lake Granbury and PKL as well as the operations of the BDTF. NRC authorized construction and operation activities would be a substantial contributor to this conclusion. To mitigate for cumulative losses to wildlife habitat, developers for this and future projects in the area could employ site planning, design, and construction to limit disturbance footprints and to permanently set aside large contiguous areas and corridors to support wildlife habitat (TPWD 2010a).

7.3.2 Aquatic Ecosystem and Wetlands Impacts

The review team evaluated other projects and activities in addition to the construction and operation of the proposed CPNPP Units 3 and 4 to determine whether past, present, and future actions would contribute to adverse cumulative impacts on aquatic and wetlands resources. For this cumulative analysis of aquatic ecosystems and wetlands, the geographic area of interest includes the following: (1) the area immediately surrounding (within approximately one mi of) the site of Units 3 and 4 near SCR; (2) the portion of the Brazos River watershed from PKL to the upper end of Lake Whitney, including Lake Granbury; (3) Squaw Creek below and including SCR; and (4) the Paluxy River from the low dam in the City of Glen Rose to the river's confluence with the Brazos River.

Anthropogenic activities potentially contributing to cumulative aquatic and wetlands impacts include the construction and operation of the proposed CPNPP Units 3 and 4; continued operation of the existing CPNPP Units 1 and 2; and impacts not directly related to CPNPP, such as the operation of other industrial facilities, residential and agricultural water use, and water-based recreational activities such as fishing and boating. Natural environmental stressors contributing to cumulative aquatic impacts include short-term and long-term changes in precipitation or temperature and the spread of invasive aquatic organisms.

Activities related to construction of the intake and discharge structures, as well as other structures to be built in conjunction with the proposed CPNPP Units 3 and 4 would have minimal and mostly temporary impacts on the aquatic ecosystems of Lake Granbury and the small streams and wetlands in the vicinity of the project site and proposed new ROWs. The greatest potential for cumulative aquatic impacts from construction activities in the area of interest would result from degraded water quality due to stormwater runoff from development sites (primarily residential with some commercial, as discussed in Section 7.1.1) along shorelines and elsewhere in watersheds, as well as sediment disturbance by inwater construction activities. TCEQ requires stormwater permits for construction sites of 1 ac or more, and obtaining a permit requires development and implementation of a stormwater pollution prevention plan specifying the BMPs to be used in protecting water bodies (TCEQ 2008). Enforcement of permitting requirements and associated use of BMPs to minimize or prevent stormwater impacts are expected to ensure that the cumulative effects on aquatic resources from construction of CPNPP Units 3 and 4 and other construction projects in the area of interest would be minimal.

As discussed in Section 5.3.2, impacts due to the operation of CPNPP Units 3 and 4 would include minor chemical, thermal, and physical effects in Lake Granbury and the Brazos River downstream due to the withdrawal of cooling water from the lake and the discharge of blowdown to the lake. Other existing water intakes on Lake Granbury (described in Section 7.2.1), including intakes for CPNPP Units 1 and 2, the Wolf Creek power facility, and the SWATS water supply facility, potentially would withdraw water in the future concurrently with Units 3 and 4; additional intakes have not been proposed. Other discharges to Lake Granbury and the Brazos River could cumulatively affect surface water quality, as discussed in Section 7.2.2.1. Many of these discharges are from sanitary wastewater treatment facilities, which have different effluent constituents than would CPNPP Units 3 and 4 and, thus, minimal cumulative effects. However, the Lake Granbury SWATS facility discharges effluent with elevated concentrations of TDS, chloride, and sulfate that would cumulatively contribute to the levels of these constituents in Lake Granbury. The De Cordova power facility discharges thermal effluent to Lake Granbury, and the Wolf Creek power facility discharges heated effluent with TDS and other constituents above ambient concentrations into the Brazos River downstream of Lake Granbury. Constituent concentrations and temperatures in these discharges are regulated by TCEQ to ensure concentrations and temperatures in the receiving water body do not exceed levels that would pose risk to aquatic life. Given the additional dilution and attenuation that occur after discharge and mixing, adverse impacts on the aquatic communities of Lake Granbury and the Brazos River from the operation of the existing intakes and discharges would be unlikely to be noticeable.

As discussed in Section 7.2.1, hydrological changes in the Brazos River, PKL, and Lake Granbury associated with increased water consumption by CPNPP Units 3 and 4 in combination with other future users of BRA water allocations would be noticeable and would have substantial cumulative impacts on the quantity of surface water in this system. The types of effects that these potentially substantial changes in hydrology would have on the aquatic biota of PKL, Lake Granbury, and the river segments between these lakes and downstream to Lake Whitney are described in Section 5.3.2 and would range from negligible to noticeable but not destabilizing. The withdrawals by Units 3 and 4 would be a major component of the increased withdrawals planned for under BRA water management policy. However, these increases are likely to occur even without the operation of CPNPP Units 3 and 4 because the 2060 Brazos G Water Plan calls for full utilization of the yield from the Brazos River system between now and 2060. This would require increased releases from PKL, which would be allocated to Units 3 and 4 and/or other water users, or would be allocated entirely to other users eventually if Units 3 and 4 were not built. Water allocated to CPNPP Units 3 and 4 also would be withdrawn from WBR to supply potable water and some process water to CPNPP as well as other water users supplied by the SCWD. The water in WBR is pumped from the Paluxy River, so the incremental use of water from this reservoir by CPNPP in conjunction with other users would have a cumulative effect on downstream flows in the 2.5-mi reach of the Paluxy River above its mouth, and in the Brazos River below the mouth of the Paluxy River. However, the planning and management of water supply allocations from WBR by the SCWD and regulations to prevent low-flow withdrawals from the Paluxy River would ensure that adverse effects on aquatic communities of WBR, the Paluxy River, and the Brazos River from the cumulative effects of water supply withdrawals from WBR would be negligible. Thus, the cumulative effects on aquatic biota from the hydrological changes in these water bodies ultimately would be similar to those described for Units 3 and 4 and likely would range from minimal to noticeable. The NRC-authorized activity is a substantial contributor to those effects.

The review team also considered potential cumulative impacts from the blowdown discharge for CPNPP Units 3 and 4 in conjunction with other sources of chemical and thermal releases to water bodies in the area of interest. Section 7.2.2 describes other activities in the area of interest that have the potential to affect water quality and, as a result, aquatic biota. Principal sources of chemical inputs are effluent discharges, including discharges from wastewater treatment facilities and existing power facilities. These effluents potentially could have cumulative effects on the concentrations of chemical constituents that they contain in common, such as TDS, chloride, and other inorganics. Such discharges are regulated and permitted by the TCEQ for compliance with TPDES permit requirements regarding chemical releases, and such monitoring is expected to continue in the future. TCEQ would take into consideration the cumulative chemical releases from existing and proposed discharges to Lake Granbury and the Brazos River before approving a TPDES permit for the proposed CPNPP Units 3 and 4. As a result, the permitted discharge limits would ensure that the potential for cumulative toxicity effects on aquatic life would be minimal. Similarly, thermal characteristics of discharges from existing power facilities and proposed CPNPP Units 3 and 4 would be required to comply with TPDES permit requirements. Cumulative thermal effects would be considered in the TCEQ permitting process to help ensure that, although these facilities contribute incrementally to a cumulative increase in heat added to Lake Granbury and the Brazos River, the increase in water temperatures beyond the mixing zones near the discharges would be negligible. Thus, the cumulative impacts on aquatic biota from the limited changes in water chemistry and temperature in the area of interest would be minimal.

As stated above, the cumulative ecological impacts of hydrological and water quality changes in the Brazos River below Lake Granbury would range from negligible to noticeable. These impacts would be further moderated as the water is impounded in Lake Whitney. Lake Whitney covers 2.7 times the area of Lake Granbury and is managed for flood control, water conservation, and hydroelectric power. Given the size of Lake Whitney and the management of water within the reservoir, the limited alterations in flow and minor changes in water quality constituents in the Brazos River upstream of Lake Whitney would not be expected to be detectable in the Brazos River below Lake Whitney downstream to the Gulf of Mexico. Consequently, the potential for fisheries and other aquatic resources in the lower Brazos River and the Gulf of Mexico to be adversely affected by the cumulative impacts that could occur upstream in the geographic area of interest is negligible.

Anthropogenic impacts not directly associated with the operation of CPNPP Units 3 and 4 also may contribute to cumulative impacts on the aquatic biota of Lake Granbury, the Brazos River, and other aquatic habitats in the area of interest. These impacts include habitat loss due to development along shorelines; nonpoint source pollution related to increased development within the watersheds of Lake Granbury, PKL, and the Brazos River; and hydrological and water quality alterations resulting from changes in stormwater runoff and infiltration as a result of development in watersheds. Such impacts could result from increased urbanization in the geographic area of interest. Recent urbanization in the area has occurred primarily around the cities of Granbury and Glen Rose, with most of the growth occurring in Hood County around and northeast of Lake Granbury. This trend is likely to continue, and future urbanization in these areas could contribute to additional demand for water, increased need for wastewater assimilation, and reduced water quality. Other parts of the area, including the area around the CPNPP site, are likely to continue to be predominantly rural in character and covered by grassland and forest. Reductions in natural vegetation and open space due to increased urbanization or agricultural land uses likely would result in increased stormwater runoff and associated increases in nonpoint source pollutants such as nutrients, pesticides, and petroleum compounds. The cumulative effects of development in combination with CPNPP operations are not expected to result in substantial adverse impacts on aquatic biota in the area of interest.

Other activities that may contribute to cumulative impacts on the aquatic biota of Lake Granbury, PKL, the Brazos River, SCR, WBR, and other aquatic habitats in the area of interest involve recreational uses of these water bodies for fishing and boating. As discussed in Sections 2.4.2.1, 2.4.2.4, and 5.3.2.8, Lake Granbury and PKL are popular for recreational fishing and are stocked with several species of game fish by the Texas Parks and Wildlife Department (TPWD) to compensate for losses from their populations due to fishing and toxic blooms of golden alga (*Prymnesium parvum*). However, recent blooms (2009) have not created drastic effects as measured by 2010 fish surveys (TPWD 2010). As the human population of the region increases in the future, there may be a similar increase in recreational fishing and boating on these lakes. Game fish populations could be reduced by the cumulative effects of fishing pressure and the other factors discussed above, including hydrological changes, reduced water quality, and other chemical, thermal, and physical effects from water withdrawals and discharges to the lakes. TPWD stocking programs likely would be continued for Lake Granbury and PKL to mitigate for game fish population losses. The use of small, gasoline-fueled watercraft on the lakes for fishing and other recreational purposes may increase in the future with increasing regional population and could contribute to cumulative effects on water quality mainly through spillage of fuel and oil. The Brazos River in the geographical area of interest also is likely to continue to be used for some recreational fishing, SCR was reopened to the public for fishing and boating, and WBR has been stocked with game fish and is expected to be used for these activities. Increased fishing pressure and pollution from boats may contribute to cumulative impacts on fish populations in conjunction with the incremental effects from CPNPP Units 3 and 4 and other activities affecting water use and the water quality of these water bodies. The occurrence of natural environmental stressors, including extremes of temperature or precipitation occurring over the short term or long term (such as changes associated with GCC) could contribute to cumulative impacts on the aquatic biota of water bodies in the area of interest. The report *Global Climate Change Impacts in the United States*

(Karl et al. 2009) summarizes the projected impacts of future climate changes in the U.S. The report divides the U.S. into nine regions, and the CPNPP site is in the Great Plains region. The GCRP climate models for this region projecting out to 2090 predict continued warming in all seasons and less rainfall. If GCC results in decreased precipitation and increased temperatures in the Brazos River Basin, the resulting reduction in surface runoff and increase in evaporation would contribute to reductions in wetlands and stream flows. Reductions in stream flows could reduce the dilution of natural salt concentrations from the Brazos River watershed, as well as other constituents in the effluents from Units 3 and 4 and other discharges, in Lake Granbury and the Brazos River downstream. Higher air temperatures also could slow the dissipation of waste heat from these water bodies. These climate-driven changes in conjunction with anthropogenic changes affecting water quantity and quality in the area of interest would have cumulative effects on aquatic biota. Such effects may include loss of native species due to altering of breeding patterns, water quality, food supply, and habitat availability; increasing vulnerability of natural communities to invasive species; and resulting changes in the composition and diversity of aquatic communities (Karl et al. 2009). Thus, under extreme climatic conditions, the operation of CPNPP Units 3 and 4 could contribute incrementally to cumulative adverse impacts on aquatic biota in this area of the Brazos River watershed. The cumulative effects of water consumption and effluent discharge by CPNPP Units 3 and 4 and other water users would likely contribute to these effects and increase the potential for natural stressors to adversely affect aquatic biota.

Only small areas of functionally impaired wetlands would be affected at the CPNPP Units 3 and 4 site, and the potential wetland areas within ROWs also would be small. Because the wetlands potentially affected by the proposed action are small and isolated, the incremental contribution to cumulative effects on wetland functions and values throughout the area of interest would be minimal. In addition, mitigation likely would be required by the USACE in conjunction with permitting under Clean Water Act (CWA) Section 404 of the development activities affecting wetlands and streams. Consequently, cumulative impacts to wetlands would be minimal, and mitigation beyond that required through the USACE permitting process would not be warranted.

Cumulative impacts on aquatic ecology and wetlands resources were assessed based on the information provided by Luminant and the review team's independent evaluation. This assessment considered impacts on aquatic communities and wetlands from factors such as direct effects of construction and operation of the facility, consumptive water loss, regulation of water levels by dams, operation of other industrial facilities on Lake Granbury, and other natural and anthropogenic stressors. Based on this assessment, the review team concludes that cumulative impacts from past, present, and future actions on aquatic and wetlands resources in the geographic area of interest would range from SMALL to MODERATE. The incremental contribution of the proposed action to impacts on aquatic resources of the water bodies and wetlands in the area of interest would be SMALL for most impacts. However, the incremental contribution to impacts on the aquatic resources of Lake Granbury, PKL, and the Brazos River from PKL to Lake Whitney that would result from reduced flows and extreme low flows during drought conditions potentially would range from SMALL to MODERATE.

7.4 Socioeconomics and Environmental Justice

The following sections describe the evaluation of cumulative impacts on socioeconomics and environmental justice.

7.4.1 Socioeconomics

The description of the affected environment in Section 2.5 serves as a baseline for the cumulative impacts assessment for socioeconomics. As described in Section 4.4, the impacts of NRC-authorized construction activities on socioeconomic resources would be SMALL with the following exceptions. First, NRC-authorized construction would result in LARGE beneficial economic and tax revenue impacts for Somervell County, and to a lesser extent Hood County. Second, NRC-authorized construction would result in MODERATE adverse impacts on traffic flow and level of service (LOS) on Farm to Market Road (FM) 56 during the project building peak. Third, NRC-authorized construction would result in MODERATE adverse impacts on wastewater treatment facilities in Somervell and Bosque counties during the building peak. As described in Section 5.4, the adverse socioeconomic impacts of operating Units 3 and 4 would be SMALL.

The combined impacts from construction and preconstruction were described in Section 4.4 and were determined to be the same as described above for NRC-authorized construction. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable projects that could affect socioeconomic resources. For this analysis, the geographic area of interest is the 50-mi region around the CPNPP site. This geographic area of interest includes the primary communities that would be affected by building and operating CPNPP Units 3 and 4.

Historically, the geographic area of interest had an agricultural based economy initially centered on cattle, corn, and cotton. By the late 20th Century, the area's demographic and economic growth had been affected by the building and operation of CPNPP Units 1 and 2 (including large refueling outages), natural gas exploration and extraction in the Barnett Shale region (Sections 2.5.2.1 and 7.1), and USACE's development of HCP on Whitney Lake (Section 7.1). The area's socioeconomic profile is now being affected by SCWD's development of WBR (Section 7.1).

The socioeconomic impact analyses in Chapters 4 and 5 are cumulative by nature and depend largely on the rate of change from existing conditions; for example, the increase in the rate of population growth. Past and current economic impacts associated with the activities listed in Table 7-1 already have been considered as part of the socioeconomic baseline presented in Section 2.5. For example, the economic impacts of existing activities such as CPNPP Units 1 and 2, mining, other electric utilities, etc., are part of the base used for establishing the Regional Input-Output Model System (RIMS) II multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team's assessment of foreseeable future impacts. State and county plans along with modeled demographic projections like those used in Sections 2.5, 4.4, and 5.4 include forecasts of future development and population increases. Thus, cumulative impacts associated with general growth in the geographic area of interest and construction, preconstruction, and operation of proposed Units 3 and 4 are evaluated in Chapters 4 and 5.

As discussed in Section 4.4, the existing operations work force at CPNPP Units 1 and 2 is 977 workers. At various times during the building period for Units 3 and 4, there would be 800 to 1200 additional workers on site for refueling outages at CPNPP Unit 1 and 2. Once operations begin at Units 3 and 4, at various times there would be 800 to 1200 additional workers on site for refueling outages at CPNPP Unit 1, 2, 3, or 4. The presence of the Units 1 and 2 operations workers and the Units 1, 2, 3, and 4 refueling outage workers during the building and operation of CPNPP Units 3 and 4 would contribute to cumulative socioeconomic impacts in the region.

For socioeconomics, the largest adverse cumulative impact would be the increase in vehicular traffic during the peak building period (Section 4.4.4.1). Given the relatively large traffic increases that would occur, especially when combined with the existing traffic related to gas exploration and extraction in the Barnett Shale region, it is likely that building CPNPP Units 3 and 4 would contribute to noticeable cumulative impacts on traffic flow and LOS on FM 56 (particularly north of the CPNPP entrance). These traffic impacts would likely require mitigation, as discussed in Section 4.4.5. It is likely that operation of CPNPP Units 3 and 4 would contribute to minor cumulative impacts on traffic flow and LOS on FM 56.

Population growth resulting from the in-migration of CPNPP Units 3 and 4 construction and operations workers would combine with continued operations at CPNPP Units 1 and 2; refueling outages at CPNPP Units 1, 2, 3, and 4; continued gas exploration and extraction in the Barnett Shale; and the other actions in the region to create additional demand for recreation, housing, public services, and education. However, the cumulative impacts of this increased demand would be SMALL in most cases, given existing and planned resources and facilities.

Cumulative impacts to socioeconomic resources from preconstruction, construction, and operation of CPNPP Units 3 and 4 and other projects are estimated based on the information provided by Luminant and the review team's independent review. The review team concludes that cumulative impacts on socioeconomic resources would be SMALL and no further mitigation would be warranted, except for three areas. First, the review team concludes that the economic and tax revenue impacts for Somervell County, and to a lesser extent Hood County, would be LARGE and beneficial. Second, the review team concludes that impacts on traffic flow and LOS on FM 56 (i.e., both the physical impacts and the impacts to infrastructure and community services) would be MODERATE during the project building peak and would require additional mitigation. Third, the review team concludes that impacts on wastewater treatment facilities in Somervell and Bosque counties (i.e., impacts to infrastructure and community services) would be MODERATE during the building peak. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that cumulative impacts on socioeconomic resources would be SMALL except for the three areas discussed above. The review team concludes that the cumulative impacts of operations on socioeconomic resources would be SMALL and no further mitigation would be warranted.

7.4.2 Environmental Justice

The description of the affected environment in Section 2.6 serves as a baseline for the cumulative impacts assessment for environmental justice. As described in Section 4.5, the environmental justice impacts of NRC-authorized construction activities would be SMALL. As described in Section 5.5, the environmental justice impacts of operations would be SMALL and no further mitigation would be warranted.

The combined impacts from construction and preconstruction are described in Section 4.5 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers past, present, and reasonably foreseeable future actions that could cause environmental justice impacts on minority and low-income populations. For this cumulative analysis, the geographic area of interest is the 50-mi region around the CPNPP site. This geographic area of interest includes the minority and low-income populations that would be affected by developing and operating CPNPP Units 3 and 4.

The environmental justice analyses in Chapters 4 and 5 are cumulative by nature. Past or current environmental justice impacts associated with the activities listed in Table 7-1 already have been considered as part of the environmental justice baseline presented in Section 2.6 and there were no unique characteristics or practices, including subsistence, noted for any of the minority populations in the region that would make them vulnerable to environmental impacts from CPNPP.

As discussed in Sections 4.5 and 5.5, the review team concludes that the building and operating CPNPP Units 3 and 4 would not have any disproportionately high and adverse human health or environmental effects on minority or low-income populations through the pathways of soil, water, or air. Similarly, the cumulative impacts of building and operating CPNPP Units 3 and 4 and the other actions in the region on socioeconomic resources would not have disproportionately high and adverse effects on minority or low-income populations. NRC staff concludes that the environmental justice impacts of developing CPNPP Units 3 and 4 would be SMALL and no further mitigation would be warranted. As described in Section 5.5, the review team concludes that the environmental justice impacts of operating Units 3 and 4 would be SMALL and no further mitigation would be warranted.

Cumulative impacts to minority and low-income populations from preconstruction, construction, and operation of CPNPP Units 3 and 4 and other projects are estimated based on the information provided by Luminant and the review team's independent review. The review team concludes that cumulative environmental justice impacts would be SMALL and no further mitigation would be warranted. Based on Luminant's estimate that 98 percent of environmental justice impacts would be attributable to NRC-authorized construction (Luminant 2009a), NRC staff also concludes that the cumulative environmental justice impacts of NRC-authorized construction would be SMALL. The review team concludes that the cumulative environmental impacts of operations would be SMALL and no further mitigation would be warranted.

7.5 Historic and Cultural Resources

The description of the affected environment in Chapter 2.7 serves as the baseline for the cumulative impact assessment of historic and cultural resources. As described in Section 4.6, the NRC staff concludes that the impacts of NRC-authorized construction activities on historic and cultural resources would be SMALL. As described in Section 5.6, the review team concludes that the impacts of operations on historic and cultural resources would also be SMALL. Mitigative actions may be warranted only in the event of an unanticipated discovery during any ground disturbing activities associated with building and maintaining the facility. Mitigation procedures would be determined by Luminant in consultation with the Texas State Historic Preservation Office (SHPO).

The combined impacts from construction and preconstruction were described in Section 4.6 of this EIS and determined to be SMALL. In addition to the impacts from construction, preconstruction, operations, the fuel cycle, transportation, and decommissioning, the cumulative analysis also considered past, present, and reasonably foreseeable future actions that could affect the historic and cultural resources, including other Federal and non-Federal projects in the geographic area of interest. For the cumulative analysis of potential impacts of construction and preconstruction on historic and cultural resources, the geographic area of interest is considered to be the CPNPP site and nearby portions of Hood and Somervell Counties.

Projects identified in Table 7-1 that may impact historic and cultural resources include operation of CPNPP Units 1 and 2, renewal of licenses for CPNPP Units 1 and 2, Somervell County Water Supply Project, and various oil and gas exploration and extraction operations. Additionally, the average population growth rate for the six counties surrounding the CPNPP site is predicted to be 41.5 percent from 2010 to 2040 (TSDC 2009). These six counties include Bosque, Erath, Hood, Johnson, Somervell, and Tarrant. Increased urbanization is expected to occur as a result of the predicted increase in population. Building and operating two additional units at the CPNPP site, in addition to the other projects identified above and urbanization could have a cumulative impact on historic and cultural resources within the geographic area of interest. Only other Federal undertakings would require a Section 106 review.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural and historic resources within the Area of Potential Effect (APE) is cumulative. Based on its evaluation, the review team concludes that the cumulative historic and cultural resources impact from construction, preconstruction, operations, other federal and non-federal projects, and urbanization would be SMALL. Because impacts to important resources from building and operating the proposed CPNPP Units 3 and 4 are not expected, the incremental impacts associated with NRC-authorized activities would not contribute significantly to the cumulative impacts.

7.6 Air Quality

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impact assessment in this resource area. As described in Section 4.7, the review team concludes that the impacts on air quality from construction would be SMALL and that no further mitigation would be warranted. As described in Section 5.7, the review team concludes that the impacts on air quality from operations would be SMALL and that no further mitigation would be warranted.

7.6.1 Criteria Pollutants

The combined impacts from construction and preconstruction were described in Section 4.7 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts to air quality. For this cumulative analysis of criteria pollutants, the geographic area of interest is Somervell County, which is in the Metropolitan Dallas-Fort Worth Intrastate Air Quality Control Region (40 CFR 81.39). Air quality attainment status for Somervell County as set forth in 40 CFR 81.344 reflects the effects of past and present emissions from all pollutant sources in the region. Somervell County is in attainment for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.344).

The air quality impact of site development for proposed Units 3 and 4 would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects that would have emissions during site development that would, in combination with emissions from CPNPP, result in degradation of air quality in the region.

The only permitted air emission sources near the location of the newly proposed units are diesel generator sources associated with the two existing reactor units at the CPNPP site. Although those sources operate under a TCEQ air quality permit (Number 19225), their emissions do not exceed the 100 tons per year that would qualify the site as a major emissions source, and therefore the CPNPP site is not currently required to have a TCEQ Title V Air Permit. The addition of additional generators associated with the two new units would include the potential for the facility exceeding the standard (100 ton/yr) and, therefore, would require a Title V Permit.

There are no other facilities that are considered major emissions sources within Somervell County (TCEQ 2009). Other new industrial projects listed in Table 7-1 would have *de minimis* impacts. Given that these other projects would be subject to institutional controls, it is unlikely that the air quality in the region would degrade to the extent that the geographic area of interest is in nonattainment of NAAQS.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the GCRP, it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one third of the greenhouse gas emissions are the result of generating electricity and heat (Karl et al. 2009). This assessment is focused on greenhouse gas emissions.

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7, 6.1.3, and 6.3. The review team concluded that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single plant are minimal. The review team also concludes that the impacts of the combined emissions for the full plant life cycle are minimal.

The cumulative impacts of a single source or combination of greenhouse gas emission sources must be placed in geographic context:

- The environmental impact is global rather than local or regional;
- The effect is not particularly sensitive to the location of the release point;
- The magnitude of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, are small when compared to the total mass of greenhouse gases resident in the atmosphere; and,
- The total number and variety of greenhouse gas emission sources is extremely large and are ubiquitous.

These points are illustrated in Table 7-2.

Table 7-2. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year
Global Emissions	28,000,000,000[a]
United States	6,000,000,000[a]
1000 MW Nuclear Power Plant (including fuel cycle, 90 percent capacity factor)	400,000[b]
1000 MW Nuclear Power Plant (operations only, 90 percent capacity factor)	5000[b]
Average U.S. Passenger Vehicle[c]	5

(a) Source: EPA 2010a.
(b) Source: Appendix J.
(c) Source: EPA 2010b.

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The GCRP report referenced above provides a synthesis of the results of numerous climate modeling studies. The review team concludes that the cumulative impacts of greenhouse emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the GCRP report and the CO_2 emissions criteria in the final EPA CO_2 Tailoring Rule (75 FR 31514), the review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions of the proposed project.

Consequently, the review team recognizes that greenhouse gas emissions, including carbon dioxide, from individual stationary sources and, cumulatively, from multiple sources, can contribute to climate change and that the carbon footprint is a relevant factor in evaluating energy alternatives. This factor is considered in the analysis of energy alternatives in Section 9.2.

7.6.3 Summary

Cumulative impacts to air quality resources are estimated based on the information provided by Luminant and the review team's independent evaluation. Other past, present and reasonably foreseeable activities exist in the geographic areas of interest (local for criteria pollutants and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the CPNPP site and other projects would be noticeable but not destabilizing. CPNPP and other projects listed in Table 7-1 would have *de minimis* impacts. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the greenhouse gas emissions from the CPNPP site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be MODERATE. The incremental contribution of impacts on air quality resources from building and operating proposed Units 3 and 4 would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

7.7 Nonradiological Health

The description of the affected environment in Section 2.10 serves as the baseline for the cumulative impacts in this resource area. As described in Section 4.8, the NRC concludes that the nonradiological health impacts from construction would be SMALL and that no further mitigation would be warranted. As described in Section 5.8, the review team concludes that the nonradiological health impacts on from operations would be SMALL to MODERATE. The MODERATE level of impact is associated with the potential for an increase level of noise as a result of operating pumps and mitigation measures could include low-noise-producing pump motors, mounting the motors on sound-dampening material, relocating the motors away from water, or enclose the pumps in a sound-absorbing structure.

As described in Section 4.8, the combined nonradiological health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted other than that described in the Comanche Peak ER. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts to nonradiological health. Based on the localized nature of nonradiological health impacts, the geographic area of interest for this cumulative impacts analysis includes projects within a 50-mi radius around the CPNPP site; and for cumulative impacts associated with transmission lines, the geographic area of interest is the transmission system associated with the proposed Units 3 and 4 (as described in Section 2.2.2). These geographic areas are expected to encompass the areas where public and worker health could be influenced by the proposed project in combination with any other past, present or reasonably foreseeable future actions.

Current projects within the geographic areas of interest that could contribute to cumulative impacts for nonradiological health include the operation of CPNPP Units 1 and 2, existing transmission lines and gas pipelines, and existing urbanization. Reasonably foreseeable future projects in the geographic areas of interest that could contribute to cumulative impacts for nonradiological health include potential future transmission line development and urbanization.

Preconstruction, construction, and operation activities that have the potential to impact the nonradiological health of the public and workers include the following: exposure to fugitive dust and vehicle emissions, occupational injuries, noise from construction and operation, exposure to etiological agents, exposure to electromagnetic fields (EMFs), and the transportation of construction materials and personnel to and from the CPNPP site. There are no existing or future projects that could contribute to cumulative nonradiological health impacts of occupational injuries. Existing and potential development of new transmission lines could increase nonradiological health impacts from exposure to acute EMFs; however, as stated in Section 5.8.3, adherence to Federal criteria and State utility codes would create minimal cumulative nonradiological health impacts. With regard to chronic effects of EMFs, the scientific evidence on human health does not conclusively link extremely low frequency EMFs to adverse health impacts. Noise and vehicle emissions associated with current urbanization and current operations of CPNPP Units 1 and 2, could contribute to public nonradiological health impacts. However, as discussed in Sections 4.8 and 5.8, the proposed Units 3 and 4 contribution to these impacts would be temporary and minimal, and existing and future facilities would likely comply with local, State, and Federal regulations governing noise and emissions. Section 7.10.2 discusses cumulative nonradiological health impacts related to additional traffic on the regional and local highway networks leading to and from the CPNPP site, and the NRC staff determines that these impacts would also be minimal.

In Section 5.8.1, the review team evaluated the health impacts of operating the existing CPNPP Units 1 and 2 and two new proposed units at the CPNPP site with regard to the ambient temperature of Lake Granbury, and the potential enhancement of thermophilic microorganisms, including those that can cause diseases (i.e., etiological agents). The evaluation indicated that operation of Units 3 and 4 would not likely increase the presence of etiological agents in Lake Granbury. This is because the discharge temperature of effluent from Units 3 and 4 is expected to result in a temperature increase of 1°C or less in the Lake Granbury receiving waters.

The review team is also aware of the potential climate changes that could affect human health; a recent compilation of the state of knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed Units 3 and 4 include an increase in average temperature and a decrease in precipitation. Potential changes in water temperature and frequency of downpours could alter the presence of thermophilic microorganisms: however, the NRC staff did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of water-borne diseases.

Cumulative impacts to nonradiological health are based on information provided by Luminant and the review team's independent evaluation of impacts resulting from the building and operation of proposed Units 3 and 4, along with a review of potential impacts from other past, present, and reasonably foreseeable projects and urbanization located in the geographic area of interest. The review team concludes that cumulative impacts on public and worker nonradiological health would be SMALL to MODERATE. The MODERATE level of impact is associated with the potential for an increase level of noise as a result of operating pumps and mitigation measures could include low-noise-producing pump motors, mounting the motors on sound-dampening material, relocating the motors away from water, or enclose the pumps in a sound-absorbing structure. The review team does acknowledge that there is no conclusive link between EMF exposure and human health impacts.

7.8 Radiological Impacts of Normal Operation

The description of the affected environment in Section 2.10 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.9, the NRC staff concludes that the radiological impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.9, the NRC staff concludes that the radiological impacts from normal operations would be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction were described in Section 4.9 and determined to be SMALL. In addition to impacts from construction, preconstruction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For this analysis, the geographic area of interest is the area within a 50-mi radius of the proposed Units 3 and 4. Historically, the NRC has used the 50-mi radius as a standard bounding geographic area to evaluate population doses from routine releases from nuclear power plants. The geographic area of interest includes the existing operating CPNPP Units 1 and 2. Also, within the 50-mi radius of the site, there are likely to be hospitals and industrial facilities that use radioactive materials.

As stated in Section 2.11, Luminant has conducted a radiological environmental monitoring program (REMP) around the CPNPP site since 1981. The REMP measures radiation and radioactive materials from all sources, including the existing CPNPP Units 1 and 2, hospitals, and industrial facilities. The year 2008 monitoring data for the waters of the SCR show that the tritium concentration ranged from 11,800 to 14,300 picocuries per liter (pCi/L) (Luminant 2009c). The annual average release of tritium into SCR due to CPNPP Units 1 and 2 operations during the period 2003 to 2008 was 1410 Ci; the annual release ranged from a low of 532 Ci to a high of 2430 Ci (TXU Power 2004, TXU Power 2005. TXU Power 2006, TXU Power 2007, Luminant 2008, Luminant 2009b). The trend in the SCR tritium levels indicates that SCR is in equilibrium with the tritium release rate of the existing CPNPP Units 1 and 2. The equilibrium value is less than Luminant's administrative action level of 30,000 pCi/L. The tritium content of SCR is the only consistent detectable indicator of CPNPP operations found in the site environment. Luminant will maintain the same administrative limit with all four units operating. Water from SCR is not used for drinking water; however, if it were, the dose from the intake of drinking water with a tritium concentration of 30,000 pCi/L (administrative level on SCR) would be less than 2 mrem/year.

As described in Section 4.9, the estimate of doses to construction workers during building of the proposed Units 3 and 4 are well within NRC annual exposure limits (i.e., 100 millirem) designed to protect the public health. This estimate includes exposure from existing Units 1 and 2 and the planned Independent Spent Fuel Storage Installation (SFSI). The estimate does not include doses from the operation of Unit 3 to workers constructing Unit 4 because the construction and fueling of Unit 4 would be completed before Unit 3 began operation. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of two new units at the CPNPP site are well below NRC regulatory limits and standards. In addition, the dose to the maximally exposed individual (MEI) from the existing Units and the proposed Units 3 and 4 at the CPNPP site would be well within the EPA regulatory standard of 40 CFR Part 190. Also, based on results of the REMP and the estimates of doses from proposed Units 3 and 4 to biota given in Chapter 5.9, the NRC staff concludes that the cumulative radiological impact on biota would not be significant. The results of the REMP indicate that effluents and direct radiation from area hospitals and industrial facilities that use radioactive materials do not contribute measurably to the cumulative dose.

Currently, there are no other nuclear facilities planned within 50 mi of the CPNPP site. The NRC, the U.S. Department of Energy, and the State of Texas would regulate or control any reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts. Therefore, the NRC staff concludes that the cumulative radiological impacts of operating two new units, along with the existing units at CPNPP and the influence of other man-made sources of radiation nearby would be SMALL, and no further mitigation would be warranted.

7.9 Postulated Accidents

As described in Section 5.11.4, the NRC staff concludes that the potential environmental impacts (risk) from a postulated accident from the operation of proposed CPNPP Units 3 and 4 would be SMALL. Section 5.11 considers both design basis accidents (DBAs) and severe accidents.

The COL application references a steam electric system of the US-APWR design. As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the Comanche Peak site would be SMALL for an US-APWR reactor. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The consequences of DBAs are bounded by the consequences of severe accidents.

As described in Section 5.11.2, the NRC staff concludes that the severe-accident probability-weighted consequences (i.e., risk) of an US-APWR reactor at the Comanche Peak site are SMALL compared to risks to which the population is generally exposed, and no further mitigation would be warranted.

The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear power plants that have the potential to increase risks at any location within 50 mi of the proposed Units 3 and 4. The 50-mi radius was selected to cover any potential risk overlaps from 2 or more nuclear facilities. The only existing reactors within geographic area of interest are CPNPP Units 1 and 2.

Tables 5-24 and 5-25 in Section 5.11 provide comparisons of estimated risk for the proposed US-APWR units at the Comanche Peak site and current-generation reactors. The estimated population dose risk for the proposed US-APWR units at the Comanche Peak site is well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (CPNPP Units 1 and 2), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR 51, Appendix B, Table B-1). The severe accident risk due to any particular nuclear power plant gets smaller as the distance from that plant increases. However, the combined risk at any location within 50 mi of the Comanche Peak site would be bounded by the sum of risks for all operating and proposed nuclear power plants. Even though there would be potentially several plants included in the combination, this combined risk would still be low. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Comanche Peak site likely would be SMALL and no further mitigation would be warranted.

7.10 Fuel Cycle, Transportation, and Decommissioning

The cumulative impacts related to the fuel cycle, radiological and nonradiological aspects of transportation, and facility decommissioning for the proposed site are described below.

7.10.1 Fuel Cycle

As described in Section 6.1, the NRC staff concludes that the impacts of the fuel cycle due to operation of proposed Units 3 and 4 would be SMALL. Fuel-cycle impacts would occur not only at the CPNPP site but would also be scattered through other locations in the United States or, in the case of foreign-purchased uranium, in other countries.

In addition to fuel-cycle impacts from proposed Units 3 and 4, this cumulative analysis also considers fuel-cycle impacts from existing Units 1 and 2. There are no other nuclear power plants within 50 mi of the CPNPP site. The fuel-cycle impacts of Units 1 and 2 would be similar to that of proposed Units 3 and 4. Per 10 CFR 51.51(a), the NRC staff concludes that impacts would be acceptable for the 1000-MW(e) reference reactor. The impacts of producing and disposing of nuclear fuel include mining the uranium ore, milling the ore, converting the uranium oxide to uranium hexafluoride, enriching the uranium hexafluoride, fabricating the fuel (where the uranium hexafluoride is converted into uranium oxide fuel pellets), and disposing of the spent fuel in a proposed Federal waste repository. As discussed in Section 6.1, advances in reactors since the development of Table S–3 in 10 CFR 51.51 would reduce environmental impacts relative to the operating reference reactor. For example, a number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. In Section 6.1, the NRC staff multiplied the values in Table S–3 by a factor of approximately four, to scale the impacts up from the 1000-MW(e) light-water reactor (LWR) model to address the fuel cycle impacts of proposed Units 3 and 4. Adding the fuel cycle impacts from Units 1 and 2 would increase the scaling to no more than a factor of six. Therefore, the NRC staff considers the cumulative fuel-cycle impacts of operating CPNPP Units 3 and 4 to be SMALL.

7.10.2 Transportation

The description of the affected environment in Section 2.5.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the CPNPP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis also considers other past, and present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis the geographic area of interest is the 50-mi region surrounding the CPNPP site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the CPNPP site. Additional traffic would result from shipments of construction materials and movements of construction personnel to and from the site. The additional traffic would increase the risk of traffic accidents, injuries, and fatalities. Other projects in the region could potentially increase nonradiological impacts if traffic to and from the CPNPP site interacts with traffic traveling to and from these other projects. Cumulative impacts could result from major construction projects, such as the Highway 121 construction project listed in Table 7-1; however, it is unlikely that the construction schedules for all of the foreseeable projects in the region would overlap to result in a significant cumulative impact.

In Sections 4.8.3 and 5.8.6, the review team concluded that the impacts of transporting construction material, and construction and operations personnel to and from the CPNPP site is a small fraction of the existing nonradiological impacts in the area. Luminant has identified mitigation measures designed to improve traffic flow at the CPNPP site (see Section 4.4.5). Based on the magnitude of nuclear power plant construction relative to the other industrial construction activities in the region, the review team concludes the cumulative nonradiological transportation impacts of constructing and operating the proposed new reactor at the CPNPP site would be SMALL and no further mitigation is warranted.

As described in Section 6.2, the NRC staff concludes that impacts transporting unirradiated fuel to the CPNPP site and irradiated fuel and radioactive waste from the CPNPP site would be SMALL. Historically, the radiological impacts to the public and environment associated with transportation of radioactive materials in the 50-mi region surrounding the CPNPP site have been primarily associated with shipments of fuel and waste to and from the existing CPNPP Units 1 and 2. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the CPNPP site, fuel fabrication facilities, and waste disposal sites located in other parts of the United States. No other major activities with the potential for cumulative radiological impacts were identified in the geographic region of interest. Radiological transportation impacts have been shown to be a small fraction of the impacts from natural background radiation.

The addition of the proposed new CPNPP Units 3 and 4 would result in additional shipments of unirradiated fuel to the site and additional shipments of spent fuel and waste from the site. Cumulative impacts would be just over twice those of the existing two operating units (Units 1 and 2). The environmental impacts from transportation of unirradiated fuel, spent fuel, and waste found in Section 6.2 of this EIS are based on the US-APWR design. Regarding transportation of waste shipments, the NRC staff concludes that the normalized number of waste shipments would be within the value specified in Table S-4 for the 1000-MW(e) reference reactor. Advances in reactor technology and operations since the development of Table S-4 would reduce environmental impacts relative to the values in Table S-4. For example, fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel requirements. This leads to fewer unirradiated and spent fuel shipments than the 1000 MW(e) reference reactor discussed in 10 CFR 51.52. In addition, advances in shipping cask designs to increase their capabilities would result in fewer shipments of spent fuel to offsite storage or disposal facilities.

Therefore, the NRC staff concludes the cumulative nonradiological and radiological transportation impacts of operating the proposed new reactors at the CPNPP site would be SMALL and no further mitigation would be warranted.

7.10.3 Decommissioning

As discussed in Section 6.3, the environmental impacts from decommissioning the proposed Units 3 and 4 are expected to be SMALL because the licensee would have to comply with decommissioning regulatory requirements.

In this cumulative analysis, the geographic area of interest is within a 50-mi radius of the CPNPP site. In addition to the proposed Units 3 and 4, the only other nuclear power plants within this geographic area of interest are the existing CPNPP Units 1 and 2. The impacts of decommissioning nuclear power plants are bounded by the assessment in Supplement 1 to

NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities.* In that document, the NRC found the impacts on radiation dose to workers and the public, waste management, water quality, air quality, ecological resources, and socioeconomics to be SMALL (NRC 2002). In addition, in Section 6.3 the review team concluded that the impact of greenhouse gas emissions on air quality during decommissioning would be SMALL. Therefore, the cumulative impacts for the CPNPP site would be SMALL, and further mitigation would not be warranted.

7.11 Conclusions and Recommendations

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operations of two additional nuclear units at the CPNPP site together with past, present and reasonable foreseeable future actions. The specific resources that could be affected by the proposed action and other past, present, and reasonable foreseeable actions, in the same geographic area, were assessed. This assessment included the impacts of construction and operations for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning impacts described in Chapter 6; impacts of past, present, and reasonably foreseeable Federal and non-Federal actions that could affect the same resources affected by the proposed action, as described in Table 7-1.

Table 7-3 summarizes the cumulative impacts by resource area. The cumulative impacts for the majority of resource areas would be SMALL, although there could be MODERATE or LARGE impacts for some resources, as described below.

Cumulative land-use impacts in the geographic area of interest would be MODERATE, primarily due to construction and preconstruction activities that include (1) the commitment of land for the new Units 3 and 4 and their associated cooling towers, for the BDTF, and for new transmission lines, (2) future urbanization, and (3) land use impacts from GCC. The incremental impacts from NRC-authorized activities on land use would be SMALL because the effects to land use from building and operating Units 3 and 4 would be minimal.

The cumulative surface water use impacts would be MODERATE to LARGE, primarily because there would be noticeable alterations in the Brazos River system to accommodate increase water demand, and under extreme drought conditions, the combined effects of past, present, and reasonably foreseeable stresses on the surface water resource could destabilize the surface water resource. The incremental impacts to water use from the NRC-authorized activities would also be MODERATE. The review team concludes that the cumulative surface water quality impacts in the geographic area of interest would be SMALL to MODERATE. The NRC staff concludes that the incremental impacts on water quality from NRC-authorized activities would also be SMALL to MODERATE.

Cumulative terrestrial ecology impacts in the geographic area of interest would be MODERATE. The development of new transmission corridors and infrastructure to support future projects, when combined with this project, could affect wildlife and may be detrimental to surrounding terrestrial habitats. Loss of vegetation, wildlife habitat, and increased habitat fragmentation from continued development and GCC are unavoidable and would continue to occur. The extents of available habitats are ultimately limited, and direct loss of habitat through continuing development, as well as habitat modifications caused by increasing scarcity of water in the region would contribute to cumulative impacts. The incremental impacts from NRC-authorized activities on terrestrial ecology would be substantial contributors to the overall MODERATE impact level.

Table 7-3. Cumulative Impacts on Environmental Resources, Including the Impacts of the Proposed CPNPP Units 3 and 4

Resource Category	Impact level
Land-Use	MODERATE
Water-Related	
Water Use-Surface Water	MODERATE to LARGE
Water Use-Groundwater	SMALL
Water Quality-Surface Water	SMALL to MODERATE
Water Quality-Groundwater	SMALL to MODERATE
Ecology	
Terrestrial Ecosystems	MODERATE
Aquatic Ecosystems and Wetlands	SMALL to MODERATE
Socioeconomic Resources	
Physical Impacts	SMALL to MODERATE
Demography	SMALL
Taxes and Economy	LARGE (beneficial)
Infrastructure and Community Services	SMALL to MODERATE
Environmental Justice	SMALL
Historic and Cultural Resources	SMALL
Air Quality	MODERATE
Nonradiological Health	SMALL to MODERATE
Radiological Health	SMALL
Severe Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

The review team concludes that cumulative impacts from past, present, and reasonably foreseeable actions to aquatic resources and wetlands in the geographic area of interest would be SMALL to MODERATE. Future development of industries that compete for water along the Brazos River, as well as management of water budgets across the State of Texas would likely affect aquatic resources in the Brazos River. The cumulative effects on aquatic biota from the hydrological changes in the Brazos River, PKL, and Lake Granbury associated with increased water consumption by the proposed CPNPP Units 3 and 4 in combination with other future users of BRA water allocations would be noticeable; however, cumulative impacts to wetlands would be minimal. Direct and indirect anthropogenic stressors, including GCC, in the geographic area of interest would cumulatively lead to effects on the aquatic communities that would be noticeable. The incremental contribution of the proposed action to impacts on aquatic resources in water bodies and wetlands in the area of interest would be SMALL for most impacts; however, the incremental contribution to impacts on the aquatic resources of Lake

Granbury, PKL and the stretch of the Brazos River from PKL to Lake Whitney that would result from the reduced flows and extreme low flows during drought conditions would potentially range from SMALL to MODERATE. The incremental impact from NRC-authorized activities on aquatic resources would also be SMALL to MODERATE.

For socioeconomic resources, the review team concludes that cumulative physical impacts would be SMALL, except for MODERATE physical impacts on FM 56 due to increased traffic associated with CPNPP Units 3 and 4. The review team concludes that cumulative impacts on demography would be SMALL. The review team concludes that cumulative impacts on the economy and taxes would be LARGE and beneficial in Somervell County, but SMALL and beneficial in the rest of the six-county study area. For infrastructure and community services, the review team concludes that cumulative impacts would be SMALL with two exceptions. First, cumulative impacts on traffic on FM 56 would be MODERATE because there would be noticeable impacts on traffic flow and LOS during peak employment. Second, cumulative impacts on wastewater treatment facilities in Somervell and Bosque counties would be MODERATE because of population growth associated with peak employment at CPNPP Units 3 and 4. Based on Luminant's estimate that 98 percent of socioeconomic impacts would be attributable to NRC-authorized construction (Luminant 2009a), the NRC staff concludes that the incremental cumulative impacts of NRC-authorized activities on socioeconomic resources would be the same as those discussed for the review team.

In regard to the potential cumulative impacts to air quality from the proposed Units 3 and 4, the review team concludes that the cumulative impacts on criteria pollutants from emissions of effluents from the CPNPP site and from other past, present and reasonably foreseeable future actions—as well as the cumulative impacts of GCC—would be noticeable, but not destabilizing. The cumulative impacts to air quality resources in the geographic areas of interest would be MODERATE; however, the incremental contribution of impacts on air quality resources from building and operating proposed Units 3 and 4 would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

The review team concludes that cumulative impacts on public and worker nonradiological health would be SMALL to MODERATE. NRC-authorized activities associate with the operation and construction of the proposed new units would be contributor the SMALL to MODERATE level of impact. The MODERATE level of impact is associated with the potential for an increase level of noise as a result of operating pumps and mitigation measures could include low-noise-producing pump motors, mounting the motors on sound-dampening material, relocating the motors away from water, or enclose the pumps in a sound-absorbing structure.

7.12 References

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10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81 "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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8.0 Need for Power

Luminant Generation Company LLC (Luminant) is the applicant for Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4. Luminant is a merchant energy company that provides electricity and related services to wholesale customers in the Electric Reliability Council of Texas (ERCOT) region (TXU Corp. 2006; CPNPP 2007). The ERCOT wholesale power market has been competitive since 1995, and the ERCOT retail power market, as shown in Figure 8-1, has been competitive since 2002 (ERCOT 2010a). ERCOT lies wholly within the State of Texas, and while not a formal member of the North American Energy Reliability Corporation (NERC), follows NERC rules. It is isolated from the rest of the power grid by a lack of alternating current (AC) compatibility and limited direct current (DC) connections. ERCOT is part of the Public Utility Commission of Texas (PUCT). ERCOT is responsible for the reliability of the electric grid and for ensuring nondiscriminatory access to transmission services by all market participants. To meet its responsibilities, ERCOT undertakes frequent assessments of long-term power needs and ensures nondiscriminatory access to transmission services by power market participants. These analyses and forecasts have supplied much of the data contained in Luminant's need for power analysis. ERCOT also approves transmission upgrades necessary to maintain grid reliability and acts as an independent system operator (ISO) for wholesale power markets.

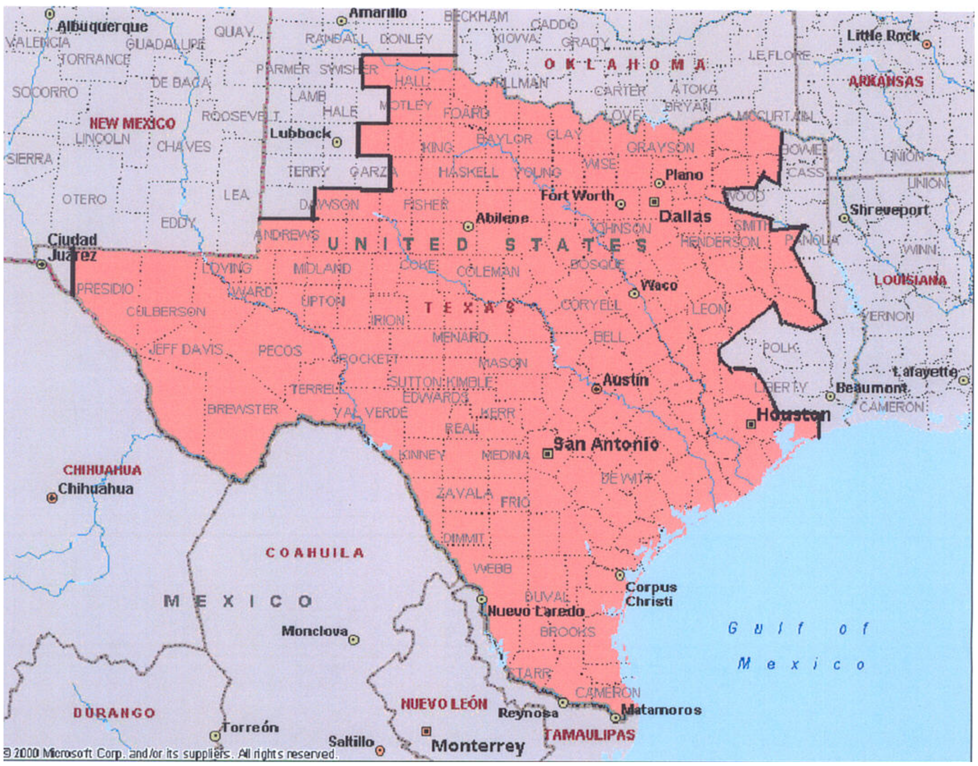

Figure 8-1. Electric Reliability Council of Texas Region. (TXU Corp. 2006, CPNPP 2007)

Luminant currently owns a mix of nuclear, coal, and gas generating plants that supply wholesale power to the ERCOT grid. Luminant's parent company is Luminant Holding Company LLC, which is a wholly owned subsidiary of Energy Future Holdings Corporation (EFH), a Dallas-based energy company that manages a portfolio of competitive and regulated energy businesses, primarily in the ERCOT market. The Luminant business segment includes merchant electric generation, a business development group, a construction group, and a wholesale market group. Luminant is also the largest purchaser of wind-generated power in Texas and the fifth-largest wind purchaser in the United States (Luminant 2009b).

Luminant proposes to construct and operate two U.S. Advanced Pressurized Water Reactor units (designed by Mitsubishi Heavy Industries, Inc.) at its CPNPP site located in North-Central Texas. Luminant currently owns and operates two Westinghouse Four-Loop Pressurized-Water Reactors, designated Units 1 and 2, as well as supporting infrastructures at the same location. Units 1 and 2 have been in commercial operation since 1990 and 1993, respectively. Supporting infrastructure will be expanded to meet the requirements of proposed Units 3 and 4. Expansion of the existing transmission infrastructure will be required (Luminant 2009a).

This need for power analysis is guided by Chapter 8 of NRC's *Standard Review Plans for Environmental Reviews for Nuclear Power Plants* (NRC 2000) and the Agency's additional guidance document, Revision 1 of the NRC Staff Memorandum *Addressing Construction and Preconstruction, Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011). NRC staff has followed these guidelines while attempting to also capture unique aspects of Luminant's application for combined operating licenses (COLs). This review recognizes that Luminant is a merchant power vendor that must compete in electricity markets with other suppliers. As a merchant power vendor, Luminant must bear market-related risks that differ from those of regulated power vendors. In particular, Luminant receives no negotiated profit margins that sometimes characterize the rate-of-return for regulated power markets. For this reason, the acceptance criteria in this need for power analysis consider whether relevant service region supply and demand conditions are consistent with market entry by a vendor with additional capacity as is proposed by Luminant. The NRC staff's determination is that market conditions justify Luminant's proposal.

In preparing the need for power analysis contained in its application, Luminant has relied heavily on analyses prepared by ERCOT as part of its assignments from the PUCT (ERCOT 2010b). The NRC staff has taken Luminant's analysis as a point of departure and conducted an updated analysis using newer data from ERCOT than was found in Luminant's application, also based on ERCOT data. In determining the validity of ERCOT analyses, the NRC staff follows guidance in Chapter 8 of NUREG-1555 (NRC 2000), which states that if the NRC staff finds an analysis to be (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty, then this analysis is acceptable and need not be subject to further review by the NRC staff. The NRC staff has determined that the ERCOT data and forecasts meet these criteria. However, the NRC staff also notes that more recent ERCOT updates than those reported by Luminant in its application are available. For this reason the NRC staff has included the new data in the need for power analysis. The NRC staff has relied on these data and forecasts in the need for power analysis, but has also developed a series of sensitivity analyses employing alternative scenarios to test how supply and demand respond to reasonably foreseeable fluctuations in key variables.

This chapter is presented in four subsections as follows:

- Section 8.1, Description of Power System, presents an overview of the ERCOT region and a brief summary of EFH's subsidiaries in the ERCOT power system, as well as a regional demand assessment based on ERCOT reports, assessments, and analyses. This section also provides a detailed discussion describing why the NRC staff finds the ERCOT analysis to meet the four criteria.

- Section 8.2, Power Demand, presents the revised forecasts prepared by the NRC staff based on more recent ERCOT data. This section also discusses potential load reductions that might result from additional conservation.
- Section 8.3, Power Supply, presents a regional supply assessment based on ERCOT reports, assessments, and analyses.
- Section 8.4, Assessment of Need for Power, provides the NRC staff's determination regarding the need for power based on the material presented in Sections 8.1, 8.2, and 8.3, drawing heavily on the ERCOT reports and also on additional material describing the evolution of the ERCOT region. This section also contains four sensitivity analyses that apply scenarios with slightly different assumptions about key supply and demand factors to test the stability of the ERCOT analyses. These scenarios include: (1) the effects of an increased estimate of conservation, (2) inclusion of greater wind generating capacity, (3) a combination of increased conservation and greater wind, and (4) the retirement of generating capacity older than 50 years.

8.1 Description of Power System

This section provides a brief overview of Luminant's company and then focuses on the history, structure, and operation of ERCOT.

8.1.1 The Applicant

EFH, TXU Corporation, is a holding company that conducts its operations principally through the following wholly owned subsidiaries:

- Oncor Electric Delivery Company LLC, (Oncor) a regulated company;
- Luminant, a competitive wholesale power company; and
- TXU Energy Company LLC (TXU Energy), a competitive retail power company.

EFH's service territory is the entire ERCOT region (Figure 8-1). Prior to deregulation, the traditional service territory in North Texas had an estimated population in excess of 7 million, which is about one-third of the population of Texas.

Oncor, EFH's regulated company, operates the largest transmission and distribution (T&D) system in Texas, providing power to more than 117,000 mi of T&D lines (Oncor 2010). The distribution grid system and transmission interties are discussed in Final Safety Analysis Report Sections 8.1 and 8.2 (Luminant 2009b).

Luminant, as a wholesale merchant generator, owns or leases 18,365 MW of thermal generation capacity, including 2300 MW of nuclear-fueled capacity (CPNPP Units 1 and 2), 5837 MW of lignite/coal-fueled capacity, and 10,228 MW of natural gas-fueled capacity. Luminant also purchased wind energy equivalent to about 900 MW capacity in 2009.

As of December 31, 2007, TXU Energy, the retail sales company, estimated that its shares of the ERCOT retail residential and small business markets were 36 percent and 25 percent, respectively (TCEH 2007). Approximately 1.9 million of TXU Energy's approximately 2.1 million retail electricity customers are in its traditional service territory. The remaining retail electricity service customers are in other areas now open to competition, including Houston, Corpus Christi, and lower Rio Grande Valley areas of Texas (TXU Corp. 2006). In North Texas, the remaining customers are served by other competitive retailers.

8.1.2 The Restructured Texas Utility Industry

Legislation enacted by the Texas Legislature in 1995 and 1999 changed the traditional regulation of electric utilities in Texas by creating a comprehensive electric wholesale market and provided for the restructuring of the retail and T&D markets. The PUCT has principal responsibility for the Texas power industry under the Public Utilities Regulatory Act (PURA), § 39.151 (PURA 1999). The restructured power industry corresponds geographically to the current ERCOT boundaries, and ERCOT was assigned major power system operating responsibilities.

In 1999, the Texas Legislature enacted Senate Bill 7 (SB 7 1999) providing for retail electric competition. SB 7 required the state's vertically integrated investor-owned utilities to separate their business activities into three components, which included competitive power generating companies, competitive retail electric providers, and regulated T&D utilities. This business separation, known as unbundling, was accomplished by establishing separate affiliated companies owned by a common holding company or by sale of assets or stock to third parties. SB 7 also mandated that each state power region create and maintain an ISO to monitor the T&D system, ensure nondiscriminatory access to T&D, and settle wholesale energy transactions (SB 7 1999). ERCOT functions as the ISO within its boundaries.

The ERCOT region is distinguished by its lack of synchronous interconnectivity with other power regions in the United States, although it can exchange a small amount of DC power with the Southwest Power Pool (SPP) and with Mexico. Because of this lack of interconnectivity, almost all of the power consumed within the ERCOT region must be generated within the region. Also, for ERCOT operations contained wholly within Texas, ERCOT is not subject to the Federal Energy Regulatory Commission (FERC). The exception is the DC lines, which, because they cross state boundaries, are subject to FERC regulation (FERC 2007, ERCOT 2005).

ERCOT manages the flow of electric power to approximately 20 million Texas customers, representing 85 percent of the state's electric load and 75 percent of the state's land area. ERCOT, functioning as the ISO for the region, schedules power on an electric grid that connects 38,000 mi of high-voltage transmission lines and more than 500 generation units. ERCOT is a membership-based, not-for-profit corporation [501(c)6] governed by a board of directors and subject to oversight by the state PUCT and the Texas Legislature. ERCOT has roughly 250 members, including retail customers, investor-owned utilities, rural electric cooperatives, river authorities, independent generators, and power marketers (ERCOT 2010a). ERCOT has a Board of Directors consisting of independent members, consumers, and representatives from the current seven power markets. This Board of Directors appoints ERCOT's officers. Representatives from all segments of ERCOT's market participants collaboratively created ERCOT's governing documents, referred to as ERCOT's protocols (ERCOT 2010c). In addition, ERCOT has a variety of advisory committees and other stakeholder interaction mechanisms.

ERCOT performs a number of roles in managing the electric power grid and marketplace (ERCOT 2010b), including:

- monitoring schedules submitted by wholesale buyers and sellers for the next day's electricity supply for purposes of load following to supplement bilateral power sales;
- managing financial settlements for wholesale sales;
- ensuring electricity transmission reliability by managing the incoming and outgoing supply of electricity over the grid, conducting a day-ahead market for ancillary services and a real-time balancing market, and issuing instructions to generation and transmission companies to maintain balance;

- serving as a central hub for retail customer registration and switching; and
- forecasting loads and analyzing transmission and related system needs.

In practice, most power sales take place through bilateral arrangements between power producers and power consumers, and ERCOT must plan for transmission capacity to facilitate power transfers between seller and buyer.

A major aspect of ERCOT's ISO role is to manage congestion across the zones that make up the current management structure for power delivery and reliability functions while facilitating the completion of contracted power deliveries. Until recently, power consumption and transfer was modeled and managed as a ten-zone system with some restrictions on inter-zonal power transfers to manage congestion (ERCOT 2010c). This resulted in inefficiencies as system management did not account fully for the real costs of congestion. ERCOT has now switched from this zonal system to a nodal system that will highlight the costs of congestion and assign congestion costs based on differences between nodal prices at point of injection and point of withdrawal (ERCOT 2010c). The new management system generally mimics the physical power system, provides greater information on the marginal costs of power at each node, and provides incentives for more efficient behavior.

8.1.3 The Role of Market Forces in the Restructured System

Under the restructured system, responsibilities for planning have seen significant reassignment. ERCOT has planning responsibilities for power system performance and is concerned with its specific functions within the context of system reliability. ERCOT must perform extensive annual and semiannual studies, issue reports, make recommendations for transmission system needs and adequacy, and make legislative recommendations to further these objectives. Beyond enforcing compliance with its operational procedures, ERCOT does not participate in the planning functions of individual power sellers and buyers within the system. Instead, individual power suppliers assess the market forces affecting the overall demand and supply for power and make individual decisions to add new capacity or to retire old capacity. ERCOT analyzes the region within the context of a competitive market using load growth projections, regional transmission topology, specialized studies, and new generation characteristics. These reports are subject to market participants' input and review. However, ERCOT is concerned primarily with overall system performance and, apart from minor concerns with ancillary services for reliability requirements, does not participate in the decisions of individual market players to increase or decrease their operating capacities.

This environment constitutes a significant departure from traditional rate-of-return regulation under which state regulators participate in many operating decisions by system players. In a traditionally regulated system, regulators assess the efficiency of choices over how system assets are operated and assess choices to add or retire system assets. Regulators also approve or disapprove pricing (tariff) decisions, usually within the context of an equitable rate of return on capital investments used in power operations. In the restructured system, ERCOT and the PUCT have limited influence over choices to invest in new assets by power generators, such as Luminant, but they also do not ratify power prices to ensure equitable rates of return. In short, market forces are the principal drivers behind power prices and vendor profits.

8.1.4 ERCOT Load Forecasting Process

In addition to its other responsibilities, the ERCOT organization has the responsibility to study the need for increased transmission and generation capacity within its boundaries, pursuant to PURA § 39.151 (PURA 1999). Key inputs to this process are the preparation of multiyear forecasts of peak electricity loads and total energy consumption, generation capacity and resources, and transmission capacity and constraints. In carrying out these responsibilities, ERCOT develops detailed load forecasts and forecasts of the generation capacity and transmission capacity changes needed to meet the load. These reports are subject to stakeholder input and review and are filed with the state legislature. The load forecasting report, *2010 ERCOT Planning Long–Term Hourly Peak Demand and Energy Forecast*, was filed on June 25, 2010 (ERCOT 2010e). The report provides a historical perspective of the load growth in ERCOT's territory, the ERCOT forecasting process, a summary of the forecast results, and a description of differences between the current year's forecast and the previous year's forecast.

The ERCOT planning process requires detailed information to study transmission system loads and potential locations of congestion with the goal of ensuring system reliability. In contrast, this need for power analysis assumes that ERCOT will provide needed access to its grid and considers only system-level loads. ERCOT also is interested in understanding how changes to the power system affect the ability of the system to follow variations in peak load. While the proposed CPNPP Units 3 and 4 are designed to meet base load needs and to have limited load-following capability they are evaluated in this need for power analysis relative to the overall power system. The NRC staff includes both energy consumption and peak load in this section to consider the impact of load and other anticipated changes on the ERCOT reserve margin, but follows a traditional capacity planning analysis based on system peaks for analyzing the impacts of the proposed units on the ERCOT reserve margin. Power loads are observed by measuring the instantaneous demands placed on the power system. Total loads can be integrated over any chosen interval, for example, an hour or a year. ERCOT peak load forecasts refer to hourly peak loads and are a measure of the highest hourly load occurring within a year. Total energy consumption is the sum of total loads supplied over a period of time, for example, total watts served for an hour or for a year. Energy consumption is typically reported as load served for an hour (watt hours, kilowatt hours, megawatt hours, etc.). ERCOT reports average load as total watt hours served divided by the number of hours in a year. Capacity planning is typically carried out by considering the various aspects of capacity and capacity management options that can be employed to meet peak loads, taking into account a measure of safety or cushion referred to as the reserve margin. These management options are discussed in detail below in Table 8-2 and in Section 8.4. Throughout this chapter the NRC staff follows the traditional approach to capacity planning to establish a need for power that takes into account observed peak system loads and the various system resources available to follow peak loads. Whereas the nuclear generating units proposed by this application are base load units, that is, units with relatively low average costs, but limited load following capacity, base power loads are not observed independently from total loads, but rather in conjunction with other types of facilities to determine the system's ability to meet reserve margins and peak loads. Generation capacity dispatch in ERCOT is largely determined by long term contracts between power buyers and sellers, supplemented by power auctions. This means that any source of generating capacity could engage in long term contracts or bid in the auctions and compete with the nuclear units, regardless of fuel and generation type. As described in Section 8.4, where applicable, the NRC staff has used sensitivity analyses to test the impact of specific scenarios, such as the potential impact of conservation programs on reserve margins. The Applicant relied heavily on the 2007 ERCOT analyses in its application. The NRC staff has used updated ERCOT forecasts and analyses in preparing this environmental impact statement (EIS) and has compared them to the Applicant's data.

8.1.4.1 Historical and Forecasted Peak Demand and Average Load

Figure 8-2 compares ERCOT's peak loads and average hourly loads between 1998 and 2009. The average hourly load corresponds roughly to the base load of the system, the load that is relatively predictable and that tends to grow at a relatively constant rate. In addition, there are also a number of cyclical changes in load that follow patterns determined by time of day, day of the week, month of the year, and so on. ERCOT conducts planning exercises to ensure that peak loads can be met with a relatively high degree of confidence and plans for the availability of a variety of system assets to ensure against brownouts or blackouts.

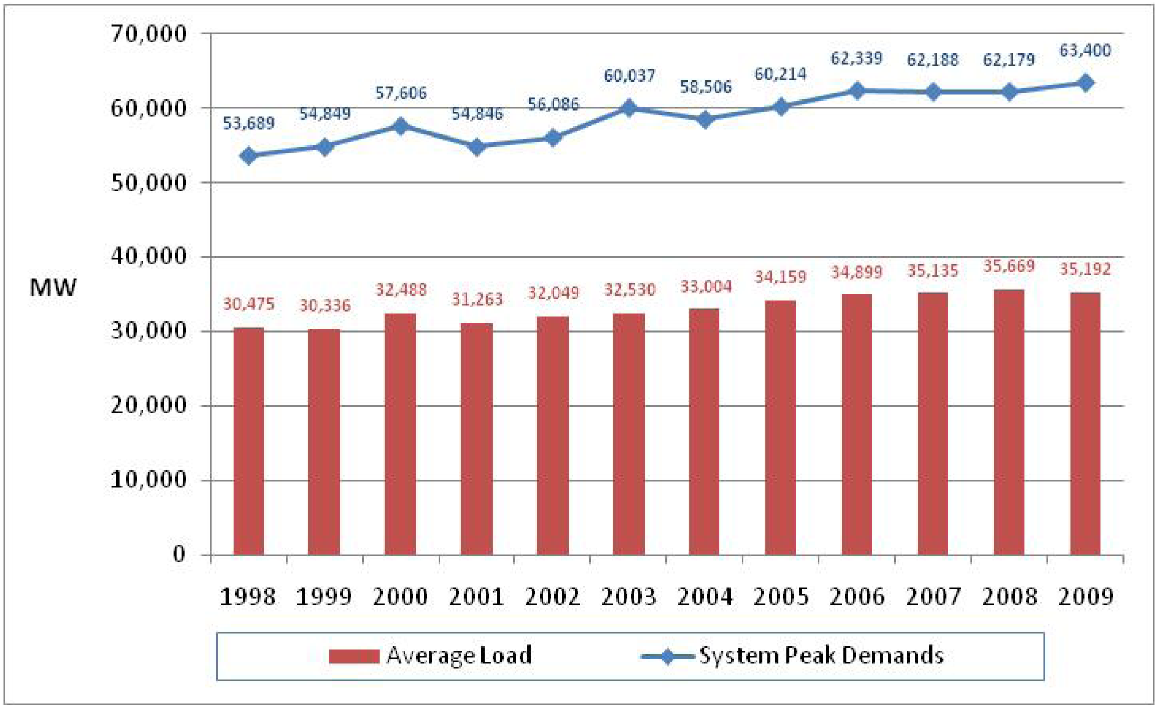

Figure 8-2. ERCOT Historical Load versus System Peak Load Growth (ERCOT 2010e)

Between 1998 and 2009, ERCOT reported average load growth of 15.5 percent (from 30,475 to 35,192 MW) and system peak growth of 18.1 percent (from 53,689 to 63,400 MW) (ERCOT2010e). Between 1997 and 2007, however, ERCOT reported average load growth of 21.3 percent and peak loads growth of 24.0 percent (ERCOT 2008a). ERCOT describes the variation in the following way: The actual system peak demand from 1997 to 2007 experienced a high growth rate that can be attributed to abnormal weather conditions, which ERCOT does not expect to reoccur in the future. Because 1997 was a mild weather year, it anchored the 1997–2007 period to a lower initial point than was representative of the longer term. In describing this period as unusual, ERCOT was arguing that arbitrary periods of peak demand and average load provide an inadequate basis for forecasting (ERCOT 2008a). Forecasting must take into account underlying causes, the use to which the forecasts will be put, and differences between transient causes and long-term ones.

Subsequently, ERCOT forecasted the average load and peak demands for the future period 2010–2019 obtaining the data shown in Figure 8-3 (ERCOT 2010d). Data in this figure indicate that over the 2010–2019 period, average load is forecasted to grow at 16.7 percent and peak load is forecasted to grow at 16.6 percent. The increases in average load and peak load represented in figure 8-3 exceed the increase in available baseload capacity represented by proposed Units 3 and 4 at the CPNPP site. Thus, the ERCOT forecasts for growth in average load and peak load provide an initial indication that growth in baseload demand in the ERCOT region in the 2010-2019 period would be enough to support the proposed units. The following sections consider the ERCOT forecasting process, the results it produces, and the steps taken by ERCOT to reflect uncertainties.

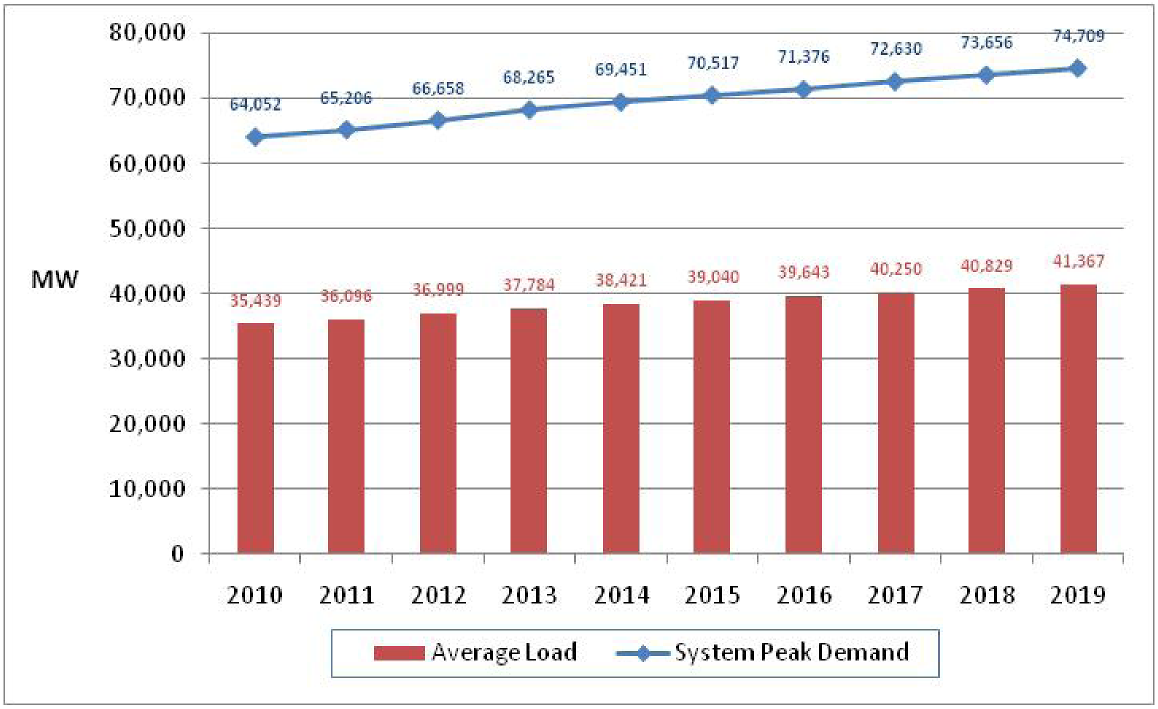

Figure 8-3. ERCOT Forecasted Average Load versus System Peak Growth (ERCOT 2009a)

8.1.4.2 Development of Peak Demand and Energy Consumption Forecasts

Appendix 3 of the *2010 ERCOT Planning Long-Term Hourly Peak Demand and Energy Forecast* (ERCOT 2010e) provides a general description of ERCOT's forecasting methodology. The basic ERCOT forecasting model consists of two components: (1) a monthly energy consumption model; and (2) an hourly load shape model. The monthly model is used to forecast energy consumption by eight weather zones throughout the ERCOT market area. These zones are shown in Figure 8-4.The hourly load shape model is an annual model that reshapes the total energy consumption into hourly components. These components change from hour to hour, day to day, and month to month, depending on such factors as average temperature, weekly work cycles, daily lifestyle cycles, and the like. The same load shape model is used for each forecast year and supplies forecasts of cyclical variation whereas the monthly model provides forecasts of electricity demand by month over the forecast period. When combined, the models forecast the hourly peak load by year on the ERCOT system by regions and the monthly total load by regions.

The monthly model is a linear econometric model that combines historical levels of several independent variables to predict future load values. Independent variables include income, population, and employment. Typically, electricity use increases (decreases) as income, population, and employment increase (decrease). This analysis is carried out by year and region and yields electricity consumption forecasts for each region and each year. System-wide forecasts are obtained by summing over the regions for each year. The modeling process is described in Figure 8-5.

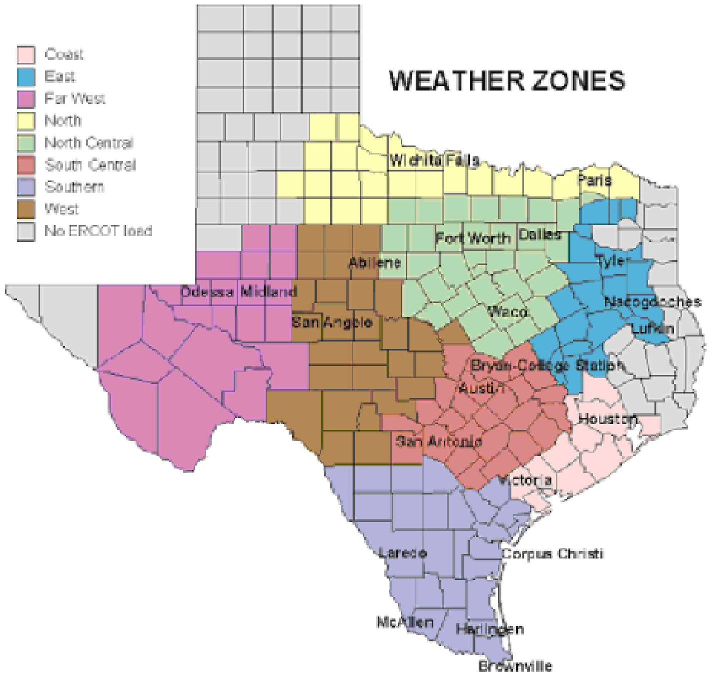

Figure 8-4. Weather Zones (ERCOT 2007a)

Several types of error can occur when forecasting. First, historical data may not apply perfectly to the future. For example, behavior may change over time, as when electricity users purchase energy-using products not available during the historical period. These are sampling errors and can often be prevented. Errors also occur when the model makes predictions because forecasts of independent variables are typically smooth while actual observed data tend to be less regular, as when a recession or a major weather event occurs. This type of error is a forecasting error, and while it cannot be removed entirely, if the model is correctly designed, a forecasting error will not introduce any bias or net positive or negative change in the independent variable predicted. Forecasting is less accurate the farther into the future the model tries to predict because sampling and forecasting errors tend to magnify over time. ERCOT analyses appear to be well structured and consider these types of errors.

8.1.4.3 Historical Trends and Long-Term Forecasts

ERCOT's annual historical and peak demand forecasts with scenarios for weather extremes, produced in 2010, are shown on Figure 8-6. Peak energy loads are the largest level of hourly demand during the course of a year. To meet this load, generation capacity and other system resources must produce enough electricity to avoid losing system stability (the ability of the system to provide all of the power demanded at all times). Similarly, the transmission system must be able to carry sufficient power to meet the need.

Historical peak loads are variable and depend on the many factors that ERCOT seeks to capture in preparing its updated annual forecasting series. Weather extremes are particularly important in causing peaks and are difficult to forecast. ERCOT takes this uncertainty into account using scenario analysis. The total increase in peak load over 2002–2009 reported by ERCOT in their annual reports was 13.0 percent. In Figure 8-6, a baseline (mid) forecast is presented and cool temperature (10-90) and high temperature (90-10) scenarios are shown. The 90-10 scenario is a "high temperature" scenario formed by assuming temperatures that exceed 90 percent of the historical temperatures experienced over the last fourteen years (i.e., are at the 90 percentile). The 10-90 scenario is a “low temperature” scenario formed by assuming temperatures fall at the 10th percentile of the historical temperatures experienced over the past fourteen years. While falling short of providing confidence intervals, this practice accounts for temperature variation and illustrates how electricity loads are influenced by temperature extremes. This underscores that the goal of forecasting is not to provide perfect predictions of future loads, but rather to provide a sound foundation for system planning that can be updated over time. To ensure that tradeoffs are captured in the planning process, the system establishes a target reserve margin (i.e., extra capacity) that will accommodate peaking requirements for most foreseeable circumstances. This is discussed below. In this specific case, optimal system management is based on meeting peak loads efficiently.

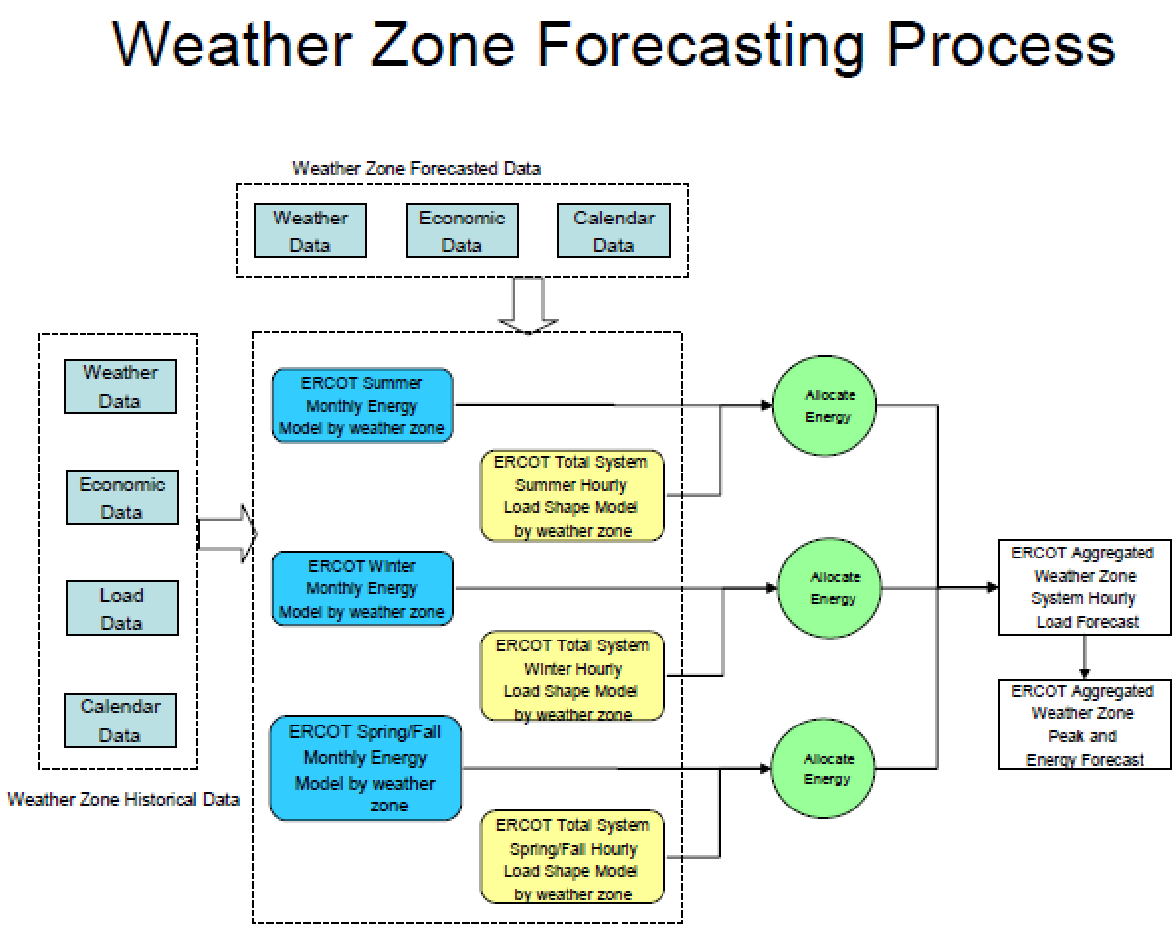

Figure 8-5. The Forecasting Process (ERCOT 2010d)

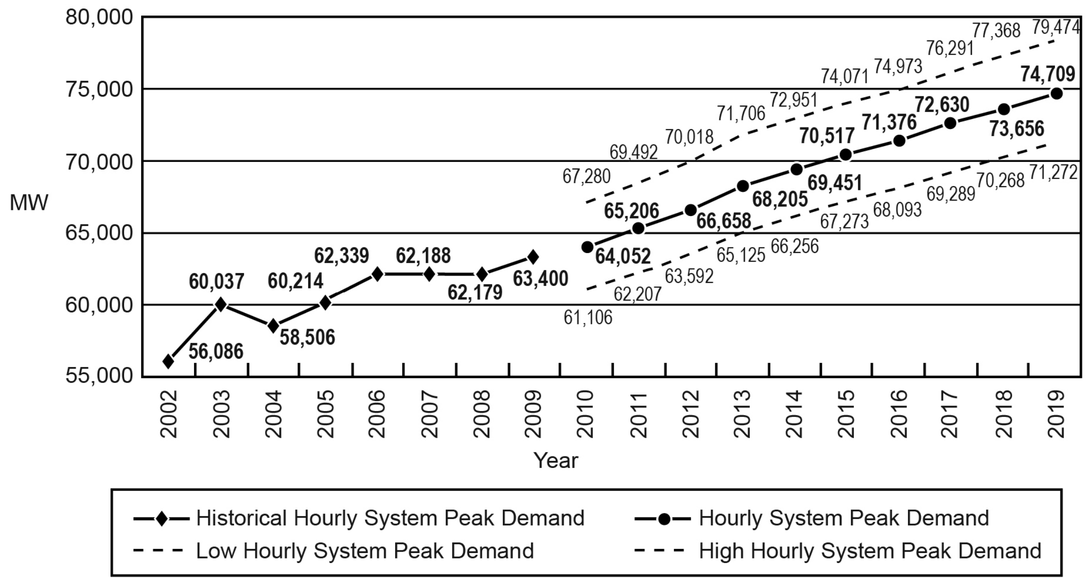

Figure 8-6. Historical and Base Forecast Hourly Peak Demand, Temperature Uncertainty Scenario (Adapted from ERCOT 2010e)

In Figure 8-6, high temperature, mid temperature and low temperature peak loads were forecasted to increase by 25.3, 17.8, and 12.4 percent over the period 2009 and 2019, respectively. For an individual year, actual temperatures could occur between levels roughly bounded by the scenario extremes, leading to corresponding changes in energy demands. The particular growth rate calculated is sensitive to the base year chosen. If the base year had a relatively low peak, the calculated percentage increase would tend to be higher and vice versa.

Figure 8-7 shows actual historical and forecasted peak demands prepared in 2009 and 2010. Owing to the national economic downturn, and the effects of extreme weather events along the Texas gulf coast, peak demands were relatively constant between 2006 and 2008. Starting in 2009 observed peak demand began to increase. Nevertheless, ERCOT's forecasts for peak load were lower in 2010 than had been the peak load forecasts produced in 2009. By 2019, the difference between the two forecasts was 3.6 percent with the more recent forecasts of peak demands for 2019 2705 MW(e) less than the demand estimates made in earlier years, because the ERCOT forecasting methodology places heavy weight on the actual historical record. The differences between the 2009 and 2010 forecasts appear to reflect long term departures from the historic patterns.

8.1.4.4 Load Participation Programs

The ERCOT Demand Side Working Group (DSWG) was created in 2001 as a task force by a directive of the PUCT and was converted to a permanent working group in 2002. A broad range of commercial and industrial consumers, load-serving entities and retail power providers, T&D service providers, and power generation companies participate in the DSWG meetings and initiatives. ERCOT market rules allow demand-side participation under three general classes of service: (1) voluntary load response, (2) qualified Balancing up Load (BUL), and (3) Load Acting as a Resource (LaaR) (ERCOT 2007b).

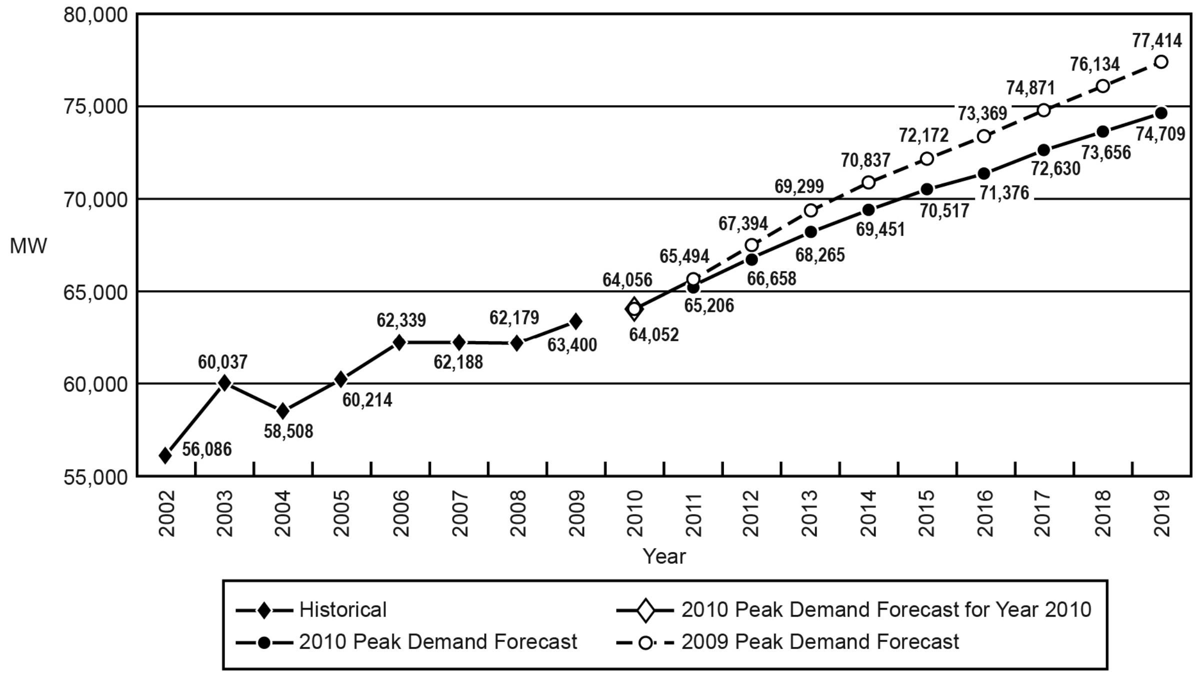

Figure 8-7. Comparison of 2009 and 2010 Forecast of Hourly System Peak Demand (Adapted from ERCOT 2010e)

Voluntary load response refers to a customer's independent decision to reduce consumption from its scheduled or anticipated level, in response to a price signal. This practice has also been known as "passive load response" and "self-directed load response." Participants gain financially by postponing consumption when prices are high and consuming the energy when prices are lower. BULs refer to loads that provide energy balancing by reducing their energy use. Customers with interruptible loads that can meet certain performance requirements may be qualified to provide operating reserves under the LaaR program. In eligible ancillary services markets, the value of the LaaR load reduction is equal to that of an increase in generation.

8.1.4.5 Conclusion: Adequacy of ERCOT Assessments as per NUREG-1555 Criteria

As discussed in Section 8.0, NUREG-1555 (NRC 2000) acknowledges that data and planning forecasts by independent bodies, including NERC reliability councils, such as ERCOT, are an appropriate basis for establishing the need for power in an environmental review for nuclear power plants licensing, provided the data and forecasts are systematic, comprehensive, subject to confirmation, and responsive to forecasting uncertainty. These ERCOT data and forecasting systems have been examined in some detail. The following sections summarize how the ERCOT data and forecasts fulfill these requirements.

Criterion 1 – Systematic

ERCOT takes a systems perspective. That is, ERCOT uses information for power producers, power consumers, capital assets linking them (including T&D systems), and the various markets in the ERCOT power system to ensure system reliability. As part of this process ERCOT also links its analyses to systems outside the power sector. As discussed in 8.1.4.2, demand forecasts take into account economic and demographic drivers and weather conditions. ERCOT uses a two-component modeling system consisting of a monthly energy consumption model and an hourly load shape model. The monthly model is used to forecast energy consumption by eight weather zones, and the hourly load shape model reshapes monthly power consumption into cyclical components by hour. The monthly model is a linear econometric model that takes into account historical levels and trends of a number of independent variables, including income, population and employment. The hourly load shape model is a time series model that uses time series analysis to convert historical cyclical trends into parameters that can reshape the monthly forecasts. Taken together, the models forecast cyclical energy consumption over the forecast horizon. In preparing its reports and analyses, ERCOT evaluates individual resources from the perspective of the system, for example, to evaluate reserve margins. Further, ERCOT systematically updates and evaluates its data collection and forecasts and in doing so promotes transparency in its forecasting and planning processes. The NRC staff concludes ERCOT data and forecasts are a neutral and independent source of information on electricity issues for policymakers. It therefore provides a continuous data base and conclusions that signal to participants throughout its service area when opportunities are available (see Sections 8.1.4.1, 8.1.4.2, and 8.1.4.3).

Criterion 2 – Comprehensive

As discussed in the preceding portions of this section, the ERCOT data and forecasting system are comprehensive in that they are inclusive of all relevant parts of the power system within its boundaries. This means that ERCOT planning resources are available from a single source and are produced under a unified operating philosophy in support of ERCOT's legal responsibilities. ERCOT performs a disaggregated analysis for each weather region to establish system demands, attributes of generating capacity, transmission system capacities, and power auction characteristics. These separate pieces are brought together to study the adequacy of generation capacity, the adequacy of various substitutes for generation capacity, transmission system stability and adequacy, and the role of ERCOT as an Independent System Operator (ISO). ERCOT is not charged with advocating or promoting specific technologies but encourages public debate by publishing its findings, holding open meetings, and encouraging stakeholder participation (See Sections 8.1.4.2 and 8.1.4.3).

Criterion 3 – Subject to Confirmation

ERCOT data and forecasting systems are subject to confirmation in the sense that they are subject to processes that require support by evidence, i.e., they are subject to corroboration and validation. For example, ERCOT carries out annual comparisons of its current and past forecasts. All data and methodologies are available to interested parties and they can be compared to analyses performed by a variety of alternative sources, such as the federal Energy Information Administration. They are also submitted to the NERC, which publishes them in volumes that are inclusive of data and forecasts from other NERC regions. As noted, ERCOT analysis and conclusions are subject to extensive stakeholder review processes in which stakeholders relevant to the ERCOT power system have an opportunity to review and comment on the data and forecasts. As an agent of the PUCT, ERCOT reports through PUCT to the Texas State Legislature. Finally, ERCOT maintains an extensive website through which members of the general public can gain access to all non-proprietary information contained in ERCOT's analyses and other affairs.

Criterion 4 – Responsive to Forecasting Uncertainty

Forecasting uncertainty recognizes that many aspects of the demand and supply of power production and consumption cannot be fully anticipated. Weather events can have significant impacts on the demand for power, as when Hurricane Ike negatively impacted economic activity on the Texas gulf coast, and weather events can contribute to unusual peak power demands, as when heat and humidity lead to higher loads for air conditioning. Economic conditions, such as housing markets and recessions can affect household incomes and business-sector levels of activity. Prices of fuels can change, affecting electricity production costs. ERCOT carries out sensitivity analyses, for example for weather, through the 90-10/10-90 scenarios, to provide rough bounds on its baseline forecasts. ERCOT also studies and makes annual modifications to trends in behavioral variables, such as income, population, and employment that influence its energy load and consumption forecasts. All of these forces and others must be recognized in the forecasting process, which in turn must be updated with sufficient regularity to account for significant changes that affect loads. Moreover, ERCOT does not "manage" power production in its service area, but rather functions to link demands and resources. This means that the important decisions regarding increasing capacity, changing generation fuel mixes and technologies, choices over heating and cooling technologies and steps taken to promote energy efficiency are made by decentralized decision makers in the private sector, rather than by system regulators. Finally, responsiveness to uncertainty does not imply that forecasts must be accurate for distant time periods. Rather, the forecasting process must inform the user about the sensitivities that forecasts have to input variables and assumptions, how accurate the forecasts have proved in the past, and what options the system has to accommodate forecasting uncertainty. This allows members of the private sector participating in the power system to make informed choices as they write contracts, plan expansions, and carry out other activities.

In sum, the NRC staff has reviewed the ERCOT forecasts and found them to meet the NUREG 1555 criteria for being systematic, comprehensive, subject to confirmation and sensitive to forecasting uncertainty. As a result, the NRC staff will use the ERCOT forecasts as the basis for its need for power analysis.

8.2 Power Demand

This section describes the calculation of peak load energy demand forecasts and the potential impacts of conservation practices and measures that are not captured by the ERCOT forecasts. Although the proposed CPNPP Units 3 and 4 are merchant power facilities designed to meet baseload needs they are evaluated in this need for power analysis relative to the overall power system as described in Section 8.1.4 of the EIS.

8.2.1 Peak Load Demand for Power

Table 8-1 presents the NRC staff's peak load forecasts, based on 2010 ERCOT data. For this purpose, the NRC staff calculates peak loads using the definition discussed below for the reserve margin calculation. As indicated below, the reserve margin provides a margin of safety to ensure capacity will be adequate to meet unusual load circumstances. By reducing the peak forecast by loads acting as resources and demand side management programs, a value termed the "corrected peak load for reserve margin," sometimes called "firm load," is obtained. For the purposes of generation capacity planning, demand side management impacts are principally those savings associated with Texas House Bill 3693 (OEECB 2007, (hereinafter referred to as HB 3693). Other trends in energy efficiency increases are captured through the monthly load forecasting model.

Table 8-1. Comparison of ERCOT Peak Load Forecasts, Loads Acting as Reserves, and Demand-Side Management Energy Saving for 2010, 2011, 2014, 2019, and 2024 (in MW)

Load	Year				
	2010	**2011**	**2014**	**2019**	**2024**
Peak Load	64,052	65,206	69,451	74,709	79,162
Less, Loads Acting as Resources	1062	1062	1062	1062	1062
Emergency Interruptible Services	336	370	492	492	492
Energy Efficiency Programs (House Bill 3693)	242	242	242	242	242
Corrected Peak Load for Reserve Margin	**62,412**	**63,532**	**67,655**	**72,913**	**77,366**
Source: ERCOT 2010e					

8.2.2 Potential Reductions to ERCOT Peak Load Forecasts due to Conservation

There are also a number of planned or ongoing conservation programs that could potentially go uncaptured in the newest ERCOT forecasts. Because ERCOT employs an econometric analysis of historical data to drive its forecasts, trends that are not reflected in the historical data will not be reflected in the forecasts. In other words, ERCOT does not speculate on the effect of potential conservation in its forecasts.

However, a number of actual or planned conservation activities could result in lower forecasts of peak demand and that might reduce peak load forecasts in the future. The American Recovery and Reinvestment Act of 2009 provided substantial temporary funding for conservation program in Texas, as described in Texas State Energy Conservation Office (SECO) report (SECO 2010). It also contributed to the existing Weatherization Assistance Program of the Texas Department of Housing and Community Affairs (TDHCA, 2011). In 2009, HB1937 went into effect, which allows municipalities to begin loan programs for retrofits of existing buildings (Property-Assessed Clean Energy Program) (Texas Legislature online, 2010). In addition SECO adopted rules implementing the 2009 International Energy Conservation Code and the 2009 International Residential Code for single family and other residential housing, effective in 2011 and 2012, respectively (Texas Register, 2010). Some related programs are already underway.

Based on review team discussions with ERCOT staff and extensive examination of Texas public documents and websites, the review team concluded that while there may be some long-range impacts resulting from these programs not currently captured by the ERCOT models, there is almost no currently available, reliable information that suggests the impacts of these programs have been significant on a statewide basis or that they require a significant adjustment to the ERCOT forecasts. The NRC staff has determined that while there is no reasonable basis upon which to alter the ERCOT forecasts for the purpose of the staff's need for power analysis, it is appropriate to recognize the potential, reasonably foreseeable impacts that conservation actions may have on future ERCOT forecasts. Therefore, the NRC staff has developed a demand scenario with greater conservation effects which adds the potential impact of HB 3693 to the demand side management adjustment made by ERCOT, referred to as Scenario 1, in Section 8.4.2 of this chapter.

8.3 Power Supply

This section presents an electricity supply assessment for the ERCOT region based on ERCOT reports, assessments, and analyses. ERCOT studies are wholly in the public domain and not subject to proprietary considerations. Although the NRC staff has drawn upon recent ERCOT documents to update data contained in Luminant's ER, for its analysis of need for power, the NRC staff has not included any new generation capacity or retirements of old generation capacity beyond that justified by ERCOT data. However, as part of its test for the reliability of ERCOT's analyses, the NRC staff performed a series of sensitivity analyses in Section 8.4.2. These sensitivity analyses test scenarios that reflect uncertainty in the growth of wind power, a relatively aggressive retirement of old generation capacity, and a combination of factors, to characterize reasonably foreseeable factors outside the scope of the ERCOT analyses.

8.3.1 Generating Capacity Analysis and Planning

Table 8-2 compares peak summer loads (discussed in Section 8.2) to resources available to meet those loads. For capacity planning analysis, forecasted peak demands are reduced by portions of peak load that will or could be avoided as part of the ERCOT demand management process described in Section 8.1. For example, loads serving as reserves can be dropped. Energy efficiency programs are also subtracted from peak load to be served.

Resource availabilities are typically calculated for summers owing to ERCOT's history of summer peak loads exceeding peak loads in other seasons. Installed generating capacity, the largest single resource in the ERCOT region, was estimated at 66,228 MW in 2010 and is forecast to decrease to 63 896 MW in 2014. This excludes available mothballed natural gas-fired generation capacity, which ranges from 0 MW in 2010 to 271 MW in 2014 (ERCOT 2009b). Mothballed capacity consists of units that have not been run for 6 months. ERCOT uses probabilities supplied by utilities that the plants could be returned to service to determine the availability of mothballed plants. Other operational resources include capacity from private networks (estimated at 4803 MW over the period), wind (829 MW starting in 2011), and reliability must-run (RMR) units (under contract of 688 MW in 2010). In sum, operational generation capacity of 72,512 MW was available in 2010, and it is forecast to decrease to 69,528 MW in 2014 and remain at that level through 2024.

Fifty-eight percent of installed ERCOT generating capacity in 2010 is from natural gas, 22.1 percent from coal, 6.0 percent nuclear, other and hydro 1.6 percent, and wind 11.4 percent (ERCOT2010e). This breakdown is based on nameplate capacity. Until recently, most new generation capacity added in the ERCOT system was fueled by natural gas, which, depending on the nature of the natural gas unit, can serve either baseload or load-following applications. Coal and nuclear facilities typically have much higher capacity factors than peaking or variable units, such as wind, but have limited load following capability (ERCOT 2010e). In some ways the rapid deployment of wind has complicated reliability planning, because the effective ability of wind to meet load is hampered by the difficulty in predicting wind speeds and other factors. As a result, ERCOT values wind capacity at 8.7 percent of nameplate capacity for reliability analyses (GE 2008), and this level is reflected in ERCOT's capacity projections. Hence, about 9500 MW of nameplate wind capacity is reflected as 829 MW in ERCOT's analysis. A recent planning study has suggested that nearly 19,000 MW of nameplate wind capacity could become available in ERCOT (ERCOT 2008b). To reflect the uncertainty of wind generation availability, the NRC staff performed a sensitivity analysis based on a scenario that doubles the nameplate wind capacity. The NRC staff refers to this scenario as scenario 2. This scenario, which uses ERCOT's wind capacity value at 8.7 percent of nameplate capacity, adds 829 MW of wind capacity in 2014, 2019, and 2024.

Other resources that are available to meet peak loads include 50 percent of nonsynchronous (DC) ties (553 MW); switchable units (2848 MW available in 2010); mothballed generation (191 MW in 2011); planned units, not wind (5495 MW in 2024); and planned wind units (96 MW in 2014). A planned unit is defined as a unit with an interconnection agreement and an air permit. Finally, a small adjustment is made for unavailable switchable units. In sum, ERCOT estimates resources available to meet peak loads at 75,913 MW in 2010, 77,449 MW in 2014, and 78,905 MW in 2019, and 2024. These increases are mostly due to the new capacity forecast to come online.

Since 1999, a total of 117 units have been decommissioned. Although ERCOT does not forecast additional units retiring between 2009 and 2014, the NRC staff expects that additional retirements will likely occur. ERCOT does not project plant closings but does carry out systematic assessments of the impacts of plant closings on reliability before decommissioning older plants. According to PUCT rules, ERCOT can maintain certain necessary units under RMR contracts, which provide voltage support and stability, or management of localized transmission constraints under first contingency criteria and maintain the option for any transmission alternatives to these RMR sources (ERCOT 2008b).

In 2008 there were 51 units totaling 8014 MW capacity that were between 40 and 49 years of age and 63 units with 2927 MW capacity that were 50 years old in the installed capacity portfolio (ERCOT 2008a). Age is one indication of the efficiency and maintenance costs of a generating unit, which are major factors in a decision to decommission. Current air quality regulations provide some incentives for retaining older plants that are grandfathered into less stringent emissions requirements. In contrast, new legislation that increases penalties for carbon emissions might not exempt older plants thereby increasing decommissioning incentives. Because it is difficult to forecast regulatory changes and the retirement process, the NRC staff does not attempt to weigh the probabilities of decommissioning, new legislation, and incentives to continue operation. For the forecasts used in Section 8.4, the NRC staff assumes that capacity remains constant from 2014 to 2024. However, the NRC staff tested the impact of retirements in Section 8.4.2. The NRC staff noted that after 2010, plants over 50 years old (the most conservative retirement assumption) could be retired based on age, cost, or for environmental reasons, based upon ERCOT's inventory (ERCOT 2010f). The NRC staff refers to this as scenario 4. Capacity reductions due to the scenario's hypothetical retirements are 4191 MW, 4952 MW, and 8606 MW respectively in 2014, 2019, and 2024.

Table 8-2. Capacity, Demand, and Reserves in the ERCOT Region Based on 2010 Data (in MW)

Load Forecast:	**2010**	**2011**	**2014**	**2019**	**2024**
Firm Load Forecast	**62,412**	**63,532**	**67,655**	**72,913**	**77,366**
Resources:	**2010**	**2011**	**2014**	**2019**	**2024**
Installed Capacity	66,228	63,896	63,896	63,896	63,896
Capacity from Private Networks	4803	4803	4803	4803	4803
Effective Load-Carrying Capability (ELCC) of Wind Generation	793	829	829	829	829
Reliability-Must-Run Units to Be under Contract	688	0	0	0	0
Operational Generation	**72,512**	**69,528**	**69,528**	**69,528**	**69,528**
50% of Nonsynchronous Ties	553	553	553	553	553
Switchable Units	2848	2962	2962	2962	2962
Available Mothballed Generation	0	191	255	271	271
Planned Units (Not Wind) with Signed Interconnection Agreement (IA) and Air Permit	0	740	4055	5495	5495
ELCC of Planned Wind Units with Signed IA	0	0	96	96	96
Total Resources	**75,913**	**73,974**	**77,449**	**78,905**	**78,905**
Less Switchable Units Unavailable to ERCOT	158	317	0	0	0
Less Retiring Units	0	0	0	0	0
Resources	**75,755**	**73,656**	**77,499**	**78,905**	**78,905**
Reserve Margin	**21.4%**	**15.9%**	**14.6%**	**8.2%**	**2.0%**

Source: ERCOT 2009b, 2010f

8.3.2 ERCOT Future Generation

As shown in Table 8-2, ERCOT includes a limited amount of planned generation capacity in its capacity and reserve calculation for 2014. This is a portion of the larger amount of proposed future generation that is being evaluated by ERCOT. To illustrate categories of planned capacity, Table 8-3 shows the interconnection request activity that took place in 2010. Table 8-3 shows proposed capacity by fuel type and separates them into three categories: Screening Studies; Interconnection Studies; and Interconnection Agreements. In total 65,125 MW of capacity are being studied by ERCOT, but only a small portion of the interconnection agreements are included in ERCOT's capacity and reserve calculation. This is because there is no firm commitment from the owner of the proposed plant until an interconnection agreement is signed. The first two categories are only studies and require minimal expense and commitment on the part of the owner of the proposed capacity. Additional information regarding future generation is provided in ERCOT's *Report on Existing and Potential Electric System Constraints and Needs* (ERCOT 2010f).

Table 8-3. Generation Interconnection Information[(a)]

Generation Interconnection Request Activity in 2010						
Fuel	**Screening Studies Requested**		**Interconnection Studies Requested**		**Interconnection Agreements Signed**	
	Number	**MW**	**Number**	**MW**	**Number**	**MW**
Coal	1	15	1	1	1	660
Gas-CC	2	645	2	645	3	2940
Gas-CT	3	643	2	247		
Wind	33	6204	2	6488	1	250
Solar	9	460	6	260		
Other	2	740	2	740	1	1300
Total	50	8707	40	8395	6	5150

(a) Projects may appear in more than one category.

Source: ERCOT 2010f

8.3.3 Reserve Margin

The reserve margin is the percentage by which the resources available to meet a peak load exceed the anticipated/forecasted peak load. This margin leads to an available capacity greater than forecasted needs and provides a cushion or margin of safety in protecting against an inability to follow load. The reserve margin is therefore a planning tool that helps ERCOT meet its reliability responsibilities and signals to the market if capacity is likely to be inadequate (ERCOT 2007a). The reserve margin, however, is a rule of thumb rather than a threshold because many system resources that contribute to the reserve margin may be old, inefficient, or otherwise less desirable than new, modern generators. The reserve margin also does not take the cost of producing electricity into account. On the other hand, ERCOT must approve plant decommissioning and will not do so if the plants under consideration for decommissioning are required to meet reserve margins. As a result, the reserve margin is considered a decision tool rather than a decision rule.

In 2005, the ERCOT Board approved a new methodology for calculating the reserve margin and based on that methodology, adopted a 12.5 percent target. The details that underlie the calculation of ERCOT's new reserve margin are shown in ERCOT 2007a. This reserve margin should be sufficient to cover, among other uncertainties, the potentially 6.4 percent higher demand peak associated with the 90-10 temperature scenario employed in the peak demand forecasts. The new methodology considered switchable capacity, mothballed capacity, and wind capacity as they apply to the ERCOT electric market. Short-term variations in forecasted economic activity, owing to Gulf storms and declines in the national economy, have reduced peak load forecasts to below previously forecast levels and caused reserve margins to be higher than those based on older peak load forecasts. In 2010 the ERCOT Board increased the margin to 13.75 per cent, and this number is used in this document (ERCOT 2010d). At that time the ERCOT Board also reaffirmed the use of the 8.7 percent load carrying capacity parameter for wind, and that number is used in this document.

8.3.3.1 Calculating the Reserve Margin

The ERCOT reserve margin is defined as:

$$RM = \frac{RA - FLF}{FLF}$$

where RM is the research margin, RA is the resources available, and
FLF is firm load forecast.

There is uncertainty associated with a number of the inputs to the ERCOT reserve margin calculation. The methodology considers these uncertainties to the extent possible, while at the same time attempting to avoid being overly cumbersome, complex, or rigid. For example, to calculate the electric load carrying capacity of wind, ERCOT employed Global Energy Decisions, Inc., (GE 2008) to calculate a carrying capacity relevant to the ERCOT context. GE used their unit commitment and dispatch software (MarketSym) to analyze the impact of load volatility, wind generation, unit maintenance, and forced unit outages on expected unserved energy, loss of load probability, and loss of load events. GE ran the model with the base set of generating units and a generic thermal generator (550 MW) and determined the expected unserved load. GE removed the generic generator and added new wind capacity until the same expected unserved energy was achieved. It was found that 6300 MW of wind nameplate capacity had the same load carrying capacity as the 550 MW thermal generator. Thus, the ELCC of wind was found to be 8.7 percent. Later studies with different assumptions yielded a somewhat higher load carrying capacity, but the PUCT reaffirmed the 8.7 percent figure in 2010 ERCOT 2010d.

The approved reserve margin methodology is intended to provide information to support system planning and a body of information that supports long-term decision making (GATF 2007). The elements included in the reserve margin calculation are shown in Table 8-2. Because of uncertainty over capacity additions, the 2011 value for operational capacity was held constant over the forecast period. This contributed to a reserve margin decrease from 15.9 percent in 2011 to 2 percent in 2024. Further details on the reserve margin can be found in ERCOT 2007a.

8.4 Assessment of Need for Power

This section assesses the need for power within the ERCOT region. The summer peak demand and energy forecasts used in this assessment are discussed in more detail in Section 8.2. Installed capacity, planned additions, and calculation of reserve margins are discussed in Section 8.3. As described in Section 8.2, the basis for the use of ERCOT forecasts in this chapter is that the ERCOT forecasts are (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. Finally, the data presented in this section, drawn from Sections 8.2 and 8.3, update the information contained in Luminant's original submission. The NRC staff identified reasonably foreseeable circumstances that were outside the scope of the ERCOT's analysis and applied them to the baseline ERCOT forecasts through a series of sensitivity analyses. To examine these circumstances, four scenarios were constructed to consider aggressive conservation, increased wind capacity, a combination of aggressive conservation and increased wind capacity, and retirement of plant capacity over 50 years of age. This section describes the circumstances under which there is a need for additional generating capacity over the time frame proposed by Luminant.

8.4.1 Need for Power Analysis

Table 8-4 summarizes the need for power analysis. This table is based on the NRC staff's forecasts using updated 2010 ERCOT forecasts. First, the peak loads and adjustments based on the NRC staff's updated forecasts and corrected for reserve margin calculation from Table 8-2 are shown on the first line of Table 8-4 for 2014, 2019, and 2024. If Comanche Peak Units 3 and 4 are not constructed, this analysis calculates that reserve margins would reach 14.6, 8.2, and 2.0 percent in 2014, 2019, and 2024, respectively.

Next, the capacity needed to meet the reserve margin (13.75 percent) is calculated and summed with the corrected peak load to obtain total capacity required. New units have not been added beyond those included in ERCOT's own analysis. The capacity for wind is entered as a relatively small amount, because, based on its own analysis, the ERCOT Board has chosen to value wind at 8.7 percent of nameplate capacity for reliability planning purposes. Third, the available capacity is subtracted from the required capacity yielding the additional capacity need to meet forecasted peak loads plus the reserve margin. These are 0, 4034 and 9099 MW for 2014, 2019, and 2024, respectively. Thus, if Comanche Peak Units 3 and 4 were added and operated at a 92 percent capacity factor, the reserve margins for 2019 and 2024 would be 12.3 and 5.8, respectively. In this case, even with the addition of Comanche Peak Units 3 and 4, additional capacity of 1091 MW and 6156 MW in 2019 and 2024, respectively, would be required to meet the reserve margin.

8.4.2 Sensitivity Analysis

The NRC staff performed a series of sensitivity analyses based on four scenarios introduced in Section 8.0: (1) an increase in the expected efficacy of conservation measures, (2) a doubling of ERCOT's expected wind generation capacity, (3) a combination of scenarios 1 and 2, and (4) retirement of all generating capacity more than fifty years old. These scenarios recognize that while ERCOT's data and forecasts are, as described in Section 8.3, the appropriate basis for the staff's need for power analysis, the analysis is limited in its scope and does not include some reasonably foreseeable circumstances. These scenarios, which use departures from the data contained in ERCOT's need for power analysis, are used to illustrate how different but reasonably foreseeable conditions in the future might affect the need for power analysis.[For example, Section 8.2.2 discusses how while ERCOT restricts the level of conservation included in their analysis, the staff determined additional conservation could be reasonable, based on legislative changes that occurred after the completion of ERCOT's analysis. These scenarios are not to be considered additions or improvements to the ERCOT forecasts, which form the foundation for the NRC staff's conclusions.

Table 8-4. Need for Power Analysis (MW)

Capacity	2014	2019	2024
Corrected Peak Load for Reserve Margin[(a)]	67,655	72,913	77,366
Capacity Needed for Reserve Margin (13.75 Percent)	9303	10,026	10,638
Total Capacity Required	76,958	82,939	88,004
Capacity Available[(a)]	77,449	78,905	78,905
Reserve Margin Without Units 2 and 3 (Percent)	14.6	8.2	2.0
Capacity Required to Reach 13.75 Reserve Margin MW Without Units 3 and 4	0	4033	9099
Capacity of Units 3 and 4 (Assuming 92 Percent Capacity Utilization	na	2943	2943
Capacity with Units 3 & 4 Added (Assumes 92% Cap Factor)	na	81,848	81,848
Reserve Margin with Units 3 and 4	na	12.3	5.8
Additional Capacity Required to Reach 13.75 Reserve Margin With Units 3 and 4 Included		1091	6156

(a) From Table 8-2.

Scenario 1 (Table 8-5), additional conservation which approximates the reduction in demand that HB3693 would produce, shows a case in which ten percent of all new load, i.e., load forecasted by ERCOT, would be displaced by conservation. This results in a load reduction in all subsequent years, holding generation capacity constant. The calculations show that even with additional conservation measures, once the new Comanche Peak units are added, about 4645 MW additional capacity in 2024 would still be required under this scenario to meet projected peak loads plus the target reserve margin.

Table 8-5. Scenario Analysis and Reserve Margins: Scenario 1—Conservation Increase

Scenario Impacts	2014	2019	2024
Total Capacity Required (from Table 8-4)	76,958	82,939	88,004
Conservation Subtraction	540	1066	1511
Adjusted Capacity Required	76,418	81,873	86,493
Available Generation Capacity (from Table 8-4)	77,499	78,905	78,905
Capacity Addition Required to Meet 13.75 Reserve Margin	0	2968	7588
Capacity Addition Required After Addition of Comanche Peak Units 3 And 4	na	25	4645

In scenario 2 (see Table 8-6), generation capacity due to wind is doubled. Loads remain the same and the generation capacity is increased. In this case, in addition to Comanche Peak Units 3 and 4, about 5327 MW additional generating capacity would be required to in 2024 to meet projected loads and the target reserve margin.

Table 8-6. Scenario Analysis and Reserve Margins: Scenario 2—Additional Wind Capacity

Scenario Impacts	2014	2019	2024
Available Generation Capacity(from Table 8-4)	77,499	78,905	78,905
Wind Capacity Addition	829	829	829
Adjusted Capacity	78,328	79,734	79,734
Required Capacity	76,958	82,939	88,004
Capacity Addition Required to Meet 13.75 Reserve Margin	0	3205	8270
Capacity Addition Required After Addition of Comanche Peak Units 3 and 4	na	262	5327

Scenario 3 combines the two scenarios for increased conservation and additional wind capacity (see Table 8-7), which leads to a lower load and high level of capacity. In this case, even with reduced demand and increased wind capacity, 3816 MW of additional generation capacity would be required to in 2024 to meet projected loads and the target reserve margin.

Table 8-7. Scenario Analysis and Reserve Margins: Scenario 3: Scenarios 1 and 2 Combined

Scenario Impacts	2014	2019	2024
Adjusted Capacity Available due to Wind	78,328	79,734	79,734
Adjusted capacity required due to Conservation	76,418	81,873	86,493
Capacity Addition Required to Meet 13.75 Reserve Margin	0	2139	6759
Capacity Addition Required After Addition of Comanche Peak Units 3 and 4	na	-804	3816

Scenario 4 (see Table 8-8), reduces operational capacity by dropping out capacity greater than 50 years of age. This is a fairly aggressive scenario, and omits consideration of the fact that ERCOT can restrict retirements if the reserve margin is below target. In this case, in addition to Comanche Peak Units 3 and 4, 14,764 MW of new capacity would be required to meet the new target reserve margin.

Table 8-8. Scenario Analysis and Reserve Margins: Scenario 4—Omit Capacity over 50 Years of Age

Scenario Impacts	2014	2019	2024
Available Generation Capacity[(a)]	77,449	78,905	78,905
Reduction due to Retirement of Capacity over 50 Years of Age	-4191	-4952	-8608
Adjusted Capacity due to Retirements	73,258	73,953	70,297
Required Capacity	76,958	82,939	88,004
Capacity Addition Required to Meet 13.75 Reserve Margin	3700	8986	17,707
Capacity Addition Required After Addition Of Comanche Peak Units 3 and 4	na	6043	14,764

In sum, the four scenarios do not reverse any of the conclusions drawn regarding the baseline analysis using ERCOT forecasts; although the first three scenarios, by design, tend to reduce the need for new power, and the fourth tends to increase the need for new power. Rather, the scenarios affirm the appropriateness of the ERCOT data and forecasts. If the new Comanche Peak units were to go on line before 2019, the ERCOT region could see an increase in the reserve margin to above the target rate for a brief period of time. Thereafter, the reserve margin would again drop and capacity additions in addition to Comanche Peak Units 3 and 4 would be required.

8.4.3 Summary and Conclusions

The NRC staff has conducted a thorough analysis of the need for power in ERCOT for the future periods 2014, 2019, and 2024. The NRC staff has reviewed Luminant's ER and has concluded that while appropriate, it contained data that failed to fully reflect current economic and other conditions. The NRC staff has updated that analysis using the newest data available. In both cases, the basis for analysis has been the body of integrated ERCOT analyses. Based on its review of the ERCOT analyses and its own sensitivity analyses, the NRC staff concluded that the ERCOT forecasts meet the NUREG 1555 criteria of being systematic, comprehensive, subject to confirmation, and responsive to forecasting uncertainty.

The NRC staff carried out a need for power analysis using the best available data from ERCOT. In this baseline analysis, the NRC staff did not speculate on capacity retirements or additions, additional conservation or additional wind capacity. ERCOT examines wind capacity explicitly in its forecasts. It also includes conservation in two ways. The first is the explicit reduction in load due to demand management. The second is the implicit capturing of additional conservation in current trends through ERCOT's econometric analysis. The baseline analysis shows that the ERCOT region is currently in a sound position when evaluated from the perspective of the reserve margin and will remain so through the 2014 period. Beyond 2014, reserve margins will grow smaller over time until 2024, when, without capacity additions, margins reach about 2.0 percent. This suggests that over time additional resources will be required to meet forecasted load expectations. .

Because of the lengthy time period over which this analysis is conducted, the NRC staff identified reasonably foreseeable conditions that were beyond the scope of the ERCOT analyses and tested them against the baseline ERCOT forecasts through a series of sensitivity analyses. To examine these conditions, four scenarios were constructed to consider aggressive conservation, increased wind capacity, and the retirement of plant capacity over 50 years of age. Although these scenarios illustrate that alternative conditions in the future could reduce the urgency of need for new capacity, assumptions about future conservation and future wind generation additions did not change the NRC staff's conclusion drawn from the ERCOT forecasts that there is a need for new baseload capacity in amounts greater than the combined output of the two proposed units. The NRC staff also examined a scenario that employed an aggressive capacity retirement program and observed the need for additional generation capacity beyond that forecasted by this analysis.

The NRC staff maintained the use of two important policy parameters set by the ERCOT Board. In particular the decision to increase the target reserve margin from 12.5 percent to 13.75 percent increased the need for new generation capacity by about 990 MW in 2024. The decision to maintain the effective load carrying capacity of wind at 8.7 percent meant that large additions of wind capacity would not eliminate the need for new baseload capacity in amounts greater than the combined output of the two proposed units.

One might further question whether trends showing a significant change in the proportions of baseload capacity to total capacity might be possible. Figure 8-3 shows that this is not the case through 2019, with peakload and total energy consumption each growing by about 16.6 percent between 2010 and 2019. A second check on this would be to apply a 40 percent rule to the relationship between total peak capacity and baseload capacity (Cordara 2008). Between 2010 and 2024, peak load capacity is projected to grow by about 15,000 MW, which yields a baseload share of 6000 MW, or roughly about twice the load carried by the proposed Comanche Peak Units 3 and 4.

Based on the information provided by Luminant and from the reports available from ERCOT, it is the judgment of the NRC staff that it is reasonable for a merchant power vendor, such as Luminant, to expand its baseload power capacity, starting construction in the relatively near term.

8.5 NRC Staff Conclusions

Based on its review of the documents discussed in this chapter of the EIS, the NRC staff determined that, in aggregate, the ERCOT documents are sufficiently (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty to serve the needs of the NRC in complying with Section 102 of the National Environmental Policy Act. In keeping with the Chapter 8 ESRPs (NRC 2000) and the Commission's statements at 68 FR 55905, the NRC staff gave particular credence to the (1) ERCOT's analysis for reasonably foreseeable need for increased transmission and generation capacity within its boundaries and (2) Luminant's need for power assessment, supplemented with updates and analyses prepared by the NRC staff.

The NRC staff concludes (1) there could become a shortage of power in the ERCOT region that could be at least partially addressed by construction of proposed Units 3 and 4 at the CPNPP site; (2) construction of Units 3 and 4 would reduce the likelihood of an electricity supply reliability crisis in Texas; and (3) construction of Units 3 and 4 would contribute to the new generation needed in the ERCOT region by 2024 to meet reserve targets. Based on its analysis, the NRC staff concludes there is a justified need for new baseload generating capacity in Texas in excess of the planned output of proposed Units 3 and 4.

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9.0 Environmental Impacts of Alternatives

This chapter describes alternatives to the proposed U.S. Nuclear Regulatory Commission (NRC) action for combined licenses (COLs) for the construction and operation of two U.S. Advanced Pressurized Water Reactor (US-APWR) units at the Comanche Peak Nuclear Power Plant (CPNPP) site, and the U.S. Army Corps of Engineers (Corps or USACE) action for permits, and discusses the environmental impacts of those alternatives. The reasonable range of alternatives is limited to those that can achieve the stated purpose and need for the actions; in addition, the no-action alternative is to be discussed even if it does not meet the purpose and need. The purpose and need for the proposed actions, which is discussed in Section 1.3 of this environmental impact statement (EIS), is to provide 3200 MW(e) of additional baseload electrical power for use in current markets and/or for potential sale on the wholesale market in the Electric Reliability Council of Texas (ERCOT) region, to meet the demand projected for 2016 and to maintain the reserve margin that is needed to maintain system reliability (Luminant 2009a). The region of interest (ROI), as defined by Luminant's purpose and need, is ERCOT's relative service area. The need for additional basesload power in the ERCOT region is discussed in Chapter 8 of this EIS. A discussion of the baseload of the power system, which is relatively predictable and tends to grow at a relatively constant rate, and how it differs from peak load, which involves cyclical changes in load that follow patterns determined by time of day, day of the week, month of the year, and so on, is provided in Section 8.1.4 of this EIS. Section 9.1 discusses the no-action alternative. Section 9.2 addresses alternative energy sources. Section 9.3 is the evaluation of the Luminant Generation Company LLC's (Luminant's) ROI, its site-selection process, and a summary and comparison of the environmental impacts for the proposed and alternative sites. Section 9.4 examines plant design alternatives. Section 9.5 lists the references cited in this chapter.

The need to compare the proposed action with alternatives arises from the requirement in Section 102(2)(c)(iii) of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321), that EISs include an analysis of alternatives to the proposed action. The NRC implements this comparison through its regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51 and its Environmental Standard Review Plan (ESRP) (NRC 2000).

The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using Council on Environmental Quality (CEQ) guidelines (40 CFR 1508.27) and set forth in the footnotes to Table B-1 of 10 CFR 51, Subpart A, Appendix B. The issues evaluated in this chapter are the same as those addressed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437[a] with the additional issue of environmental justice. Although NUREG-1437 was developed for NRC's review of renewal of nuclear power plant operating licenses, it provides useful information for this review and is referenced throughout this chapter. Additional guidance on conducting environmental reviews is provided in Revision 1 of the NRC Staff Memorandum *Addressing Construction and Preconstruction, Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011).

As part of the evaluation of permit applications subject to Section 404 of the Federal Water Pollution Control Act (Clean Water Act), the Corps is required by regulation to apply the criteria set forth in the 404(b)(1) guidelines (33 USC 1251 et seq.; 40 CFR Part 230). These guidelines

[a] NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999 (NRC 1999). Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404.

Section 230.10(a) of the Guidelines [40 CFR 230.10(a)] requires that “no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.” Section 230.10(a)(2) of the Guidelines states that “[A]n alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by Luminant which could reasonably be obtained, used, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered.” Thus, this analysis is necessary to determine which alternative is the Least Environmentally Damaging Practicable Alternative (LEDPA) that meets the project purpose and need.

Where the activity associated with a discharge is proposed for a special aquatic site (as defined in 40 CFR Part 230, Subpart E), and does not require access or proximity to or siting within these types of areas to fulfill its basic project purpose (i.e., the project is not “water dependent”), practicable alternatives that avoid special aquatic sites are presumed to be available, unless clearly demonstrated otherwise [40 CFR 230.10(a)(3)].

9.1 No-Action Alternative

For purposes of a COL application, the no-action alternative refers to a scenario in which the NRC would deny Luminant’s request for authorization to build and operate two new units. Upon such a denial, the construction and operation of CPNPP Units 3 and 4 in accordance with 10 CFR Part 52 would not occur and the predicted environmental impacts associated with the project would not occur. Pre-construction impacts associated with activities not within the definition of construction in 10 CFR 50.10(a) and 51.4 may occur nonetheless. If no power plants were to be built in lieu of the proposed project or other strategy implemented in its place, then the benefits of the additional electrical capacity and electricity generation to be provided by the project would not occur. If no additional measures (e.g., conservation, importing power, restarting retired power plants, and/or extending the life of existing power plants) were implemented to realize the amount of electrical capacity that would otherwise be required for power in Luminant’s ROI (see Section 9.3.1), then the need for baseload power supply to meet the projected demand and to maintain reserve margin, discussed in Chapter 8, would not be met. Therefore, the purpose and need of this project would not be satisfied if the no-action alternative was selected and the need for power was not met by other means.

For purposes of a Department of the Army permit for the project, the no-action alternative refers to a scenario in which the USACE would deny Luminant’s application request. Upon such a denial, the results and impacts would be the same as discussed above.

If Luminant were to do nothing in response to the denial of the COLs or Corps permit, the ERCOT’ forecasts indicate that its ability to maintain an adequate reserve margin would be impaired and it could fail to meet its public service obligations to provide sufficient power within its service territory (see Section 8.3.4). ERCOT is the entity that operates the electric grid and manages the deregulated market for 75 percent of Texas. To address growing power demands, it would be ERCOT’s obligation to pursue alternative options in power generation or demand reduction by implementing one or some combination of the following actions (Luminant 2009a):

- Demand-Side Management (DSM): In addition to the existing and planned DSM programs (see Section 9.2.1.3), it would be the responsibility of ERCOT to implement more aggressive programs as conditions necessitate. As a merchant power producer, Luminant has no authority to implement DSM programs.

- Purchase Power: As discussed in Section 9.2.1, ERCOT could attempt to purchase power from other suppliers of electricity within ERCOT's service area to fill short-term needs. However, ERCOT's restricted existing interconnections with neighboring reliability regions limit its ability to purchase significant power from other sources.
- Construct Other Baseload Power Options: ERCOT could look to one or more of the baseload power-generation alternatives which could include Luminant pursuing construction of a nuclear power station at one of the alternative sites discussed in Sections 9.2 and 9.3 of this EIS.

All of the alternatives listed above could have environmental impacts. In some cases, these impacts would be realized in another location or at different times. These impacts are discussed in more detail in Section 9.2.1.1 (purchased power), Section 9.2.2.1 (coal-fired alternative), Section 9.2.2.2 (gas-fired alternative), Section 9.2.2.3 (wind generation), Section 9.2.3 (other alternatives), and Section 9.3 (alternative sites).

9.2 Energy Alternatives

Luminant's objective in seeking COLs for CPNPP Units 3 and 4 is to identify a site where it can provide 3200-MW(e) baseload power generation for sale to ERCOT. This section examines the potential environmental impacts associated with alternatives to building a new baseload nuclear power-generating facility. Section 9.2.1 discusses energy alternatives not requiring new generating capacity. Section 9.2.2 discusses energy alternatives requiring new generating capacity. Other alternatives are discussed in Section 9.2.3. A combination of alternatives is discussed in Section 9.2.4. Section 9.2.5 compares the environmental impacts from new nuclear, coal-fired, and natural-gas-fired generating units at the CPNPP site and a combination of energy sources.

For analysis of energy alternatives, Luminant assumed a bounding electrical output target value of 3200-MW(e) (Luminant 2009a). The NRC staff and Corps staff (review team) also used this level of output in analyzing energy alternatives.

9.2.1 Alternatives Not Requiring New Generation Capacity

Four alternatives to the proposed action that do not require the ERCOT to pursue the construction of new generating capacity include

- purchasing the needed electric power from other suppliers,
- reactivating retired power plants,
- extending the operating life of existing power plants, and
- implementing DSM programs, including conservation.

9.2.1.1 Purchased Power

Texas produces and consumes more electricity than any other state. Despite large net interstate electricity imports in some areas, the Texas interconnect power grid is largely isolated from the integrated power systems serving the eastern and western United States. In addition, most areas of Texas have little ability to export or import electricity to and from other states (DOE/EIA 2009b). As described in Section 9.1 of this EIS, the ROI, as defined by Luminant's purpose and need, is ERCOT's relevant service area (Luminant 2009a). The option of purchasing electricity from neighboring utilities or resources outside of ERCOT's relevant service area is limited by ERCOT's limited synchronous interconnections across state lines

(Luminant 2009a). The ERCOT region has no synchronous connections with any area of the United States or Mexico. Although there are some asynchronous connections in the ERCOT region, these connections only service the Southwest Power Pool and Mexico. Therefore, system reliability is dependent upon maintaining a constant balance of energy produced and used in the region (ERCOT 2009b). These limitations restrict the import and export of power. As such, nearly all of the power used within the ERCOT region must be generated within the region.

If interconnections with other regional power suppliers outside the ERCOT region did exist or were developed such that ERCOT could import enough power to replace the capacity of CPNNP Units 3 and 4, then the source for this power would most likely be one of those described in NUREG-1437 (e.g., existing or new coal, natural-gas, or nuclear power facilities) (NRC 1996). Under the purchased-power alternative, the environmental impacts of imported power production would be located outside of the ERCOT region but would still occur. The environmental impacts of baseload coal-fired and natural-gas-fired plants are discussed in Section 9.2.2.

New interconnections for purchased power would require new transmission lines. Construction and operation of new transmission lines could have environmental consequences. Such impacts are discussed in Sections 4.4.1 and 5.4.1.

Under the current limited interconnections with other power regions, purchased power is not a viable option for the replacement of the power that would be generated by CPNPP Units 3 and 4. Furthermore, ERCOT identified no additional interconnections for power purchases in its long-term system assessment (ERCOT 2008b).

Based on the preceding discussion, the review team concludes that the option of purchasing electric power from other suppliers is not a reasonable alternative to providing new baseload power generation capacity. However, should interconnections be expanded to allow for the import of more power, then environmental impacts of power generation would depend on the generation technology and location of the power plant. The construction of new transmission lines could have environmental consequences, particularly if new transmission line corridors were needed. The review team concludes that the local environmental impacts from purchased power would be SMALL when existing transmission line corridors are used and could range from SMALL to LARGE if acquisition of new corridors is required. The overall environmental impacts of power generation would depend on the generation technology and location of the generation site and, therefore, are unknown. However, as discussed in Section 9.2.5, the review team concluded that the reasonable and viable energy alternatives would not be environmentally preferable to construction of a new baseload nuclear power generation plant located within Luminant's ROI.

9.2.1.2 Reactivating Retired Power Plants or Extending Operating Life

Many factors, including fuel cost, operation and maintenance costs, efficiency, environmental requirements, and revenue influence whether a generating unit will remain in service or be decommissioned. Age, as an indication of the relative efficiency and maintenance cost of a generating unit, has been used to provide some limited insight into the factors that are considered in the decommissioning of units.

Since 1999 a total of 108 power production units have been decommissioned within the ERCOT service area. Decommissioning older plants near metropolitan areas due to economics or environmental restrictions requires ERCOT to undertake a careful assessment of the reliability needs to propose maintaining certain units under Reliability Must-Run (RMR) contracts and any transmission alternatives to these RMR sources (ERCOT 2008a).

Currently, ERCOT identifies *available* generation facilities no longer intended to produce power, i.e., "mothballed" facilities, totaling 848 MW(e) by the year 2014 in its system planning document (ERCOT 2009b). ERCOT defines *available* mothballed generation as "the probability that a mothballed unit will return to service, as provided by its owner, multiplied by the capacity of the unit." Return probabilities are proprietary information and are not included in planning documents. ERCOT predicts a mothballed capacity of 4314 MW(e) by 2014 (ERCOT 2008a). In general, there is about a 20 percent likelihood of the mothballed facilities returning to service at their original capacities and a similar probability of mothballed facilities replacing the 3200 MW(e) that would be generated from the proposed project.

Currently there is almost 11,000 MW of generation capability within ERCOT that is over 40 years in age with about 3000 MW of generation more than 50 years old (ERCOT 2008a). Fossil-fueled plants slated for extensive refurbishment, predominately coal-fired and natural gas-fired plants, tend to be old enough to have economic difficulty meeting the current and more restrictive environmental standards. It is unlikely that these older plants will remain cost effective compared to new power generation facilities leading up to and during the operating period of CPNPP Units 3 and 4.

Luminant currently operates or maintains 19 fossil-fueled plants within the ERCOT service area. Of the operating plants, most began operations in the 1960s or 1970s and one facility, Trinidad, was commissioned into service in 1926 (Luminant 2009a). The Trinidad plant was the first major power station in the world to be fueled by lignite, a soft brown fuel with characteristics that place it between coal and peat. In 1942, the Trinidad plant was converted from lignite to natural gas.

As discussed in Section 9.2.2.1, fossil-fueled power plants are not environmentally preferable to CPNPP Units 3 and 4. Furthermore, environmental restrictions are becoming increasingly more stringent making reactivating old plants more difficult. Therefore, the review team concludes that (1) extending the operation of Luminant's fossil fuel plants, many of which are more than 40 years old, beyond the lifetime expected in the ERCOT projections or (2) restarting mothballed Luminant plants are not reasonable alternatives to new power generation to meet the capacity needs of the service area.

The 40-yr operating licenses for CPNPP Units 1 and 2 are scheduled to expire in 2030 and 2033, respectively. Luminant has not yet applied for 20-yr license extension for these units; similar to most of the U.S. reactor fleet, it is not unlikely that Luminant would apply for the license renewals in the future. The environmental impacts of continued operation of a nuclear power plant are less than building and operating a new plant. The expected generating capacity of CPNPP Units 1 and 2 is included in the need-for-power assessment included in Chapter 8 of this EIS. Therefore, continued operation of CPNPP Units 1 and 2 would not provide additional generating capacity.

Based on the preceding discussion, the review team concludes that the options of reactivating retired power plants and extending the operating life of existing power plants beyond that already accounted for in long-term energy forecasts are not reasonable alternatives to providing new baseload power generation capacity.

9.2.1.3 Demand Side Management

DSM programs consist of planning, implementing, and monitoring activities that enable and encourage consumers to reduce and/or modify their levels and patterns of electricity usage. By reducing customers' demand for energy through energy-efficiency, conservation, and load management, the need for additional generation capacity can be reduced, postponed, or even eliminated. However, these programs are not within the responsibility of a merchant power supplier such as Luminant. As previously determined by the Commission (NRC 2005) and described in NUREG-1555 (NRC 2000), a DSM analysis is not required for an applicant seeking to build a merchant plant.

Furthermore, while DSM programs could play an important role in reducing peak load power in the ERCOT region, they are not generally expected to significantly reduce baseload consumption, and would not be a reasonable alternative for the 3200-MW additional baseload capacity expected with CPNPP Units 3 and 4.

Nevertheless, some cities in the region are taken actions to reduce and/or modify their levels and patterns of electricity usage. In March 2008, the City of Dallas adopted Ordinance No. 27109 to the Dallas Energy Conservation Code (City of Dallas 2008), an amended version of the 2006 International Energy Conservation Code. The code applies to any additions, alterations, renovations or repairs to existing building or residences including any changes in occupancy that would result in an increase in demand for either fossil fuel or electrical energy. Resource management programs have been implemented in Fort Worth in response to Texas Senate Bill 5 (SB 5). The goal of SB 5 is to improve environmental air quality through demand-side energy conservation (City of Fort Worth 2010).

9.2.1.4 Conclusions

The review team finds that it would be unreasonable for an applicant to request COLs if (1) the power could be purchased from other electricity suppliers at a reasonable cost, (2) the power could be obtained by reactivating one or more mothballed generating plants or by extending the life of one or more existing generating plants beyond the lifetime expected in the ERCOT projections, or (3) conservation or DSM programs could make the additional power from new power generating units unnecessary.

As discussed in Chapter 8 of this EIS, ERCOT took account of conservation and DSM programs in preparing its report, 2009 ERCOT Planning Long-Term Hourly Peak Demand and Energy Forecast (ERCOT 2009a). In this report, ERCOT determined that there was a need for additional baseload power in Luminant’s ROI, even taking into account conservation and demand side management programs. Based on the preceding discussion, the review team concludes that the options of purchasing electric power from other suppliers, reactivating mothballed power plants, extending the operating life of existing power plants beyond the lifetime expected in the ERCOT projections, or any combination of these are already fully utilized in the capacity projections for the ERCOT service area (ERCOT 2008b) and that additional efforts do not present reasonable alternatives to providing new baseload power-generation capacity.

9.2.2 Alternatives Requiring New Generation Capacity

Consistent with the NRC’s evaluation of alternatives to the renewal of operating licenses, a reasonable set of energy alternatives to the construction and operation of one or more new nuclear units at the CPNPP site should be limited to analysis of discrete power-generation sources, a combination of sources, and those power-generation technologies that are technically reasonable and commercially viable (NRC 1996). The current mix of baseload power generation options in the ERCOT region is one indicator of the feasible choices for power generation technology within the region. As of 2009, the generation profile in the ERCOT region (ERCOT 2009b) was approximately as follows: natural gas (43 percent), coal (37.1 percent), nuclear (13.2 percent), wind (4.9 percent), hydroelectric (0.2 percent), and other sources (1.6 percent).

Furthermore, in accordance with NUREG-1555, the basic criteria for a viable alternative energy source include (1) use of the energy source is consistent with national energy policy goals for energy use, and (2) Federal, State, and local regulations do not prohibit or restrict the use of the energy source. This section discusses the environmental impacts of energy alternatives to the proposed action that would require construction of new facilities to meet the demand for power-generating capacity.

Additional criteria listed in NUREG-1555 include the following:

- The energy technology should be developed, proven, and available in the relevant region;
- The energy source should provide power generation equivalent to power level output of Luminant's proposed project [3200 MW(e) baseload power with a capacity factor of 93 percent[a]];
- The power should be available within the time frame needed for the proposed project; and
- No unusual environmental impacts or exceptional costs are associated with the energy source that would make it impractical.

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. In its *Annual Energy Outlook 2010* (DOE/EIA 2010), the EIA's reference case projects that the total electrical energy demand in 2008 [3873 TW(e)] will increase by 30 percent by 2035 reference case [5021 TW(e)]; the coal-fired capacity is projected to decrease from 48 percent in 2008 to 44 percent in 2035. Previous projections relied heavily on the construction of new coal-fired plants with the coal-fired portion accounting for about 50 percent of the power industry, followed by smaller amounts of renewable, gas, and nuclear capacity. These projections align with the current ERCOT energy production mix with natural gas (combined cycle) the more likely baseload alternative.

The discussion in Sections 9.2.2.1 through 9.2.2.2 is limited to the individual alternatives that meet the criteria provided in the previous paragraphs and that appear to the review team to be viable baseload generation sources: coal-fired and natural gas combined cycle-fired power generation. The impacts discussed in this section are estimates based on present technology. For the purpose of assessing the environmental impacts of each of these alternatives, the review team assumed that (1) the new power generation facilities would be located at the CPNPP site for the coal-fired and natural-gas-fired alternatives; (2) a mechanical draft cooling tower (MDCT) of the type proposed by Luminant for Units 3 and 4, would be used for plant cooling; and (3) no new offsite transmission line rights-of-way (ROWs) would be needed, which is consistent with Luminant's COL application for Units 3 and 4. Section 9.2.3 addresses alternative generation technologies that have demonstrated commercial acceptance but may be limited in application, total capacity, or technical feasibility when analyzed based on the need to supply reliable, baseload capacity. Section 9.2.4 discusses combinations of alternatives that could be used to generate 3200 MW(e) of baseload power. For the purpose of assessing the environmental impacts of the combination of energy sources alternative, the review team assumed that (1) the new power generation facilities would be located at the CPNPP site for the natural-gas-fired contribution to the alternative; (2) a MDCT of the type proposed by Luminant for Units 3 and 4, would be used for plant cooling; and (3) new offsite transmission line ROWs would be needed only for that portion of the alternative involving wind or solar technologies.

[a] The capacity factor is the ratio of the net electricity generated, for the time considered, to the energy that could have been generated at continuous full-power operation during the same period.

9.2.2.1 Coal-Fired Power Generation

For the coal-fired power generation alternative, the review team assumed construction and operation of supercritical pulverized coal-fired units with a closed-cycle cooling system and cooling towers at the CPNPP site. The site is assumed to contain six units with a power level rated at 530-MW(e) each, having a total rated power level of 3180 MW(e). Although this alternative assumes slightly less power than the proposed 3200 MW(e) from the two US-APWR units, it approximates Luminant's purpose and the slight variance in the total rated power level need for the project and has little impact on the assessment of environmental impacts. The review team assumes that the coal-fired alternative would use existing transmission lines and ROWs to the CPNPP site.

Supercritical pulverized coal-fired plants are similar to conventional pulverized coal-fired plants except that the facilities would operate at slightly higher temperatures and higher pressures, which results in greater thermal efficiency. Supercritical coal-fired plants are commercially proven and represent an increasing proportion of new coal-fired power plants. The coal-fired plant is assumed to have an operating life of 30 years. The coal-fired plant is assumed to have a capacity factor of 85 percent; the capacity factor discounts for that portion of the time that a power generation facility is not producing boilerplate, nameplate, or the maximum rated power level.

The review team also considered an integrated gasification combined cycle (IGCC) coal-fired plant. IGCC is an emerging technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. The IGCC technology is less polluting than conventional pulverized coal plants because major pollutants can be removed from the gas stream before combustion. The IGCC alternative also generates less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, a black, glassy, sand-like material that may be a marketable by-product. The other large-volume by-product produced by IGCC plants is sulfur, which is extracted during the gasification process and can also be marketed rather than placed in a landfill. IGCC units do not produce ash or scrubber wastes.

In spite of the preceding advantages, the review team concludes that, at present, a new IGCC plant is not a reasonable alternative to a 3200-MW(e) nuclear power generation facility for the following reasons: (1) IGCC plants are more expensive than comparable pulverized coal plants (NETL 2007), (2) existing IGCC plants have considerably smaller rated power levels than the proposed 3200-MW(e) nuclear plant, (3) system reliability of existing IGCC plants has been lower than pulverized coal plants, (4) the existing IGCC plants have required an extended (though ultimately successful) start up period (NWPCC 2005), and (5) a lack of overall plant performance warranties for IGCC plants has hindered commercial financing (NWPCC 2005). While Luminant is currently developing two commercial IGCC demonstration projects in Texas (Luminant 2009a), for the reasons stated above IGCC plants are not considered further in this EIS.

The review team estimates that a 3180 MW(e) coal-fired power generation plant at the CPNPP site would consume approximately 15,000,000 tons of Powder River Basin subbituminous coal per year. Coal and lime (calcium carbonate) for a pulverized coal-fired plant could be delivered to the CPNPP site by train. Lime or limestone, used in the scrubbing process for control of sulfur dioxide (SO_2) emissions, is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with SO_2 to form calcium sulfite, which precipitates and is removed from the process as sludge. The review team estimates that approximately 900,000 tons/yr of limestone would be used for flue gas desulfurization (NETL 2007).

Air Quality

The impacts on air quality from coal-fired power generation would vary considerably from those of nuclear generation because of emissions of sulfur dioxide, nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM), and hazardous air pollutants such as mercury (Hg) and lead. In its environmental report (ER), Luminant assumed a coal-fired plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Luminant estimates that the coal-fired alternative emissions for SO_2, NO_x, CO, and PM would be approximately as follows (Luminant 2009a):

- SO_2 = 4270 tons/yr
- NO_x = 3625 tons/yr
- CO = 3625 tons/yr
- PM_{10} = 87 tons/yr

In addition, the review team estimates the total $PM_{2.5}$ emissions would be of the order of 22 tons/yr and mercury emissions would be less than 1 ton/yr.

PM_{10} is PM with a diameter equal to or less than 10 microns (40 CFR 50.6). $PM_{2.5}$ is PM with a diameter equal to or less than 2.5 microns (40 CFR 50.7).

Based on data from previous NRC EIS documents, the review team determined that the preceding emission estimates are not unreasonable. A new coal-fired plant at the CPNPP site would also have approximately 35,000,000 tons/yr of carbon dioxide (CO_2) emissions (Luminant 2009a) that could affect climate.

The acid rain requirements of the Clean Air Act (CAA) capped the nation's sulfur dioxide emissions from power plants. Luminant would need to obtain sufficient pollution credits either from a set-aside pool or from purchases on the open market to cover annual emissions from the plant. The market-based allowance system, such as that used for sulfur dioxide emissions is not used for nitrogen oxides emissions.

A new coal-fired power generation plant at the CPNPP site would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the CAA Amendments of 1990 and an operating permit from the Texas Commission on Environmental Quality (TCEQ). The plant would need to comply with the new source performance standards (NSPS) for such plants in 40 CFR 60, Subpart Da. The standards establish emission limits for PM and opacity (40 CFR 60.42Da), sulfur dioxide (40 CFR 60.43Da), nitrogen oxides (40 CFR 60.44Da), and mercury (40 CFR 60.45Da).

The Dallas–Fort Worth (DFW) Attainment Demonstration (AD) State Implementation Plan (SIP) Revision for the 1997 Eight-Hour Ozone Standard was adopted by the TCEQ in May 2007 and submitted to the U.S. Environmental Protection Agency (EPA) in June 2007. The May 2007 DFW AD SIP Revision introduced control strategies for nitrogen oxides (NO_X) and volatile organic compounds (VOC), and it demonstrates attainment of the 1997 8-hr ozone National Ambient Air Quality Standard (NAAQS) in the nine-county DFW 8-hr ozone nonattainment area (DFW area) by June 15, 2010. The AD is based on photochemical modeling that included new control strategies as well as an evaluation of corroborative evidence. The DFW area is classified as a moderate nonattainment area for the 8-hr ozone standard with an attainment date of June 15, 2010. The DFW Reasonable Further Progress (RFP) SIP was not required or intended to demonstrated attainment of the ozone NAAQS, but rather is intended to demonstrate that emissions will be reduced by 15 percent for the period 2002 through 2008. This SIP revision demonstrates that the RFP 15 percent reduction requirement would be met for the analysis period 2002 to 2008. Demonstration of RFP is based on the guidelines set forth in the EPA Phase II Eight-Hour Ozone Implementation Rule (70 FR 71612) specifying how the 8-hr ozone nonattainment areas must demonstrate RFP.

The nearest nonattainment area to Comanche Peak is the nine-county DFW metropolitan area which is classified a "moderate" ozone nonattainment area under the 8-hr ozone standard (TCEQ 2007). The DFW nonattainment area is located north and east of the CPNPP site and borders Hood County to the north and east, and Somervell County to the east.

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as in attainment or unclassified for criteria pollutants under the CAA [40 CFR 51.307(a)]. Criteria pollutants under the CAA are lead, ozone, particulates, CO, nitrogen dioxide, and sulfur dioxide. Ambient air-quality standards for criteria pollutants are in 40 CFR 50. The CPNPP site is in an area designated as in attainment or unclassified for all criteria pollutants (40 CFR 81.344).

The fugitive dust emissions from construction activities would be mitigated using best management practices (BMPs) (Luminant 2009a). Such emissions would be temporary.

The greenhouse gas (GHG) emissions with respect to the construction of the coal plants compared to the two new nuclear units are considered to be similar; however, the GHG emissions with respect to the operation of coal plants compared to the two new nuclear units are considerably greater. Texas currently does not have GHG emissions reduction targets.

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, the EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and confirm no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a new coal-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. No mandatory Class I Federal areas are within 50 mi of the CPNPP site.

In NUREG-1437 (NRC 1996) the NRC staff did not quantify emissions from coal-fired power plants, but suggested that air impacts would be substantial. The GEIS for license renewal identified global warming from carbon dioxide emissions and acid rain from sulfur oxides and nitrogen oxides emissions as a potential impact (NRC 1996). Any new coal-fired power facility would need to comply with the suite of Federal and State permitting requirements described above. Overall, the review team concludes that air quality impacts from new coal-fired generation at the CPNPP site would be MODERATE. The impacts would be noticeable, but would not destabilize air quality.

Waste Management

NUREG-1437 (NRC 1996) and the NRC's experience from operating license renewal analyses indicate that coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction (SCR) catalyst, and scrubber sludge. Luminant estimates the coal would have 5.21 percent ash content, and 75 percent of the ash would be recycled, resulting in approximately 188,000 tons of ash per year requiring disposal in a land fill (Luminant 2007).

Luminant also estimated that SO_2 control scrubbers would require approximately 1,049,400 tons/yr of lime (Luminant 2009a). Combined with the ash waste, the NRC estimates that the total 30-yr ash and scrubber waste would be approximately 37 million tons requiring some 653 ac of landfill area based on assumed densities and spreading the waste in a 30-ft-thick layer.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (65 FR 32214). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because of health concerns. Accordingly, the EPA announced its intention to issue regulations for disposal of coal-combustion waste under Subtitle D of the Resource Conservation and Recovery Act of 1976, as amended. The EPA anticipates submitting a proposed rule for public comment in 2010 (EPA 2009c).

Waste impacts on groundwater and surface water could extend beyond the operating life of the plant if leachate or runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Construction-related debris would be generated during plant construction activities.

Any new coal-fired power facility would need to comply with the suite of Federal and State permitting requirements described above. For the reasons stated above, the review team concludes that the impacts from waste generated at a coal-fired plant would be MODERATE. The impacts would be noticeable but would not destabilize any important attribute of the affected resources.

Human Health

In NUREG-1437, the NRC staff identified cancer and emphysema as a potential health risk from coal-fired plants (NRC 1996). The risk may be attributable to nitrogen oxides emissions that contribute to ozone formation, which in turn contribute to health risk. Air emissions from a coal-fired power generation plant located at the CPNPP site would be regulated by the TCEQ. Coal-fired power generation also introduces worker risks from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, worker and public risk from disposal of coal-combustion waste, and public risk from inhalation of stack emissions. In addition, natural uranium and thorium contained in routine air emissions from coal-fired power plants could result in radiological doses that could be in excess of those from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by the EPA and State agencies, the review team concludes that the human health impacts from radiological doses, inhaled toxins, and criteria pollutants (including particulates and nitrogen oxides) generated from coal-fired generation would be SMALL.

Other Impacts

Approximately 150 ac would need to be converted to industrial use for the powerblock, infrastructure and support facilities, coal and limestone storage, and handling sludge based on a 47 ac per 1000 MW average for the Luminant plants listed in Table 9-1. The total acreage of the CPNPP site is 7950 ac; however, approximately 3500 ac of the site include the Squaw Creek Reservoir (3125 ac), developed areas (439 ac), and shoreline buffer areas. No additional land would be needed to accommodate the operations of a coal-fired plant. The total acreage required to operate a coal-fired power plant is more than the nuclear power plant; thus, the ecological disruption due to permanent loss of wetlands and forest acreage would be greater. In addition, land-use changes would occur offsite in an undetermined coal mining area to supply coal for the plant and for landfill disposal of ash and scrubber sludge. Overall, the review team concludes that land-use impacts would be MODERATE primarily because of the impacts associated with disposal of ash and the large area of offsite land affected by mining activities.

Table 9-1. Land Areas of Luminant Lignite Coal Plants

Plant Site Name	Total Site MW(e)	Total Site Acreage (ac)	Location
Martin Lake	2400	95	Rusk County, TX
Shadow 5	590	30	Milam County, TX
Oak Grove	1800	100	Robertson County, TX
Totals	**4790**	**225**	
Average ac per 1000 MW(e)		47	

The impacts on water use and quality from constructing and operating a coal-fired plant at the CPNPP site would be comparable to the impacts associated with a new nuclear plant. Cooling water would likely be withdrawn directly from Lake Granbury. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increase in temperature and concentration of dissolved solids in the receiving waterbody and intermittent low concentrations of biocides. Discharges would be regulated by the TCEQ through a Texas Pollutant Discharge Elimination System (TPDES) permit. Indirectly, water quality could be affected by acids and mercury from air emissions. In NUREG-1437, the NRC staff determined that some erosion and sedimentation would likely occur during construction of new facilities (NRC 1996). Construction activities would also require a TPDES permit. The amount of water that would be used for a coal-fired power plant would be comparable to that for a nuclear facility assuming similar power levels and cooling water systems. Any new coal-fired power facility would need to comply with the suite of Federal and State permitting requirements for water use and quality described above. Overall, the review team concludes that the water-use and water-quality impacts would be MODERATE.

The coal-fired generation alternative would introduce ecological impacts from construction and new incremental impacts from operations. The impacts would be similar to those of the proposed action at the CPNPP site along the transmission corridors. The impacts could include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. The impacts could occur at the CPNPP site and at the sites used for coal and limestone mining. Some of the impacts at the CPNPP site would occur in areas that were previously disturbed during the construction of Units 1 and 2. Extraction of cooling makeup water could have adverse impacts on aquatic resources, which would be similar to impacts from a new nuclear facility at the CPNPP site. Cooling tower drift would have minimal impact on terrestrial ecology. Disposal of waste products ash could affect water quality and the aquatic environment. Impacts on threatened and endangered species would likely be similar to the impacts from a new nuclear facility located at the CPNPP site. Overall, the review team concludes that the ecological impacts would be MODERATE primarily because of the impacts associated with disposal of ash and the large area of offsite land affected by mining activities.

Socioeconomic impacts would result from the approximately 3000 temporary workers needed to construct the facility and an additional 382 employees to operate the plant (Luminant 2007). These workers would impact the demands on housing and public services during construction, and the loss of jobs would have a counter impact after construction. Overall, because the scale of activity for coal-fired power generation would be smaller than that for CPNPP Units 3 and 4 but still significant, the review team concludes that these impacts would be SMALL to MODERATE. Luminant would pay taxes based on the improvements made to the property to Somervell County. Considering the population and economic condition of the county, the review team concludes that the taxes would have a LARGE beneficial impact to the tax recipients.

The CPNPP site is currently an industrial site located in a rural area. The coal-fired powerblock units would be as much as 200 ft tall and would be visible offsite during daylight hours. The six exhaust stacks would be as much as 600 ft high. The stacks and associated emissions would likely be visible in daylight hours for distances greater than 10 mi. Even accounting for downward lighting, the powerblock units and associated stacks would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that structures exceeding an overall height of 200 ft above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2007). The visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impacts at night could be further mitigated by reduced use of lighting, down-facing lighting, and alternate lighting equipment provided the lighting meets FAA requirements, and appropriate use of shielding. Overall, the review team concludes that the aesthetic impacts associated with new coal-fired power generation at the CPNPP site would be MODERATE.

Coal-fired power generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise and light from the plant would be detectable offsite. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the delivery route. The Federal Railroad Administration (FRA) provides information on the noise levels of railroad operations. According to the FRA, at a distance of 100 ft, a railroad horn ranges between about 95 and 115 dBA, a locomotive operates between 90 and 95 dBA, and passing railcars at 50 mph are at about 75 to 85 dBA (FRA 2009). Daytime rural sound levels are between 40 and 50 dBA. The six-unit coal-fired facility would require 15 to 16 million tons of coal and limestone to be delivered each year. Assuming a 100-car train at 100 tons per car, this translates to about 25 to 30 rail deliveries per week. An equal number of empty rail cars would have to leave the site as well. The review team concludes that the impacts of noise on residents in the vicinity of the facility, including the communities of Tular and Granbury, would be LARGE. These impacts could be reduced to MODERATE if the units were built in remote locations away from residential communities allowing for greater attenuation of noise generated by plant activities.

Historic and cultural resource impacts for a new coal-fired plant located at the CPNPP site would be similar to the impacts for a new nuclear plant, as discussed in Sections 4.6 and 5.6 of this EIS. However, because a greater amount of land would be disturbed on a permanent basis, the likelihood of impacting cultural resources would be greater. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. The studies would likely be needed for areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste-disposal sites, and along associated corridors where new construction would occur such as roads. Presently no resources eligible for the National Register of Historic Places (NRHP) are in the vicinity of the plant. The review team concludes that the historic and cultural resource impacts would likely be SMALL.

As discussed in Section 2.6 of this EIS, there are few minority populations (2 of 32 census blocks within a 2-mi radius) and no low-income populations near the CPNPP site. Environmental impacts on minority and low income populations associated with a new coal-fired plant located at the CPNPP site would be similar to those for a new nuclear plant, which the review team has concluded are SMALL.

Other construction and operation impacts are likely to be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation beyond that discussed would not be warranted.

The construction and operation impacts of coal-fired power generation at the CPNPP site are summarized in Table 9-2.

9.2.2.2 Natural Gas-Fired Power Generation

For the natural gas-fired power generation alternative, the review team assumed construction and operation of a natural gas-fired plant with a closed-cycle cooling system and cooling towers located at the CPNPP site. The review team assumed that the plant would use combined-cycle combustion turbines, which is consistent with the application. The site is assumed to contain six units with a power level rated at of 530-MW(e) each, having a total rated power level of 3180 MW(e). Although this alternative assumes slightly less power than the proposed 3200 MW(e) from the two US-APWR units, it approximates Luminant's purpose and need for the project and the slight variance in the total rated power level has little impact on the assessment of environmental impacts. The review team assumes that the gas-fired alternative would use existing transmission lines and ROWs to the CPNPP site.

Air Quality

Natural gas is a relatively clean burning fuel. When compared to a coal-fired plant, a natural gas-fired plant would release similar types of emissions but in lower quantities.

The impacts on air quality from natural gas-fired power generation would vary considerably from those of nuclear generation because of emissions of sulfur dioxide, nitrogen oxides, CO, and PM. Luminant estimates that the gas-fired alternative emissions for sulfur dioxide, nitrogen oxides, CO, and PM would be approximately as follows (Luminant 2009a):

- SO_2= 253 tons/yr
- NO_x= 2676 tons/yr
- CO= 1115 tons/yr
- $PM_{2.5}$ = 142 tons/yr

A new natural gas-fired plant at the CPNPP site would also have carbon dioxide emissions of approximately 8,200, 000 tons/yr (Luminant 2009a).

The acid rain requirements of the CAA capped the nation's sulfur dioxide emissions from power plants. Prior to operating a natural gas-fired plant at the CPNPP site, Luminant would need to obtain sufficient pollution credits either from a set-aside pool or from purchases on the open market to cover annual emissions from the plant.

Table 9-2. Summary of Environmental Impacts of Coal-Fired Power Generation

Resource Area	Impact Category Level	Comment
Land use	MODERATE	Uses approximately 800 ac for the powerblock, infrastructure and support facilities, coal and limestone storage and handling, and landfill disposal of ash and scrubber sludge. Mining activities would have additional offsite impacts.
Water use and quality	MODERATE	Impacts would be comparable to the impacts for a new nuclear power plant located at the CPNPP site.
Ecology	MODERATE	Some impacts could occur from onsite construction, but major impacts would occur offsite ash disposal and mining. These impacts could include wildlife habitat loss and fragmentations, reduced productivity, and a local reduction in biological diversity.
Socioeconomics	LARGE beneficial to LARGE adverse	Construction-related impacts on housing would be noticeable. Local property tax base would likely have beneficial impacts mainly during operations. Depending on where the workforce lives, the construction-related impacts would be noticeable or minor. Impacts of noise on residents in the CPNPP vicinity would be destabilizing. The stacks would be visible offsite for distances greater than 10 mi.
Waste management	MODERATE	Approximately 1,049,400 tons/yr limestone waste and 188,000 tons/yr coal ash waste would be generated.
Environmental justice	SMALL	There are few minority populations and no low-income populations near the site; impacts to such populations would likely be minimal.
Historic and cultural resources	SMALL	Adverse effects are unlikely as there are no NRHP-eligible resources in the vicinity of the site.
Air quality	MODERATE	SO_2 = 4270 tons/yr NO_x = 3625 tons/yr CO = 3625 tons/yr PM_{10} = 87 tons/yr $PM_{2.5}$ = 22 tons/yr CO_2 = 35 million tons/yr Hg = < 1 ton/yr
Human health	SMALL	Regulatory controls and oversight are assumed to be protective of human health.

A new natural gas-fired power generation plant at the CPNPP site would likely need a PSD permit from the TCEQ and an operating permit from TCEQ under the CAA Amendments of 1990. The plant would need to comply with the NSPS for such plants in 40 CFR 60, Subpart Da. The standards establish emission limits for PM and opacity (40 CFR 60.42Da), SO_2 (40 CFR 60.43Da), NO_x (40 CFR 60.44Da), and Hg (40 CFR 60.45Da).

The Dallas-Fort worth (DFW) AD SIP Revision for the 1997 Eight-Hour Ozone Standard was adopted by the TCEQ in May 2007 and submitted to the EPA in June 2007. The May 2007 DFW AD SIP Revision introduced control strategies for NOX and VOC, and it demonstrates attainment of the 1997 8-hr ozone NAAQS in the nine-county DFW 8-hr ozone nonattainment area (DFW area) by June 15, 2010. The AD is based on photochemical modeling that included new control strategies as well as an evaluation of corroborative evidence. The DFW area is classified as a moderate nonattainment area for the 8-hr ozone standard with an attainment date of June 15, 2010. The DFW RFP SIP was not required or intended to demonstrate attainment of the ozone NAAQS, but rather is intended to demonstrate that emissions would be reduced by 15 percent for the period 2002 through 2008. This SIP revision demonstrates that the RFP 15 percent reduction requirement will be met for the analysis period 2002 to 2008. Demonstration of RFP is based on the guidelines set forth in the EPA Phase II Eight-Hour Ozone Implementation Rule (70 FR 71612) specifying how the 8-hr ozone nonattainment areas must demonstrate RFP.

The nearest nonattainment area to Comanche Peak is the nine-county DFW metropolitan area which is classified a “moderate” ozone nonattainment area under the 8-hr ozone standard (TCEQ 2007). The DFW nonattainment area is located north and east of the CPNPP site and borders Hood County to the north and east, and Somervell County to the east.

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as in attainment or unclassified under the CAA. The CPNPP site is in an area designated as in attainment or unclassified for all criteria pollutants (40 CFR 81.344).

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period [40 CFR 51.308(d)(1)]. If a new natural gas-fired power generation station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. There are two mandatory Class I Federal areas in Texas, Big Bend National Park and Guadalupe Mountains National Park (EPA 2009d). Neither of these is within 50 mi of the CPNPP site.

The combustion turbine portion of the combined-cycle plant would be subject to EPA’s National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR 63, Subpart YYYY) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 10 tons/yr or more of any single hazardous air pollutant or 25 tons/yr or more of any combination of hazardous air pollutants [40 CFR 63.6085(b)].

The review team assumes that fugitive dust emissions from construction activities would be mitigated through the implementation of BMPs (Luminant 2009a). Such emissions would be temporary.

In NUREG-1437 (NRC 1996) the NRC staff did not quantify emissions from natural gas-fired power plants, but expected that the impacts would be generally less than for other fossil technologies because fewer pollutants are emitted and there would not be an appreciable impact related to acid rain from SO_2 emissions. Air quality impacts result from emissions of criteria pollutants as well as carbon dioxide. The impacts of emissions from a natural gas-fired power generation plant would be noticeable, but would not be sufficient to destabilize air resources. Overall, the review team concludes that air quality impacts resulting from construction and operation of new natural gas-fired power generation at the CPNPP site would be SMALL to MODERATE.

Waste Management

In NUREG-1437, the NRC staff concluded that waste generation from natural gas-fired technology would be minimal (NRC 1996). The only significant waste generated at a natural gas-fired power plant would be spent SCR catalyst, which is used to control nitrogen oxide emissions. The spent catalyst would be regenerated or disposed of offsite. Other than spent SCR catalyst, waste generation at an operating natural gas-fired plant would be largely limited to typical operations and maintenance waste. Construction-related debris would be generated during construction activities. Overall, the review team concludes that waste impacts from natural gas-fired power generation would be SMALL.

Human Health

In NUREG-1437, the NRC staff identified cancer and emphysema as a potential health risk from natural gas-fired plants (NRC 1996). The risk may be attributable to emissions of nitrogen oxides that contribute to ozone formation, which in turn contribute to health risk. Air emissions from a natural gas-fired power generation plant located at the CPNPP site would be regulated by the TCEQ. Nevertheless, the human health effect is expected to be either undetectable or sufficiently minor. Overall, the review team concludes that the impacts on human health from natural gas-fired power generation would be SMALL.

Other Impacts

A natural gas-fired generating plant would require approximately 350 ac for the powerblock and support facilities based on an estimated 0.11 ac/MW (Luminant 2009a). Construction of a natural gas pipeline would be needed from the CPNPP site to a supply point where a firm supply of gas is available. An additional pipeline would need to be constructed from an existing 36-in transmission pipeline traversing the Comanche Peak Exclusion Area approximately 2.4 mi north of the plant location. Construction of the new pipeline would require approximately 3 ac. In the GEIS for license renewal (NRC 1996), the NRC staff estimated that approximately 3600 ac would be needed per 1000 MW(e) plant for natural gas wells and collection stations. Overall, the review team concludes that the land-use impacts from new natural gas-fired power generation at the CPNPP site would be SMALL to MODERATE.

The impacts on water use and quality from constructing and operating a natural gas-fired plant at the CPNPP site would be comparable to the impacts associated with a new nuclear plant. Cooling water would likely be withdrawn directly from Lake Granbury. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving waterbody and intermittent low concentrations of biocides. Discharges would be regulated by the TCEQ through a TPDES permit. Indirectly, water quality could be affected by acids and mercury from air emissions. In the GEIS for license renewal, the NRC staff determined that some erosion and sedimentation would likely occur during construction of new facilities (NRC 1996). Construction activities would also require a TPDES permit. Overall, the review team concludes that the water-use and water-quality impacts would be similar to those of constructing and operating the proposed new reactors at the site and would be would be MODERATE.

The natural gas-fired generation alternative would introduce ecological impacts from construction and new incremental impacts from operations comparable to the impacts associated with a new nuclear plant. The impacts could include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. Constructing a new underground gas pipeline to the site of the new plant would cause temporary ecological impacts. Some of the ecological impacts at the CPNPP site would occur in areas that were previously disturbed during the construction of Units 1 and 2. Extraction of cooling makeup water could have adverse impacts on aquatic resources. Cooling tower drift would have minimal impact on terrestrial ecology. Overall, types of impacts, including those on threatened and endangered species, would likely be similar to the impacts from a new nuclear facility located at the CPNPP site. Therefore, the review team concludes that the ecological impacts would be MODERATE.

Socioeconomic impacts would result from the approximate 800 temporary workers needed to construct plant and an additional 150 permanent employees to operate the plant (Luminant 2009a). These impacts would include demands on housing and public services during construction, and the loss of jobs after construction. Overall, the review team concludes that these impacts would be SMALL. Luminant would pay significant property taxes for the plant to Somervell County. Considering the population and economic condition of the county, the review team concludes that the taxes would have a MODERATE beneficial impact to the tax recipients.

The CPNPP site is currently an industrial site located in a rural area. The turbine buildings, six exhaust stacks (approximately 200 ft tall) and associated emissions, cooling towers, condensation plumes from the cooling towers, and the gas pipeline compressors would be visible during daylight hours from offsite. Noise and light from the plant would be detectable offsite. Overall, the review team concludes that the aesthetic impacts associated with new natural gas-fired power generation at the CPNPP site would be SMALL.

Historic and cultural resource impacts for a new natural gas-fired plant located at the CPNPP site would be similar to the impacts for a new nuclear plant, as discussed in Sections 4.6 and 5.6 of this EIS. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. The studies would likely be needed for areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste-disposal sites, and along associated corridors where new construction would occur such as roads. Presently there are no NRHP-eligible resources in the vicinity of the plant. The review team concludes that the historic and cultural resource impacts would likely be SMALL.

As discussed in Section 2.6, there are few minority populations (2 of 32 census blocks within a 2-mi radius) and no low-income populations near the CPNPP site. Environmental impacts on minority and low income populations associated with a new gas-fired plant located at the CPNPP site would be similar to those for a new nuclear plant, which the review team has concluded would be SMALL.

Other construction and operation impacts are likely to be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation beyond that discussed would not be warranted. The construction and operation impacts of natural gas-fired power generation at the CPNPP site are summarized in Table 9-3.

Table 9-3. Summary of Environmental Impacts of Natural Gas-Fired Power Generation

Resource Area	Impact Category Level	Comment
Land use	SMALL to MODERATE	Uses approximately 350 ac for the powerblock, infrastructure and support facilities. Drilling and collection activities would have additional offsite impacts.
Water use and quality	MODERATE	Impacts would be comparable to the impacts for a new nuclear power plant located at the CPNPP site.
Ecology	MODERATE	Impacts could occur both onsite and offsite and could include wildlife habitat loss and fragmentations, reduced productivity, and a local reduction in biological diversity similar to the impacts associated with a new nuclear plant.
Socioeconomics	MODERATE beneficial to SMALL adverse	Construction-related impacts would be noticeable. Local property tax base would be beneficial mainly during operations. Depending on where the workforce lives, the construction-related impacts would be noticeable or minor. The plant would have only minor aesthetic impacts.
Waste management	SMALL	Spent catalyst would be regenerated or disposed of offsite.
Environmental justice	SMALL	There are few minority populations and no low-income populations near the site; impacts to such populations would likely be minimal.
Historic and cultural resources	SMALL	Adverse effects are unlikely as there are no NRHP-eligible resources in the vicinity of the plant.
Air quality	SMALL to MODERATE	Sulfur oxides = 253 tons/yr Nitrogen oxides = 2676 tons/yr Carbon monoxide = 1115 tons/yr $PM_{2.5}$ = 142 tons/yr CO_2 = 8.2 million tons/yr
Human health	SMALL	Regulatory controls and oversight are assumed to be protective of human health.

9.2.3 Other Alternatives

This section discusses energy alternatives that Luminant determined are not reasonable power generation options to provide power equal to that generated by the proposed CPNPP Units 3 and 4. The review team's conclusions about the overall environmental impacts of each alternative and the review team's basis for the conclusions are provided. A feasible alternative to the new nuclear units must meet the purpose and need of the project, which is to generate 3200 MW(e) of baseload power. In performing its initial evaluation in its ER, Luminant relied on NUREG-1437 for license renewal (NRC 1996). The review team reviewed the information submitted by Luminant and conducted an independent evaluation and finds that Luminant's conclusion, that these individual generation options are not reasonable alternatives to one or more new nuclear units, is appropriate.

The review team has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would have to be installed at a location other than the CPNPP site. While the review team followed CEQ's guidance not to speculate on future land utilization and locations, it was able to describe the types of effects that could be realized under the other energy alternatives.

9.2.3.1 Wind Power Generation

Luminant is the top wind power purchaser in the State with more than 900 MW(e) purchased in 2009; a recent planning study, discussed in Section 8.3.1, has suggested that additional wind capacity could become available in ERCOT (ERCOT 2008b). In 2008, 2671 MW(e) of wind capacity was installed in Texas, an amount that, by comparison, is more than that produced by any country other than China [America Wind Energy Association (AWEA) 2009b)]. Texas is also home to the four largest wind farms in the United States, the largest being Horse Hollow at 735 MW(e) (AWEA 2009b). Horse Hollow consists of 291 1.5-MW wind turbines and 130 2.3-MW wind turbines spread over more than 19,020 ha (47,000 ac) or 190 km² (about 73 mi^2) of land in Taylor and Nolan Counties. As of April 2009, an additional 1102 MW(e) is under construction (AWEA 2009a). This includes the recently completed 457.5 MW Panther Creek Wind Farm in West Texas (MacDonald 2010).

While Texas leads the nation in wind energy production, Luminant concluded that wind power generation is not yet a reasonable alternative to baseload power (Luminant 2009a). Luminant also concluded that more than 10,000 MW(e) of wind generating capacity, which is more than the entire State's current installed capacity, would be needed to replace the baseload power that would be provided by the proposed CPNPP Units 3 and 4 based on a 25 to 45 percent capacity factor. The capacity factor is the ratio of the net electricity generated, for the time considered, to the energy that could have been generated at continuous full-power operation during the same period (Luminant 2009a). Newer wind turbines typically operate at approximately a 36 percent capacity factor (DOE 2008a). By comparison, the average capacity factor for a nuclear generation plant in 2008 in the United States was 91.5 percent (NEI 2009). As of September 2008, ERCOT was tracking interest in an additional 51,000 MW(e) of wind generation projects in Texas (ERCOT 2008a). Therefore, based on the significant wind resources in Texas and the existing and anticipated amount of ERCOT interconnection requests, the review team determined that consideration of wind power generation warranted a more detailed analysis before determining if it is a reasonable alternative.

In ERCOT's December 2008 long-term system assessment, which reports the need for increased transmission and generation capacity throughout the State of Texas, it analyzed a highwind generation case (ERCOT 2008a). The review team concludes that this case presented by ERCOT as an alternative to the construction and operation of CPNPP Units 3 and 4 warranted additional evaluation. To achieve the target reserve power margin of 12.5 percent for ERCOT, the high-wind generation case did not include CPNPP Units 3 and 4. The ERCOT high-wind generation case includes 24,622 MW(e) of installed new wind capacity in 10 years, two new nuclear units at the South Texas Project totaling 2724 MW(e) (which have not been approved yet), and 3295 MW(e) of new combustion natural gas turbines across the system (ERCOT 2008a).

To improve the availability of energy from wind for the purpose of baseload supply, ERCOT considers Compressed Air Energy Storage (CAES) to store and distribute energy from wind (ERCOT 2008a). A CAES plant consists of motor-driven air compressors that consume low cost off peak electricity to compress air into an underground storage medium. During high electricity demand periods, the stored energy is recovered by releasing the compressed air through a combustion turbine to generate electricity (NWPCC 2009). Two CAES plants are currently in operation worldwide. A 290-MW plant near Bremen, Germany, began operating in 1978, and a 110-MW plant located in McIntosh, Alabama, has been operating since 1991. Both facilities use salt caverns for compressed air storage (Succar and Williams 2008). A CAES plant requires suitable geology such as an underground cavern for energy storage. A 268-MW CAES plant coupled to a wind farm, the Iowa Stored Energy Park, has been proposed for construction near Des Moines, Iowa. The Iowa facility would use a porous rock storage reservoir for the compressed air (Succar and Williams 2008). The review team is not aware of any known, proposed, or operational projects in Texas for wind generation with storage project that exceed 10 percent of the power level to be generated by the proposed CPNPP Units 3 and 4 project. Pilot, demonstration, prototype, and research projects are increasing in numbers, including projects in California, New York and Texas. In addition, projects such as the Conoco-Phillips General Compression venture may use compressed air storage directly, without the combustion of fuel such as natural gas, thus increasing the efficiency of wind power above the 25 to 45 percent capacity factor. Furthermore, the review team is not aware of any other proposed project for wind power generation with storage that approaches the scale of 3200 MW(e) that has yet been contemplated in the United States.

In one of ERCOT's power supply scenarios analyzed for determining potential needs for increased transmission capacity, two scenarios were evaluated with CAES units located in West Texas near Texas' significant wind resources; one scenario considered two 250-MW CAES units and the other four 500-MW CAES units. These scenarios were evaluated using both the recent Competitive Renewable Energy Zones ruling by the Public Utilities Commission of Texas predicted wind capacity of 18,456 MW(e) and the high-wind generation case of 24,622 MW(e) (ERCOT 2008a).

Additional wind energy storage can be achieved using batteries. Recent advances in sodium-sulfur batteries provide storage of excess energy supply during periods of low demand for usage during peak demand. According to American Electric Power (AEP 2009), AEP has entered into a joint venture with MidAmerican Energy Holding Company to build a 4-MW sodium-sulfur battery system in Presidio, Texas. The cost of the batteries, about $2500 per kilowatt (about 10 percent more than a new coal plant), has discouraged independent wind farm developers from utilizing these batteries because it would necessarily increase wholesale electricity prices that they would charge (Davidson 2007).

The review team considered that the wind power alternative would require new transmission lines and ROWs from West Texas, where wind is most plentiful as a resource, to the east, where the electric load growth rate is highest. The ERCOT high-wind generating case [24,622 MW(e)] was used by the review team as a surrogate to predict transmission needs.

In NUREG-1437, the NRC staff stated that wind energy is expected to require the use of approximately 61,000 ha (150,000 ac) or 610 km^2 (about 235 mi^2) of land to generate 1000 MW(e) of power (NRC 1996) or about 6100 ha per 100 MW(e). The Horse Hollow wind farm, the Nation's largest, covers about 2600 ha per 100 MW(e). The Panther Creek Wind Farm covers some 26,300 ha (65,000 ac) of contiguous ranch land, about 5750 ha per 100 MW(e) (MacDonald 2010). Recently, the DOE estimate the land needed to be about 2000 ha per 100 MW(e) (DOE 2008a). The DOE also estimated that actual land use of constructed wind turbines ranges from two percent to five percent of the total amount of land needed the turbines and related infrastructure (DOE 2008a). Each wind turbine requires an access road. For the Kenedy Ranch wind project near Corpus Christi, Texas, 59 mi of access roads were required to support 118 wind turbines (Mettler 2009). The remaining land can be used for other activities such as agriculture. For the high-wind generation case, which includes about 25,000 MW(e) of wind generating capacity, ERCOT predicts the need for as many 230 mi of additional transmission lines. The CPNPP site is not large enough to host the needed wind generating capacity and most of the wind turbines would have to be located off site, most likely in high wind regions.

Concern regarding GHG emissions is fueling interest in wind power as an option for new power generation. U.S. electricity demand is growing rapidly and some power sources such as renewables and nuclear could help meet much of the new demand while reducing GHG emissions. In 2008, the U.S. wind energy industry brought over 8500 MW(e) of new wind power capacity online, increasing the Nation's cumulative total by 50 percent to over 25,300 MW (AWEA 2009b). Wind energy that displaces fossil-fueled power generation can also help meet existing regulations for emissions of conventional pollutants, including sulfur dioxide, nitrogen oxides, and mercury. Neglecting the impacts from the manufacturing, installation, and maintenance operations, electricity produced directly from installed wind energy capacity will result in no GHG emissions. However, as described in ERCOT's high-wind generation scenario in its long-term system assessment (ERCOT 2008a), such a scenario that does not include CPNPP Units 3 and 4 does includes additional new nuclear and fossil fuel capacity within the ERCOT region. Beyond the small amount of localized short-term traffic associated with the installation and maintenance of wind turbines and new transmission lines, the impacts to air quality resource from operation would be minor.

Wind turbines typically have a service life of at least 20 yr (DOE 2008a). As such, waste generation from wind power technology would be minimal. Some construction-related debris could be generated during construction activities.

The DOE predicts that there will be substantial water savings, especially in the west, as wind power production increases (DOE 2008a). While there are no water discharges for wind turbines, erosion and sedimentation, which could be managed, could occur and affect land and water resources.

In NUREG-1437, the NRC staff stated that birds are likely to collide with the turbines, and wind energy developers should consider migration areas and nesting locations when sites for wind energy facilities are selected (NRC 1996). However, relative to other human causes of avian mortality, wind energy's impacts are minimal. The DOE shows, bird fatalities from anthropogenic causes range from 100 million to 1 billion annually, and currently, it is estimated that for every 10,000 birds killed by human activity, less than one death is caused by wind turbines (DOE 2008a). A recent National Research Council study concluded that current wind energy generation is responsible for 0.003 percent of human-caused avian mortality (National Research Council 2007). Estimates of temporary construction impacts from turbines, service roads, and other infrastructure range from 0.2 to 1.0 ha per turbine; estimates of permanent habitat spatial displacement range from 0.3 to 0.4 ha per turbine (Strickland and Johnson 2006). Indirect impacts can include trees being removed around turbines, edges in a forest being detrimental to some species, and the presence of turbines causing wildlife habitat loss and fragmentations, reduced productivity, and a local reduction in biological diversity. For example, a grassland songbird study on Buffalo Ridge in Minnesota found species displacement of 180 m to 250 m from the wind turbines (Strickland and Johnson 2006). Also, depending on the amount of water and wetland crossings, aquatic resources could also be affected.

The workforce needed to install and maintain wind turbines at a wind farm is a small fraction of that for fossil fuel or nuclear power options. Transporting the large wind turbine components can result in temporary local traffic disruptions. Individuals with turbines on their properties might actually see an increase in their property values because of the lease payments paid by the wind project owner. Lease payments tend to be $2000 to $5000 per turbine per year, either through fixed payments or as a small share of the revenue (DOE 2008a).

Turbine noise might be considered obtrusive in some instances. However, to reasonably ensure that sound levels are acceptable and nonintrusive, standard setbacks from residences and other buildings are used (DOE 2008a). While the optimal areas for siting wind turbines tend to be those with lower population densities, less populated areas are also often prized for their natural beauty unimpaired by human activity.

There are few minority or low-income populations in the West Texas high wind regions where many of the existing wind farms are located. These include Borden, Scurry, Howard, Mitchell, Nolan, Taylor, Glasscock, and Coke Counties.

Historic and cultural resource impacts for wind farms would be dependent on the amount of land disturbed for wind turbines, access roads, and transmission line corridors. Lands that are acquired to support wind power generation would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions.

Wind turbines can be highly visible because of their height and locations (e.g., ridgelines and open plains). The Horse Hollow wind farm has 421 wind turbines on 19,020 ha (47,000 ac). The land area for 10,000 MW(e) of wind generating capacity for about 5700 wind turbines would be 260,000 ha (643,000 ac), an area about the size of Rhode Island. The aesthetic impacts based on the large number of wind turbines would be significant.

For the preceding reasons the review team concluded that wind power (with or without CAES) generation would not be a reasonable alternative to building a 3200 MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.2 Oil-Fired Power Generation

In its *Annual Energy Outlook 2010,* the EIA's reference case projects that electricity production using crude oil and lease condensate increase less than 1 percent of through the year 2035 (DOE/EIA 2010). Oil-fired generation is more expensive than nuclear, natural-gas-fired, or coal-fired power generation options. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive. The high cost of oil has resulted in a decline in its use for electricity generation. In Section 8.3.11 of the GEIS for license renewal, the NRC staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land (NRC 1996). The review team estimates that a petroleum-fired power plant with a net output of 3200 MW would require approximately 384 ac to construct, which would be comparable to the land requirements for a gas-fired plant. Operation of an oil-fired power plant would have environmental impacts that would be similar to those of a comparably sized coal fired plant (NRC 1996).

For the preceding reasons, the review team concludes that an oil-fired power plant at or in the vicinity of the proposed site would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.3 Solar Power Generation

Solar technologies use energy and light from the sun to provide heating and cooling, light, hot water, and electricity for consumers. Solar energy can be converted to electricity using solar thermal technologies or photovoltaics. Solar thermal technologies employ concentrating devices to create temperatures suitable for power production. Concentrating thermal technologies are currently less costly than photovoltaics for bulk power production. They can also be provided with energy storage or auxiliary boilers to allow operation during periods when the sun is not shining (NWPCC 2006).

The ERCOT region has a solar generation capacity of up to 4600 MW(e) with most of the solar resources in the far southwestern region of the State (ERCOT 2008a). As of November 30, 2008, there were 863 MW(e) of solar projects in the ERCOT interconnection process (ERCOT

2008a). In March 2009, the Austin City Council decided to approve building a solar power array. The new solar power array that will serve Austin will produce almost one percent, or 30 MW(e), of the city's current total power generation needs of 2900 MW(e) (Austin City Council 2009).

The world's largest operating solar power site is Solar Energy Generating System (SEGS) located on approximately 600 ha (1500 ac) in the Mojave Desert in southern California collectively producing 354 MW(e) (California Energy Commission 2010); the land used is approximately 2 ha (5 ac) per MW. In February 2010, DOE awarded a conditional loan guarantee for nearly $1.4 billion to BrightSource Energy for three utility-scale concentrated solar power plants in southeastern California (DOE 2010). Pending regulatory approval, the Ivanpah Solar Complex will generate about 400 MW(e) by the end of 2013 (California Energy Commission 2010); land use is approximately 4 ha (10 ac) per MW. DOE reports that capacity factors for solar facilities range from 0.24 to 0.50 with the higher value in the range resulting from solar storage systems (DOE 2010).

Based on the SEGS and Ivanpah land utilization, to fully develop the region's 4600 MW capacity, almost 200 to 400 ha (23,000 to 46,000 ac) would be needed. This could result in wildlife habitat loss and fragmentations, reduced productivity, and a local reduction in biological diversity.

In addition to CAES systems (discussed in Section 9.2.2.3), there have been recent advances in energy storage systems for solar projects to help control the variability of solar energy production. At the National Solar Thermal Test Facility at Sandia National Laboratories in Albuquerque, New Mexico, research is being conducted in the use of molten salt as a thermal storage media (Sandia National Laboratories 2009). In September 2008, the DOE announced new funding for research opportunities in *Advanced Heat Transfer Fluids* that was designed to fund more than a dozen research and development projects (DOE 2008c). The energy storage systems do not increase solar generation capacity or reduce land use requirements and, therefore, do not provide a substantial increase in baseload capacity.

Solar thermal electric technologies also typically require considerable water supplies. While the quantity of water needed per acre of use is similar to or less than that needed for irrigated agriculture, dependability of the water supply is an important issue in the sunny, dry areas of Texas that would be favored for large-scale solar power plants (TSECO 2008).

For the preceding reasons, the review team concludes that solar energy would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.4 Hydropower Generation

Most of Texas does not lend itself to large-scale hydroelectric projects. The reported hydropower capacity in the ERCOT service area is only 546 MW(e) (winter capacity) and 586 MW(e) (summer capacity) and no new capacity is expected through 2013 (ERCOT 2008a). In NUREG-1437, the NRC staff estimated that land requirements for hydroelectric power are approximately 43,000 ha (1 million ac) per 1000 MW(e) (NRC 1996).

Because of the relatively low amount of undeveloped hydropower resource in Texas and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities, the review team concludes that hydropower would not be a reasonable alternative to building of a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.5 Geothermal Power Generation

Hydrothermal resources, reservoirs of steam or hot water, are available primarily in the western states, Alaska, and Hawaii. However, Earth's energy can be tapped almost anywhere with geothermal heat pumps and direct-use applications. Sources of other geothermal resources (e.g., hot dry rock, magma) require further technology development (DOE 2006).

Texas has some low-temperature resources that are suitable for electricity generation, as well as direct use and heat pump applications. These resources are found primarily in two large areas: one area is along the Rio Grande in the Trans-Pecos region and another is from the southern Rio Grande through the Balcones Trend region in Central Texas (DOE 2006). Ground source heat pumps are used throughout Texas for residents, schools, and commercial buildings. Power generation is also considered possible and Texas's extensive oil and gas wells provide easy access to geothermal resources. Data indicate the possibility of generating 500 MW(e) to 2000 MW(e) from existing oil and gas wells (DOE 2006).

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. Geothermal systems have a relatively small footprint and minimal emissions. However, geothermal technology is not widely used as baseload power generation because of the limited geographical availability of the resource and immature status of the technology (NRC 1996). A recent study led by the Massachusetts Institute of Technology (MIT) concluded that a $300–$400 million research investment over 15 years would be needed to make early generation enhanced geothermal system power plant installations competitive in the evolving U.S. electricity supply markets (MIT 2006).

Geothermal energy in Texas does have a potential for providing some of the State's renewable energy portfolio, however, the review team concludes geothermal power generation would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.6 Power Generation from Wood Waste

In NUREG-1437, the NRC staff determined that a wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required for a wood waste facility are variable and site specific. A significant impediment to the use of wood waste to generate electricity is the high cost of fuel delivery and high construction cost per megawatt of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS for license renewal suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Similar to coal-fired plants, wood waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

A 100 MW(e) wood-fired biomass power plant being developed in Sacul, Texas, will use logging residue as its main fuel source, but also could use urban wood waste (Texas Comptroller of Public Accounts 2008). The plant owner, Southern Power, estimates that the plant will require approximately 1 million tons of biomass per year, which it plans to procure within a 75-mi radius of the project site (Southern 2009). The plant is scheduled for startup in summer 2012.

Because of (1) uncertainties associated with obtaining an adequate supply of wood or wood waste to fuel a baseload power plant, (2) the ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and (3) low power conversion efficiency, the review team concludes that a wood waste power generation would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.7 Power Generation from Municipal Solid Waste

Municipal solid-waste combustors incinerate the waste products and use the resultant heat to produce steam, hot water, or electricity. The combustion process reduces the volume of waste and the need for new solid waste landfills (EPA 2009a). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. In NUREG-1437, the NRC staff determined that the initial capital cost for municipal solid-waste plants is greater than for comparable steam-turbine technology at wood-waste facilities because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996).

Municipal solid-waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Currently, approximately 87 waste-to-energy plants are operating in the United States. These plants generate approximately 2500 MW(e), or an average of approximately 28 MW(e) per plant (EPA 2009a). However, because construction costs of new plants have increased, economic factors have limited new construction (EPA 2009a). Given the small size of existing plants, the review team concludes that generating electricity from municipal solid waste would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.8 Power Generated from Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuel, several other biomass-derived fuels are available for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). Texas is the largest producer of biodiesel transportation fuel in the United States, capable of producing more than 100 million gallons annually, with another 87 million gallons of capacity under construction (Texas Comptroller 2008). In 2007, Texas produced 72.9 million gallons of biodiesel (Texas Comptroller 2008).

In NUREG-1437, the NRC staff determined that none of these technologies has progressed to the point of being competitive on a large scale or of being sufficiently reliable to replace a large baseload generating plant. EIA estimates that biomass will be the largest source of renewable electricity generation among the nonhydropower renewable fuels through the year 2030 (DOE/EIA 2009a). The DOE estimates that, in Texas, biomass could produce about 400 MW(e) of power associated with biomass liquid fuels production (DOE 2009a).

Co-firing biomass with coal is possible when low-cost biomass resources are available. Co-firing is the most economic option for the near future to introduce new biomass power generation. These projects require small capital investments per unit of power generation capacity. Co-firing systems range in size from 1 MW to 30 MW of biopower capacity (DOE 2009a).

Construction of a biomass plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste and agricultural residues for fuel would be built on a smaller scale. Similar to coal-fired plants, biomass-fired plants require areas for fuel storage, processing, and waste (i.e., ash) disposal. Additionally, operation of biomass-fired plants has environmental impacts on the aquatic environment and air.

Given the relatively small size of biomass generation facilities, the review team concludes that generating electricity from biomass-fueled power plants would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.3.9 Fuel Cells Power Generation

Fuel cells work without combustion and its associated environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode, air over a cathode, and then separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. A variety of hydrocarbon resources can generate by subjecting it to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. Higher temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies and afford the capability to generate steam for cogeneration and combined-cycle operations.

During the past three decades, demonstration efforts have been undertaken to develop more practical and affordable fuel cell designs for stationary power applications. The high cost of fuel cell power systems must be reduced before they can become competitive with conventional technologies (DOE 2008b).

The review team concludes that, at the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. For the preceding reasons, the review team concludes that generating electricity from fuel cells would not be a reasonable alternative to building a 3200-MW(e) nuclear power plant that would be operated as a baseload plant within Luminant's ROI.

9.2.4 Combination of Alternatives

Individual alternatives to the construction of two new nuclear units at the CPNPP site might not be sufficient to maintain ERCOT's target reserve power margin of 12.5 percent through the operating period of the proposed Units 3 and 4 because of the small size of the resource or lack of cost-effective opportunities. However, while individual alternatives may not be economically or technologically competitive for baseload power generation, it is conceivable that a combination of alternatives might be cost effective as an alternative to the 3200 MW(e) that would be generated from the new units.

There are many possible combinations of alternatives. It would not be reasonable to examine every possible combination of energy alternatives in an EIS. Doing so would be counter to CEQ's admonition that an EIS should be analytic rather than encyclopedic, shall be kept concise, and shall be no longer than absolutely necessary to comply with NEPA. Given that Luminant's objective is to provide a new merchant baseload generation facility, a fossil-fueled energy source, most likely coal or natural gas, would need to be a significant contributor to a reasonable combination of energy alternatives. As discussed in Section 9.2.1.3, DSM (including conservation) need not be considered by an applicant seeking to build a merchant plant and would not change the evaluation appreciably.

For a combination of energy alternatives, the review team assessed the environmental impacts of a combination of energy supply sources; for reasons explained in Section 9.2.1 and above, DSM was not considered. The review team considered whether 3200 MW(e) could be provided by wind and solar, each with storage; a combination of sources including biomass, municipal solid waste, and geothermal; and natural gas. Wind or solar energy sources without storage are not considered for baseload purposes, but that does not preclude development; in fact, there is great interest in developing such renewable energy sources. The consumption of natural gas by the facility in the combination of alternatives case can be offset by wind and solar (without storage) energy production when available; however, a combination of alternatives would still necessitate the installation of natural gas power facilities to ensure that power is available as a baseload power source when wind and solar (without storage) sources cannot meet the demand. The review team considered a spectrum of energy alternatives that were reasonable for the ERCOT region and developed a combination of alternatives comprised of 650 net MW(e) wind power generation with storage (for example, CAES involving caverns or salt domes in Texas); 430 net MW(e) biomass, municipal solid waste, geothermal, and solar with energy storage; and four 530 MW(e) [2120 net MW(e)] natural-gas-fired, combined-cycle generating units using closed-cycle cooling with cooling towers at the CPNPP site. Of the 430 net MW(e), the review team assumes that 100 net MW(e) would be a combination of biomass, municipal solid waste, and geothermal energy and 330 net MW(e) would be from a solar energy source with storage. The review team recognized that biomass energy is commercialized in the State of Texas and, given the experience in the State with oil and gas extraction, there is interest in determining the potential for “geo-powering” Texas to meet a portion of its energy demand (DOE 2006). The 650 net MW(e) contribution of wind power generation with storage and the 330 net MW(e) contribution of solar generation with energy storage to the combination of alternatives case already exceeds the combined total of the two largest operating plants in the world, as was discussed in Section 9.2.3.1 and 9.2.3.3, respectively.

The review team assumed that the 2120 MW(e) natural gas-fired portion of the combination of alternatives would be built at the CPNPP site in a manner similar to the natural gas-fired alternative discussed in Section 9.2.2.2. Consequently, the environmental effects for this portion of the combination of alternatives would be scaled to be of the order of 2/3 of the natural gas-fired alternative.

In its long-term system assessment, ERCOT analyzed a combination of power technologies in its high-wind generation case for determining potential needs for increased transmission capacity (ERCOT 2008a). To achieve the target reserve power margin of 12.5 percent for ERCOT, the high-wind generation case includes 24,622 MW(e) of installed wind capacity in 10 years, two new nuclear units at the South Texas Project totaling 2724 MW(e), and 3295 MW(e) of new combustion gas turbines across the system (ERCOT 2008a).

As described in Section 9.2.3.1 a capacity of 0.25 to 0.45 for wind power generation is not unreasonable; the higher the capacity factor, the less land necessary to support the wind turbine facilities. Assuming the 0.45 capacity factor, the 650 net MW(e) would require an installed capacity of 1450 MW(e). Land use required for this installed capacity based on the Horse Hollow wind farm land use would be 37,700 ha (92,700 ac). The optimal locations for obtaining energy from wind sources is from northwestern Texas; as discussed earlier, transmission lines of over 200 mi would have to be added to the grid.

As described in Section 9.2.3.3, a capacity factor of 0.24 to 0.50 for solar power operation is not unreasonable. Assuming the 0.50 capacity factor the 330 net MW(e) would require an installed capacity of 660 MW(e). Land use required for this installed capacity based on the 354 MW(e)-SEGS and Ivanpah land use would be 1200 ha (3000 ac). The optimal locations for obtaining energy from solar sources are in southwestern Texas, which may necessitate additional transmission lines to provide service to those areas in the east with the largest load growth rate.

For the remainder of the energy sources that make up the combination of alternatives (biomass, municipal solid waste, and geothermal), the review team assumed a capacity factor of 0.90, which is consistent with DOE estimates (DOE 2010). While land would necessarily be used to host these facilities and, in the cases of biomass and municipal solid waste, additional land would be needed for storage of fuel materials, combustion residue (such as fly ash), and landfills, the review team did not attempt to quantify the additional land used. In addition there may be attendant environmental effects on air, water, ecology, socioeconomics, waste, cultural and historic resources, and human health; these were discussed earlier for each of the other power sources.

Beyond the reliable sources that make up the combined energy sources alternative to the proposed action to provide for baseload power, additional installed wind and solar capacity without storage could be constructed and made available to offset the use of 2120 MW(e) of natural gas-fired power generation. When wind and solar energy systems (without storage) are available, this energy supply would result in reduced air emissions and fuel consumption from the natural gas-fueled power facilities. To offset all of the installed natural gas capacity necessary to provide baseload power in this scenario, the review team assumed that 80 percent [or 1700 net MW(e)] could be provided by wind and 20 percent [or 420 net MW(e)] could be provided by solar. Assuming a more nominal capacity factor of 0.345 for wind and 0.25 for solar, both without storage; this would result in installed capacities of 4850 MW(e) of wind and 1680 MW(e) of solar, which in turn, would require 125,000 ha (310,000 ac) and 3000 ha (7600 ac), respectively.

The review team believes that the preceding contributions are representative of a combination of energy sources that could be considered for comparison with the proposed project and together form a reasonable combination alternative. A summary of the review team's characterization of the environmental impacts associated with the construction and operation of the preceding combination of energy alternatives is shown in Table 9-4.

9.2.5 Summary Comparison of Alternatives

Table 9-5 contains a summary of the review team's environmental impact evaluation for building and operating new nuclear, coal-fired, natural gas-fired combined-cycle generating units at the CPNPP site, and a combination of energy alternatives within ERCOT's service area. The nuclear power impacts presented in the comparison table are evaluated in Chapters 4 and 5. The impacts of fossil fuel alternatives presented in the comparison table are evaluated in Section 9.2.2 and the combination of alternatives in Section 9.2.4. The combination of alternatives shown in Table 9-5 assumes the siting of natural gas combined-cycle generating units at the CPNPP site and the siting of other generating units within ERCOT's service area. Closed-cycle cooling with natural draft or mechanical cooling towers is assumed for all thermal plants.

Table 9-4. Summary of Environmental Impacts of a Combination of Power Sources

Impact Category	Impact	Comment
Land use	LARGE	Uses approximately 250 ac for the natural gas-fired powerblock, infrastructure and support facilities; 200 to 600 km^2 per 1000 MW(e) for wind farms plus as many as 230 mi of new transmission capacity. Biomass and municipal solid waste facilities and associated transmission lines would also have land use impacts. A portion of the land required may be available for other compatible uses such as agriculture.
Water use and quality	MODERATE	Impacts would be comparable to the impacts for a new nuclear power plant.
Ecology	MODERATE	Impacts could occur both onsite and offsite and could include wildlife habitat loss and fragmentations, reduced productivity, and local reductions in biological diversity comparable to the impacts associated with a new nuclear plant but with a slight potential for greater habitat loss due to increases in land use from wind farms.
Socioeconomics	MODERATE beneficial to LARGE adverse	Construction-related impacts would be noticeable. Local property tax base would benefit mainly during operations. Depending on where the workforce lives, the construction-related impacts would be noticeable or minor. Temporary local traffic disruptions when transporting wind turbine components. The aesthetic impacts based on the large number of wind turbines would be significant.
Waste management	SMALL	Spent SCR catalyst would be regenerated or disposed of offsite. Ash from biomass and municipal solid-waste sources would require disposal.
Environmental justice	SMALL	There are few minority populations and no low-income populations near the CPNPP site; impacts to such populations would likely be minimal.
Historic and cultural resources	SMALL	Adverse effects are unlikely as there are no NRHP-eligible resources in the vicinity of the site. Potential offsite impacts from biomass facilities could likely be effectively managed. Important site-specific resources could be affected by turbines or transmission lines, but these could likely be effectively managed.
Air quality	SMALL to MODERATE	Emission from the natural-gas fired plant would be approximately: Sulfur oxides = 235 tons/yr Nitrogen oxides = 1784 tons/yr Carbon monoxide = 743 tons/yr $PM_{2.5}$ = 95 tons/yr CO_2= 5.5 million tons/yr Municipal solid waste and biomass facilities would also have emissions, but in smaller amounts than above.
Human health	SMALL	Regulatory controls and oversight are assumed to be protective of human health.

Table 9-5. Summary of Environmental Impacts (Impact Category Level) of Construction and Operation of New Nuclear, Coal-Fired, and Natural Gas-Fired Generating Units, and a Combination of Alternatives

Resource area	Nuclear	Coal	Natural Gas	Combination
Land use	MODERATE	MODERATE	SMALL to MODERATE	LARGE
Water use and quality	MODERATE	MODERATE	MODERATE	MODERATE
Ecology	MODERATE	MODERATE	MODERATE	MODERATE
Socioeconomics	LARGE beneficial to MODERATE adverse	LARGE beneficial to LARGE adverse	MODERATE beneficial to SMALL adverse	MODERATE beneficial to LARGE adverse
Waste management	SMALL	MODERATE	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Human health	SMALL	SMALL	SMALL	SMALL

Because of current concerns related to GHG emissions, it is appropriate to specifically discuss the differences among the alternative energy sources regarding carbon dioxide (CO_2) emissions. The CO_2 emissions for the proposed action and energy generation alternatives are discussed in Sections 5.7.1, 9.2.2.1, 9.2.2.2, and 9.2.4. Table 9-6 summarizes the CO_2 emission estimates for a 40-year period for the reasonable alternatives considered by the review team for baseload power generation. These estimates are limited to the emissions from power generation and do not include CO_2 emissions for workforce transportation, building, fuel-cycle, or decommissioning. Among the reasonable energy generation alternatives, the CO_2 emissions for nuclear power are a small fraction of the emissions of the other energy generation alternatives. Even when the transportation emissions for the nuclear plant workforce and fuel cycle emissions are added in, which would increase the emissions for plant operation over a 40-year period to about 72,000,000 metric tons, this number is still significantly lower than the emissions for the other reasonable alternatives.

Table 9-6. Comparison of Direct Carbon Dioxide Emissions for Energy Alternatives

Generation Type	Years	CO_2 Emission (metric tons)
Nuclear Power [(a)]	40	380,000
Coal-Fired Generation [(b)]	40	980,000,000
Natural Gas-Fired Generation [(c)]	40	250,000,000
Combination of Alternatives [(d)]	40	180,000,000

(a) From Section 5.7.1, value is for two units.
(b) From Section 9.2.2.1
(c) From Section 9.2.2.2
(d) From Section 9.2.4 (assuming only natural gas generation has significant CO2 emissions).

On June 3, 2010, EPA issued a rule tailoring the applicability criteria that determines which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the PSD and Title V programs of the Clean Air Act (75 FR 31514). According to the Tailoring Rule, GHG is a regulated new source review (NSR) pollutant under the PSD major source permitting program if the source (1) is otherwise subject to PSD (for another regulated NSR pollutant) and (2) has a GHG potential to emit equal to or greater than 75,000 tons per year of CO_2e ("carbon dioxide equivalent" adjusting for different global warming potentials for different GHGs). Such sources would be subject to best available control technology (BACT). The use of BACT has the potential to reduce the amount of GHGs emitted from stationary source facilities. The implementation of this rule could reduce the amount of GHGs from the values indicated in Table 9-6 for coal and natural gas, as well as from other alternative energy sources that would otherwise have appreciable uncontrolled GHG emissions. The GHG emissions from the production of electricity from a nuclear power source are primarily from the fuel cycle and such emissions could be reduced further if the electricity from the assumed fossil fuel source powering the fuel cycle is subject to BACT controls. GHG emissions from the production of electrical energy from a nuclear power source are orders of magnitude less than those of the reasonable alternative energy sources. Accordingly, the comparative relationship between the energy sources listed in Table 9-6 would not change meaningfully, even if the GHG emissions from the nuclear fuel cycle reductions are ignored, because GHG emissions from the other energy source alternatives would not be sufficiently reduced to make them environmentally preferable to the proposed project.

The CO_2 emissions associated with generation alternatives such as wind power, solar power, and hydropower would be associated with workforce transportation, construction, and decommissioning of the facilities. Because these generation alternatives do not involve combustion, the review team considers the emissions to be minor and concludes that the emissions would have a minimal cumulative impact. Other energy generation alternatives involving combustion of wood waste, municipal solid waste, or biomass-derived fuels would have CO_2 emissions from combustion as well as from workforce transportation, plant construction, and plant decommissioning. It is likely that the CO_2 emissions from the combustion process for these alternatives would dominate the other CO_2 emissions (e.g., from transportation) associated with the generation alternative. It is also likely that the CO_2 emissions from these alternatives would be the same order of magnitude as the emissions for the fossil-fuel alternatives considered in Sections 9.2.2.1, 9.2.2.2, and 9.2.4. However, because the review team determined that these alternatives do not meet the need for baseload power generation, the review team has not evaluated the CO_2 emissions quantitatively. Insofar as some of these alternatives, such as biomass, are considered in the combination of alternatives discussed in Section 9.2.4, they would increase the total CO_2 emissions beyond the 180,000,000 metric tons; however, the review team considers the small fraction [i.e., 100 net MW(e) compared to the natural gas component, i.e., 2120 net MW(e)] to the combination of alternatives case to have a minimal further cumulative impact that does not warrant more precise analysis.

As summarized in Table 9-5 for each of the resource areas, the review team reviewed the available information on the environmental impacts of power generation alternatives compared to the construction of new nuclear units at the CPNPP site. The review team concludes that there are no environmentally preferable, technically reasonable alternatives to baseload nuclear power.

9.3 Alternative Sites

NRC guidance in Section 9.3 of the ESRP (NRC 2000) provides information on the scope of the evaluation of alternative sites to determine if any obviously superior alternative exists to the site proposed. This section includes a discussion of Luminant's ROI for siting a new nuclear power plant, and describes its site selection process. It provides the NRC staff's description of the alternative sites that were considered and discusses the environmental impacts of locating the new 3200 MW(e) units at each alternative site. And finally, the impacts of alternative sites are compared to the proposed site.

9.3.1 Site Selection Process

NRC EISs prepared in conjunction with a COL application are to analyze alternatives to the proposed action [10 CFR 51.71(d)]. This section discusses CPNPP's process for selecting its proposed and alternative sites and the review team's evaluation of the process. CPNPP's site selection process was based on guidance in the following documents (Luminant 2009a): NRC's Regulatory Guide 4.7 (NRC 1998) and the Electric Power Research Institute's (EPRI) Siting Guide (EPRI 2002).

NRC's site selection process guidance calls for identification of an ROI followed by successive screening to candidate areas, potential sites, candidate sites, and the proposed site (NRC 2000, ESRP 9.3).

Within the ROI, screening criteria are applied to sequentially evaluate candidate areas, potential sites, and candidate sites, leading to the selection of the proposed site and alternative sites. The process Luminant used to identify its alternative sites is described in the following sections.

9.3.1.1 Selection of Region of Interest

The ROI is the geographic area considered in searching for candidate sites (NRC 2000). The ROI is typically the State in which the proposed site is located or the relevant service area for the proposed plant, if it is sufficiently large (NRC 2000).

Luminant selected the ERCOT service area as its ROI; the areal extent of the ERCOT service area is sufficiently expansive to ensure that an adequate slate of potential sites could be found. The designated ROI is consistent with the ROI description in NRC's ESRP for preparation of EISs. The review team concludes that the ROI used in Luminant's COL application is reasonable for consideration and analysis of potential sites. The review team also finds that Luminant's basis for defining its ROI did not arbitrarily exclude desirable candidate locations.

9.3.1.2 Selection of Candidate Areas

Candidate areas are one or more areas within an applicant's ROI that remain after unsuitable areas for a new nuclear power plant (e.g., due to high population, lack of water, fault lines, or distance to transmission lines) have been removed (NRC 2000). Luminant's site selection process is described in a document titled *NuBuild Project, Nuclear Power Plant Siting Report* (Luminant 2007). The site selection process used by Luminant was based on the *EPRI Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application* (EPRI 2002). The process described in the Siting Guide was used as a general basis, and Luminant adapted the criteria used to evaluate sites based on its specific business needs.

The general approach, initially, was to apply a multi-step process as follows:

- Step 1: Regional Analysis, including desktop review and helicopter reconnaissance, to identify candidate areas and potential sites with the ROI for evaluation;
- Step 2: Site screening analysis of potential sites against screening criteria to develop a list of highly feasible (primary) sites to be visited;
- Step 3: Conduct site visits and identification of candidate sites; and,
- Step 4: Detailed evaluation of candidate sites to select proposed site.

9.3.1.3 Selection of Potential Sites

Potential sites are those sites within a candidate area that have been identified by an applicant for preliminary assessment in establishing candidate sites (NRC 2000). The first step in the process was a desktop review of maps, data, and knowledge of existing plant sites throughout the ROI to identify general areas in which power plant development could be feasible (Luminant 2009a). These areas were assessed using aerial helicopter reconnaissance, resulting in the definition of sites to be selected for screening level analysis. This process was performed in September 2006, and resulted in the identification of 47 potential sites which were subjected to a screening analysis for the selection of "highly suitable" primary sites.

9.3.1.4 Selection of Primary Sites

The site screening analysis step was actually performed by Luminant two separate times. The initial site screening analysis consisted of evaluation of the 47 sites against six screening criteria, which included:

- Land area availability of at least 1000 ac;
- Water availability of at least 50,000 ac-ft per year;
- Distance to existing transmission lines;
- Distance to existing railroad access;
- Geotechnical criteria, including availability of a bedrock foundation and the level of seismic risk; and,
- Environmental acceptability, including presence of population centers, sites eligible for the NRHP, and adjacent land uses.

This process resulted in the characterization of eight primary sites as "highly suitable."

At this point, Luminant used information obtained during the process to refine the characterization of some of the potential sites. This included refining the site boundaries of some of the potential sites, and splitting some large individual properties into multiple potential sites for evaluation. This refinement resulted in a total of 60 potential sites being subjected to a second site screening analysis in October 2006.

In addition to refining the characterization of the potential sites, Luminant also refined the screening criteria that were used. The original criteria of water availability, available land area, railroad access, transmission line access, and geotechnical characteristics remained the same as in the initial screening analysis. The criterion of environmental acceptability was still used, but was modified from the initial screening analysis. In the initial screening analysis, the density of population was used, qualitatively, as part of the environmental acceptability criterion. In the second screening analysis, population density was extracted from the evaluation of environmental acceptability, and was made a separate screening criterion. In addition, the population density criterion was made quantitative, based on a number of 25,000 persons within a 10-mi radius. Finally, a criterion on cost was added, and it applied specifically to the cost to acquire and transport cooling water.

This second screening analysis increased the population of primary sites from 8 to 13, and carried them forward into Step 3 of the process. The 13 primary sites included:

- Coastal (McFaddin West)
- Coastal
- Lake Livingston – Goodrich
- Lake Livingston – Staley
- Lake Livingston – Glendale
- Lake O' the Pines
- Sam Rayburn Reservoir – Pineland
- Sam Rayburn Reservoir – North
- Sam Rayburn Reservoir – South
- Comanche Peak Nuclear Power Plant
- Toledo Bend – Blue Hills
- Toledo Bend – West
- Tradinghouse

9.3.1.5 Selection of Candidate Sites

Site visits were conducted by Luminant at the 13 primary sites to field-check the information used in the screening process. The field evaluations included review of site-specific issues including potential for site flooding, presence of previously unknown populations or environmentally sensitive features, and means of access to cooling water. In addition, this process included contact with landowners, resulting in identification of complex land ownership patterns or landowners who were unlikely to make the land available for acquisition.

In some cases, multiple sites were located within a single candidate area, and the process was used to identify the single best site from within that candidate area. This was the case for the Coastal (McFaddin West) site; it is located near the Coastal site, but was not considered further because the owner of the Coastal site was more receptive to allow Luminant to conduct more detailed analysis. Similarly, the Pineland site was judged to be the best of the three potential sites located on Sam Rayburn Reservoir.

The results of the field evaluations were used to establish four candidate sites for detailed analysis and site selection. These four candidate sites are the CPNPP site, the Tradinghouse site, the Pineland site, and the Coastal site, as shown in Figure 9-1.

Of the candidate sites, only one location (i.e., Comanche Peak) has undergone a thorough NEPA review; it is currently an active nuclear site with operating reactors. Co-locating new nuclear generating units with an existing power plant can have the advantages of using less land for each unit in that existing infrastructure and support facilities can be shared between new and existing units.

The four candidate sites were subjected to a detailed evaluation process to select a proposed site. The evaluation criteria were derived from Chapter 3 of the EPRI Siting Guide (EPRI 2002), and included 34 separate evaluations. The importance of each criterion was included in the assessment by incorporation of a criteria weighting factor. The result of the analysis was Luminant's selection of the CPNPP site as the proposed site. The review team's detailed analysis of the other three candidate sites as alternative sites is presented in Section 9.3.2.

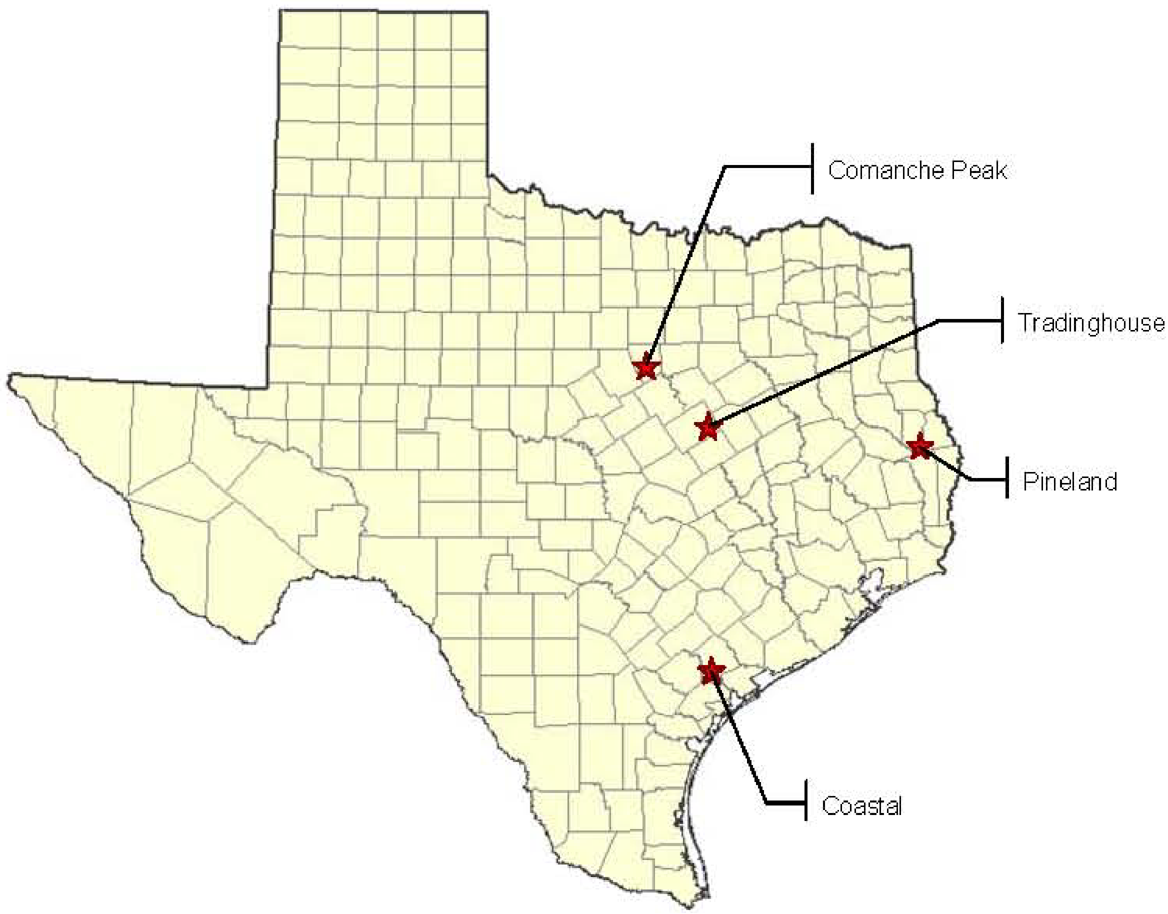

Figure 9-1. Map Showing the Locations of Luminant's Alternative Sites (Luminant 2009a)

Through this site identification and analysis process, two sites that had previously been considered potentially suitable for nuclear power development were not evaluated as candidate sites, although they were considered potentially viable nuclear sites (Luminant 2007). These are the Toledo Bend–Blue Hills site and the Allen's Creek site. Both of these sites are considered feasible nuclear sites and were considered candidate sites as part of the selection process; however, the distance from railroads and transmission lines (Blue Hills) as well as the close proximity to a National Forest (Blue Hills) and to a population center (Allen's Creek) reduced the desirability of these two sites as candidate sites. In addition, both sites had unique circumstances that had to be overcome to acquire adequate access to cooling water (Luminant 2007; BRA 2005). For these reasons, these sites were not selected as final candidate sites by Luminant.

9.3.1.6 Evaluation of Luminant's Site Selection Process

The review team evaluated the methodology used by Luminant to select its proposed and alternative sites. The ROI selected by Luminant covers a largely isolated grid system (ERCOT) that encompasses a large and ecologically varied area. Use of such an area is consistent with the guidance in ESRP 9.3 (NRC 2000). Luminant then established candidate areas based on a group of exclusionary criteria similar to those described in ESRP 9.3. Next Luminant identified potential sites within the candidate areas based on qualitative criteria. The list of sites was further narrowed using more detailed criteria to identify the primary of "highly suitable" sites. Finally, Luminant used more specific criteria to evaluate the primary sites and identify the alternative sites. Based on its review of Luminant's site selection process and the guidance in ESRP 9.3 (NRC 2000), the review team concludes that Luminant's process for selecting its ROI, candidate areas, potential sites, primary sites, candidate sites, and the proposed CPNPP site was reasonable and did not arbitrarily exclude locations that might be suitable choices for siting two new nuclear generating units to satisfy the need for power identified in Chapter 8.

The three alternative sites examined in detail in Section 9.3 are the Coastal site in Victoria County, the Pineland site in San Augustine County, and the Tradinghouse site in McLennan County. The review team used information in Luminant's ER related to the three alternative sites, independently collected and analyzed reconnaissance-level information for each of the alternative sites using ESRP 9.3 (NRC 2000) as guidance, and conducted site visits at each of the alternative sites.

In the discussion of the alternative sites that follows, the review team evaluated cumulative impacts of building and operating two new nuclear units at each site for each resource category, considering the impacts of other nearby projects on that resource. Included in the cumulative analysis are past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action. For purposes of this analysis, the past is defined as the time period before receipt of the COL application. The present is defined as the time period from the receipt of the COL application until the start of building proposed CPNPP Units 3 and 4. The future is defined as the start of building Units 3 and 4 through operation and eventual decommissioning.

Using Chapter 7 as a guide, the specific resources and components that could be affected by the new incremental effects of the proposed action if implemented at the alternative site and other actions in the same geographic area were identified. The affected environment that serves as the baseline for the cumulative impacts analysis is described for each alternative site and includes a qualitative discussion of the general effects of past actions. For each resource area, the geographic area over which past, present, and future actions could reasonably contribute to cumulative impacts is defined and described in later sections. The analysis for each resource area at each alternative site concludes with a cumulative impact finding (SMALL, MODERATE, or LARGE). For those cases in which the impact level to a resource was greater than SMALL, the review team also discussed whether building and operating the nuclear units would be a significant contributor to the cumulative impact. In the context of this evaluation, "significant" is defined as a contribution that is important in reaching that impact level determination.

The impacts described in Chapter 6 (e.g., nuclear fuel cycle; decommissioning) would not vary significantly from one site to another. This is true because the alternative sites and the proposed site are in low-population areas and because the review team assumes the same reactor design (therefore, the same fuel cycle technology, transportation methods, and decommissioning methods) for each of the sites. As such, these impacts would not differentiate between the sites and would not be useful in the determination of whether an alternative site is environmentally preferable to the proposed site. For this reason, these impacts are not discussed in the evaluation of the alternative sites.

The cumulative impacts are summarized for each resource area at each site in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area. The findings for each resource area at each alternative site then are compared in Table 9-24 at the end of this section to the cumulative impacts at the proposed site (brought forward from Chapter 7). The results of this comparison are used to determine if any of the alternative sites are environmentally preferable to the proposed site.

9.3.2 The Coastal Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Coastal site in Victoria County, Texas. The Coastal site is a greenfield site near McFaddin, Texas, and is not currently owned by Luminant.

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the new incremental effects of the proposed action if implemented at the Coastal site and other actions in the same geographical area were considered. This assessment includes the impacts of NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Coastal site. Other actions and projects considered in this cumulative analysis are described in Table 9-7.
The CPNPP site is approximately 260 mi from the Coastal site and was therefore not included in this analysis. The only other nuclear power plant currently operating in Texas is the South Texas Project, near Bay City, Texas. The South Texas Project plant is approximately 60 mi east of the Coastal site and, with the exception of cumulative impacts of postulated radiological accidents, is not included in other resource area analyses. The site for the proposed Victoria County Nuclear Station is located within 5 mi of the Coastal site.

Table 9-7. Projects and Other Actions Considered in the Cumulative Analysis at the Coastal Site

Project Name	Summary of Project/Activity	Location	Status
Energy Projects			
Victoria County Nuclear Station	One or more large-scale nuclear power reactors	Within 5 mi of the Coastal site	Proposed.[a] Exelon Generation submitted an application to the NRC for an Early Site Permit on March 25, 2010.
Calhoun Liquefied Natural Gas (LNG) Terminal	LNG terminal on Port Lavaca-Point Comfort	About 25 mi east	Proposed.[b]
E.S. Joslin Power Plant Project	Proposed upgrade from 261 MW to 303 MW power plant fueled by petroleum coke	About 25 mi east	The plant operated from 1971 until 2004. Currently not operating; however, NuCoastal Power Corp plans to repower the plant. Air permits have been issued. Scheduled to be on line by late 2012.[c]
South Texas Project	Two large scale nuclear reactors with two additional reactors proposed	About 60 mi east	South Texas Project Units 1 and 2 – currently operating South Texas Project Units 3 and 4 – STP Nuclear Operating Company submitted to obtain a combined license for two Advanced Boiling Water Reactors designated as South Texas Project, Units 3 and 4.
Transportation Projects			
I-69 Trans-Texas Corridor	New interstate corridor connecting Texarkana/Shreveport to Mexico (possibly the Rio Grande Valley or Laredo)	Section B of corridor could come within 5 mi west	Proposed.[d]

Table 9-7. (cont'd)

Project Name	Summary of Project/Activity	Location	Status
Parks			
Parks, forests, and reserves	Numerous State and National parks, forests, reserves, and other recreational areas are located within a 50-mi region	Throughout 50-mi region	Parks are currently being managed by National, State, and/or local agencies.
Other Actions/Projects			
Invista-DuPont Plant	Manufactures chemicals, polymers, and resins related to the textiles, carpet, and fiber industries	About 8 mi northeast	Operational.[e]
Formosa Plastics Corporation	Manufactures plastic resins and petrochemicals	About 25 mi east	Operational.[f]
Alcoa Aluminum Plant	Aluminum manufacturing	About 25 mi east	Operational.[g]
Texas Liquid Fertilizer Co. (Point Comfort)	Manufactures nitrogenous fertilizer	About 25 mi east	Operational.[h]
Air emissions sources	Air emissions sources within county include small-scale commercial facilities (emissions below reporting limits), on-road mobile sources (cars and trucks), non-road mobile sources (airplanes, boats, tractors, etc), and industrial stationary point emissions sources[i]	Within Victoria County	Emissions already result in Victoria County being a Near Non-Attainment Area for ozone.[j] New emissions in County subject to Eight-Hour Ozone Maintenance Plan.[i]
Various hospitals and industries that use radioactive materials	Medical and other isotopes	Within 50 mi	Operational in nearby cities and towns.
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and rail; construction of water- and/or wastewater treatment and distribution facilities and associated pipelines, as described in local land use planning documents	Throughout region	Construction would occur in the future, as described in State and local land use planning documents.

(a) Source: Exelon 2010b
(b) Source: FERC 2007
(c) Source: O'Grady 2008
(d) Source: TxDOT 2010
(e) Source: DuPont 2009
(f) Source: EPA 2009b
(g) Source: EPA 2009
(h) Source: EPA 2009f
(i) Source: TCEQ 2007
(j) Source: TCEQ 2009

9.3.2.1 Land Use

The Coastal site is located in the southern portion of Victoria County, Texas, near the border with Calhoun County. The site is approximately 7 mi east of U.S. Highway 77, 17 mi south of the City of Victoria, and 5 mi east of the unincorporated community of McFaddin. An existing rail line approximately 2.3 mi northwest of the site could be used to transport heavy equipment and components to the vicinity of the site, but a spur rail line or heavy-duty haul road would be required to reach the construction area. Local paved and gravel roads provide vehicular access to the site.

The greenfield site is privately owned and is currently used for cattle ranching. A nuclear power plant at the Coastal site would make use of the current owner's water rights. The site is subject to multiple mineral leases, and several pipelines cross the site carrying natural gas, ethylene glycol, gasoline, and water. Using data from the National Wetlands Inventory, Luminant estimates that the site contains approximately 65 ac of wetlands (Luminant 2009a).

Two possible configurations could be considered for the Coastal site; one encompasses about 2000 ac of land, and the other encompasses about 2500 ac. Luminant estimates that less than one-half of the site would be disturbed for building and operating the nuclear power plant. Based on data presented in the ER (Luminant 2009a), 500,919 ac of land in Victoria and Calhoun Counties is currently devoted to non-crop agricultural uses. Assuming that the entire site is presently used for grazing and would be converted to energy production use, the addition of a nuclear power plant would reduce non-crop agricultural land in the two counties by approximately 0.3 to 0.5 percent. This would represent a minimal impact on the predominant land use of the surrounding agricultural landscape. However, the introduction of such a large and intensive industrial facility into the rural landscape would constitute a disruptive impact on local land-use patterns. This direct impact would be compounded by the indirect impacts of induced changes in land use associated with preconstruction, construction, and operations workforces.

The site is located outside the boundary of the Texas Coastal Management Program, and no State or local zoning or land use restrictions apply to the site. The site is outside the 100-yr floodplain (Luminant 2009a). Sensitive lands in the area include Guadalupe Delta Wildlife Management Area (approximately 9 mi to the east), Aransas National Wildlife Refuge (approximately 22 mi to the south), and Matagorda Island Wildlife Management Area and State Park (approximately 29 mi to the southeast). Workers at a nuclear power plant would likely increase recreational use of these sites modestly, but resulting in only a minimal impact.

An existing 345-kV transmission line is located approximately 2 mi southeast of the site. While detailed information concerning the routing of possible new transmission line corridors is not known at this time, a connection to the nearby 345-kV line would likely cross grassland, forested areas, and wetlands along Kuy Creek, Smith Bayou, and Elm Bayou. It appears that new transmission lines in this area could be supported on towers placed outside wetlands. Thus, installing and operating the transmission lines are not expected to result in substantial changes to land use. Ranching and crop uses of land in the ROWs would be able to continue except at the tower pads and along tower access roads. Transmission towers or poles would be built outside of floodplains wherever possible; however towers or poles built in floodplains would not substantially interfere with movement of floodwaters. The selection of a final transmission line route would be subject to environmental review and approval by the Public Utilities Commission of Texas.

Cumulative Impacts

The geographic area of interest for consideration of cumulative land-use impacts includes Victoria and Calhoun Counties. This area includes most other projects and actions that could combine with development and operation of two nuclear power units at the Coastal site to produce cumulative land-use impacts. These counties are located in a coastal prairie region that is nearly level to gently rolling and covered with grasses and deciduous forest. Major land uses in the area are oil production and agriculture (sorghum, rice, corn, beef cattle, hogs, and poultry).

Historically, land in the area of interest has been used primarily for livestock grazing and farming. Port Lavaca in Calhoun County also has a strong history of shipping and trade. Oil and gas production has increased since the 1930s, and the amount of land devoted to manufacturing has grown since World War II (TSHA 2010). However, land use in the area continues to be dominated by non-farm agriculture (such as ranching). Based on information provided by Luminant (Luminant 2009a), approximately 85 percent of the land in the two-county area of interest is in agricultural use. Of this amount, approximately 66 percent, or 500,919 ac, is used for non crop-agriculture, primarily supporting cattle, hogs, sheep, and poultry.

Other proposed projects and actions that could contribute to cumulative impacts on land use in the area of interest include the Victoria County Nuclear Station (VCNS), the Calhoun Liquefied Natural Gas Terminal (CLNGT), and the E.S. Joslin Power Plant Project (JPPP) (see Table 9-7). The VCNS is being considered for property immediately adjacent to the Coastal site. The CLNGT and JPPP are proposed for the eastern shore of Lavaca Bay, approximately 24 mi east of the Coastal site. The addition of these facilities, particularly the development and operation of another nuclear plant on an adjacent parcel, would potentially have a major effect on land use in the two county area. In addition to the sizeable amount of land devoted to the projects themselves, induced development due to increases in the area workforce could induce significant changes in land-use patterns and future land availability and could change the rural character of the area.

The Texas State Data Center (TSDC) projects that the population in a seven-county area surrounding the CPNPP site (including Calhoun, DeWitt, Goliad, Jackson, Lavaca, Refugio, and Victoria Counties) will increase by 10.7 percent by the year 2040 (TSDC 2009). Future urbanization in the review area could contribute to decreases in grazing lands, cultivated lands, forests, and wetlands. Urbanization in the vicinity of the Coastal site would reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat. Despite the relatively low TSDC projection of population growth, development of a nuclear power plant at the Coastal site, in combination the proposed VCNS, CLNGT, and JPPP, could substantially increase the projected level of urbanization and overwhelm the existing predominantly rural character of the surrounding landscape. The increased levels of urbanization could noticeably alter land uses in the geographic area of interest.

The report, *Global Climate Change Impacts in the United States*, provided by the U.S. Global Change Research Program (GCRP), summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions. The Coastal site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase in of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. The GCRP states that the warming projected for the Southeast could result in a potential reduction in crop yields and livestock productivity, which may change portions of agricultural and ranching land uses in the area of interest. In addition, the GCRP projects increase sea level and storm surges in this area, thus potentially changing land use through inundation and loss of coastal wetlands and other low-lying areas.

Based on the information provided by Luminant and the review team's independent review, the review team concludes that the cumulative land-use impacts of constructing and operating two new nuclear generating units at the Coastal site would be LARGE. This conclusion reflects (1) the substantial amount of land (up to 2500 ac onsite plus additional offsite land for roads and a railroad spur) that would be needed for the proposed project, (2) the combined direct and indirect land-use impacts from the proposed nearby VCNS, CLNGT, and JPPP, and (3) increased urbanization beyond that currently projected by TSDC. Because part of the onsite land use requirements would accommodate nuclear safety related structures, the review team concludes that NRC-authorized construction and operation of two new nuclear units at the Coastal site would be a substantial contributor to the LARGE impact.

9.3.2.2 Water Use and Quality

The Coastal site is in an area of generally flat topography on the Gulf Coastal Plain near San Antonio Bay, between the Guadalupe and San Antonio Rivers. It is in the South Central Texas Regional Water Planning Area (Region L of the Texas State Water Plan) and within the jurisdiction of the Guadalupe-Blanco River Authority (GBRA). For this analysis, the geographic area of interest encompasses the entire South Central Texas Regional Water Planning Area, with primary focus on surface water and groundwater in the immediate site vicinity and downstream.

The combined watersheds of the Guadalupe and San Antonio Rivers encompass 10,128 mi^2 in a region with a humid subtropical climate (Exelon 2010a). The San Antonio River flows into the Guadalupe River upstream of the Lower Guadalupe Diversion Dam and Salt Water Barrier, which is a short distance upstream from the mouth of the Guadalupe at San Antonio Bay. A significant consideration for water management in this region is the extensive interaction between groundwater and surface water. In upstream areas, springs discharging from the Edwards aquifer are a major source of streamflow to Guadalupe River tributaries, while near the coast there is extensive interaction between streams and shallow groundwater (TWDB 2007). Freshwater inflows from the rivers are important for maintaining salinity concentrations in downstream tidal estuaries (Guadalupe River estuary and San Antonio Bay) within ranges required for aquatic organisms. Plant water use may need to be coordinated with maintenance of salinity concentrations, including delivery of freshwater pulses needed during the spring and early summer (South Central Texas Regional Water Planning Group 2009, Exelon 2010a).

Building Impacts

Facility construction activities would not cause significant surface hydrologic alterations, but dewatering of shallow groundwater might be necessary. Impacts would, however, be temporary and localized. Except for water intakes, discharge structures, and pipelines, there would be no construction within 100-yr or 500-yr floodplains or in the zone potentially subject to storm surge from hurricanes. Impacts on surface water quality from construction of water intakes and discharge structures would depend on the extent of required dredging and the waterbody affected. There would be little impact on groundwater from construction, as there would be no use of groundwater and the potential for contamination would be minimized by implementation of appropriate management practices during construction.

Operational Impacts

It is assumed that two new nuclear units at the Coastal site would use closed-cycle cooling with a MDCT, and that no Blowdown Treatment Facility (BDTF) would be required at the Coastal site due to the lack of a need for water treatment prior to discharge. Cooling water requirements are assumed to be somewhat larger than the 62,400 ac-ft/yr annual consumption estimated for the CPNPP site due to the warmer air temperatures (TSECO 2008) and higher humidity (NOAA 2009) of the Coastal site. Although the current availability of water and the excess of supply over demand in the water planning region may provide water for operation, over the long term a nuclear power plant at the Coastal site may contribute to regional water-use conflicts or shortages, as well as contribute to increased salinity in sensitive estuarine habitats downstream from the site.

Legal rights to the water required for a nuclear power plant would be obtained from the site landowner, who has senior rights to a large volume of water. These water rights are currently used for some other purpose. Several possible physical sources of water exist, including treated wastewater effluent from the City of San Antonio, water withdrawn from the nearby Victoria Barge Canal above the Lower Guadalupe Diversion Dam and Salt Water Barrier (about 50,000 ac-ft/yr potentially available), or water withdrawn from the Calhoun Canal system, a network of irrigation canals located in the coastal plain on the downstream side of the Lower Guadalupe Diversion Dam and Salt Water Barrier that is supplied by water diverted from the rivers above the barrier (about 65,000 ac-ft/yr potentially available). Luminant considers the Calhoun Canal system to be the most likely source. Effluent discharge would be directed to either the barge canal or one of the rivers; the barge canal is considered more likely. The Calhoun Canal system diverts water from the Guadalupe River and distributes to industrial, municipal, and agricultural customers in Calhoun County through a series of irrigation canals, checks, pump stations and pipelines (GBRA 2009). The Guadalupe River and Victoria Barge Canal appear to have adequate dimensions to provide suitable water intake sites; however, when the Calhoun Canal system was observed by the review team in February 2009, it was narrow and appeared shallow (typical depth in the main canal is about 10 ft). Significant dredging and other modifications likely would be needed to construct and maintain a suitable water intake for a nuclear station in the canal system.

Siltation is likely to be a considerable problem in the Calhoun Canal system, which appears to have sluggish flow. High suspended solids loads in this water source would necessitate extensive pretreatment (i.e., settling) of cooling water. High salinity would likely constrain cooling water discharge at the Coastal site and would increase the environmental impacts of cooling tower drift.

Operations at the Coastal site would affect surface water quality due to the moderately high salinity and suspended solids in the intake water and the potential need for periodic maintenance dredging at intakes. There would be no use of groundwater for operations; therefore, the impact on groundwater availability would be minimal. Impacts on groundwater quantity and quality would be minor, as there would be no use of groundwater, there is little or no use of near-surface groundwater that might be subject to contamination from the facility, and the potential for contamination would be minimized by implementation of appropriate management practices.

Cumulative Impacts

In addition to water use and water quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that impact the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the Coastal site is considered to be the drainage basin of the Guadalupe and San Antonio Rivers and downstream of the site because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts to water supply and water quality in the watersheds of the

Guadalupe and San Antonio Rivers include the management of the existing Calhoun Canal system.

The report, *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions, and the Coastal site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase in of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. The GCRP states that the warming projected for the Southeast region could result in a potential reduction in crop yields and livestock productivity, which may change portions of agricultural and ranching land uses in the area of interest. Decreased water availability due to increased temperatures and longer periods between rainfall events would likely affect the region's economy as well as its natural systems.

Ward (2009) incorporated global climate modeling results into water budgets for four regions of Texas to estimate the potential cumulative impacts on each region's water resources from future climate change and future increases in water demand. His analysis assumes that climate change would increase Texas' statewide air temperatures by 3.6°F and reduce precipitation by 5 percent. In Ward's analysis, the Coastal site is part of the Central Region of Texas, which includes the Guadalupe and San Antonio River basins. Considering climate conditions and increases in water demand projected for the year 2050, and assuming that new water supplies are developed to meet increased demand, Ward's analysis found that in "normal" years streamflow to the Gulf of Mexico from the Central Region would be 36 percent less than in normal years under baseline conditions for the year 2000. Increased water demand accounts for only a 6 percent reduction in streamflow, with the remainder of the reduction attributed to climate change. Under drought conditions comparable to those of the years 1950 to 1956 (the period that includes the drought of record), the analysis indicates that streamflow to the Gulf would be 24 percent of normal under year 2000 baseline conditions, 18 percent of the normal baseline with year 2050 water demand but no change in climate, and just 3 percent of the normal baseline if the effect of global climate change (GCC) and the effect of year 2050 water demand are combined.

Cumulative Water Use Impacts

Total existing water availability for consumptive use in Region L is estimated at 1,049,769 ac-ft/yr on average, and existing demand is estimated at 985,237 ac-ft/yr (TWDB 2007). By 2060, regional demand is projected to grow to 1,273,003 ac-ft/yr, thus exceeding existing supply. However, it is expected that a combination of management strategies, including water conservation, water reuse, groundwater and seawater desalination, and interbasin transfers from the Colorado River, can be used to increase supply to both accommodate the increased demand and provide excess capacity, at a total capital cost of about $5.2 billion (TWDB 2007).

The analysis by Ward (2009) indicates, however, that climate change coupled with increased demand could result in more severe impacts during times of drought. Overall cumulative impacts to water use in the region would be MODERATE to LARGE. Because construction and operation of a nuclear facility at the Coastal site would be a minor contributor to cumulative impacts when compared with the impacts of climate change, the cumulative impacts to water use from construction and operation would be SMALL to MODERATE.

Cumulative Water Quality Impacts

Principal contributors to cumulative impacts to surface water quality at the Coastal Site would be the moderately high salinity and suspended solids in the water sources. Climate change could increase the potential for salinity impacts due to reduced flows of freshwater in rivers. The potential need for dredging for building and periodic maintenance of the nuclear facility's water intakes is an additional source of cumulative impacts. Impacts on groundwater quality would be minimal. Overall cumulative impacts to water quality would be SMALL to MODERATE, with construction and operation of a new nuclear facility contributing to these cumulative impacts at the SMALL to MODERATE level.

9.3.2.3 Terrestrial Resources

The following impact analysis includes impacts from building activities and operations on the Coastal site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact terrestrial resources, including other Federal and non-Federal projects listed in Table 9-8.

Table 9-8. Threatened or Endangered Terrestrial Species that May Occur within 10 mi of Coastal Site

Group	Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]
Reptiles	Texas scarlet snake	*Cemophora coccinea lineri*	-	T
Birds	Atwater's greater prairie chicken	*Tympanuchus cupido attwateri*	E	E
	Bald eagle	*Haliaeetus leucocephalus*	-	T
	Peregrine falcon	*Falco peregrinus*	-	T/E
	Piping plover	*Charadrius melodus*	T	T
	Interior least tern	*Sterna antillarum athalassos*	E	E
	Whooping crane	*Grus americana*	E	E
Mammals	Jaguarundi	*Herpailurus yaguarondi*	E	E

(a) Federal status: E = endangered; T = threatened.
(b) State status: E = endangered; T = threatened.

Source: TPWD 2009a

The Coastal site lies in the Western Gulf Coastal Plain ecoregion (Griffith et al. 2004). It is on relatively level land near the confluence of the Guadalupe and San Antonio Rivers. The surrounding landscape consists of a mixture of low-lying grassland interspersed with brush, as well as agricultural land. Two possible configurations could be used for development of the proposed units on the site, one consisting of 2000 ac of land, and the other 2500 ac. Should this site be developed, then it is likely that the ultimate footprint of development would be even less than 2000 ac. The Coastal site is currently used for cattle ranching.

The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat topography and mainly grassland natural vegetation. The flora includes tall grasses and live oaks (*Quercus virginiana*), mesquite (*Prosopis* spp.), prickly pear (*Opuntia* spp.), and other native vegetation. Where native vegetation has been displaced by agriculture, the principal crops are rice (*Oryza sativa*), grain sorghum (*Sorghum bicolor*), cotton (*Gossypium* spp.), and soybeans (*Glyine max*). Animal life includes quail (*Colinus virginianus*), whitetail deer (*Odocoileus virginianus*), doves (*Zenaida macroura*), cottontail rabbits (*Sylvilagus floridanus*), armadillos (*Dasypus novemcinctus*), skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), raccoons (*Procyon lotor*), and coyotes (*Canis latrans*). Of these species white-tailed deer and doves are highly sought after by hunters and are considered important species. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common (Griffith et al. 2004).

The Western Gulf Coastal Plains is one of the most ecologically complex and biologically diverse regions of Texas. With nearly 500 recorded species of resident and migratory birds, it is one of the richest birding areas in North America (Griffith et al. 2004). Nearby protected areas of ecological value include the Guadalupe Delta Wildlife Management Area (WMA), Aransas National Wildlife Refuge (NWR), and Matagorda Island WMA. The Guadalupe Delta WMA is closest to the site at 7.5 mi to the southeast; Aransas NWR and Matagorda Island WMA are located 17 and 26 mi to the south, respectively. The Guadalupe delta area was identified by the U.S. Fish and Wildlife Service (USFWS) and Texas Parks and Wildlife Department (TPWD) in the 1970s as a wetlands area that needed to be preserved to protect the wildlife habitat (Luminant 2007).

Federally and State-Listed Species

No site specific surveys have been conducted for threatened and endangered species at the Coastal site. The list in Table 9-8 of threatened and endangered species that occur within 10 mi of the Coastal site was compiled from information on rare resource occurrences contained in the Texas Natural Diversity Database. The information was provided by Texas Parks and Wildlife Department (TPWD 2009a).

Building Impacts

The Coastal site is relatively level and relatively little grading would be required to prepare the site for development. It is reported that development of the plant facilities would affect from 2000 to 2500 ac (Luminant 2007). The review team believes that the ultimate footprint of development would be less than the 2000 ac reported. Most of the area is currently used for cattle production and its value as undisturbed wildlife habitat is therefore limited.

New transmission lines on new ROWs would be required to connect the proposed units to an existing 345-kV transmission line approximately 2 mi to the southeast (Luminant 2007). While detailed information concerning the routing of new transmission lines is not known at this time, the review team expects the ROWs would cross grassland, forested areas, and wetlands along Kuy Creek, Smith Bayou, and Elm Bayou. The required ROWs would not come closer than about 5 mi to the protected areas described above. Building new transmission lines would be subject to additional environmental review by ERCOT and Public Utility Commission of Texas (PUCT). To support that review, the new ROWs would be subjected to site-specific investigations prior to development, possibly including, but not limited to, reconnaissance to determine the presence or absence of Federally and State-listed species and other important species and habitats defined in NUREG-1555 or as required by Federal or State agency regulatory requirements.

Little grading would be required to build the new transmission lines due to the level terrain. Furthermore, the ability to relocate proposed transmission tower sites laterally along the ROW means that towers could usually be sited to avoid environmentally sensitive areas such as those that might contain small populations of special interest plants, waterbodies and waterways, and wetlands.

Building the proposed facilities at the Coastal site would result in the permanent loss of mostly agricultural land and grassland currently used as cattle range. However, the agricultural land

and range also provide habitat for a diversity of terrestrial wildlife; hence, its loss and fragmentation would noticeably alter terrestrial resources. New power transmission lines on new ROWs could result in additional alteration of habitat and possible fragmentation of some of widely scattered remaining tracts of forest in the surrounding landscape. Other sources of impacts to terrestrial resources such as increased traffic, noise, and displacement of wildlife would likely be temporary and/or result in minimal impact.

Operational Impacts

Terrestrial ecological impacts that may result from operation of new nuclear units at the Coastal site include those associated with cooling towers, transmission system structures, and maintenance of transmission line ROWs (Luminant 2007).

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the type (mechanical or natural draft), number, and specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the type (mechanical or natural draft for a wet cooling system; dry for a dry system) and number of cooling towers at the site. The impacts of cooling-tower drift and bird collisions for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be of minor significance for nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team concludes, for the purpose of comparing the alternative sites, that the impacts of cooling-tower drift and bird collisions with cooling towers resulting from operation of new nuclear units would be minor.

For MDCTs, the anticipated noise level from cooling-tower operation is anticipated to be approximately 55 dBA at 1000 ft (Luminant 2009a). This noise level is well below the 80 to 85 dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Coastal site would not be likely to disturb wildlife beyond 1000 ft from the source. The noise level for natural draft cooling towers (NDCT) would be lower. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

The impacts associated with transmission-line corridor maintenance activities include alteration of habitat due to cutting and herbicide application, as well as similar related impacts where corridors cross floodplains and wetlands.

Impacts from bird collisions with transmission lines and the effects of electromagnetic fields (EMFs) on flora and fauna are expected to be minimal. Transmission lines and associated structures are recognized as a potential avian collision hazard. Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including transmission-line corridors with variable numbers of power lines (NRC 1996). Although additional transmission lines would be required for new nuclear units at the Coastal site, increases in bird collisions would be minor and would likely not be expected to cause a measurable reduction in local bird populations. Consequently, the number of bird collisions posed by the addition of new transmission lines is expected to be negligible.

EMFs are unlike other agents (e.g., toxic chemicals and ionizing radiation) that have an adverse impact in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle. A review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures. The impacts of EMFs on terrestrial flora and fauna are recognized as being of small significance at operating nuclear power plants, including transmission systems with variable numbers of power lines (NRC 1996). Therefore, the risk of EMF impacts of new transmission lines at the Coastal site would be negligible.

New access roads would be required during the establishment of new transmission line ROWs at the Coastal site. Transmission line ROW management activities (such as cutting and herbicide application) and related impacts to terrestrial habitats in transmission line ROWs are of minor significance at operating nuclear power plants, including those with transmission line ROWs of variable widths (NRC 1996). Consequently, the effects of transmission line ROW maintenance and associated impacts to terrestrial habitats of new transmission line ROWs at the Coastal site would be negligible.

Cumulative Impacts

For purposes of this cumulative analysis, the geographic area of interest is defined as Victoria and Calhoun Counties. These counties encompass the Coastal site, anticipated transmission line ROWs, and adjoining areas. This geographic area of interest is expected to encompass the ecologically relevant landscape features and species. The impacts of building and operating two nuclear units at the Coastal site were evaluated by the review team to determine their contribution to cumulative impacts on terrestrial ecological resources. Activities related to building include loss of habitat due to land clearing for the plant and transmission lines. Past actions that have affected terrestrial resources include conversion of most natural terrestrial habitat for land used in crop production and grazing, as well as rural residential development. This agricultural and other development has displaced wildlife habitat and increased fragmentation of remaining habitats. Highway projects such as the I-69 Trans-Texas Corridor, and development of the proposed Victoria County Nuclear Station and ancillary facilities (Table 9-7), as well as possible future residential development, and increasing urbanization would continue to consume and fragment the wildlife habitat that remains in this predominately agricultural landscape.

The TSDC projects that the population in a seven-county area surrounding the Coastal site (including Calhoun, DeWitt, Goliad, Jackson, Lavaca, Refugio, and Victoria Counties) will increase by 10.7 percent by the year 2040 (TSDC 2009). Future urbanization in the review area could contribute to decreases in grazing lands, cultivated lands, forests, and wetlands. Urbanization in the vicinity of the Coastal site would reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat. Despite the relatively low TSDC projection of population growth, development of a nuclear power plant at the Coastal site, in combination the VCNS, CLNGT, and JPPP, could substantially increase the projected level of urbanization.

The cumulative urbanization in the geographic area of interest could noticeably alter attributes of land use by reducing wildlife habitat in localized areas. However, this would not be expected to substantially affect the overall availability of wildlife habitat or wildlife migration corridors near the Coastal site or the general extent of forests near the Coastal site.

The report on *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions. The Coastal site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. The warming projected by the GCRP for the Southeast could possibly alter the character of terrestrial habitats. This could further stress terrestrial resources affected by the activities described above.

The potential cumulative impacts to terrestrial resources considering the two new reactors at the Coastal site, plus the proposed Victoria County Nuclear Station, in addition to the other activities described above, would noticeably alter terrestrial resources. These activities would remove or modify terrestrial habitats with the potential to affect important species living or migrating through the area. For the reasons discussed above, the incremental contribution of building and operating the two new reactors at the Coastal site to the cumulative impacts would be clearly noticeable.

Summary

Impacts to terrestrial ecology resources were analyzed based on the information provided by Luminant and the review team's independent review. Terrestrial resources in the areas that would be temporarily disturbed if the Coastal site were to be developed are expected to return to predominantly pre-development conditions. However, a substantial area of terrestrial habitat would be lost to permanent project structures. Therefore, the review team concludes that the cumulative impacts on terrestrial plants and wildlife, including threatened or endangered species, and wildlife habitat would be noticeable in the surrounding landscape, and therefore MODERATE. The incremental contribution of NRC-authorized activities would, be SMALL because of the limited area affected by NRC-authorized construction and operation activities. However, the incremental contribution of the overall project (including site preparation activities that are part of preconstruction) would be noticeable.

9.3.2.4 Aquatic and Wetlands Resources

Affected Environment

The Coastal site is located near the Texas Gulf Coast in the southeastern portion of Victoria County, west of Port Lavaca, south of Victoria, close to McFaddin, and near Green Lake. The site is on private property that is a working cattle ranch and is located approximately 1.5 mi west of the Guadalupe River. Approximately 65 ac of wetlands are present on the 2500-ac site (Luminant 2009a). As discussed in Section 9.3.2.2, there are several possible sources of water for the facility, including treated wastewater effluent from the City of San Antonio, water withdrawn from the nearby Victoria Barge Canal above the Lower Guadalupe Diversion Dam and Salt Water Barrier, or water withdrawn from the Calhoun Canal System, which is considered by Luminant the most likely water source. The Calhoun Canal System, managed by the Guadalupe Brazos River Authority (BRA), diverts water from the Guadalupe River above the Lower Guadalupe Diversion Dam and Salt Water Barrier (located near Tivoli about 10 mi upstream of the mouth of the Guadalupe River) and distributes it to industrial, municipal, and agricultural customers in Calhoun County through a series of irrigation canals, pump stations, and pipelines on the downstream side of the barrier (GBRA 2009). Thus, the ultimate source of cooling water for this site would be the Guadalupe River near Green Lake, and the Guadalupe River is the aquatic resource with the greatest potential to be affected by construction and operation of new reactor units at the Coastal site.

The Guadalupe River flows approximately 370 mi southeast from Hunt, Texas to its mouth at San Antonio Bay. The Coastal site is adjacent to segment 1803 of the lower Guadalupe River, an approximately 170-mi reach below the confluence with the San Marcos River. In this reach, the Guadalupe River is a freshwater stream that flows with little turbulence through the flat coastal plain (GBRA 2008). The banks of this coastal reach of the Guadalupe River are lined by pecan bottoms, and the river itself is characterized by slow-moving flow and a silty substrate (GBRA 2008). The aquatic community of the Guadalupe River and associated canals in the vicinity of the site likely includes a variety of minnows and shiners, catfish, darters, and sunfish, such as the largemouth bass (*Micropterus salmoides*), Guadalupe bass (*M. treculii*), and green sunfish (*Lepomis cyanellus*) (Hassan-Williams and Bonner 2007). Downstream the river empties into Guadalupe Bay and San Antonio Bay. This estuarine system provides essential fish habitat (EFH) as defined by the National Marine Fisheries Service for at least one life stage of the following managed species: red drum (*Sciaenops ocellatus)*, gray snapper (*Lutjanus griseus*), lane snapper (*L. synagris*), yellowtail snapper (*Ocyurus chrysurus*), Spanish mackerel (*Scomberomorus maculatus*), Gulf stone crab (*Menippe mercenaria*), brown shrimp (*Farfantepenaeus aztecus)*, pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*) (GMFMC 2004).

Important Species

No Federally listed threatened or endangered aquatic species occur in Victoria County; however, five aquatic State-listed species listed as threatened potentially occur in the county: Cagle's map turtle (*Graptemys caglei*), the black-spotted newt (*Notophthalmus meridionalis*), and three freshwater mussels, the golden orb (*Quadrula aurea*), Texas pimpleback (*Q. petrina*), and false spike mussel (*Quincuncina mitchelli*). Aquatic species with the potential to occur in Victoria County and with a State listing status or designation as a State species of concern are included in Table 9-9. Listed species are described below.

Table 9-9. State-Listed Aquatic Species and State Species of Concern Potentially Occurring in the Vicinity of the Coastal Site

Scientific Name	Common Name	State Status[a]	County[b]
	Reptile		
Graptemys caglei	Cagle's map turtle	ST	Victoria
	Amphibian		
Notophthalmus meridionalis	black-spotted newt	ST	Victoria
	Fish		
Anguilla rostrata	American eel	SSC	Victoria
	Mussels		
Quadrula aurea	golden orb	ST	Victoria
Quadrula petrina	Texas pimpleback	ST	Victoria
Quincuncina mitchelli	false spike mussel	ST	Victoria
Tritogonia verrucosa	pistolgrip	SSC	Victoria
Arcidens confragosus	rock pocketbook	SSC	Victoria
Strophitus undulates	creeper (squawfoot)	SSC	Victoria
	Insects		
Asaphomyia texensis	Texas asaphomyian tabanid fly	SSC	Victoria
Tortopus circumfluus	a mayfly	SSC	Victoria

(a) State status definitions: ST = State-listed, threatened; SSC = State species of concern.
(b) Counties listed are those in which components of the alternative would be located and where TPWD has identified the potential for occurrence of the species based on evidence such as recorded occurrences, historic ranges, field guides, staff expertise, and scientific publications.

Source: TPWD 2010e

Cagle's map turtle is endemic to the Guadalupe River system of south-central Texas. Its preferred habitat is short segments of shallow water with moderate to swift current and a substrate of cobble or gravel connected by pools with deeper water, slower current, and a substrate of mud or silt. Riffles are especially important as a source of insects on which they feed. Eggs are laid in nests in gently sloping, sandy banks within about 30 ft of the water (TPWD 2008b). Only about 7 percent of the overall population of Cagle's map turtle occurs in the lower reach of the Guadalupe River, and the southern extent of the turtle's range in the Guadalupe River is in the vicinity of Victoria (Killebrew et al. 2002), which is slightly upstream of the Coastal site. Given the distribution of Cagle's map turtle in the Guadalupe River and the low potential for riffle habitat to be present in the lower segment of the river, occurrence of this turtle in the reach adjacent to the site is unlikely. If individuals of this species were to be present in the area where the intake and/or discharge would be located, the potential for turtles to be affected by their construction or operation likely would be minimal due to the turtle's mobility and ability to avoid the area.

The black-spotted newt is an aquatic amphibian that feeds on invertebrates, inhabits wet or sometimes wet areas, such as canals, ditches, or depressions, and can aestivate underground during dry periods. Its range in Texas is within the Gulf Coastal Plain south of the San Antonio River (TPWD 2010e). The Coastal site would be located slightly north of the northern end of this current known range of the black-spotted newt; consequently, its occurrence in potentially affected habitats is unlikely.

The golden orb inhabits substrates of gravel, sand, or mud in rivers in the Guadalupe, San Antonio, and Nueces River basins; it typically is intolerant of impoundments (TPWD 2010e); it has not been recorded in the lower Guadalupe River in decades (Howells 2002). The false spike mussel, which possibly has been extirpated in Texas, probably occurred in medium to large rivers (including the Guadalupe, Brazos, Colorado, and Rio Grande River basins) and utilized substrates ranging from mud to mixtures of sand, gravel, and cobble. The Texas pimpleback inhabits substrates of mud, sand, and gravel usually in areas of slow current in medium-size streams and rivers of the Colorado and Guadalupe River basins (TPWD 2010e), though it is no longer known to survive in the Guadalupe River system (Howells 2002).

Building Impacts

The review team believes that the footprint of development on the site would be less than 2000 ac; most of the site is currently used for cattle grazing. The approximately 65 ac of wetlands on the site likely would not be affected directly by building the proposed facility but could be affected by building pipelines for cooling water access and transmission lines and their access roads (Luminant 2007).

New pipelines on new ROWs would be required to carry water from the source to the proposed facility and from the facility to the discharge structure. New transmission lines on new ROWs would be required to connect the proposed facility to an existing 345-kV transmission line approximately 2 mi to the southeast (Luminant 2007). The review team assumed that during the building of new transmission line and pipeline ROWs, new access roads also would be required. While detailed information concerning the routing of possible new transmission line ROWs is not available at this time, ROWs could cross wetlands along Kuy Creek, Smith Bayou, and Elm Bayou. Construction of any new transmission lines and pipelines would be subject to additional environmental review. The new ROW would be subjected to site-specific pre-development investigations, possibly including, but not limited to, reconnaissance to ascertain the presence or absence of Federally and State-listed species and other important species and habitats defined in NUREG-1555 or as required by Federal or State agency regulatory requirements. Little to no grading would be required for the new transmission lines due to the level terrain. Further, the ability to relocate proposed transmission tower sites laterally along the ROWs means that towers could usually be sited to avoid environmentally sensitive areas such as waterbodies and wetlands.

TCEQ requires stormwater permits for construction sites of 1 ac or more; obtaining a permit requires development and implementation of a stormwater pollution prevention plan (SWPPP) specifying the best management practices (BMPs) to be used in protecting water bodies (TCEQ 2008). Compliance with permitting requirements and associated use of BMPs to minimize or prevent stormwater impacts is expected to minimize erosion-related impacts on surface waters and wetlands. BMPs that likely would be implemented under an SWPPP include the installation and maintenance of silt fencing, the maintenance of vegetated buffer zones between waterbodies and areas undergoing development, and the diversion of runoff to sediment retention basins.

The aquatic impacts from construction of the proposed type of closed-cycle cooling system at this site likely would be similar to the impacts of such systems at other sites and would be of minor significance, involving localized and mostly temporary effects of building intake and discharge structures near the shoreline. Except for water intakes, discharge structures, and pipelines, there would be no construction within 100-yr or 500-yr floodplains. Facility construction activities would not cause substantial changes in surface water quality, hydrology, or aquatic communities. Aquatic species would be unlikely to be substantially affected by the loss of small areas of aquatic or wetland habitat potentially within the footprint of facilities that would be built for the project. Threatened species of mussels would not be expected to occur in the potentially affected habitats, and the mobility of Cagle's map turtle and the black-spotted newt likely would allow them to avoid the construction activities even if they were present in the area. Thus, construction of water intakes and discharge structures likely would have minor impacts on aquatic resources during the construction period, with the specific effects being dependent on the extent of required dredging and the waterbody affected.

Operational Impacts

Operational impacts on aquatic and wetlands ecology that may result from new nuclear units at the Coastal site include entrainment and impingement of organisms due to the cooling water intakes; thermal, chemical, and physical effects from the discharge of cooling water and other effluents; impacts related to operation/maintenance of transmission line and pipeline ROWs; and impacts from increased water use, such as higher salinities downstream. In the immediate vicinity of the site, the increased impervious surface resulting from buildings and paving could increase runoff and cause greater storm flows in nearby streams, rivers, and wetlands. Nearby water bodies and wetlands also could be affected by salt deposition from cooling tower drift, which my increase salinities and alter the aquatic communities of the affected habitats. A detailed evaluation of impacts resulting from operation of the intake and discharge and maintenance of the ROWs could be conducted due to lack of specific survey information that would have to be developed (i.e., more than reconnaissance-level information), such as the design and location of cooling water intakes and discharges at this site, and the numbers and locations of new ROWs that could be required. Consequently, the NRC review team relies upon the conclusions in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437 (NRC 1996) to inform the assessment of aquatic impacts from the operation of the cooling system and maintenance of transmission line ROWs. Additionally, designated EFH could be adversely affected as a result of these operational impacts if salinities in downstream estuaries are increased.

NUREG-1437 (NRC 1996) evaluated aquatic ecological impacts resulting from operation of existing nuclear power plants. In evaluating this alternative site, the review team assumed that a new nuclear power plant would utilize a cooling system similar to that proposed at the CPNPP site, consisting of a closed-cycle system with cooling towers. Consequently, the types of aquatic ecological impacts that would result from operation of the new nuclear units would be similar to those of existing nuclear power plants that have closed-cycle cooling systems with cooling towers. For impacts resulting from ROW maintenance, the review team assumed that construction of the proposed project at the Coastal greenfield site would require new transmission line and pipeline ROWs. However, operation and maintenance of the new ROWs after they are built would be the same as for existing ROWs elsewhere. Given these assumptions, conclusions in NUREG-1437 (NRC 1996) were considered to be appropriate to inform the review team's assessment of impacts resulting from transmission line ROW maintenance.

The aquatic impacts from operation of cooling systems for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be of minor significance for all plants that utilize closed-cycle cooling systems with cooling towers. With regard to cooling water intakes, NRC found that entrainment and impingement of fish and shellfish have not been a problem at existing facilities that use closed-cycle systems with cooling towers. Minimal impacts from intake operation would be expected if it is assumed the following conditions would apply at this site in accordance with EPA's Phase I regulations for new facilities under Section 316(b) of the Clean Water Act (CWA) (66 FR 65256): (1) a closed-cycle cooling system, (2) a maximum through-screen velocity of 0.5 ft/s at the cooling water intake, (3) an intake flow that would be less than or equal to 5 percent of the mean annual flow of the Guadalupe River at the Coastal site, and (4) location of the new intake in an area of the source waterbody away from areas with the potential for high productivity of fish or other important organisms (66 FR 65256). With regard to effluent discharges from facilities with closed-cycle cooling systems, NRC found that the thermal and water-quality effects from the relatively small volumes of blowdown water discharged did not have more than minor impacts on the aquatic ecology of the receiving waterbody (NRC 1996). Likewise, although specific survey information is not available to prepare a detailed EFH assessment, the adverse impacts on EFH are not likely to be noticeable assuming that the intake and discharge designs would be similar to those proposed for the CPNPP site.

Operation of the intake for the Coastal site could have minimal to noticeable impacts on surface water quality due to the possible need for periodic maintenance dredging at intakes. The limited dimensions of the canals in the Calhoun Canal System make it likely that substantial dredging and other modifications would be needed to maintain the operation of a water intake in the canal system. The Guadalupe River and Victoria Barge Canal appear to have adequate dimensions to provide suitable water intake sites. Effluent discharge would be directed to either the Victoria Barge Canal or Guadalupe River, with the barge canal considered more likely. Moderately high salinity in the intake water would likely constrain the discharge of cooling water and would increase the potential for cooling tower drift to increase salinities in downwind wetlands or water bodies. Increased water use by a nuclear power facility at the Coastal site may contribute to regional water shortages over the long term and increased salinity in estuarine habitats downstream due to lower freshwater inflows. This could adversely affect EFH for at least nine species that utilize San Antonio bay at various life stages; depending on the locations of the intake and discharge and on the dredging activities, such adverse impacts on EFH could range from minor to noticeable.

The potential for impacts to aquatic ecosystems from transmission line and pipeline ROW maintenance activities mainly are associated with the possibility of soil disturbance leading to erosion and sedimentation impacts in adjacent aquatic habitats, and the possibility of herbicides used to control terrestrial vegetation running off into waterbodies crossed by ROWs.

Transmission line ROW management activities (vegetation cutting and herbicide application) and related impacts to wetlands, floodplains, and associated waterbodies in transmission line ROWs have been found to be of no more than minor significance at operating nuclear power plants (NRC 1996). Assuming standard best management practices (BMPs) are followed as described in Section 5.3, the effects of these activities are expected to be similarly minor at the Coastal site with the potential exception of adverse impacts on EFH.

As discussed above, five aquatic species that are State listed as threatened have recorded occurrences in Victoria County, in which the cooling water intake and discharge and the transmission lines and pipelines would be located. Based on their ranges and habitats, these species are unlikely to occur in the areas where the intake, discharge, and ROWs potentially could be located. However, even the low rates of entrainment and impingement at the intake for a closed-cycle cooling system and the relatively small volumes of effluent discharged could be a concern if an unusually important aquatic resource such as a threatened species would be affected (NRC 1996). It is unlikely that such species or their habitats would be noticeably affected by the relatively small volumes of water withdrawn and discharged by the closed-cycle cooling system proposed for the Coastal site (NRC 1996). However, if individuals of these species were to occur in these areas, then they could be adversely affected by the operation of the intake (such as from impingement of newts or turtle hatchlings, reduced water levels, or changes in flow) or discharge (such as from physical alteration of habitat or increased water temperatures) or by maintenance dredging. Given the assumption that BMPs would be followed, these State-listed species would be unlikely to be affected by operation of transmission lines and pipelines and the maintenance of their ROWs.

Thus, the potential for operation of two new reactor units at the Coastal site to adversely affect aquatic resources, including threatened or endangered species, is expected to range from minimal to noticeable depending on the intake, discharge, and ROW locations and whether threatened or endangered species are present.

Cumulative Impacts

The impacts of building and operating two nuclear units at the Coastal site were evaluated by the review team to determine the magnitude of their contribution to cumulative impacts on aquatic and wetlands resources in the geographic area of interest. The area of interest includes the site; adjacent water bodies in the vicinity, including Guadalupe River, Victoria Barge Canal, and Calhoun Canal System; and the Guadalupe River downstream to Guadalupe Bay. Past actions that have affected aquatic resources in the area include water use for agricultural, industrial, commercial, and residential development; contribution by these land uses to increased stormwater runoff carrying sediment, chemicals, and nutrients to water bodies and wetlands; and discharge of sewage and other effluents. Possible future actions that could affect aquatic resources in the geographic area of interest include development of the proposed Victoria County Nuclear Station (VCNS) within 5 mi northwest of the Coastal site, associated facilities, and construction of water and/or wastewater treatment and distribution facilities in conjunction with future residential and commercial development (Table 9-7).

The TSDC projects that the population in a seven-county area surrounding the Coastal site (including Calhoun, DeWitt, Goliad, Jackson, Lavaca, Refugio, and Victoria Counties) will increase by 10.7 percent by the year 2040 (TSDC 2009). Future urbanization in the geographic area of interest could contribute to decreases in undeveloped land, including wetlands, as well as increased demand for water and reduced water quality. These impacts also would result from the development of a nuclear power plant at the Coastal site in combination with the proposed VCNS. The potential cumulative impacts on aquatic resources from the two new reactors proposed for the Coastal site in addition to the proposed Victoria County Nuclear

Station nearby and the other development activities described above would be likely to noticeably alter aquatic and wetlands resources in the geographic area of interest. Increased use of freshwater by these facilities and activities likely would reduce freshwater input to the downstream estuaries of Guadalupe and San Antonio Bays, resulting in increased salinities in the estuaries. A noticeable increase in salinity could adversely affect EFH for at least nine managed species of fish and shellfish (GMFMC 2004) and habitat for estuarine species such as the opossum pipefish (*Microphis brachyurus*), which is State-listed as threatened, and the American eel (*Anguilla rostrata*), a State species of concern (TPWD 2009b). Changes in estuarine salinities could affect ecological communities in the bay area, including those in sensitive areas such as Guadalupe Delta Wildlife Management Area, Matagorda Island WMA, and Aransas National Wildlife Refuge.

In addition to direct effects from anthropogenic activities, GCC could affect aquatic communities. The report *Global Climate Change Impacts in the United States* (Karl et al. 2009), from the GCRP, summarizes the projected impacts of future climate changes in the United States. The report divides the United States into nine regions, and the Coastal site is located in the southwestern part of the Southeast region and is also in the Coastal region. The GCRP climate models for this region project continued warming in all seasons and an increase of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. The warming projected for the Southeast region could result in decreased water availability due to increased temperatures and longer periods between rainfall events, which would affect the region's aquatic ecosystems. In addition, the GCRP projects increases in sea level, storm surges, coastal storm intensity, and increased nonpoint source pollution from runoff during such storms in the geographic area of interest, resulting in inundation and loss of coastal wetlands and other low-lying areas.

Such changes could alter salinity, change freshwater inflow, and reduce dissolved oxygen, which could directly affect aquatic habitat in the Guadalupe River and San Antonio Bay. Rising sea levels due to GCC could alter water levels in the lower Guadalupe River and San Antonio Bay and affect the mixing of freshwater and estuarine waters (Montagna et al. 1995; Nielsen-Gammon 1995; Karl et al. 2009). The effects of rising sea level likely would add to the effects of increased use of freshwater upstream in increasing estuarine salinities. Changes in water quality downstream of the Coastal site could create areas that are hypoxic (low in dissolved oxygen) and lead to further stress on aquatic communities (Montagna et al. 1995). These stressors would result in shifts in species ranges, habitats, and migratory behaviors and also alter ecosystem processes (Karl et al. 2009).

Summary

Cumulative impacts on aquatic and wetlands resources were estimated based on the information provided by Luminant and the review team's independent evaluation. Past, present, and future activities in the geographic area of interest could contribute to cumulative effects. Future development of industries that compete for water in the region as well as the management of water budgets across the South Central Texas Regional Water Planning Area by the GBRA likely would affect aquatic resources in the lower Guadalupe River. The building and maintenance of transmission line and pipeline ROWs for the proposed new nuclear units at the Coastal site would have minimal effects on aquatic species in the area and would be a minor contribution to cumulative impacts on aquatic communities from other projects in the geographic area of interest. Direct and indirect anthropogenic and natural environmental stressors, including other energy projects, in the geographic area of interest would cumulatively affect aquatic communities and may noticeably alter important attributes, such as species diversity, abundance, and distributions; habitat availability, and ecosystem processes.

The review team concludes that the impacts on aquatic resources from building two new nuclear units at the Coastal site would be noticeable but not destabilizing to aquatic and wetlands resources. Based on the information provided by Luminant and the review team's independent evaluation, the review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future activities to aquatic and wetlands resources in the geographic area of interest would be MODERATE. The incremental contribution of building and operating two new reactors at the Coastal site to cumulative impacts on aquatic and wetlands resources in the geographic area of interest would range from minimal to noticeable.

9.3.2.5 Socioeconomics

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact socioeconomics, including the other Federal and non-Federal projects listed in Table 9-8. For the analysis of socioeconomic impacts at the Coastal site, the geographic area of interest is the 12-county area around the Coastal site (Table 9-10) that was evaluated in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007). In evaluating the socioeconomic impacts of site development and operation at the Coastal site, the review team used the population and labor force data provided in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007).

Table 9-10. Population and Labor Force in Victoria County, Texas, and the Other Counties Surrounding the Coastal Site

County	Total Population 2006	Projected Total Population 2010	Total Labor Force 2000	Total Construction Labor Force 2000
Victoria	85,648	87,280	38,464	3311
Calhoun	20,606	20,560	8246	1246
Jackson	14,339	14,280	6034	474
Lavaca	18,925	18,640	8677	763
De Witt	20,507	21,020	7893	629
Goliad	7102	7280	2949	357
Wharton	41,475	41,641	17,563	1816
Nueces	321,457	326,600	131,718	16,484
Refugio	7639	7460	3239	272
Bee	32,873	33,400	9944	690
Aransas	24,831	26,544	8578	1468
San Patricio	69,209	71,350	24,212	2578
Total	**649,932**	**676,055**	**267,787**	**30,088**

Source: Luminant 2007

The Coastal site is located in Victoria County, Texas, approximately 7 mi east of U.S. Highway 77, 17 mi south of the city of Victoria, and 5 mi east of the unincorporated community of McFaddin. Section 9.3.2.1 contains a description of the Coastal site.

As indicated in Table 9-10, Victoria County and the 11 other counties surrounding the Coastal site have a combined 2010 population of 676,055, a combined 2000 labor force of 267,787, and a combined 2000 construction labor force of 30,088. Thus, the Coastal site has a relatively smaller labor pool from which to draw construction and operations, which would result in more in-migrating workers. More in-migrating workers would result in larger socioeconomic impacts, especially to housing and public services.

The review team concludes that building and operating a new two-unit nuclear power plant at the Coastal site would have MODERATE to LARGE socioeconomic impacts in Victoria County and the surrounding counties for three reasons. First, the Coastal site is a greenfield site and significant road, rail, and infrastructure development would be required in the surrounding area to access and use it. Second, the Coastal site has a relatively small labor force from which to draw construction and operations workers, so large numbers of workers would need to in-migrate. Third, the Coastal site is in a rural area that likely would not have the existing housing, infrastructure, and public services to support the in-migration of a large number of workers and their families.

9.3.2.6 Environmental Justice

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact socioeconomics, including the other Federal and non-Federal projects listed in Table 9-8. For the analysis of environmental justice impacts at the Coastal site, the geographic area of interest is the 12-county area around the Coastal site (Table 9-11) that was evaluated in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007). In evaluating the environmental justice impacts of site development and operation at the Coastal site, the review team used the minority and low-income data provided in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007).

Table 9-11. Minority and Low-Income Percentages in Victoria County, Texas, and the Other Counties Surrounding the Coastal Site

County	Total Population 2006	Percent Non-minority[(a)]	Percent Minority[(b)]	Percent Low-income
Victoria	85,648	51.1	48.9	15.5
Calhoun	20,606	49.4	50.6	16.3
Jackson	14,339	64.9	35.1	14.1
Lavaca	18,925	79.0	21.0	13.3
De Witt	20,507	59.8	40.2	19.0
Goliad	7102	58.7	41.3	15.2
Wharton	41,475	49.5	50.5	15.7
Nueces	321,457	34.7	65.3	19.1
Refugio	7639	47.9	52.1	15.9
Bee	32,873	55.7	44.3	24.6
Aransas	24,831	72.0	28.0	18.2
San Patricio	69,209	44.2	55.8	17.9
Total	**649,932**	**55.6**	**44.4**	**17.1**

(a) Non-minority = White persons, not Hispanic.
(b) Minority = Black persons, American Indian and Alaska Native persons, Asian persons, Native Hawaiian and Other Pacific Islander persons, and Hispanic persons.

Sources: Luminant 2007; USCB 2009b

As indicated in Table 9-11, Victoria County and the 11 other counties surrounding the Coastal site have a combined minority percentage of 44.4 percent. This percentage of minority residents is much lower than that for the State of Texas (61.1 percent) (Table 2-27). Thus, when compared to the State of Texas, the Coastal site has a relatively small minority percentage for purposes of environmental justice analysis.

In terms of low-income residents, the 12 counties surrounding the Coastal site have a combined low-income percentage of 17.1 percent. This percentage of low-income residents is slightly higher than that for the State of Texas (14.0 percent) (Table 2-27). However, when compared to the State of Texas, the Coastal site does not have a significantly higher low-income percentage for purposes of environmental justice analysis.

In Section 9.3.2.5, the review team concluded that building and operating a new two-unit nuclear power plant at the Coastal site would have MODERATE to LARGE socioeconomic impacts in Victoria County and the surrounding counties. Based on that conclusion, the review team concludes that the socioeconomic impacts of building and operating at the Coastal site could have MODERATE environmental justice impacts by disproportionately and adversely affecting low-income populations, especially in the area of housing price and availability.

9.3.2.7 Historic and Cultural Resources

The following impact analysis includes impacts from building and operating two new nuclear power plants at the Coastal site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact historic and cultural resources, including Federal and non-Federal projects listed in Table 9-7. For the analysis of historic and cultural impacts at the Coastal site, the geographic area of interest is considered to be the Area of Potential Effect (APE) that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as the additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have a particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EIS, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the Coastal site the following information was used:

- Luminant ER (Luminant 2009a);
- Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4, Luminant Nuclear Power Plant Siting Report (Luminant 2007)
- Texas Historical Commission's Texas Archaeological Sites Atlas (THC 2010); and,
- NRC Alternative Sites Visit, February 2009.

The Coastal site is a greenfield site located in Victoria County in southeastern Texas on the Coastal Plain. Historically, the site has been used for agricultural purposes. The current major industries in Victoria County are oil and agriculture.

The siting report provided by Luminant indicated that there were 50 properties listed in the NRHP located in Victoria County, Texas (Luminant 2007). These sites, except for one NRHP eligible archaeological site (location is undisclosed), are located in the City of Victoria, 16 mi north of the site. Additionally, artifacts from the Paleo-Indian period and paleontological resources have been recorded in Victoria County.

According to the Texas Historical Commission's Texas Archaeological Sites Atlas, there are no National Register Properties or National Register Districts located within the APE (THC 2010). There are, however, two recorded Texas Historical Landmarks and one undesignated site located nearby in the city of McFaddin. The project has the potential to affect resources through visual impacts from buildings and transmission lines. Should such properties be subsequently listed on the National Register, then these impacts may result in significant alterations to the visual landscape within the geographic area of interest.

Historic and cultural resource impacts for a new plant located at the Coastal site would likely be similar to the impacts for a new plant at the CPNPP site as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any portion of the property that has not been previously surveyed at the Coastal site. Other lands that may be acquired to support the plant would also likely require a survey to identify potential historic and archaeological resources, and identification of mitigative measures to offset adverse effects of ground disturbing activities. These studies would likely be needed for areas of potential disturbance at the Coastal site, offsite affected areas, such as mining and waste disposal sites, and along associated corridors where new construction would occur, for example, roads and pipeline corridors. The types of historic and cultural resource impacts resulting from operation of new nuclear units would likely be similar to those of existing nuclear power plants.

There are no existing transmission corridors connecting directly to the Coastal site (Luminant 2007). However, there is a 345-kV transmission line located approximately 2-mi southeast of the site. A new transmission line corridor would be needed to connect the Coastal site to this line. There are no listed NRHP or known historic or prehistoric sites in the area where the transmission line would be routed. In the event that the Coastal site was chosen for the proposed project, the review team assumes that the transmission service provider for this region would conduct its transmission line related cultural resource surveys and procedures similar to those performed by Oncor for the CPNPP site in section 4.6 of this EIS. In addition, visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest.

One project listed in Table 9-7 has the potential to contribute to cumulative impacts to historic and cultural resources. The Victoria County Nuclear Station Early Site Permit project is located approximately 5 mi from the coastal site and would have impacts similar to those associated with building and operating new nuclear units at the Coastal site. Additionally, the TSDC predicts the average population growth rate will be 10.7 percent from 2010 to 2040 for the 7 counties surround the coastal site (TSDC 2009). The seven counties included Calhoun, DeWitt, Goliad, Jackson, Lavaca, Refugio, and Victoria counties. The average population growth rate could result in an increase in urbanization in the area. Urbanization includes increases in residential, commercial, industrial, and infrastructure development that could encroach on historic cultural resources near the geographic area of interest.

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the reconnaissance level information the review team concludes that the cumulative impacts on historic and cultural resources of building and operating new nuclear units on the Coastal site and from other projects and urbanization would be SMALL. This impact level determination reflects no known cultural resources that could be affected. However, if the Coastal site were to be developed, cultural resource surveys could reveal important historic and archaeological resources that might result in greater cumulative impacts.

9.3.2.8 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact air quality, including other Federal and non-Federal projects listed in Table 9-7. The geographic area of interest for the Coastal site is Victoria County.

The emissions related to building and operating a nuclear power plant at the Coastal site alternative would be similar to those associated with the proposed location at CPNPP. The air quality attainment status for Victoria County as set forth in 40 CFR 81.344 reflects the effects of past and present emissions from all pollutant sources in the region. Victoria County is designated by the TCEQ as a “Near Non-Attainment Area” for ozone (TCEQ 2009). Victoria County has previously been designated as non-attainment for ozone, and is subject to an Eight-Hour Ozone Maintenance Plan adopted in March 2007 (TCEQ 2007).

The atmospheric emissions related to building and operating a nuclear power plant at the CPNPP site in Somervell County, Texas, are described in Chapters 4 and 5. The criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of the criteria pollutants at the CPNPP site were evaluated and also determined to be SMALL.

Reflecting on the specific industrial projects listed in Table 9-7, the most significant are the Early Site Permit application for the proposed Victoria County Nuclear Station, the Calhoun Liquified Natural Gas Terminal, and the E.S. Joslin Power Plant. Other industrial projects listed in Table 9-7 would have *de minimis* impacts. Although these projects would be subject to institutional controls, Victoria County is already designated as a Near Non-Attainment Area for ozone due to the combined effect of industrial projects and other general air emission sources.

The air quality impact of the Coastal site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. Although the Coastal site development and the specific industrial projects listed in Table 9-7 would be subject to institutional controls, the current designation of Victoria County as a Near Non-Attainment Area for ozone suggests that site development, in combination with other air emissions sources, could potentially result in degradation of air quality within the region.

Releases from operation of two units at the Coastal site would be intermittent and made at low levels with little or no vertical velocity. The air quality impacts of other general emissions sources in the area are included in the baseline air quality status. The cumulative impacts from emissions from the Coastal site and the aforementioned sources could be noticeable but not destabilizing. Should the Coastal site be developed, additional air permits, a conformity review, and more stringent emissions limits would likely be required for operations.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.5. The impacts of the emissions are not sensitive to location of the source. Consequently, the discussion in Section 7.5 is applicable to a nuclear power plant located at the Coastal site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions of the project at the Coastal site.

Cumulative impacts to air quality resources are estimated based on the information provided by Luminant and the review team’s independent evaluation. Other past, present and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the Coastal site and other projects could be noticeable but not destabilizing, principally as a result of the existing emissions sources that have resulted in designation of Victoria County as a Near Non-Attainment Area for ozone. The national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions from the Coastal site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be MODERATE for criteria pollutants and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the Coastal site would be insignificant for both criteria pollutants and GHG emissions.

9.3.2.9 Nonradiological Health Impacts

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact nonradiological health, including other Federal and non-Federal projects listed in Table 9-7. This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Coastal site in Victoria County, Texas. The Coastal site is a greenfield site not currently owned by Luminant. Additionally, the Coastal site would not require the use of a BDTF to treat blowdown water discharges.

For the analysis of nonradiological health impacts at the Coastal alternative site, the geographic area of interest is considered to include projects within a 5-mi radius from the site's center based on the localized nature of the impacts. For impacts associated with transmission lines, the geographic area of interest in the transmission line corridor.

The building activities that have the potential to impact the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the transport of construction materials and personnel to and from the sites. The operation-related activities that have the potential to impact the health of members of the public and workers includes exposure to etiological agents, noise, EMFs, and impacts from the transport of workers to and from the site.

Building Impacts

Nonradiological health impacts to construction workers and members of the public from building two nuclear units at the Coastal site would be similar to those evaluated in Section 4.8 for the CPNPP site. The impacts include noise, vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. Applicable Federal and State regulations on air quality and noise would be complied with during the site preparations and building phase. The incidence of construction worker accidents would not be expected to be significantly different from the incidence of accidents estimated for the CPNPP site. Some modifications to the transportation routes immediately near the Coastal site may be warranted to facilitate traffic flow. The Coastal site is located in a rural area, and nonradiological health impacts from building would likely be negligible on the surrounding populations.

Exelon Generation submitted an application to the NRC for a proposed site of a nuclear station in Victoria County within 5 mi of the Coastal site (Exelon 2010b). If so, there would be the potential for traffic impacts in the vicinity of the Coastal site include traffic associated with the proposed Exelon station. Interactions between the traffic destined for the Coastal site nuclear power plant project and the proposed Exelon station would likely increase the nonradiological health effects from traffic accidents in the vicinity of the Coastal site. The additional injuries and fatalities from traffic accidents involving transportation of materials and personnel for building of a new nuclear power plant at the Coastal site would be similar to those evaluated in Section 4.8.3 for the CPNPP site and would represent a small fraction of the total traffic fatalities in Victoria County. If Corpus Christi is included in the construction workforce there would be a 6.7 percent increase in the available nearby workforce, if not the number would be 14.7 percent (Luminant 2009a). In either case, the workforce increase represents a minor addition to the general area.

There are no past or present construction projects in the geographic area of interest that have similarly impacted the public and workers from nonradiological resources. Proposed future actions that would impact nonradiological health in a similar way to development at the Coastal site within the geographical area of interest include the proposed Exelon nuclear station (Exelon 2010b) and construction of the I-69 Trans-Texas Interstate Corridor, which could pass within 5 mi of the site.

Operational Impacts

Nonradiological health impacts from operation of two nuclear units on occupational health and members of the public at the Coastal site would be similar to those evaluated in Section 5.8. Occupational health impacts to workers (e.g., falls, electric shock or exposure to other hazards) at the coastal site would likely be similar to those evaluated for workers at the new units at the CPNPP site.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. Luminant's current safety and health programs promote safe work practices and respond to occupational injuries and illnesses. The same or a similar program would be expected for new units at the Coastal site. Health impacts to workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable Occupational Safety and Health Administration (OSHA) regulations and would be minimal.

Exposure to the public from water-borne etiological agents at the Coastal site would be similar to the types of exposures evaluated in Section 5.8.1, and the operation of the new units at the alternative sites would not likely lead to an increase in water-borne diseases in the vicinity. Noise and EMF exposure would be monitored and controlled in accordance with applicable OSHA regulations. Effects of EMF on human health would be controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and adherence to the standards for transmission systems regulated by the PUCT. Nonradiological impacts of traffic associated with the operations workforce would be less than the impacts during building. Mitigation measures taken during building to improve traffic flow would also minimize impacts during operation of the two new units.

There are no past and present activities in the geographic areas of interest that would have nonradiological impacts to the public or workers similar to those discussed for the Coastal site. The only significant proposed operation in the area of interest is the Victoria County Nuclear Station. These proposed transmission line systems, and future growth and urbanization would have nonradiological impacts to the public and workers, and these impacts would be similar to those described for the proposed two new nuclear units at the Coastal site.

The review team is also aware of the potential climate changes that could affect human health; a recent compilation of the state of the knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in any reservoir that would be used. The review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of water-borne diseases.

Summary

Based on the information provided by Luminant and the review team's independent evaluation, the review team expects that nonradiological health impacts from building and operation of two new units at the Coastal alternative site would be similar to the impacts evaluated for the CPNPP site. These impacts would be localized and managed through adherence to existing regulatory requirements. The review team concludes, therefore, that cumulative impacts would be SMALL.

9.3.2.10 Radiological Health Impacts of Normal Operations

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact radiological health, including other Federal and non-Federal projects listed in Table 9-7 within the geographical area of interest. As described in Section 9.3.2, the Coastal site is an undeveloped site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the Coastal site. In addition, an application for an early site permit for a new nuclear power plant at Victoria County site has been submitted to the NRC. Finally, there are likely to be hospitals and industrial facilities within 50 mi of the Coastal site that use radioactive materials.

The radiological impacts of building and operating the proposed US-APWR units at the Coastal site include doses from direct radiation, and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. These impacts are expected to be similar to those estimated for the CPNPP site.

The radiological impacts of the other operating nuclear power plants listed above also include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring programs (REMP) conducted around these plants. The proposed plants at the Victoria County site would also result in radiological impacts from direct radiation and liquid and gaseous radioactive effluents. The NRC staff expects that these pathways would result in low doses to people and biota offsite that would be well below regulatory limits. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive materials would be an insignificant contribution to the cumulative impact around the Coastal site. This conclusion is based on data from REMPs conducted around currently operating nuclear power plants.

Based on the information provided by Luminant and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the proposed Mitsubishi Heavy Industries, Ltd. (MHI) US-APWR units and other existing and planned projects and actions in the geographic area of interest around the Coastal site would be SMALL.

9.3.2.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the Coastal alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact radiological health from postulated accidents, including other Federal and non-Federal projects and those projects listed in Table 9-7 within the geographic area of interest. As described in Section 9.3.2, the Coastal site is a greenfield site near McFaddin, Texas. There are currently no nuclear facilities on the site. The geographic area of interest considers existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Coastal site. Table 9-12 summarizes the nearby nuclear facilities.

Table 9-12. Nearby Nuclear Projects/Facilities Considered in the Cumulative Analysis at the Coastal Site

Project Name	Summary of Project	Location	Status
Energy Projects			
Victoria County Nuclear Station	One or more large-scale nuclear power reactors	Within 5 mi of the Coastal site	Proposed. Exelon Generation submitted an application to the NRC for an Early Site Permit on March 25, 2010.
South Texas Project	Two large scale nuclear reactors with two additional reactors proposed	About 60 mi east	South Texas Project Units 1 and 2 – currently operating. South Texas Project Units 3 and 4 – STP Nuclear Operating Company submitted to obtain a combined license for two Advanced Boiling Water Reactors designated as South Texas Project, Units 3 and 4 on September 20, 2007.

Existing facilities potentially affecting radiological accident risk within this geographic area of interest are the existing South Texas Project Units 1 and 2, the proposed South Texas Project Units 3 and 4, and the proposed Exelon Victoria County Nuclear Station. No other reactors have been proposed within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design basis accidents (DBAs) at the CPNPP site would be minimal for US-APWR DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The US-APWR design is independent of site conditions and the meteorology of the Coastal and CPNPP sites are similar. Therefore, the NRC staff concludes that the environmental consequences of DBAs at the Coastal site would be minimal. Because the meteorology, population distribution, and land use for the Coastal alternative site are expected to be similar to the proposed CPNPP site, risks from a severe accident for a US-APWR reactor located at the Coastal alternative site are expected to be similar to those analyzed for the proposed CPNPP site. These risks for the proposed CPNPP site are presented in Table 5-23 and Table 5-24 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing nuclear power plants within the geographic area of interest, which are South Texas Project Units 1 and 2, the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR 51, Appendix B, Table B-1). Because of the NRC's safety review criteria, it is expected that risks for any new reactors at the South Texas Project and the Exelon Victoria County site would be well below risks for current-generation reactors and meet the Commission's safety goals. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Coastal alternative site would be SMALL.

9.3.3 The Pineland Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Pineland site in San Augustine County, Texas. The Pineland site is located on the northern shore of the Sam Rayburn Reservoir approximately 5 mi south of Pineland, Texas. The site is a greenfield site not currently owned by Luminant.

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if implemented at the Pineland site, and other actions in the same geographical area were considered. This assessment includes the impacts of NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Pineland site. Other actions and projects considered in this cumulative analysis are described in Table 9-13.

Table 9-13. Projects and Other Actions Considered in the Cumulative Analysis at the Pineland Site

Project Name	Summary of Project/Activity	Location	Status
Energy Projects			
Sam Rayburn Dam	Hydroelectric power generation of up to 118,000 kW annually	About 10 mi southwest, on Sam Rayburn Reservoir	Operational.[a]
Transportation Projects			
Highway improvements to U.S. 96	$6.2 million repaving and infrastructure improvements funded by the Texas Department of Transportation under the American Recovery and Reinvestment Act	Within 5 mi to east	Proposed.[b]
Highway improvements to U.S. 59	$1.3 million repaving and infrastructure improvements funded by the Texas Department of Transportation under the American Recovery and Reinvestment Act	25 mi north	Less than 50 percent complete.[c]
I-69 Trans-Texas Corridor	New interstate corridor connecting Texarkana/Shreveport to Mexico (possibly the Rio Grande Valley or Laredo)	Section D of corridor could come within 40 mi northwest	Proposed.[d]

Table 9-13. (contd)

Project Name	Summary of Project/Activity	Location	Status
Parks and Other Recreation			
Sam Rayburn Reservoir	A 114,500 ac impoundment of the Angelina River. Provides recreational opportunities, including over 300 fishing tournaments annually	Adjacent to and surrounding the site	Operational.[(a)]
Sam Rayburn Reservoir	A 114,500 ac impoundment of the Angelina River. Provides recreational opportunities, including over 300 fishing tournaments annually	Adjacent to and surrounding the site	Operational.[(a)]
San Augustine Park	A highly developed campground managed by USACE for public recreation with 100 campsites with water and electricity. Also contains three waterborne restroom/shower buildings, a group shelter, a trailer dump station, a playground, a designated swimming area, a courtesy dock, an interpretive trail, two volleyball courts, a basketball court, a horseshoe court, and a boat ramp with four launching lanes	Within 3 mi to northwest	Operational.[(e)]
Other parks, forests, and reserves	Numerous State and National parks, forests, reserves, and other recreational areas are located within a 50-mi region	Throughout 50-mi region	Parks are currently being managed by National, State, and/or local agencies.
Other Actions/Projects			
City of Pineland Sewer System Replacement	Infrastructure improvements funded by the U.S. Department of Housing and Urban Development under the American Recovery and Reinvestment Act	5 mi northeast	Proposed.[(f)]
Future Urbanization	Building of housing units and associated commercial buildings; roads, bridges, and rail; building of water- and/or wastewater- treatment and distribution facilities and associated pipelines, as described in local land use planning documents	Throughout region	Building would occur in the future, as described in local land use planning documents.
Existing residential developments on the peninsula in Sam Rayburn Reservoir	Construction of residential structures and supporting utilities and infrastructure	As close as 1.5 mi to site	Possible future actions.

Table 9-13. (contd)

Project Name	Summary of Project/Activity	Location	Status
Various hospitals and industries that use radioactive materials	Medical and other isotopes	Within 50 mi	Operational in nearby cities and towns.

(a) Source: USACE 2010
(b) Source: RATB 2010e
(c) Source: RATB 2010b
(d) Source: TxDOT 2010
(e) Source: USACE 2009
(f) Source: RATB 2010b

The CPNPP site is approximately 230 mi from the Pineland site and was therefore not included in this analysis. The only other nuclear power plant currently operating in Texas is the South Texas Project, near Bay City, Texas. The South Texas Project plant is approximately 200 mi southwest of the Pineland site and is therefore also not included in this analysis.

9.3.3.1 Land Use

The Pineland site is located on a peninsula abutting the Sam Rayburn Reservoir in San Augustine and Sabine Counties in east Texas. The site is near the border with Jasper County. The site is located approximately 4 mi west of U.S. Highway 96 and approximately 5 mi south of the Town of Pineland. The site covers about 3800 ac and is managed for timber production. The site is accessed via a gravel road, and no rail or barge access is available in the vicinity.

The greenfield site is privately owned and covered mostly by pine forest managed for timber production. There are no mineral leases or pipelines on the site. Based on data from the National Wetlands Inventory, Luminant estimates there are approximately 214 ac of wetlands are located on the site (Luminant 2009a). No zoning ordinances restrict land use on the site. The site is outside the 100-yr floodplain (Luminant 2009a).

Sam Rayburn Reservoir is owned and operated by the U.S. Army Corps of Engineers (USACE). The USACE also controls an easement of approximately 200 ft from the mean high water line around the shoreline of the reservoir in addition to other recreational and operational lands. The USACE operates a campground, San Augustine Park, located approximately 0.6 mi west of the Pineland site. Two residential areas are located on the peninsula adjacent to the site. One of these areas consists of moderately priced homes covering an area of approximately 170 ac; the other area covers roughly 180 ac and is currently under development. Access to both of these residential areas is provided by the single gravel road that runs down the spine of the peninsula and transects the potential nuclear power plant site.

Luminant estimates that less than half of the 3800-ac site would likely be disturbed for building and operating the nuclear power plant. However, even if the entire site were closed to timber production, the impact would be minimal because of the large amount of remaining timberlands in the surrounding area.

Building and operating a nuclear power plant would noticeably affect recreational use of Sam Rayburn Reservoir and surrounding areas. During daylight hours, the heavy evergreen timber cover on remaining on and adjoining the site would help hide the facility from the view of recreation users on the lake and surrounding lands. However, noise associated with building and operating the power plant would likely be noticeable in nearby recreational areas, such as

San Augustine Park. In addition, nighttime security and safety lighting of the power plant would also likely be visible from these sensitive surrounding areas.

Access to residential areas located on the same peninsula as the proposed new units would likely be significantly disrupted while the project is being built. Construction traffic would almost certainly rely on the single road providing access to the peninsula, and the location of the road would likely have to be changed. Access to the peninsula could improve compared to current conditions during project operations because the access road would be paved at least to the location of the power plant. However, the residential areas would likely be exposed to some noise and light pollution from the facility.

At least one transmission corridor would be required to connect a nuclear plant at the Pineland site to the ERCOT grid. The closest existing 345 kV transmission line is located approximately 45 mi northwest of the site. A transmission line through this area would cross predominantly forested and agricultural areas. The line would have the potential to cross and impact portions of the San Angelina National Forest. Because detailed information concerning the routing of the possible new transmission line corridors is not known at this time, a complete evaluation of potential land-use impacts cannot be made. Nevertheless, based on the available information, the review team estimates that construction of one or more transmission lines could have significant impacts on land use including land use within the San Angelina National Forest. The selection of a final transmission line route would be subject to environmental review and approval by PUCT.

Cumulative Impacts

The geographic area of interest for consideration of land-use impacts includes San Augustine, Sabine, and Jasper Counties. The area of interest is located at the border between the Redlands and east Texas Timberland physiographic regions, characterized by gently rolling to hilly terrain that is naturally covered by pines interspersed with hardwoods and native grasses. Direct and indirect land use impacts of building two nuclear power generating units at the Pineland site would be largely confined to this area.

Historically, land in the geographic area of interest has been used primarily for timber production and agriculture. Major changes in the use of land occurred first in the 1930s as land was purchased for the Sabine and Angelina National Forests, and then in the 1960s with the impoundment of the Sam Rayburn and Toledo Bend Reservoirs. Approximately 185,200 ac of the two national forests are located within the area of interest. The reservoirs cover approximately 335,000 ac, of which roughly one-half is in the three-county area. These changes reinforced the use of land for timber production and also opened up the area for recreation use. Currently, the primary land uses in the area include agriculture (cattle, dairy products, poultry, grain, and timber), manufacturing (agricultural products, building products, and industrial products), and public forests and parks (TSHA 2010).

Other projects and actions that could contribute to cumulative impacts on land use in the area of interest include highway improvements proposed for U.S. Highway 96 and future urbanization and GCC. The proposed highway improvements are scheduled to be completed before building would start on the nuclear power plant, so cumulative land use impacts are expected to be negligible.

The TSDC projects that the population in a six-county area surrounding the CPNPP site (including Angelina, Jasper, Nacogdoches, Sabine, San Augustine, and Shelby Counties) will increase by 14.5 percent by the year 2040 (TSDC 2009). Future urbanization in the review area could contribute to additional decreases in grazing lands, cultivated lands, forests, and wetlands. Urbanization in the vicinity of the Pineland site could reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat. However, the level of growth projected by TSDC is relatively low and therefore, capable of only relatively low land-use impacts.

The report on *Global Climate Change Impacts in the United States*, provided by the, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions. The Pineland site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase in of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. The GCRP states that the warming projected for the Southeast could result in a potential reduction in crop yields and livestock productivity, which may change portions of agricultural and ranching land uses in the area of interest.

Based on information provided by Luminant and the review team's independent review, the review team concludes that the cumulative land-use impacts of constructing and operating two new nuclear generating units at the Pinelands site would be MODERATE. This conclusion reflects the substantial amount of land (up to 1900 ac onsite plus additional offsite land for roads and a railroad spur) that would be disturbed for the proposed project, access disruption and noise and light pollution experienced by nearby residential and recreational areas and the possibility of having to construct a transmission line across the San Angelina National Forest. Because some of the noise and lighting impacts to nearby residential and recreational land uses would be associated with construction of nuclear safety-related structures, NRC-authorized construction and operation of two new nuclear units at the Pinelands site would be a substantial contributor to the MODERATE impact.

9.3.3.2 Water Use and Quality

The Pineland site is located on a peninsula on the northern shore of the Sam Rayburn Reservoir near Pineland in eastern Texas. The site is in the East Texas Regional Water Planning Area (Region I of the Texas State Water Plan) and within the territorial jurisdiction of the Angelina & Neches River Authority. For this analysis, the geographic area of primary interest is the immediate site vicinity and the Sam Rayburn Reservoir, but the entire East Texas Regional Water Planning Area is also considered in the analysis. This is the ROI because it encompasses the water resources potentially affected by the proposed project if it were to be located at the Pineland site.

The principal surface water feature related to the Pineland site is the Sam Rayburn Reservoir, a USACE water project on the Angelina River, built and operated in cooperation with the Lower Neches Valley Authority, which is based in Beaumont, Texas. The 114,500-ac reservoir, which has a maximum depth of 90 ft and a watershed area of about 3449 mi^2, was completed in 1965 for purposes that include flood control, hydroelectric power, and water supply. The reservoir also is used for recreation, including fishing. It has a storage capacity of 2,898,300 ac-ft and a firm (dependable) yield of 820,000 ac-ft/yr (TWDB 2007). The Lower Neches Valley Authority holds water rights to the entire firm yield of the reservoir (LNVA 2010). The City of Lufkin holds rights to 43,000 ac-ft annually, but uses groundwater for its public water supply (East Texas Water Planning Group 2010).

Total water supply in the 20-county East Texas Regional Water Planning Area as of the year 2060 is estimated at about 3 million ac-ft per year in 2060, with about 85 percent from surface-water sources and 15 percent from groundwater (East Texas Water Planning Group 2010). Regional water demand is estimated to be 875,189 ac-ft/yr in 2010, increasing to 1,405,971 ac-ft/yr in 2060 (East Texas Water Planning Group 2010).

Soil on the peninsula is sandy, derived from local bedrock. The peninsula is drained by several small streams that enter the reservoir. These streams are assumed to have associated floodplains. No wetlands have been identified on the peninsula.

Water quality data for Sam Rayburn reservoir indicate good natural water quality, including very low dissolved solids concentrations and high water clarity. Samples collected near the Pineland site between 1967 and 1999 had chloride values less than 25 mg/L and measurements of specific conductance that were typically less than 200 μS/cm (USGS 2010a, USGS 2010b), corresponding to very low levels of dissolved solids. Secchi disk readings during the 1990s ranged from 1.3 to 2.7 m, which corresponds to very clear water (USGS). The reservoir water appeared relatively clear during the review team visit to the site in 2009. TCEQ-designated uses of the reservoir are for contact recreation, high aquatic life use, and public water supply. The reservoir fully supports the designations for recreation and water supply. However, it is classified as having impaired water quality because several areas of the reservoir do not fully support the aquatic life designation due to water-quality limitations, including low dissolved oxygen concentrations in several areas, high concentrations of nutrients in several areas, and elevated concentrations of dissolved aluminum in one 5120-ac area (Angelina & Neches River Authority 2010). Septic systems and poultry production operations around the reservoir and in its watershed are among the possible contributors to these water quality concerns (TetraTech 2003). Also, 29 facilities discharge a total of about 22.5 million gpd of wastewater into the reservoir and tributary streams under State-issued discharge permits (Angelina & Neches River Authority 2010).

The uppermost aquifer in the immediate site area is the Yegua-Jackson aquifer, which is a minor contributor to regional water supply (TWDB 2007). It has limited geographic extent, but produces good quality water in a limited area (East Texas Water Planning Group 2010). Groundwater is an important resource in other parts of the East Texas Regional Water Planning Area. Major aquifers in this region are the Carrizo-Wilcox aquifer in the upper basin (north of the Pineland site) and the Gulf Coast aquifer in the lower basin (south of the site) (East Texas Water Planning Group 2010).

Building Impacts

For purposes of this analysis, the review team assumed that the water needed for building and operating the proposed plant at this site would be obtained from Sam Rayburn reservoir through a contract with the Lower Neches Valley Authority.

Water requirements for building the plant would be similar to those for building the plant at the CPNPP site. This water use would not have detectable effects on water quantity in the reservoir or water availability for other uses. Building activities on the peninsula would alter onsite hydrologic conditions, including increasing runoff and possibly changing the courses of natural streams on the peninsula. During building activities, runoff from the site could increase sediment transport into the reservoir.

Sam Rayburn reservoir would be the water source and effluent discharge site for a nuclear power plant, with the water intake on one side of the peninsula and the outfall on the other side. The intake and discharge sites probably would be located in areas of relatively deep water near the lake shore. Installation of a raw water intake and discharge line would disturb the bed of the reservoir, but significant dredging is not likely to be needed to construct or maintain the intake and outfall. Although these actions could temporarily affect surface water quality, effects would be minor due to the expected implementation of best management practices and site-specific factors such as the small size of the disturbed area relative to the total area of the reservoir and the sandy character of the soil and lake bottom sediment, which is unlikely to contribute significantly to turbidity.

There would be no use of groundwater in building the plant. Dewatering of excavated areas, if needed, would lower the shallow groundwater table in the site vicinity, but this would not affect existing uses or users of groundwater. Implementation of appropriate management practices would minimize the potential impacts to groundwater of accidental contaminant releases.

Operational Impacts

MDCTs would likely be used for nuclear units at this site, since natural draft cooling would not be an option due to the warm humid climate. Also, no BDTF would be required at the Pineland site due to the lack of a need for water treatment prior to discharge. Cooling water requirements for a mechanical draft system are assumed to be somewhat larger than the 62,400 ac-ft/yr annual consumption estimated for two units at the CPNPP site due to the warmer air temperatures and higher humidity of the Pineland site. Water for cooling and other water required for facility operations would be obtained from Sam Rayburn reservoir. Because the required water volume is well below estimates of available water supply from the reservoir, use of this volume of water would not noticeably affect water availability for other uses. Similarly, effects on water levels in the reservoir would be minor. Annual water consumption would be only about 2 percent of the reservoir's total volume, and effects on water levels would be small relative to the annual fluctuation of about 8 ft (TetraTech 2003) that results from reservoir operations.

Water from Sam Rayburn Reservoir water likely would need only minimal treatment prior to use in the facility. Sanitary wastewater generating during building and operation of the facility would require treatment in a wastewater treatment plant before discharge to the lake, but cooling tower blowdown and most other effluents likely could meet water quality standards for dissolved constituents with little or no treatment before being discharged to the reservoir. Discharge of this water would have no more than minor impacts on chemical water quality in the reservoir, as the volume of water in the reservoir would be sufficient for assimilation of dissolved materials in facility effluents. Thermal impacts to the reservoir from the discharge of cooling water would depend on the temperature and volume of discharged water as well as mixing processes in the reservoir, but are assumed to be minor because the volume of water in the reservoir would be sufficient for assimilation of thermal loads and because discharges would need to comply with requirements of a State-issued discharge permit. No detectable water quality effects would be expected downstream from Sam Rayburn dam.

Plant operation would not use groundwater and would not affect groundwater quantities. Implementation of appropriate management practices would minimize the potential impacts to groundwater from accidental contaminant releases during plant operation.

Cumulative Impacts

In addition to water use and water quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that impact the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the Pineland site is considered to be the Sam Rayburn Reservoir and downstream of the site because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts to water supply and water quality in the Sam Rayburn Reservoir include the operation and maintenance of the reservoir and its hydroelectric dam.

The report on *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions, and the Pineland site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase in of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. Decreased water availability due to increased temperatures and longer periods between rainfall events would likely affect the region's economy, as well as its natural systems. Ward (2009) incorporated global climate modeling results into water budgets for four regions of Texas to estimate the potential cumulative impacts on each region's water resources from future climate change and future increases in water demand. His analysis assumes that climate change would increase Texas' statewide air temperatures by 3.6°F and reduce precipitation by 5 percent. In Ward's analysis, the Pineland site is part of the East Region of Texas, where water is more abundant than in the State's three other regions. Considering climate conditions and increases in water demand projected for the year 2050, and assuming that new water supplies are developed to meet increased demand, Ward's analysis found that in "normal" years streamflow to the Gulf of Mexico from the East Region would be 21 percent less than in normal years under baseline conditions for the year 2000. Increased water demand accounts for only a 2 percent reduction in streamflow, with the remainder of the reduction attributed to climate change. Under drought conditions comparable to those of the years 1950 to 1956 (the period that includes the drought of record), the analysis indicates that streamflow to the Gulf would be 40 percent of normal under year 2000 baseline conditions, 38 percent of the normal baseline with year 2050 water demand but no change in climate, and 28 percent of the normal baseline if the effect of GCC and the effect of year 2050 water demand are combined.

Cumulative Water Use Impacts

The East Texas Water Plan addresses the impacts of ongoing and projected future water demands in the East Texas Regional Water Planning Area (East Texas Water Planning Group 2010). Based on a comparison of projected water availability and projected demands through 2060, water supply in the planning area should continue to be more than adequate to meet demands for the reasonably foreseeable future. The addition of two nuclear power units at the Pineland site would not change this situation. The analysis by Ward (2009) indicates that during times of drought, climate change coupled with increased demand would reduce streamflows, but would not destabilize the resource. Based on consideration the potential impacts to water use from building and operating the proposed plant at the Pineland site, and effects resulting from other sources of impact to these resources in the site vicinity and the East Texas Regional Water Planning Area, the review team concluded that cumulative impacts to water use for two new nuclear power units at the Pineland site would be SMALL for both surface water and groundwater resources.

Cumulative Water Quality Impacts

Point and nonpoint sources of pollution, particularly nutrients, in the Sam Rayburn reservoir watershed are likely to continue to contribute to dissolved oxygen depletion and other water quality concerns in the reservoir. Future urbanization and residential development near the reservoir are likely to contribute to dissolved oxygen depletion by adding to the reservoir's nutrient load, but building and operating two new nuclear power units at the Pineland site would not be expected to make more than a minor contribution to either the nutrient load or the resulting oxygen depletion; hence, the impacts on surface water quality would be SMALL.

Impacts on groundwater quality from construction and operation would be SMALL, as there would be no use of groundwater, there is little or no use of near-surface groundwater that might be subject to contamination from the facility, and the potential for contamination would be minimized by implementation of appropriate management practices.

9.3.3.3 Terrestrial Resources

The following impact analysis includes impacts from building activities and operations on the Pineland site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact terrestrial resources, including other Federal and non-Federal projects listed in Table 9-14.

The Pineland site lies in the Tertiary Uplands of the South Central Plains ecoregion (Griffith et al. 2004). It is located on a peninsula near the northeastern side of Sam Rayburn Reservoir in eastern Texas. The site is in gently rolling topography currently covered by a loblolly pine (*Pinus taeda*) plantation in an area once blanketed by a mix of pine and hardwood forests (Luminant 2009a). Surrounding land is covered in pines interspersed with hardwoods, particularly oaks, and some native grasses. Wildlife includes quail, white-tailed deer, doves, cottontail rabbits , skunks , opossums , raccoons, and coyotes. Of these species white-tailed deer and doves are highly sought after by hunters and are therefore considered important species as determined by NRC (NRC 2000). The area in which Pinelands is located is locally termed the “piney woods.” Many parts of the historic longleaf pine (*Pinus palustris*) forest on rolling sandy uplands of in Texas were characterized by a species-rich herbaceous understory with bluestem grasses and a variety of forbs and shrubs. Today, about one sixth of the region is in cropland, and about two thirds of the region is in forests and woodland. Lumber, pulpwood, oil, and gas production are major economic activities (Griffith et al. 2004). The peninsula on which the Pineland site is located lies immediately between two ecologically important areas: the Sabine and Angelina National Forests.

Table 9-14. Threatened or Endangered Terrestrial Species that May Occur within 10 mi of the Pineland Site

Group	Common Name	Scientific Name	Federal Status(a)	State Status(b)
Reptiles	Louisiana pine snake	*Pituophis ruthveni*	-	T
	Northern scarlet snake	*Cemophora coccinea copei*	-	T
	Bald eagle	*Haliaeetus leucocephalus*	-	T
Birds	Red-cockaded woodpecker	*Picoides borealis*	E	E
Mammals	Black bear	*Ursus americanus*	-	T
	Rafinesque’s big-eared bat	*Corynorhinus raffinesquii*	-	T
Plants	White bladderpod	*Lesquerella pallida*	E	E
	Navasota ladies’-tresses	*Spiranthes parksii*	E	E

(a) Federal status: E = endangered; T = threatened
(b) State status: E = endangered; T = threatened

Source: TPWD 2009a

Federally and State-Listed Species

No site-specific surveys have been conducted for threatened and endangered species at the Pineland site. The list in Table 9-14 of threatened and endangered species that occur within 10 mi of the Pineland site was compiled from information on rare resource occurrences contained in the Texas Natural Diversity Database. The information was provided by TPWD (TPWD 2009a).

Suitable habitat for one of these species, the red-cockaded woodpecker, is located on the eastern boundary of the peninsula away from the proposed power block location. This 30-ac area of mature pines is not subject to logging, and has been preserved to protect the desirable habitat and would continue to be even if the site were selected (Luminant 2007).

Building Impacts

The Pineland site is in gently rolling topography, and clearing and substantial grading would be necessary to prepare the site for development. Since most of the site is in rotation for loblolly pine harvest, its value as undisturbed wildlife habitat is limited. A new transmission line on a new ROW would be required to connect the power plant to existing transmission lines. Either of two lines could be developed. One is 45 mi northwest of the Pineland site, the other is 25 mi to the southeast. Either route would cross predominantly forested and agricultural areas. The route to the northeast would have the potential to cross and impact portions of the Angelina National Forest.

Development of new transmission lines would be subject to additional environmental review requirements. The new ROWs would be subjected to site-specific pre-disturbance investigations, possibly including, but not limited to, reconnaissance to ascertain the presence or absence of Federally and State-listed species and other important species and habitats or as required by Federal or State agency regulatory requirements. If the new transmission line route crosses the Angelina National Forest, the process would likely involve required mitigation for impacts to sensitive resources located there.

Building two new nuclear reactors at the Pineland site would reportedly result in the permanent loss of about half of the 3800-ac site (Luminant 2007). The review team believes that the ultimate footprint of development would be less than the estimated 1900 ac reported. However, regardless of the exact development footprint area, loss of terrestrial habitat and forest fragmentation at the site would noticeably alter terrestrial resources in the surrounding landscape. New power transmission lines on new ROWs would result in additional alteration of habitat in the surrounding landscape. Other sources of impacts to terrestrial resources at the site such as increased traffic, noise, and displacement of wildlife would likely be temporary and/or result in minimal impact.

Operational Impacts

Terrestrial ecological impacts that may result from operation of new nuclear units at the Pineland site include those associated with cooling towers, transmission system structures, and maintenance of transmission line ROWs (Luminant 2007).

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the type (mechanical or natural draft), number, and specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the type (mechanical or natural draft for a wet cooling system; dry for a dry system) and number of cooling towers at the site. The impacts of cooling-tower drift and bird collisions for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be of minor significance for nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team concludes, for the purpose of comparing the alternative sites, that the impacts of cooling-tower drift and bird collisions with cooling towers resulting from operation of new nuclear units would be minor.

For MDCTs, the anticipated noise level from cooling-tower operation is anticipated to be approximately 55 dBA at 1000 ft (Luminant 2009a). This noise level is well below the 80 to 85 dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Pineland site would not be likely to disturb wildlife beyond 1000 ft from the source. The noise level for NDCT would be lower. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

The impacts associated with transmission-line corridor maintenance activities include alteration of habitat due to cutting and herbicide application, and similar related impacts where corridors cross floodplains and wetlands.

Impacts from bird collisions with transmission lines and the effects of EMFs on flora and fauna are expected to be minimal. Transmission lines and associated structures are recognized as a potential avian collision hazard. Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including transmission-line corridors with variable numbers of power lines (NRC 1996). Although additional transmission lines would be required for new nuclear units at the Pineland site, increases in bird collisions would be minor and these would likely not be expected to cause a measurable reduction in local bird populations. Consequently, the number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible.

EMFs are unlike other agents (e.g., toxic chemicals and ionizing radiation) that have an adverse impact in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle. A review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures. The impacts of EMFs on terrestrial flora and fauna are recognized as being of small significance at operating nuclear power plants, including transmission systems with variable numbers of power lines (NRC 1996). Therefore, the EMF impact posed by addition of new transmission lines for new nuclear units at the Coastal site would be noticeable.

New access roads would be required during the establishment of new transmission line ROW at the Pineland site. Transmission line ROW management activities (such as cutting and herbicide application) and related impacts to terrestrial habitats in transmission line ROWs are of minor significance at operating nuclear power plants, including those with transmission line ROWs of variable widths (NRC 1996). Consequently, the effects of transmission line ROW maintenance and associated impacts to terrestrial habitats posed by the addition of new transmission line ROWs for new nuclear units at the Pineland site would be negligible.

Cumulative Impacts

The impacts of building and operating two nuclear units at the Pineland site were evaluated by the review team to determine the magnitude of their contribution to cumulative impacts on terrestrial ecological resources. For purposes of this cumulative analysis, the geographic area of interest is defined as San Augustine, Sabine, and Jasper Counties. These counties encompass the Pineland site, anticipated transmission line ROWs, and adjoining areas. This geographic area of interest is expected to encompass the ecologically relevant landscape features and species. Activities related to building include loss of habitat due to clearing for building the plant and transmission lines. Past actions that have affected terrestrial resources include the creation of Sam Rayburn Reservoir, the replacement of natural forests with those managed for wood production and cropland, and residential development in the area. These changes have displaced wildlife habitat and increased habitat fragmentation. Highway and sewer replacement projects in the area, as well as possible future residential development, increasing urbanization, and potential impacts of GCC would continue to change habitat (Table 9-13).

The TSDC projects that the population in a six-county area surrounding the Pineland site (including Angelina, Jasper, Nacogdoches, Sabine, San Augustine, and Shelby Counties) will increase by 14.5 percent by the year 2040 (TSDC 2009). Future urbanization in the review area could contribute to additional decreases in grazing lands, cultivated lands, forests, and wetlands. Urbanization in the vicinity of the Pineland site could reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat. However, the level of growth projected by TSDC is relatively low and, therefore, capable of only relatively low terrestrial ecology impacts.

The report on *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions. The Pineland site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase in of approximately 4.5°F by the 2080s. Additionally, climate models project that there will tend to be less rainfall in this area. The warming projected by the GCRP could result in a decrease in annual precipitation over time, possibly altering the character of terrestrial habitats. This could further stress terrestrial resources affected by the activities described above.

The potential cumulative impacts to terrestrial resources considering the two new reactors at the Pineland site, in addition to the other activities described above, would noticeably alter terrestrial resources. These activities would remove or modify terrestrial habitats with the potential to affect important species living or migrating through the area. For the reasons discussed above, the incremental contribution of building and operating the two new reactors at the Pineland site to the cumulative impacts would be substantial.

Summary

Impacts to terrestrial ecology resources were analyzed based on the information provided by Luminant and the review team's independent review. Should the proposed new facilities be built at the Pineland site, terrestrial resources in the areas that are temporarily disturbed are expected to return to predominantly pre-development conditions. However, much habitat would be lost to permanent project structures and by development and operation of the required power transmission ROW. The review team therefore concludes that the cumulative impacts on terrestrial plants and wildlife, including threatened or endangered species, and wildlife habitat would be MODERATE.

The incremental contribution of NRC-authorized activities, which do not include preconstruction, would, be SMALL. The incremental contribution of the overall project, including preconstruction, would however be noticeable.

9.3.3.4 Aquatic and Wetlands Resources

Affected Environment

The Pineland site is located on the border of San Augustine and Sabine Counties in eastern Texas near the northeastern portion of Sam Rayburn Reservoir. The facility, intake, and discharge would be located on a peninsula extending from the north into the central portion of the reservoir. The dam was built across the Angelina River, the largest tributary to the Neches River. The reservoir, which covers an area of 142,500 ac at normal water surface elevation, would supply cooling water. The shoreline is predominantly undeveloped and wooded. The topography of the 3800-ac site is mostly gently rolling upland. The site is outside the 100-yr floodplain.

Important Species

Game fish are important species in Sam Rayburn Reservoir, which provides excellent recreational fishing. The largemouth bass (*Micropterus salmoides*) is the most popular game fish in the reservoir. Other common game fish in the reservoir include white crappie (*Pomoxis annularis*), catfish (*Ictalurus* spp.), white bass (*Morone chrysops*), hybrid striped bass (*M. chrysops* x *saxatilis*), bluegill (*Lepomis macrochirus*), and redear sunfish (*L. microlophus*) (TPWD 2008a).

No Federally listed threatened or endangered aquatic species occur in San Augustine, Sabine, or Jasper Counties, the counties in which the reservoir is located (the downstream reach of the Angelina River also is in Jasper County). However, four State-listed threatened aquatic species potentially occur or have occurred historically in one or more of these counties. Two fish species that are State-listed as threatened, creek chubsucker (*Erimyzon oblongus*) and paddlefish (*Polyodon spathula*), potentially occur in the three counties, whereas another fish that is State-listed as threatened, the blue sucker (*Cycleptus elongatus*), potentially occurs in Sabine and Jasper Counties. In addition, the alligator snapping turtle (*Macrochelys temminckii*) is State-listed as threatened and potentially occurs in San Augustine and Sabine Counties. Aquatic species that have a State listing status or designation as a State species of concern and the potential to occur in San Augustine, Sabine, or Jasper Counties are included in Table 9-15. Listed species are described below.

The creek chubsucker inhabits creeks and small rivers and seldom if ever occurs in impoundments (Hassan-Williams and Bonner 2007). Thus, the creek chubsucker is unlikely to occur in the reservoir but potentially could occur in the Angelina River downstream. The blue sucker inhabits large, deep rivers and deep areas of lakes, though few occur in reservoirs. Their preferred spawning habitat appears to be deep riffles with substrates of cobble and bedrock in rivers (Hassan-Williams and Bonner 2007). Thus, the blue sucker potentially could occur but is unlikely to occur in the reservoir or the river downstream.

The paddlefish is a potentially large (up to 7 ft in length) fish that inhabits large rivers and their tributaries, particularly backwaters, oxbows, and deep channels. The paddlefish prefers large, free-flowing rivers providing an abundance of the zooplankton on which it filter feeds, but it also inhabits impoundments that have access to spawning sites upstream with substantial flow and substrates of gravel and cobble (Hassan-Williams and Bonner 2007). Sam Rayburn Reservoir potentially could provide habitat supportive of paddlefish, and paddlefish fingerlings were stocked in the reservoir as recently as 1995 (TPWD 2007a).

The alligator snapping turtle is native to eastern Texas, and its range extends east and north in the Mississippi River drainage and south in other Gulf Coast drainages. It is a highly aquatic and potentially large turtle that can reach a weight of over 250 lb. Its preferred habitat is deep waters primarily in rivers, but also in lakes and swamps, where it feeds on mainly fish, smaller turtles, crayfish, and mollusks (Fuller and Somma 2010). Based on its range and habitat requirements, this turtle potentially could occur in Sam Rayburn Reservoir or the Angelina River downstream.

Table 9-15. State-Listed Aquatic Species and State Species of Concern Potentially Occurring in the Vicinity of the Pineland Site

Scientific Name	Common Name	State Status[(a)]	Counties[(b)]
Reptiles			
Macrochelys temminckii	Alligator snapping turtle	ST	San Augustine, Sabine
Graptemys ouachitensis sabinensis	Sabine map turtle	SSC	San Augustine, Sabine
Amphibian			
Rana grylio	Pig frog	SSC	Jasper
Fishes			
Erimyzon oblongus	Creek chubsucker	ST	San Augustine, Sabine, Jasper
Etheostoma radiosum	Orangebelly darter	SSC	San Augustine, Sabine, Jasper
Polyodon spathula	Paddlefish	ST	San Augustine, Sabine, Jasper
Cycleptus elongatus	Blue sucker	ST	Sabine, Jasper
Notropis chalybaeus	Ironcolor shiner	SSC	Sabine, Jasper
Ammocrypta clara	Western sand darter	SSC	Sabine, Jasper
Mussels			
Fusconaia askewi	Texas pigtoe	ST	San Augustine, Sabine
Fusconaia lananensis	Triangle pigtoe	ST	San Augustine
Lampsilis satura	Sandbank pocketbook	ST	San Augustine, Sabine
Obovaria jacksoniana	Southern hickorynut	ST	San Augustine, Sabine
Pleurobema riddellii	Louisiana pigtoe	ST	San Augustine, Sabine
Potamilus amphichaenus	Texas heelsplitter	ST	San Augustine, Sabine
Arcidens confragosus	Rock pocketbook	SSC	San Augustine, Sabine
Fusconaia flava	Wabash pigtoe	SSC	San Augustine, Sabine
Quadrula nodulata	Wartyback	SSC	San Augustine, Sabine
Strophitus undulates	Creeper (squawfoot)	SSC	San Augustine, Sabine
Tritogonia verrucosa	Pistolgrip	SSC	San Augustine, Sabine
Truncilla donaciformis	Fawnsfoot	SSC	San Augustine, Sabine
Villosa lienosa	Little spectaclecase	SSC	San Augustine, Sabine
Insects			
Somatochlora margarita	Texas emerald dragonfly	SSC	San Augustine, Sabine
Plauditis gloveri	A mayfly	SSC	Jasper

(a) State status definitions: ST = State-listed, threatened; SSC = State species of concern.
(b) Counties listed are those in which components of the alternative would be located and where TPWD has identified the potential for occurrence of the species based on evidence such as recorded occurrences, historic ranges, field guides, staff expertise, and scientific publications.

Sources: TPWD 2010a, 2010c, and 2010d

The six species of State-listed freshwater mussels (Texas pigtoe [*Fusconaia askewj*], triangle pigtoe [*F. lananensis*], sandbank pocketbook [*Lampsilis satura*], southern hickorynut [*Obovaria jacksoniana*], Louisiana pigtoe [*Pleurobema riddellii*], and Texas heelsplitter [*Potamilus amphichaenus*]) occur predominantly in riverine habitats. The Texas pigtoe inhabits mixed mud, sand, and fine gravel substrates in protected areas with fallen trees or other structure in the Sabine, Trinity, and San Jacinto River basins of east Texas. The triangle pigtoe inhabits substrates of mixed mud, sand, and fine gravel in the Angelina Branch of the Neches River basin. The sandbank pocketbook inhabits substrates of sand, gravel-sand, and gravel in small to large rivers with moderate to swift current in the Neches River and other river basins of east Texas. The southern hickorynut inhabits substrates of medium-size gravel in rivers with low to moderate current in the Neches, Sabine, and Cypress River basins. The Louisiana pigtoe inhabits substrates of mud, sand, and gravel usually in flowing water of streams and moderate-size rivers of the Neches, Sabine, and, historically, Trinity River basins. The Texas heelsplitter inhabits substrates of mud or sand in quiet waters of streams in the Neches, Sabine, and Trinity River basins, and it also inhabits reservoirs (TPWD 2010d). Given their ranges and habitat preferences, five of these species (the triangle pigtoe, sandbank pocketbook, southern hickorynut, Louisiana pigtoe, and Texas heelsplitter) potentially occur in the Neches River downstream of Sam Rayburn Reservoir. Only the Texas heelsplitter inhabits reservoirs and, thus, has a potential to occur in the lake and, if present, to be directly affected by the intake or discharge of water by the facility.

Building Impacts

The aquatic impacts from construction of the proposed type of closed-cycle cooling system at this site likely would be similar to the impacts of such systems at other sites and would be of minor significance, involving localized and mostly temporary effects of building intake and discharge structures at the shoreline. Building activities could increase stormwater runoff due to increased areas of impervious surface, increase storm flows in streams, or change the course of streams on the site. Soil disturbance combined with increased runoff could increase sediment transport into the reservoir. TCEQ requires stormwater permits for construction sites of 1 ac or more, and obtaining a permit requires development and implementation of an SWPPP specifying the BMPs to be used in protecting water bodies (TCEQ 2008). Compliance with permitting requirements and associated use of BMPs to minimize or prevent stormwater impacts would minimize erosion-related impacts on surface waters and wetlands. BMPs that likely would be implemented under an SWPPP include the installation and maintenance of silt fencing, the maintenance of vegetated buffer zones between waterbodies and areas undergoing development, and the diversion of runoff to sediment retention basins.

Sam Rayburn reservoir would be the water source for the proposed nuclear power facility. The water intake would be located on one side of the peninsula and the outfall on the other side, and the intake and discharge sites probably would be located in areas of relatively deep water near the lake shore. Installation of a raw water intake and discharge line would disturb the sediments on the bottom of the reservoir, but significant dredging is not likely to be needed to construct or maintain the intake and outfall. Although these actions could temporarily affect surface water quality, effects would be minor due to the expected implementation of BMPs, the small size of the disturbed area relative to the total area of similar habitat in the reservoir, and the sandy characteristics of the soil and lake bottom, making it unlikely that their disturbance would contribute significantly to turbidity. Thus, building of facilities would not cause substantial changes in surface water quality or hydrology, and aquatic communities would not be noticeably affected.

A new transmission line on a new ROW would be required to connect the proposed nuclear power facility to existing transmission lines. Either of two existing lines could be tapped: one is 45 mi to the northwest, and the other is 25 mi to the southeast. Either route would cross mostly forested and agricultural areas. It is assumed that during the building of new transmission line ROWs, the building of new access roads also would be required. While detailed information concerning the routing of possible new transmission line ROWs is not available at this time, ROWs would cross streams and possibly wetlands. Construction of new transmission lines would be subject to additional environmental review. The new ROW would be subjected to site-specific pre-development investigations, possibly including, but not limited to, reconnaissance to ascertain the presence or absence of listed species and other important species and habitats defined in NUREG-1555 or as required by Federal or State agency regulatory requirements. The ability to relocate proposed transmission tower sites laterally along the ROW means that towers could usually be sited to avoid environmentally sensitive areas such as waterbodies and wetlands.

Aquatic species would be unlikely to be substantially affected by the loss of small areas of aquatic or wetland habitat potentially within the footprint of facilities and the ROW that would be built for the project. If State-listed species potentially occurring in the region, described above, were present near a location where facilities were being built, the mobility of some species, including the fish and alligator snapping turtle, would allow them to avoid the activities. Individuals of relatively immobile species, such as mussels, would not be able to avoid the activities and may be injured or killed if present in the affected area. Of the listed mussels potentially occurring in the area, only the Texas heelsplitter inhabits reservoirs and may occur in the lake where it could be affected. Thus, building of water intakes and discharge structures would likely have minimal impacts on aquatic resources, but impacts could be noticeable if the Texas heelsplitter is present at the affected location in the lake.

Operational Impacts

Operation of proposed new nuclear units at the Pineland site could affect aquatic resources as a result of entrainment and impingement of organisms at the cooling water intake and thermal, chemical, and physical effects from the discharge of cooling water and other effluents. An evaluation of impacts resulting from operation of the intake and discharge cannot be conducted in detail due to lack of specific information that would have to be developed (i.e., more than reconnaissance-level information), such as the design and location of cooling water intakes and discharges at this site, and the locations of a new ROW that could be required. Consequently, the review team relies upon the conclusions in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437 (NRC 1996) to inform the assessment of aquatic impacts from the operation of the cooling system.

NUREG-1437 (NRC 1996) evaluated aquatic ecological impacts resulting from operation of existing nuclear power plants. The aquatic impacts from operation of cooling systems for existing power plants were found to be of minor significance for all plants that utilize closed-cycle cooling systems with cooling towers. In evaluating this alternative site, the review team assumed that the new nuclear power plant that would be constructed at this site would utilize a similar cooling system, consisting of a closed-cycle system with cooling towers. Consequently, the types of aquatic ecological impacts that would result from operation of the new nuclear units would be similar to those of existing nuclear power plants that have closed-cycle cooling systems with cooling towers.

With regard to cooling water intakes, NRC found that entrainment and impingement of fish and shellfish have not been a problem at existing facilities that use closed-cycle systems with cooling towers. Minimal impacts from intake operation would be expected if it is assumed the following conditions would apply at this site in accordance with EPA's Phase I regulations for new facilities under Section 316(b) of the CWA (66 FR 65256): (1) a closed-cycle cooling system, (2) a maximum through-screen velocity of 0.5 ft/s at the cooling water intake, (3) an intake flow that would not disrupt the natural thermal stratification or turnover pattern of the lake at the Pineland site, and (4) location of the new intake in an area of the source waterbody away from areas with the potential for high productivity of fish or other important organisms (66 FR 65256). With regard to effluent discharges from facilities with closed-cycle cooling systems, NRC found that the thermal and water-quality effects from the relatively small volumes of blowdown water discharged did not have more than minor impacts on the aquatic ecology of the receiving waterbody (NRC 1996).

Thermal impacts on the reservoir from the discharge of cooling water are expected to be minor because cooling towers would be used, the large volume of water in the reservoir would be sufficient for dissipation of thermal inputs, and discharges would need to comply with requirements of a State-issued discharge permit. Use of Sam Rayburn Reservoir as the source for cooling and other water required for facility operations would not have more than minor effects on water levels in the reservoir. Effects on water levels would be small relative to the annual fluctuation of about 8 ft (TetraTech 2003) that results from reservoir operations. Discharge of cooling tower blowdown and other effluents, such as treated sanitary wastewater, would have no more than minor impacts on chemical water quality in the reservoir, as the volume of water in the reservoir would be sufficient for assimilation of dissolved materials in facility effluents. In periods of low flow through the reservoir, there may be a potential for recirculation of water from the discharge to the intake. Such a recirculation pattern may result in constituent concentrations that are locally elevated above ambient concentrations in a larger than normal area in the vicinity of the diffuser. However, the effluent concentrations discharged likely would remain below water quality criteria. Given the assimilative capacity of the reservoir, detectable water quality effects would not be expected downstream from Sam Rayburn Dam. Thus, aquatic species are unlikely to be adversely affected by hydrological alterations or water quality, thermal, or other physical effects from operations in either the lake or the river downstream.

As discussed above, ten aquatic species that are State-listed as threatened have recorded occurrences in San Augustine, Sabine, or Jasper Counties, in which the reservoir and the downstream reach of the Angelina River (Jasper County) are located: the alligator snapping turtle, creek chubsucker, blue sucker, paddlefish, and five mussel species. It is unlikely that such species or their habitats would be substantially affected by the relatively small volumes of water withdrawn and discharged by the closed-cycle cooling system proposed for the Pineland site (NRC 1996). However, even the low rates of entrainment and impingement at the intake for a closed-cycle cooling system and the relatively small volumes of effluent discharged could be a concern if an unusually important aquatic resource such as a threatened species would be affected (NRC 1996).

The creek chubsucker seldom if ever occurs in impoundments, and the blue sucker has rarely been found in impoundments (Hassan-Williams and Bonner 2007), so these fish are unlikely to occur in the reservoir or near the intake or discharge. If present in the Angelina River downstream, they would be unlikely to be affected by operation of the proposed facility. The paddlefish was stocked in the reservoir historically and potentially could be present, but its size, mobility, and life history make it unlikely that this species would be affected. Similarly, the alligator snapping turtle could occur in the reservoir but would not be affected by facility operation. Of the listed mussels potentially occurring in the area, only the Texas heelsplitter may inhabit the reservoir, but it would be unlikely to be affected by facility operation. The State-listed mussels in Table 9-15 could occur in the Angelina River downstream of the reservoir, but these species would be unlikely to be adversely affected by the minimal hydrological and water quality effects on the river from facility operation at the Pineland site.

Given the assumption that BMPs would be followed in maintaining the new ROW, if State-listed aquatic species occur in the small streams and wetlands that may be traversed by the transmission lines, then they would be unlikely to be affected by operation of the lines and the maintenance of the ROW. Thus, the overall potential for operation of two new reactor units at the Pineland site and a new ROW to affect threatened or endangered species is expected to be minimal.

Cumulative Impacts

The impacts of building and operating two nuclear units at the Pineland site were evaluated by the review team to determine the magnitude of their contribution to cumulative impacts on aquatic and wetlands resources in the geographic area of interest. The area of interest includes the site and adjacent water bodies wetlands in the vicinity, including Sam Rayburn Reservoir and the Angelina River downstream to where it enters the upper reaches of Steinhagen Lake, approximately 18 mi southeast of Sam Rayburn Dam. Past actions that have affected aquatic resources in the area include use of water for agriculture, residential development, increased runoff from clearing of forests and development that creates impervious surfaces associated with buildings and pavement, ongoing operation of Sam Rayburn dam and its hydroelectric turbines, and sewage discharge. Possible future actions that could affect aquatic resources in the geographic area of interest include the continued operation of Sam Rayburn Reservoir and its hydroelectric facility, and construction of water and/or wastewater treatment and distribution facilities in conjunction with future residential and commercial development (Table 9-13). In addition, GCC could alter aquatic habitats in the area.

Past actions that have affected aquatic resources in the area include water use for operation of the existing electric power facility at the site (which is ceasing operation in 2010), operation of Tradinghouse Dam, water use for and runoff from agriculture, and water use and sewage discharge from some residential development. Possible future actions that could affect aquatic resources in the geographic area of interest include the continued operation of Tradinghouse Reservoir and construction of water and/or wastewater treatment and distribution facilities in conjunction with future residential and commercial development (Table 9-17). In addition, GCC could alter aquatic habitats in the area.

Future urbanization in the geographic area of interest could contribute to decreases in undeveloped land, including wetlands, as well as increased demand for water and reduced water quality. The TSDC projects that the population in a six-county area surrounding the Pineland site (including Angelina, Jasper, Nacogdoches, Sabine, San Augustine, and Shelby Counties) will increase by 14.5 percent by the year 2040 (TSDC 2009). Future urbanization in the geographic area of interest could contribute to additional demand for water, increased need for wastewater assimilation, and reduced water quality. Water supply in the area should continue to be more than adequate to meet demand from users for the reasonably foreseeable future even with the addition of two nuclear power units at the Pineland site. Point and nonpoint sources of pollution, particularly nutrients, in the watershed of Sam Rayburn reservoir are likely to continue to contribute to dissolved oxygen depletion and other water quality effects in some areas of the reservoir. Urbanization and residential development near the reservoir in the future are likely to contribute to dissolved oxygen depletion by adding to the reservoir's nutrient load. However, building and operating two new nuclear power units at the Pineland site would not be expected to make more than a minor contribution to either the nutrient load or the resulting oxygen depletion. Cumulatively, these effects on water quality would likely have minimal impacts on aquatic organisms.

The report on *Global Climate Change Impacts in the United States* (Karl et al. 2009), provided by the GCRP, summarizes the projected impacts of future climate changes in the United States. The report divides the United States into nine regions, and the Pineland site is located in the Southeast region. The GCRP climate models for this region project continued warming in all seasons and an increase in average temperatures in the region of approximately 4.5°F by the 2080s. Additionally, the amount of water available to natural systems and its timing are likely to be affected by climate change and human responses to it. Climate models project that there will tend to be less water available in the region due to the higher temperatures and longer periods between rainfall events combined with increased demand for water, which may drive the building of dams for storage capacity and increases in crop irrigation. Thus, the projected effects of climate change for the Southeast region could affect aquatic ecosystems through higher water temperatures, longer periods of drought, increased damming of rivers, and higher human consumption of water.

Summary

The review team concludes that the impacts on aquatic resources from building two new nuclear units at the Pineland site would be noticeable but not destabilizing to aquatic resources. The review team also concludes that the impacts from operation of two new units would be minimal. Based on the information provided by Luminant and the review team's independent evaluation, the review team concludes that the cumulative impacts of from past, present, and reasonable foreseeable activities affecting aquatic and wetlands resources in the geographic area of interest would be SMALL. The incremental contribution of building and operating two new reactors at the Pineland site to cumulative impacts on aquatic and wetlands resources in the geographic area of interest would be minimal.

9.3.3.5 Socioeconomics

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact socioeconomics, including the other Federal and non-Federal projects listed in Table 9-8. For the analysis of socioeconomic impacts at the Pineland site, the geographic area of interest is the 14-county area around the Pineland site (Table 9-16) that was evaluated in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007). In evaluating the socioeconomic impacts of site development and operation at the Pineland site, the review team used the population and labor force data provided in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007).

The Pineland site is located in San Augustine County in east Texas on a peninsula on Sam Rayburn Reservoir. The site is located approximately 4 mi west of U.S. Highway 96 and approximately 5 mi south of the town of Pineland. Section 9.3.3.1 contains a description of the Pineland site.

As indicated in Table 9-16, San Augustine County and the 13 other counties and parishes surrounding the Pineland site have a combined 2010 population of 480,767, a combined 2000 labor force of 177,738, and a combined 2000 construction labor force of 24,786. Thus, the Pineland site has a relatively small labor pool from which to draw construction and operations workers, which would result in more in-migrating workers. More in-migrating workers would result in larger socioeconomic impacts, especially to housing and public services.

Table 9-16. Population and Labor Force in San Augustine County, Texas, and the Other Counties and Parishes Surrounding the Pineland Site

County	Total Population 2006	Projected Total Population 2010	Total Labor Force 2000	Total Construction Labor Force 2000
San Augustine	8888	8852	3210	472
Sabine	10,457	10,451	3258	502
Jasper	35,293	35,081	13,327	2189
Angelina	82,524	84,174	33,857	3927
Tyler	20,557	20,351	6827	1168
Newton	14,090	13,484	5222	1047
Nacogdoches	61,079	62,362	25,637	2388
Shelby	26,575	27,532	9801	1158
Vernon Parish, Louisiana	46,748	43,335	16,520	2767
Sabine Parish, Louisiana	23,934	24,245	8466	1220
DeSoto Parish, Louisiana	26,390	27,261	9707	1526
Rusk	48,354	49,030	18,825	2815
Panola	22,989	23,150	9075	1505
Polk	46,995	51,459	14,006	2102
Total	**468,264**	**480,767**	**177,738**	**24,786**

Source: Luminant 2007

The review team concludes that building and operating a two-unit nuclear power plant at the Pineland site would have MODERATE to LARGE socioeconomic impacts in San Augustine County and the surrounding counties and parishes for three reasons. First, the Pineland site is a greenfield site and significant road, rail, and infrastructure development would be required in the surrounding area to access and use it. Second, the Pineland site has a relatively small labor force from which to draw construction and operations workers; consequently a large numbers of workers would need to in-migrate. Third, the Pineland site is in a rural area that likely would not have the existing housing, infrastructure, and public services to support the in-migration of a large number of workers and their families. In addition, building and operating a nuclear power plant at the Pineland site could affect use of the USACE's existing San Augustine Park as well as existing residential developments on the peninsula in Sam Rayburn Reservoir (Section 9.3.3.1).

9.3.3.6 Environmental Justice

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact socioeconomics, including the other Federal and non-Federal projects listed in Table 9-8. For the analysis of environmental justice impacts at the Pineland site, the geographic area of interest is the 14-county area around the Pineland site (Table 9-16) that was evaluated in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007). In evaluating the environmental justice impacts of site development and operation at the Pineland site, the review team used the minority and low-income data provided in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007).

As indicated in Table 9-17, San Augustine County and the 13 other counties and parishes surrounding the Pineland site have a combined minority percentage of 28.3 percent. This percentage of minority residents is much lower than that for the State of Texas (61.1 percent) (Table 2-27). Thus, when compared to the State of Texas, the Pineland site has a small minority percentage for purposes of environmental justice analysis.

In terms of low-income residents, the 14 counties and parishes surrounding the Pineland site have a combined low-income percentage of 17.9 percent. This percentage of low-income residents is slightly higher than that for the State of Texas (14.0 percent) (Table 2-27). However, when compared to the State of Texas, the Pineland site does not have a significantly higher low-income percentage for purposes of environmental justice analysis.

In Section 9.3.3.5, the review team concluded that building and operating a new two-unit nuclear power plant at the Pineland site would have MODERATE to LARGE socioeconomic impacts in San Augustine County and the surrounding counties. Based on that conclusion, the review team concludes that the socioeconomic impacts of building and operating at the Pineland site could have MODERATE environmental justice impacts by disproportionately and adversely affecting low-income populations, especially in the area of housing price and availability.

9.3.3.7 Historic and Cultural Resources

The following impact analysis includes impacts from building and operating two new nuclear power plants at the Pineland site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact historic and cultural resources, including Federal and non-Federal projects listed in Table 9-13. For the analysis of historic and cultural impacts at the Pineland site, the geographic area of interest is considered to be the APE that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as the additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have a particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EIS, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area.

Table 9-17. Minority and Low-Income Percentages in San Augustine County, Texas, and the other Counties and Parishes Surrounding the Pineland Site

County	Total Population 2006	Percent Nonminority[(a)]	Percent Minority[(b)]	Percent Low-Income
San Augustine	8888	68.3	31.7	20.2
Sabine	10,457	86.9	13.1	16.4
Jasper	35,293	76.5	23.5	18.7
Angelina	82,524	67.0	33.0	17.3
Tyler	20,557	82.3	17.7	18.1
Newton	14,090	73.2	26.8	21.1
Nacogdoches	61,079	67.8	32.2	20.1
Shelby	26,575	65.0	35.0	18.8
Vernon Parish, Louisiana	46,748	71.3	28.7	16.4
Sabine Parish, Louisiana	23,934	70.9	29.1	18.8
DeSoto Parish, Louisiana	26,390	56.4	43.6	19.9
Rusk	48,354	68.9	31.1	13.1
Panola	22,989	75.0	25.0	13.7
Polk	46,995	73.9	26.1	17.5
Total	**468,264**	**71.7**	**28.3**	**17.9**

(a) Non-minority = White persons, not Hispanic.
(b) Minority = Black persons, American Indian and Alaska Native persons, Asian persons, Native Hawaiian and Other Pacific Islander persons, and Hispanic persons.

Sources: Luminant 2007; USCB 2009a; USCB 2009b

To identify the historic and cultural resources at the Pineland site the following information was used:

- Luminant ER (Luminant 2009a);
- Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4, Luminant Nuclear Power plant Siting Report (Luminant 2007)
- Texas Historical Commission’s Texas Archaeological Sites Atlas (THC 2010); and,
- NRC Alternative Sites Visit, February 2009.

The Pineland site is a greenfield site located in San Augustine County in east Texas in the Timberlands region. Historically, the site has been used for its timber resources and agricultural purposes. The current major industries in San Augustine County are oil, silviculture, tourism, and agriculture.

The siting report provided by Luminant indicated that there were 7 properties listed in the NRHP located in San Augustine County and 2 NRHP sites in adjacent Sabine County (Luminant 2007). The NRHP sites are located in City of San Augustine (approximately 25 mi from the Pineland site), city of Hemphill (in Sabine County approximately 12.6 mi from the Pineland site), and city of Milam (also in Sabine County approximately 20 mi from the Pineland site). Additionally, prehistoric fossils and artifacts from the Paleo-Indian period are known to occur in the county.

According to the Texas Historical Commission’s Texas Archaeological Sites Atlas, there are no National Register Properties or National Register Districts located in the APE or visual APE

(THC 2010). Additionally, there are no recorded Texas Historical Landmarks located near the APE or visual APE.

Historic and cultural resource impacts for a new plant located at the Pineland site would likely be similar to the impacts for a new plant at the CPNPP site as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any portion of the property that has not been previously surveyed at the Pineland site. Other lands that may be acquired to support the plant would also likely require a survey to identify potential historic and archaeological resources, and identification of mitigative measures to offset adverse effects of ground disturbing activities. These studies would likely be needed for areas of potential disturbance at the Pineland site, offsite affected areas, such as mining and waste disposal sites, and along associated corridors where new construction would occur, for example, roads and pipeline corridors. The types of historic and cultural resource impacts resulting from operation of new nuclear units would likely be similar to those of existing nuclear power plants.

There are no existing transmission corridors connecting directly to the Pineland site (Luminant 2007). However, there is a 345-kV transmission line located approximately 45-mi northwest of the site and a 500 kV transmission line is located approximately 25 mi southeast of the site (Luminant 2009a). New transmission line corridors would be needed to connect the Pineland site to these existing lines. Several historic and cultural resource sites are located in this region and could potential be affected by the addition of new transmission line corridors. In the event that the Pineland site was chosen for the proposed project, the review team assumes that the transmission service provider for this region would conduct its transmission line related cultural resource surveys and procedures similar to those performed by Oncor for the CPNPP site in section 4.6 of this EIS. In addition, visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. Given the potential size of the area to be disturbed by adding new transmission line corridors, the visual impacts of the transmission line corridor could noticeably alter historic and cultural resources. However, the visual impact would not destabilize important attributes of the resource.

One project listed in Table 9-12 has the potential to contribute to cumulative impacts to historic and cultural resources. Proposed highway improvements to U.S. 96 is within 5 mi of the Pineland site. There are also residential developments within 1.5 mi of the site on the Sam Rayburn Reservoir. Additionally, the TSDC predicts the average population growth rate will be 14.57 percent from 2010 to 2040 for the 6 counties surround the Pineland site (TSDC 2009). The 6 counties included Angelina, Jasper, Nacogdoches, Sabine, San Augustine, and Shelby counties. The average population growth rate could result in an increase in urbanization in the area. Urbanization includes increases in residential, commercial, industrial, and infrastructure development. The highway improvement, residential development, and urbanization could encroach on historic cultural resources near the geographic area of interest.

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the reconnaissance level information, specifically the potential addition of new transmission line corridors, the review team concludes that the cumulative impacts on historic and cultural resources of construction, pre-construction, and operating new nuclear units on the Pineland site and from other projects, developments, and urbanization would be MODERATE. The incremental impact associated with NRC-authorized construction and operation would be SMALL. This impact level determination reflects that no known cultural resources would be affected on the Pineland site. However, if the site were to be developed, cultural resource surveys may reveal important historic properties that could result in greater cumulative impacts. In this event, documentation and mitigation procedures laid out in Section 106 of the National Historic Preservation Act would need to be followed to minimize the effect of this action.

9.3.3.8 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact air quality, including other Federal and non-Federal projects listed in Table 9-13. The geographic area of interest for the Pineland site is Sabine and San Augustine counties.

The emissions related to building and operating a nuclear power plant at the Pineland site alternative would be similar to those associated with the proposed location at CPNPP. The air quality attainment status for both Sabine and San Augustine counties as set forth in 40 CFR 81.344 reflects the effects of past and present emissions from all pollutant sources in the region. Sabine and San Augustine counties are not out of attainment of any NAAQ.

The atmospheric emissions related to building and operating a nuclear power plant at the CPNPP site in Somervell County, Texas, are described in Chapters 4 and 5. The criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of the criteria pollutants at the CPNPP site were evaluated and also determined to be SMALL.

Reflecting on the projects listed in Table 9-13, they are not expected to be significant with respect to emission of criteria air pollutants. The industrial projects listed in Table 9-13 would have *de minimis* impacts, and it is therefore unlikely that the air quality in the region would degrade to the extent that the region is in nonattainment of NAAQs.

The air quality impact of the Pineland site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned sources, that would have emissions during site development that would, in combination with emissions from the Pineland site, result in degradation of air quality in the region.

Releases from operation of two units at the Pineland site would be intermittent and made at low levels with little or no vertical velocity. The air quality impacts of other general emissions sources in the area are included in the baseline air quality status. The cumulative impacts from emissions from the Pineland site and the aforementioned sources could be noticeable but not destabilizing. The cumulative impacts from emissions of effluents from the Pineland site and the aforementioned sources could be noticeable but not destabilizing.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.5. The impacts of the emissions are not sensitive to location of the source. Consequently, the discussion in Section 7.5 is applicable to a nuclear power plant located at the Pineland site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions of the project at the Pineland site.

Cumulative impacts to air quality resources are estimated based on the information provided by Luminant and the review team's independent evaluation. Other past, present and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the Pineland site and other projects could be noticeable but not destabilizing. The national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions from the Pineland site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be SMALL for criteria pollutants and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the Pineland site would be insignificant for both criteria pollutants and GHG emissions.

9.3.3.9 Nonradiological Health Impacts

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact nonradiological health, including other Federal and non-Federal projects listed in Table 9-13. This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Pineland site on the Sam Rayburn reservoir. The Pineland site is a greenfield site, not currently owned by Luminant. Additionally, the Pineland site would not require the use of a BDTF to treat blowdown water discharges.

For the analysis of nonradiological health impacts at the Pineland site, the geographic area of interest is considered to include projects within a 5-mi radius from the site's center based on the localized nature of the impacts. Only one unincorporated area of population is found in this radius, but there is a seasonal influx of tourists, because the site is between the Angelina and Sabine National Forests (Luminant 2007). In addition, there are approximately 300 fishing contests held annually on the reservation. For impacts associated with transmission lines, the geographic area of interest in the transmission line corridor.

The building activities that have the potential to impact the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the transport of construction materials and personnel to and from the site. The operation-related activities that have the potential to impact the health of members of the public and workers includes exposure to etiological agents, noise, EMFs, and impacts from the transport of workers to and from the site.

Building Impacts

Nonradiological health impacts to construction workers and members of the public from building two nuclear units at the Pineland site would be similar to those evaluated in Section 4.8 for the CPNPP site. These impacts include noise, vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. Applicable Federal and State regulations on air quality and noise would be met during the site preparation and building phase. The incidence of construction worker accidents would not be expected to be different from the incidence of accidents estimated for the CPNPP site Some modifications to the transportation routes immediately near the Pineland site may be warranted to facilitate traffic flow. The Pineland site is located in a rural area, and nonradiological health impacts from building would likely be negligible on the surrounding populations.

Some current pipelines through the site may require relocation (Luminant 2007). Proposed future actions would include transmission line development and/or upgrading, and transportation upgrades, including improvements to U.S. 96, which would both occur throughout the designated geographical areas of interest. An additional 345 kV transmission line is already planned for the area (Luminant 2009a).

In the past, the construction of the Sam Rayburn Dam (10 mi away) may have had similar nonradiological impacts on the public and workers. There are no major current construction projects in the geographic area of interest that would cumulatively impact nonradiological health. Part of the proposed improvements to U.S. Highway 59 would be within 5 mi of the site.

Operational Impacts

Nonradiological health impacts from operation of two nuclear unit on occupational health and members of the public at the Pineland site would be similar to those evaluated in Section 5.8. Occupational health impacts to workers (e.g., falls, electric shock or exposure to other hazards) at the Pineland site would likely be similar to those evaluated for workers at the new units at the CPNPP site

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. Luminant's current safety and health programs promote safe work practices and respond to occupational injuries and illnesses. The same or a similar program would be expected for new units at the Pineland site. Health impacts to workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be minimal.

Exposure to the public from water-borne etiological agents from the MDCTs would not likely increase the incidence of water-borne diseases in the vicinity of the site. Noise and EMF exposure would be monitored and controlled in accordance with applicable OSHA regulations. Effects of EMF on human health would be minimized by conformance with NESC criteria. Nonradiological impacts of traffic associated with the operations workforce would be less than the impacts during construction. Road improvements during construction would also minimize impacts during operation of the two new units.

There are no identified past and present activities in the geographic areas of interest that could have nonradiological impacts to the public or workers. In the future, these facilities, the proposed transmission line systems, and growth and future urbanization would have nonradiological impacts to the public and workers, and these impacts would be similar to those described for the proposed two new units at the CPNPP site.

The review team is also aware of the potential climate changes that could affect human health; a recent compilation of the state of the knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in any reservoir that would be used. The review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of water-borne illness.

Summary

Based on the information provided by Luminant and the review team's independent evaluation, the review team expects that the impacts to nonradiological health from construction and operation of a new unit at the Pineland site would be similar to the impacts evaluated for the CPNPP site. These impacts would be localized and managed through adherence to existing regulatory requirements. The review team concludes, therefore, that the cumulative impacts would be SMALL.

9.3.3.10 Radiological Health Impacts of Normal Operations

The following impact analysis includes impacts from building activities and operations for two nuclear units at the Pineland alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact radiological health, including other Federal and non-Federal projects listed in Table 9-13. As described in Section 9.3.3, the Pineland site is an undeveloped site in the east Texas timberlands near the small town of Pineland; there are currently no nuclear facilities on site. The geographic area of interest is the area within a 50-mi radius of the Pineland site. There are no major facilities that result in regulated exposures to the public or biota within the 50-mi radius of the Pineland site. However, there are likely to be hospitals and industrial facilities within 50 mi of the Pineland site that use radioactive materials.

The radiological impacts of building and operating the proposed two MHI US-APWR units at the Pineland site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. These impacts are expected to be similar to those estimated for the CPNPP site. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Pineland site. This conclusion is based on data from the REMP in place around currently operating nuclear power plants.

Based on the information provided by Luminant and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed MHI US-APWRs and other existing and planned projects and actions in the geographic area of interest around the Pineland site would be SMALL.

9.3.3.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the Pineland alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact radiological health from postulated accidents, including other Federal and non-Federal projects and those projects listed in Table 9-13. As described in Section 9.3.3, the Pineland site is a greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest considers existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Pineland site. There are no existing or proposed reactors that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Pineland site.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design basis accidents (DBAs) at the CPNPP site would be minimal for US-APWRs. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The US-APWR design is independent of site conditions, and the meteorology of the Pineland and CPNPP sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Pineland site would be minimal.

Because the meteorology, population distribution, and land use for the Pineland alternative site are expected to be similar to the proposed CPNPP site, risks from a severe accident for a US-APWR reactor located at the Pineland alternative site are expected to be similar to those analyzed for the proposed CPNPP site. These risks for the proposed CPNPP site are presented in Tables 5-23 and 5-24 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Pineland alternative site would be SMALL.

9.3.4 The Tradinghouse Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Tradinghouse site in McLennan County, Texas. The

Tradinghouse site is located approximately 8 mi east of Waco, Texas, and the site is owned by Luminant; a fossil-fueled power plant was in operation at the site until December 2009.

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if implemented at the Tradinghouse site and other actions in the same geographical area were considered. This assessment includes the impacts of NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Tradinghouse site. Other actions and projects considered in this cumulative analysis are described in Table 9-18.

The CPNPP site is approximately 70 mi from the Tradinghouse site and was therefore not included in this analysis. The only other nuclear power plant currently operating in Texas is the South Texas Project, near Bay City, Texas. The South Texas Project plant is approximately 200 mi south-southeast of the Tradinghouse site and is therefore also not included in this analysis.

9.3.4.1 Land Use

The Tradinghouse site is located in McLennan County, Texas, approximately 8 mi east of the City of Waco. The site occupies approximately 2010 ac and, according to data from the National Wetlands Inventory, includes approximately 220 ac of wetlands (Luminant 2009a). The site is currently owned by Luminant and housed two gas-fired power-generating units that were taken out of service in 2009. The majority of the site is covered by an impoundment, Tradinghouse Creek Reservoir, which provided water to the power plant. The remainder of the site is fairly flat and covered by grassland and evergreen and deciduous forest. The site is outside the 100-yr floodplain. The site is not subject to local zoning regulations. Vehicular access to the site is provided by Lake Felton Parkway, and a rail line is located approximately 5 to 10 mi south of the site.

Tradinghouse Creek Reservoir, although owned by Luminant and designed to support the gas-fired power plant, is used by the local population for fishing, swimming, and passive recreation. McLennan County Park, a county-maintained picnic area with boat ramps, is located on leased land on the opposite bank of the reservoir from the power plant site, and land on the upper reaches of the reservoir (approximately 2 mi east of the potential reactor locations) is leased to the Boy Scouts of America. Because the site was recently used for energy production, building and operating two nuclear generating units would not substantially change the current land use of the Tradinghouse site. The impact of site disturbance activities would be similar to that described for the CPNPP site. While the presence of two nuclear power plants would necessitate increasing the security of the site, the public would likely continue to have access to Tradinghouse Creek Reservoir. Impacts on recreational use, of the reservoir, including impacts to McLennan County Park and the area leased to the Boy Scouts, would be similar to impacts associated with the current gas-fired power plant.

Offsite impacts on land use would include constructing a rail spur to the site. The rail spur would be between 5 and 10 mi long and would affect mostly grass and scrub land used primarily for livestock grazing.

Table 9-18. Projects and Other Actions Considered in the Cumulative Analysis at the Tradinghouse Site

Project Name	Summary of Project/Activity	Location	Status
Energy Projects			
Tradinghouse Power Plant	Two gas-fired units that provide electric power to customers in the area	Adjacent to Tradinghouse site	Both units were to be taken out of service by end of 2010[(a)]; the units were actually taken out of service in 2009.
Limestone Electric Generating Station	Currently comprised of two lignite/coal-fueled steam units, with a combined 1700 MW capacity. The proposed expansion project would add a third 744 MW unit	About 50 mi southeast	Units 1 and 2 operational. Unit 3 expected to begin operating in 2012[(b)]
Streetman Expanded Shale and Clay Plant	Lightweight aggregate production facility	About 30 mi southeast	Operational.[(c)]
Parks			
McLennan County Park	Park managed by McLennan County for public recreation. Park has two public boat ramps with parking but no public campgrounds	Southern shore of Tradinghouse Creek Reservoir	Operational.[(d)]
Other parks, forests, and reserves	Numerous State and National parks, forests, reserves, and other recreational areas are located within a 50-mi region	Throughout 50-mi region	Parks are currently being managed by National, State, and/or local agencies.
Other Actions/Projects			
Waco Airport Runway Improvements	$3.2 million in infrastructure improvements funded by the Department of Transportation under the American Recovery and Reinvestment Act	About 15 mi west	Proposed.[(e)]
China Springs Water System Improvements	$3.1 million in new wells and irrigation infrastructure improvements funded by the Department of Agriculture under the American Recovery and Reinvestment Act	About 20 mi northwest	Proposed.[(f)]
Various hospitals and industries that use radioactive materials	Medical and other isotopes	Within 50 mi	Operational in nearby cities and towns.

Table 9-18. (cont'd)

Project Name	Summary of Project	Location	Status
Future Urbanization	Building of housing units and associated commercial buildings; roads, bridges, and rail; building of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land use planning documents	Throughout region	Building would occur in the future, as described in local land use planning documents.

(a) Source: Smith 2010
(b) Source: NRG 2009
(c) Source: EPA 2009g
(d) Source: TPWD 2009d
(e) Source: RATB 2010c
(f) Source: RATB 2010a

Six existing transmission line ROWs exit the Tradinghouse site and pass through generally flat to gently rolling agricultural lands. While only existing transmission line ROWs would be used to connect with the potential new nuclear units, Luminant assumes that some of the lines would have to be replaced. It might be necessary to widen parts of some ROWs to accommodate replacement structures. Detailed information about the design of the transmission lines is not yet available; however, since new ROWs would follow existing ROWs, the land-use impacts of the transmission lines would be minimal.

Cumulative Impacts

The geographic area of interest for consideration of land-use impacts is McLennan County. This area includes most other projects and actions that could combine with development and operation of two nuclear power units at the Tradinghouse site to produce cumulative land-use impacts. The county is located in the Grand Prairie and Blackland Prairie regions which are characterized by flat to rolling terrain (TSHA 2010). Agricultural farmland is the predominant land use, and most industrial uses in the county are agriculturally related (e.g., poultry processing and manufacture of feeds). Sensitive land uses in the larger region include four wildlife management areas: Aquilla approximately 30 mi NNW of the proposed site, Richland Creek approximately 40 mi NE, Gus Engeling approximately 64 mi ENE, and Cedar Creek Islands approximately 71 mi NE.

Historically, land in the area of interest has been used primarily for farming and livestock grazing. Before the Civil War, large cotton plantations were located near the Brazos River with cattle grazing taking place on the surrounding prairie. After the war, the plantations were broken up into smaller tenant farms raising cotton, wheat, and corn. The introduction of new rail lines through the county led to an increase in the use of land to support livestock and also led to the creation of numerous small new communities at rail stops. The county became increasingly industrialized after 1900. Industrial growth accelerated following World War II, leading to a corresponding shift in agricultural land use as tenant farms gave way to much larger commercial agricultural enterprises and cotton cultivation yielded to a more diverse mix of crops (TSHA 2010). According to information provided by Luminant (Luminant 2009a), approximately 81 percent of the land area of McLennan County is devoted to agricultural use. Of this amount, 55 percent is in cropland (primarily cotton, corn, and wheat), and 45 percent supports livestock (cattle, hogs, sheep, and poultry).

The TSDC projects that the population in a seven-county area surrounding the CPNPP site (including Bell, Bosque, Coryell, Falls, Hill, Limestone, and McLennan Counties) will increase by 29.2 percent by the year 2040 (TSDC 2009). Urbanization in the vicinity of the Tradinghouse site would reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat. Building and operating two nuclear power generating units at the site could contribute to urbanization by attracting workers needed to build and operate the facility. Future urbanization trends could noticeably alter land uses in the geographic area of interest.

The report on *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions. The Tradinghouse site is located in the Great Plains region. The GCRP climate models for this region project continued warming in all seasons and an increase of as much as 12°F from 2000 to 2090. Additionally, climate models project that there will tend to be less rainfall in this area. The GCRP states that the precipitation decrease projected for the Great Plains could result in a potential reduction in crop yields and livestock productivity, which may change distribution of agricultural and ranching land, as well as reduce forests and wetlands.

Based on information provided by Luminant and the review team's independent review, the review team concludes that the cumulative land-use impacts of building and operating two new nuclear generating units at the Tradinghouse site would be MODERATE. This conclusion reflects primarily the impacts of building a rail connection to the site and, to a lesser extent, the indirect land-use impacts associated with increased urbanization. NRC-authorized construction and operation of the two new nuclear units at the Tradinghouse site, which do not include preconstruction activities such as building the rail spur, would not be a significant contributor to the MODERATE impact. However, the incremental contribution of the overall project, including preconstruction, would be noticeable.

9.3.4.2 Water Use and Quality

The Tradinghouse site is on the shore of Tradinghouse Creek Reservoir, an impoundment of Tradinghouse Creek, a tributary of the Brazos River. The site is in the Brazos River Region G of the Texas State Water Plan and within the jurisdiction of the BRA. For this analysis, the geographic area of interest encompasses Brazos Region G, with primary focus on Tradinghouse Creek Reservoir, the immediate site vicinity, and downstream.

Tradinghouse Creek Reservoir is impounded by an earthen dam with a concrete control structure. The lake has a surface area of 2010 ac, a maximum depth of 42 ft (TPWD 2007b), and a conservation storage capacity of 35,100 ac-ft (TWDB 2007). It was impounded in 1968 (TPWD 2007b). The dam is owned by Luminant, but Luminant does not own the reservoir. The reservoir currently is a source of cooling water for Luminant's two existing natural gas-fired units. Inflow to the reservoir is augmented by water diverted from the Brazos River and delivered by a pipeline from the river to the lake. The Brazos River intake is in a section of the river that is impounded. The principal groundwater aquifer underlying the Tradinghouse site is the Trinity Aquifer, present in the subsurface near the eastern limit of its suitability for water supply (TWDB 2007).

Public recreational use of the Tradinghouse Creek Reservoir would be maintained if a nuclear power plant were to be developed on the site.

Building Impacts

Building a new nuclear power plant at the Tradinghouse site would require some recontouring of the site, resulting in changes in stormwater runoff patterns and a temporary increase in release of sediment into Tradinghouse Creek Reservoir. The relatively flat terrain and the past disturbance of the area would reduce the potential for impacts on hydrology and water quality from site preparation, and implementation of standard control measures would further reduce impacts.

Impacts on groundwater quantity and quality from building new nuclear units would be minimal, as there would be no use of groundwater and the potential for contamination would be minimized by implementation of appropriate management practices.

Operational Impacts

It is assumed that two nuclear power units at the Tradinghouse site would use the same mechanical-draft cooling design as is proposed at the CPNPP site and would consume about the same volume of water (62,400 ac-ft/yr) as is estimated for the CPNPP site. Water needed for operation of the two new nuclear power units would be supplied from Tradinghouse Creek Reservoir and the Brazos River. The existing water rights to 27,000 ac-ft per year that Luminant currently holds would be transferred to the new facility. Additional Brazos River water would be obtained from the BRA. The existing pipeline from the Brazos River would need to be expanded to accommodate the additional water requirements of a nuclear power plant.

Because the Tradinghouse site is in the same water planning region as the CPNPP site, the operational impacts of surface water use on water supply would be similar in kind to those at the CPNPP site (Section 5.2). The magnitude of effects would be less, however, because the redirection of water supply from the retired natural-gas units to the new nuclear units would reduce the new water demand from the Brazos River for operation of the nuclear units.

The potential for adverse impacts on surface water quality would be somewhat less than at CPNPP (Section 5.2.3.1) because salinities in Tradinghouse Creek Reservoir and in the Brazos River near the Tradinghouse site are lower than in Lake Granbury and the Brazos River downstream from Lake Granbury; consequently, the concentration of salts in blowdown water would be less likely to lead to exceedance of critical thresholds in receiving waters. Discharge location for facility effluents has not been identified; effluents could be discharged to either Tradinghouse Creek Reservoir or the Brazos River. Unlike the CPNPP site, it is expected that no BDTF would be required at the Tradinghouse site due to the lack of a need for water treatment prior to discharge. If water treatment were needed at the Tradinghouse site, less water would need treatment than at the CPNPP site.

Potential thermal impacts to the quality of surface waters receiving effluents are expected to be similar to potential thermal impacts at the CPNPP site.

Impacts on groundwater quantity and quality from operation would be minimal, as there would be no use of groundwater, there is little or no use of near-surface groundwater that might be subject to contamination from the facility, and the potential for contamination would be minimized by implementation of appropriate management practices.

Cumulative Impacts

In addition to water use and water quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that impact the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the Tradinghouse site is considered to be the drainage basin of Tradinghouse Creek and the nearby Brazos River and downstream of the site because this is the resource that would be affected by the proposed project. Key actions that have past, present, and future potential impacts to water supply and water quality in the geographic area of interest include the continued operation and maintenance of Tradinghouse Creek Reservoir and the consumption of water from the nearby Brazos River.

The report on *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions, and the Tradinghouse site is located in the southern part of the Great Plains region. The GCRP climate models for this region project continued warming in all seasons, with the summer changes projected to be larger than those in winter for the Tradinghouse area. An increase in of approximately 5°F is projected for the area by the 2080s. Climate change is projected to result in less spring rainfall in the southern Great Plains region and median annual runoff in the subregion that includes the Brazos River basin is estimated to be 2 to 5 percent lower in the years 2041-2060 than it was during the years 1901-1970. Ward (2009) incorporated global climate modeling results into water budgets for four regions of Texas to estimate the potential cumulative impacts on each region's water resources from future climate change and future increases in water demand. His analysis assumes that climate change would increase Texas' statewide air temperatures by 3.6 F and reduce precipitation by 5 percent. In Ward's analysis, the Tradinghouse site is part of the Central Region of Texas. Considering climate conditions and increases in water demand projected for the year 2050, and assuming that new water supplies are developed to meet increased demand, Ward's analysis found that in "normal" years streamflow to the Gulf of Mexico from the Central Region would be 36 percent less than in normal years under baseline conditions for the year 2000. Increased water demand accounts for only a 6 percent reduction in streamflow, with the remainder of the reduction attributed to climate change. Under drought conditions comparable to those of the years 1950 to 1956 (the period that includes the drought of record), the analysis indicates that streamflow to the Gulf would be 24 percent of normal under year 2000 baseline conditions, 18 percent of the normal baseline with year 2050 water demand but no change in climate, and just 3 percent of the normal baseline if the effect of GCC and the effect of year 2050 water demand are combined.

Cumulative Water Use Impacts

Growing demand for water and other cumulative changes are expected to result in lower average streamflows in the Brazos River, more frequent occurrence of low water levels in Brazos River Basin reservoirs, and reduced seasonal variation in streamflow in the Brazos River. If GCC results in decreased precipitation and increased temperatures in the Brazos River Basin as many predictions suggest, the resulting reduction in surface runoff and increase in evapotranspiration would contribute to cumulative impacts on surface water quantity by reducing streamflows in the river and streams such as Tradinghouse Creek. Water management under the SOP and other TWDB-approved strategies would, however, minimize adverse impact on water availability for users with valid water rights under the Texas Water Code. The analysis by Ward (2009) indicates, however, that climate change coupled with increased demand could result in more severe impacts during times of drought. Based on this analysis, the review team concludes that overall cumulative impacts on surface-water quantity for the Tradinghouse site are MODERATE under most conditions because there would be noticeable alterations in the Brazos River System, but LARGE impacts could occur during periods of drought due to the combined effects of increased water demand and climate change. Because water consumption for operation of nuclear units at the Tradinghouse site would be an important contributor to these cumulative impacts, but would be a relatively modest contributor when compared with the impacts of climate change, construction and operation would contribute to the cumulative impacts to surface water use at a MODERATE level..

Water demand in the region is a cumulative source of stress on groundwater supplies, but increased emphasis on sustainable aquifer management is expected to mitigate adverse impacts (TWDB 2007). The review team concludes that cumulative groundwater use impacts for the Tradinghouse site are SMALL. Building and operating nuclear units at the site would not contribute to cumulative groundwater use impacts.

Cumulative Water Quality Impacts

Cumulative impacts of past and ongoing actions have resulted in Tradinghouse Creek Reservoir having a moderately high salinity that generally ranges between 400 and 500 ppm (Tarleton undated). The discharge of blowdown water to the Brazos River from two new nuclear units at this site could contribute to salinity concerns. Cumulative impacts on surface water quality at the Tradinghouse site are judged to be MODERATE.

Potential sources of cumulative adverse impacts to groundwater quality in the region include (1) oil and gas exploration and extraction and (2) spills and leaks at construction and industrial sites. These potential impacts would be localized, and implementation of good engineering practices could avoid or reduce the potential impacts. Accordingly, the review team concludes that cumulative impacts to groundwater quality would be SMALL. Building and operating nuclear units at the site would be a minimal contributor to cumulative groundwater quality impacts because there is little or no use of the near-surface groundwater that might be subject to contamination from the facility and the potential for contamination would be minimized by implementation of appropriate management practices.

9.3.4.3 Terrestrial Resources

The following impact analysis includes impacts from building activities and operations on the Tradinghouse site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact terrestrial resources, including other Federal and non-Federal projects listed in Table 9-19.

The Tradinghouse site lies in the Northern Blackland Prairies ecoregion (Griffith et al. 2004). The site consists of about 2010 ac owned by Luminant where it operated a natural gas-fired steam electric plant on a lake, Tradinghouse Creek Reservoir, about 8 mi east of Waco, Texas. Should this site be selected, it is likely that the ultimate footprint of development would be less than the entire 2010 ac. The terrain is flat to rolling. Vegetation in undeveloped areas of the site consists of a mixture of deciduous forest and brushland containing postoak (*Quercus stellata*), mesquite, and broomsedge (*Andropogon* sp.), as well as various invasive species. Mesquite is widely distributed and is reported to have spread throughout what was previously grassland following suppression of wildfire. Wildlife in the area includes white-tail deer, coyotes, rabbits, bobcats (*Lynx rufus*), beaver (*Castor canadensis*), opossums, fox (*Vulpes vulpes*), raccoon , mink (*Mustela vison*), skunks , Eastern spotted skunk (*Spilogale putorius*), as well as assorted birds, fish, and reptiles; prior to extensive settlement, the county's wildlife also included antelope (*Antilocapra americana*), buffalo (*Bison bison*), and bear (*Ursus americanus*). Typical game species include mourning dove and northern bobwhite (*Colinus virginianus*) on uplands, and eastern fox squirrel (*Sciurus niger*) along bottomlands (Griffith et al. 2004). Of these species white-tailed deer and rabbits are highly sought after by hunters and are considered important species.

Table 9-19. Threatened or Endangered Terrestrial Species that May Occur within 10 mi of Tradinghouse Site

Group	Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]
Birds	Bald eagle	*Haliaeetus leucocephalus*	-	T
	Black-capped vireo	*Vireo atricapillus*	E	E
	Golden-cheeked warbler	*Dendroica chrysoparia*	E	E
	Interior least tern	*Sterna antillarum athalassos*	E	E
Plants	Large-fruited Sand-verbena	*Abronia macrocarpa*	E	E
	Navasota ladies'-tresses	*Spiranhes parksii*	E	E

(a) Federal status: E = endangered; T = threatened.
(b) State status: E = endangered; T = threatened.

Source: TPWD 2009a

Historically, land in McLennan County has been used primarily for farming and livestock grazing, and that is still the case today. About 81 percent of the county is currently in agricultural use. Slightly more than half of this is cropland, and the rest is used for livestock (Luminant 2009a). Less than one percent of the original vegetation of the Texas Blackland Prairies remains and it is scattered in small parcels throughout the region (Griffith et al. 2004). The closest ecologically important areas to the Tradinghouse site are wildlife management areas to the north: Aquilla Lake, Richland Creek, Cedar Creek Islands, and Gus Engeling. The closest of these areas to the Tradinghouse site is 30 mi to the NNW (Aquilla Lake), and thus well outside the geographic area of interest.

Federally and State-Listed Species

No site-specific surveys have been conducted for threatened and endangered species at the Tradinghouse site. The list in Table 9-19 of threatened and endangered species that occur within 10 mi of the Tradinghouse site was compiled from information on rare resource occurrences contained in the Texas Natural Diversity Database. The information was provided by TPWD (TPWD 2009a).

Building Impacts

The Tradinghouse site is relatively level and relatively little grading would be required to prepare the site for development. Most of the area where plant structures would be located is presently occupied by a deteriorating aircraft runway of limited wildlife habitat value. Transmission line upgrades associated with the project would follow existing ROW and thus impacts would be minimal.

Building two new nuclear reactors at the Tradinghouse site would result in the permanent loss of terrestrial habitat over much of the 2010 ac site. The review team believes that the ultimate footprint of development would be less than the estimated 2010 ac reported. Additional loss of terrestrial habitat and habitat fragmentation would occur; however, much of this area is currently (or was formerly) in industrial use. Upgrade of power transmission lines on existing ROWs would be expected to have only short-term impacts. Other sources of impacts to terrestrial resources at the site such as increased traffic, noise, and displacement of wildlife would likely be temporary and/or result in minimal impact.

Operational Impacts

Terrestrial ecological impacts that may result from operation of new nuclear units at the Tradinghouse site include those primarily associated with cooling towers (Luminant 2007).

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the type (mechanical or natural draft), number, and specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the type (mechanical or natural draft for a wet cooling system; dry for a dry system) and number of cooling towers at the site. The impacts of cooling-tower drift and bird collisions for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be of minor significance for nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team concludes, for the purpose of comparing the alternative sites, that the impacts of cooling-tower drift and bird collisions with cooling towers resulting from operation of new nuclear units would be minor.

For MDCTs, the anticipated noise level from cooling-tower operation is anticipated to be approximately 55 dBA at 1000 ft (Luminant 2009a). This noise level is well below the 80 to 85 dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Tradinghouse site would not be likely to disturb wildlife beyond 1000 ft from the source. The noise level for NDCTs would be lower. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

Because the new transmission lines replace already existing lines, and would be located entirely within existing ROW, impacts from operation of the transmission lines, including the impacts of EMFs, would generally continue at present levels.

Cumulative Impacts

The impacts of building and operating two nuclear units at the Tradinghouse site were evaluated by the review team to determine their contribution to cumulative impacts on terrestrial ecological resources. For purposes of this cumulative analysis, the geographic area of interest is defined as McLennan County. This county encompasses the Tradinghouse site, anticipated transmission line ROWs, and adjoining areas. This geographic area of interest is expected to encompass the ecologically relevant landscape features and species. Terrestrial ecological impacts related to building new facilities predominantly consist of loss of habitat due to clearing and grading. Past actions that have affected terrestrial resources include the construction and operation of the two gas-fired units that provide power to customers in the area presently served by the Tradinghouse site, and the agricultural and urban development that has displaced wildlife habitat and increased habitat fragmentation in the surrounding landscape. These changes have displaced wildlife habitat and caused habitat fragmentation.

The TSDC projects that the population in a seven-county area surrounding the Tradinghouse site (including Bell, Bosque, Coryell, Falls, Hill, Limestone, and McLennan Counties) will increase by 29.2 percent by the year 2040 (TSDC 2009). Urbanization in the vicinity of the Tradinghouse site would reduce natural vegetation and open space, resulting in an overall decline in the extent and connectivity of wetlands, forests, and wildlife habitat.

The report on *Global Climate Change Impacts in the United States*, provided by the GCRP, summarizes the projected impacts of future climate changes in the United States (Karl et al. 2009). The report divides the United States into nine regions. The Tradinghouse site is located in the Great Plains region. The GCRP climate models for this region project continued warming in all seasons and an increase of as much as 12°F from 2000 to 2090. Additionally, climate models project that there will tend to be less rainfall in this area. The precipitation decrease projected by the GCRP for the Great Plains could result in a decrease in annual precipitation over time, possibly altering the character of terrestrial habitats. This could further stress terrestrial resources affected by the activities described above.

These activities, including the building and operation of the two new reactors at the Tradinghouse site, would remove or modify terrestrial habitats with the potential to affect important species living or migrating through the area. However, some of the affected area consists of an abandoned aircraft runway of limited habitat value. In addition, the two new nuclear units would replace the retired gas fired units at the Tradinghouse site. The additional cumulative impacts from the two nuclear units would be largely offset by those lost by closure of the gas fired units. Noise, heat, and many other impacts from nuclear plant operation would replace similar impacts that previously resulted from operation of the gas fired units. Thus, while the cumulative impacts within the geographic area of interest to terrestrial resources are and would continue to be noticeable, the contribution of building and operating two new nuclear units at the Tradinghouse site would not substantially add to those impacts.

While the potential cumulative impacts from the other activities described above, could noticeably alter important attributes of terrestrial resources, the incremental contribution of building and operating the two new reactors at the Tradinghouse site to the cumulative impacts would be minimal.

Summary

Impacts to terrestrial ecology resources were analyzed based on the information provided by Luminant and the review team's independent review. Should the proposed facilities be built at the Tradinghouse site, terrestrial resources in the areas that are temporarily disturbed are expected to return to predominantly pre-development conditions. Some habitat would be lost to permanent project structures, but the losses would be minimal due to the already low habitat value present on the site. Although other development activities expected within the geographic area of interest might result in noticeable impacts to terrestrial ecological resources in the landscape surrounding the Tradinghouse site, the potential impacts from building and operating the proposed nuclear facilities at the Tradinghouse site would be minimal and would not exacerbate impacts resulting from the other development actions. The review team therefore concludes that the cumulative impact on terrestrial plants and wildlife from the proposed nuclear project at the Tradinghouse site would be SMALL.

9.3.4.4 Aquatic and Wetlands Resources

Affected Environment

The Tradinghouse site is adjacent to a recently retired natural-gas-fired power plant in McLennan County approximately 8 mi east of Waco. The intake and discharge would be located on Tradinghouse Creek Reservoir on a peninsula extending from the north into the central portion of the reservoir. The reservoir covers an area of 2010 ac at normal water surface elevation and is about 60-ft deep where the earthfill dam crosses the streambed of Tradinghouse Creek. Water levels in the lake can fluctuate widely (Luminant 2007). Adjacent to the proposed site is existing recently retired gas-fired power facility with two units.

Tradinghouse Creek is a tributary to the middle Brazos River near Waco. Inflow to the reservoir is augmented by pumping water through a 36-in.-diameter pipeline from the Brazos River. The shoreline is lined by cattails and bulrushes, and adjacent land is predominantly undeveloped and wooded. The geographic area of interest for aquatic and wetland resources includes the site and adjacent water bodies and wetlands in the vicinity, including Tradinghouse Reservoir, Tradinghouse Creek below the reservoir, and the reach of the Brazos River from the City of Waco and the mouth of Tradinghouse Creek south to the border of McLennan County. McLennan County encompasses Tradinghouse Reservoir and the existing transmission line ROWs that would be used by the proposed facility, and the reach of the Brazos River with the greatest potential to be affected by hydrology or water quality effects.

Important Species

Important species in the aquatic community of Tradinghouse Creek Reservoir include game fish. The reservoir provides good fishing, particularly for largemouth bass. Other common game fish in the reservoir include white crappie, catfish, white bass, and bluegill and other sunfish. Another game fish present is the red drum (*Sciaenops ocellata*), which is an introduced estuarine/marine fish that is stocked in Tradinghouse Creek Reservoir and grows well in the warm, slightly salty conditions of Tradinghouse Creek (TPWD 2007b, TPWD 2009c).

No Federally listed threatened or endangered aquatic species occur in McLennan County. However, two fish species potentially occurring in the county, the sharpnose shiner (*Notropis oxyrhynchus*) and smalleye shiner (*N. buccula*), are designated as Federal candidates for listing. Three State-listed aquatic species potentially occur in McLennan County, all of which are freshwater mussels with a State status of threatened. Aquatic species with the potential to occur in McLennan County and having a Federal or State status or designation as species of concern are included in Table 9-20. Listed species are described below.

The characteristics and life histories of the sharpnose and smalleye shiners were described in Section 2.4.2.3.4. Both species are endemic to the Brazos River basin, occur in riverine habitats, and likely have been extirpated from the middle reaches of the Brazos River, including the area near Tradinghouse Creek. Given these characteristics, neither species would occur in Tradinghouse Creek Reservoir, neither would be likely to occur downstream of the dam in Tradinghouse Creek or the Brazos River, and neither would be adversely affected by construction or operation of a cooling water system at the Tradinghouse site.

The habitat requirements of the Texas fawnsfoot (*Truncilla macrodon*) are not well known; it appears to occur in rivers and larger streams with moderate flows, to be intolerant of impoundments, and to utilize substrates that may include gravel, sand, or sandy mud. The false spike (*Quincuncina mitchelli*), which possibly has been extirpated in Texas, probably occurred in medium to large rivers (including the Brazos River) and utilized substrates ranging from mud to mixtures of sand, gravel, and cobble. The smooth pimpleback (*Quadrula houstonensis*) occurs in rivers and streams of moderate to small size and moderate-size reservoirs; it prefers substrates of mixed mud, sand, and fine gravel; it tolerates moderate to very slow flows; and it appears not to tolerate dramatic fluctuations in water levels or substrates of scoured bedrock or shifting sand (TPWD 2010b). Of the State-listed mussels, only the smooth pimpleback inhabits reservoirs and, thus, has a potential to occur in the lake and, if present, to be directly affected by the intake or discharge of water by the facility. The listed Texas fawnsfoot and false spike potentially could occur in Tradinghouse Creek or the Brazos River downstream of the reservoir. The pistolgrip and rock pocketbook are State species of concern that also may occur downstream in the Brazos River, and the rock pocketbook also can occur in reservoirs, so it may be present in Tradinghouse Reservoir.

Table 9-20. Federally and State-Listed Aquatic Species and State Species of Concern Potentially Occurring in the Vicinity of the Tradinghouse Site

Scientific Name	Common Name	Federal Status[(a)]	State Status[(b)]	Counties[(c)]
		Fishes		
Notropis oxyrhynchus	sharpnose shiner	FC	SSC	McLennan
Notropis buccula	smalleye shiner	FC	SSC	McLennan
Micropterus treculii	Guadalupe bass	---	SSC	McLennan
		Mussels		
Quadrula houstonensis	smooth pimpleback	---	ST	McLennan
Quincuncina mitchelli	false spike	---	ST	McLennan
Truncilla macrodon	Texas fawnsfoot	---	ST	McLennan
Tritogonia verrucosa	pistolgrip	---	SSC	McLennan
Arcidens confragosus	rock pocketbook	---	SSC	McLennan

(a) Federal status definitions: FC = Federal candidate for listing.
(b) State status definitions: ST = State-listed, threatened; SSC = State species of concern.
(c) Counties listed are those in which components of the alternative would be located and where TPWD has identified the potential for occurrence of the species based on evidence such as recorded occurrences, historic ranges, field guides, staff expertise, and scientific publications.

Source: TPWD 2010b

Building Impacts

The aquatic impacts from building of the proposed type of closed-cycle cooling system at this site likely would be similar to the impacts of building such systems at other sites. These impacts would be minor and involve localized and mostly temporary effects from building intake and discharge structures, which probably would be located in areas of relatively deep water near the lake shore. Building activities could increase stormwater runoff due to increased areas of impervious surface, resulting in increased storm flows in streams and other drainages on the site. Soil disturbance combined with increased runoff could increase sediment transport into the reservoir. TCEQ requires stormwater permits for construction sites of 1 ac or more, and obtaining a permit requires development and implementation of a stormwater pollution prevention plan specifying the BMPs to be used in protecting water bodies (TCEQ 2008). Compliance with permitting requirements and associated use of BMPs to minimize or prevent stormwater impacts are expected to minimize erosion-related impacts on surface waters and wetlands. BMPs that likely would be implemented under an SWPPP include the installation and maintenance of silt fencing, the maintenance of vegetated buffer zones between water bodies and areas undergoing development, and the diversion of runoff to sediment retention basins.

Six transmission line ROWs currently extend from the Tradinghouse site due to the presence of the existing gas-fired power facility. These existing ROWS would be used to connect the potential new nuclear units, though Luminant assumes that some lines within those ROWs would need to be replaced. Because existing ROWs would be used, the potential for impacts on water bodies and wetlands from upgrading the transmission lines would be negligible.

Aquatic species would be unlikely to be substantially affected by the loss of small areas of aquatic habitat potentially within the footprint of facilities that would be built for the project. Important species such as game fish are highly mobile and would be able to avoid areas where building activities occur. State-listed mussels are essentially immobile and could be lost if present within the relatively small building footprint within the reservoir. Only the smooth pimpleback potentially could occur in this habitat. Thus, building of water intakes and discharge structures would be expected to have minimal impacts on aquatic resources. However, if a State-listed mussel species were to be present in the reservoir in an area of building activity, impacts may be noticeable.

Operational Impacts

Operation of proposed new nuclear units at the Tradinghouse site could affect aquatic resources as a result of entrainment and impingement of organisms at the cooling water intake and thermal, chemical, and physical effects from the discharge of cooling water and other effluents. An evaluation of impacts on aquatic biota resulting from operation of the intake and discharge cannot be conducted in detail due to lack of specific information that would have to be developed (i.e., more than reconnaissance-level information), such as the design and location of cooling water intakes and discharges at this site. Consequently, the review team relies upon the conclusions in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996) to inform the assessment of aquatic impacts from the operation of the cooling system.

NUREG-1437 (NRC 1996) evaluated aquatic ecological impacts resulting from operation of existing nuclear power plants. The aquatic impacts from operation of cooling systems for existing power plants were found to be of minor significance for all plants that utilize closed-cycle cooling systems with cooling towers. In evaluating this alternative site, the review team assumed that the new nuclear power plant that would be constructed at this site would utilize a similar cooling system, consisting of a closed-cycle system with cooling towers. Consequently, the types of aquatic ecological impacts that would result from operation of the new nuclear units would be similar to those of existing nuclear power plants that have closed-cycle cooling systems with cooling towers.

With regard to cooling water intakes, NRC found that entrainment and impingement of fish and shellfish have not been a problem at existing facilities that use closed-cycle systems with cooling towers. Minimal impacts from intake operation would be expected if it is assumed the following conditions would apply at this site in accordance with EPA's Phase I regulations for new facilities under Section 316(b) of the CWA (66 FR 65256): (1) a closed-cycle cooling system, (2) a maximum through-screen velocity of 0.5 ft/s at the cooling water intake, (3) an intake flow that would not disrupt the natural thermal stratification or turnover pattern of the lake at the Tradinghouse site, and (4) location of the new intake in an area of the source waterbody away from areas with the potential for high productivity of fish or other important organisms (66 FR 65256). With regard to effluent discharges from facilities with closed-cycle cooling systems, NRC found that the thermal and water-quality effects from the relatively small volumes of blowdown water discharged did not have more than minor impacts on the aquatic ecology of the receiving waterbody (NRC 1996).

Thermal impacts on Tradinghouse Reservoir from the discharge of cooling water are expected to be minor because cooling towers would be used, the large volume of water in the reservoir likely would be sufficient for dissipation of thermal inputs, and discharges would need to comply with requirements of a State-issued discharge permit. The relative locations of the intake and discharge are not known at this time, but it is assumed they would be on opposite sides of the peninsula. Discharge of cooling tower blowdown and other effluents, such as treated sanitary wastewater, likely would have minor effects on chemical water quality in the reservoir, as the volume of water in the reservoir would be sufficient for assimilation of dissolved materials in facility effluents. In periods of low flow through the reservoir, there may be a potential for recirculation of water from the discharge to the intake. Such a recirculation pattern may result in constituent concentrations that are locally elevated above ambient concentrations in a larger than normal area in the vicinity of the diffuser. However, the effluent concentrations discharged likely would remain below water quality criteria limits.

Water quality effects downstream from Tradinghouse Reservoir are likely to be minimal assuming State-issued permit limits are met at the discharge in the reservoir. Thus, aquatic species are unlikely to be adversely affected by water quality, thermal, or other physical effects from operations in the reservoir or the creek and river downstream. However, the consumption of water from the Brazos River system by the proposed new nuclear units at the Tradinghouse site likely would result in alterations by the BRA of water management within its system and could result in altered flow regimes and reduced river flows downstream.

Reduced flows would reduce the average extent and volume of aquatic habitat available in the river relative to existing conditions. As a result, fish and invertebrates could lose protective cover and nesting, spawning, foraging, and nursery areas. Such habitat losses could result in increased predation, crowding, and competition. Lower flows also can affect substrate characteristics by altering processes such as sediment transport, suspension, siltation, and sorting. Changes in sediment composition and other characteristics could alter the benthic habitats available on and within the substrate for invertebrates, fish, and their eggs. In addition, lower flows and shallower water can increase water temperatures and reduce turbulence, which may reduce dissolved oxygen levels in some areas of the river. Effects on riverine habitat such as these potentially could result in reductions in populations of some species of fish and invertebrates.

The magnitude of potential changes in flow in the Brazos River above and below the withdrawal for Tradinghouse Reservoir has not been defined, and the likelihood and magnitude of associated effects on the aquatic communities of these river reaches similarly are undefined. Riverine organisms are adapted to the highly variable flow regime of the Brazos River, and there is uncertainty about the magnitude of the impacts on riverine biota that may result from the relatively limited alterations in river flow that may be associated with the operation of new nuclear units at the Tradinghouse site. Such impacts may range from negligible to noticeable depending on the species and the degree to which its habitat is affected.

As discussed above, important species known to be present in the reservoir and potentially affected by the operation of the proposed new nuclear power facility are game fish. Also, there is a possibility that a State-listed mussel, the smooth pimpleback, could occur in the reservoir. It is unlikely that such species or their habitats would be substantially affected by the relatively small volumes of water withdrawn and discharged by the closed-cycle cooling system proposed for the Tradinghouse site (NRC 1996). Three mussels that are State-listed as threatened as well as others that are State species of concern, could occur in Tradinghouse Creek or the Brazos River in the area of interest. These mussels as well other rare species and game fish could be adversely affected, as described above, by reduced flows or other hydrological changes in the Brazos River.

Cumulative Impacts

The impacts of building and operating two nuclear units at the Tradinghouse site were evaluated by the review team to determine the magnitude of their contribution to cumulative impacts on aquatic and wetlands resources in the geographic area of interest. Past actions that have affected aquatic resources in the area include water use for operation of the recently retired electric power facility at the site, operation of Tradinghouse Dam, water use for and runoff from agriculture, water use and sewage discharge from some residential development, and recreational fishing. Many of the past actions have continued and are present activities as well. Possible future actions that could affect aquatic resources in the geographic area of interest include the change in operating status of the gas-fired power facility at the site, continued operation of Tradinghouse Reservoir and construction of water and/or wastewater treatment and distribution facilities in conjunction with future residential and commercial development (Table 9-20), and continued recreational fishing in the lake. In addition, GCC could alter aquatic habitats in the area.

Future urbanization in the geographic area of interest could contribute to decreases in undeveloped land, including wetlands, as well as increased demand for water and reduced water quality. The TSDC projects that the population in a seven-county area surrounding the Tradinghouse site (including Bell, Bosque, Coryell, Falls, Hill, Limestone, and McLennan Counties) will increase by 29.2 percent by the year 2040 (TSDC 2009). Future urbanization in the geographic area of interest could contribute to additional demand for water, increased need for wastewater assimilation, reduced water quality and increased fishing pressure. Urbanization in the vicinity of the Tradinghouse site would reduce natural vegetation and open space, resulting increased stormwater runoff and an overall decline in the extent and connectivity of wetlands and aquatic habitat. Cumulatively, these effects on water quality would likely have minimal impacts on aquatic organisms.

The report on *Global Climate Change Impacts in the United States* (Karl et al. 2009) summarizes the projected impacts of future climate changes in the United States. The report divides the United States into nine regions, and the Tradinghouse site is located in the Great Plains region. The climate models for this region project continued warming in all seasons, with the summer changes projected to be larger than those in winter for the Tradinghouse area. An increase in temperature of approximately 5°F is projected for the area by the 2080s. More frequent extreme events, such as heat waves, droughts, and heavy rainfall, will affect this region in combination with the projected decreases in annual precipitation. Such factors would reduce aquatic habitat causing shifts in species ranges, diversity, and abundances in the geographic area of interest for the Tradinghouse site.

Summary

The review team concludes that the impacts on aquatic resources from building two new nuclear units at the Tradinghouse site would be noticeable but not destabilizing to important attributes of aquatic resources. The review team also concludes that the impacts from operation of two new units would range from minimal to noticeable. Based on the information provided by Luminant and the review team's independent evaluation, the review team concludes that the cumulative impacts from past, present, and reasonably foreseeable activities on aquatic and wetlands resources in the geographic area of interest would be SMALL to MODERATE. The incremental contribution of building and operating two new reactors at the Tradinghouse site to cumulative impacts on aquatic and wetlands resources in the geographic area of interest would range from minimal to noticeable.

9.3.4.5 Socioeconomics

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact socioeconomics, including the other Federal and non-Federal projects listed in Table 9-8. For the analysis of socioeconomic impacts at the Tradinghouse site, the geographic area of interest is the nine-county area around the Tradinghouse site (Table 9-21) that was evaluated in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007). In evaluating the socioeconomic impacts of site development and operation at the Tradinghouse site, the review team used the population and labor force data provided in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007).

Table 9-21. Population and Labor Force in McLennan County, Texas, and the Other Counties Surrounding the Tradinghouse Site

County	Total Population 2006	Projected Total Population 2010	Total Labor Force 2000	Total Construction Labor Force 2000
McLennan	226,189	235,010	94,076	9822
Bell	257,897	272,339	90,230	9382
Falls	17,547	18,511	6359	872
Limestone	22,720	23,174	8533	1026
Navarro	49,440	52,604	18,477	2167
Hill	35,806	38,384	13,365	1775
Coryell	72,667	74,141	21,078	2473
Bosque	18,058	18,609	7101	993
Ellis	139,300	162,563	53,528	7032
Total	**773,105**	**895,380**	**312,747**	**35,542**

Source: Luminant 2007

The Tradinghouse site is located in McLennan County, Texas, approximately 8 mi east of the City of Waco. Section 9.3.4.1 contains a description of the Tradinghouse site.

As indicated in Table 9-21, McLennan County and the eight other counties surrounding the Tradinghouse site have a combined 2010 population of 895,380, a combined 2000 labor force of 312,747, and a combined 2000 construction labor force of 35,542. Therefore, the Tradinghouse site has a relatively small labor pool from which to draw construction and operations workers, which would result in more in-migrating workers. More in-migrating workers would result in larger socioeconomic impacts, especially to housing and public services.

The review team concludes that building and operating a two-unit nuclear power plant at the Tradinghouse site would have MODERATE to LARGE socioeconomic impacts in McLennan County and the surrounding counties for three reasons. First, although the site is not a greenfield site, some rail and infrastructure development would be required in the surrounding area to access and use it. Second, the Tradinghouse site has a relatively small labor force from which to draw construction and operations workers, so large numbers of workers would need to in-migrate. Third, the Tradinghouse site is in a rural area that likely would not have the existing housing, infrastructure, and public services to support the in-migration of a large number of workers and their families. In addition, building and operating a nuclear power plant at the Tradinghouse site could adversely affect or eliminate recreational use of Tradinghouse Creek Reservoir (Section 9.3.4.1). The reservoir has one public park (McLennan County Park) and is popular with local anglers.

9.3.4.6 Environmental Justice

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact socioeconomics, including the other Federal and non-Federal projects listed in Table 9-8. For the analysis of environmental justice impacts at the Tradinghouse site, the geographic area of interest is the nine-county area around the Tradinghouse site (Table 9-22) that was evaluated in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007). In evaluating the environmental justice impacts of site development and operation at the Tradinghouse site, the review team used the minority and low-income data provided in *Luminant Nuclear Power Plant Siting Report* (Luminant 2007).

Table 9-22. Minority and Low-Income Percentages in McLennan County, Texas, and the Other Counties Surrounding the Tradinghouse Site

County	Total Population 2006	Percent Non-minority[(a)]	Percent Minority[(b)]	Percent Low Income
McLennan	226,189	62.0	38.0	18.3
Bell	257,897	54.8	45.2	13.2
Falls	17,547	55.0	45.0	21.7
Limestone	22,720	64.4	35.6	7.8
Navarro	49,440	62.1	37.9	17.1
Hill	35,806	75.7	24.3	16.2
Coryell	72,667	60.2	39.8	13.7
Bosque	18,058	81.7	18.3	19.6
Ellis	139,300	66.1	33.9	10.7
Total	**773,105**	**64.7**	**35.3**	**16.5**

(a) Non-minority = White persons, not Hispanic.
(b) Minority = Black persons, American Indian and Alaska Native persons, Asian persons, Native Hawaiian and Other Pacific Islander persons, and Hispanic persons.

Sources: Luminant 2007; USCB 2009b

As indicated in Table 9-22, the nine counties surrounding the Tradinghouse site have a combined minority percentage of 35.3 percent. This percentage of minority residents is much lower than that for the State of Texas (61.1 percent) (Table 2-27). Thus, when compared to the State of Texas, the Tradinghouse site has a small minority percentage for purposes of environmental justice analysis.

In terms of low-income residents, the nine counties surrounding the Tradinghouse site have a combined low-income percentage of 16.5 percent. This percentage of low-income residents is slightly higher than that for the State of Texas (14.0 percent) (Table 2-27). However, when compared to the State of Texas, the Tradinghouse site does not have a significantly higher low-income percentage for purposes of environmental justice analysis.

In Section 9.3.4.5, the review team concluded that building and operating a new two-unit nuclear power plant at the Tradinghouse site would have MODERATE to LARGE socioeconomic impacts in McLennan County and the surrounding counties. Based on that conclusion, the review team concludes that the socioeconomic impacts of building and operating at the Tradinghouse site could have MODERATE environmental justice impacts by disproportionately and adversely affecting low-income populations, especially in the area of housing price and availability.

9.3.4.7 Historic and Cultural Resources

The following impact analysis includes impacts from building and operating two new nuclear power plants at the Tradinghouse site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact historic and cultural resources, including Federal and non-Federal projects listed in Table 9-18. For the analysis of historic and cultural impacts at the Tradinghouse site, the geographic area of interest is considered to be the APE that would be defined for this proposed undertaking. This includes the physical APE, defined as the area directly affected by the site-development and operation activities at the site and transmission lines, and the visual APE. The visual APE is defined as the additional 1-mi radius around the physical APE as a reasonable assumption for defining a maximum distance from which the structures can be seen.

Reconnaissance activities in a cultural resource review have a particular meaning. For example, these activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing its EIS, the review team relies upon reconnaissance-level information to perform its alternative site evaluation. Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the Tradinghouse site the following information was used:

- Luminant ER (Luminant 2009a);
- Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4, Luminant Nuclear Power Plant Siting Report (Luminant 2007)
- Texas Historical Commission's Texas Archaeological Sites Atlas (THC 2010); and,
- NRC Alternative Sites Visit, February 2009.

The Tradinghouse site is in industrial site located in McLennan County in central Texas situated partially in the Grand Prairie and Blackland Prairie region (Luminant 2007). Historically, the site has been used for agricultural purposes. Currently the site hosts a recently retired gas-fired electric generating plant. The major industries in the area include poultry processing, manufacture of prepared feeds, and dairy production.

The Texas Historical Commission's Archaeological Sites Atlas indicates that there are 17 NRHP located in McLennan County, Texas (THC 2010). The City of Waco has 12 NRHP sites and 4 National Register Districts (THC 2010) and is located approximately 10 mi from the Tradinghouse site. The City of McGregor contains 1 NRHP site and is located 27 mi from the Tradinghouse site.

According to the Texas Historical Commission's Texas Archaeological Sites Atlas, there are no National Register Properties, National Register Districts, or sites designated as having historic or cultural value in the APE (THC 2010). The project has the potential to affect resources through visual impacts from buildings and transmission lines. Should such properties be subsequently listed on the National Register, then these impacts may result in significant alterations to the visual landscape within the geographic area of interest.

Since the site has been previously disturbed for industrial purposes, historic and cultural resource impacts for a new plant located at the Tradinghouse site would likely be similar to the impacts for a new plant at the CPNPP site as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any portion of the property that has not been previously surveyed at the Tradinghouse site. Other lands that may be acquired to support the plant would also likely require a survey to identify potential historic and archaeological resources, and identification of mitigative measures to offset adverse effects of ground disturbing activities. These studies would likely be needed for areas of potential disturbance at the Tradinghouse site, offsite affected areas, such as mining and waste disposal sites, and along associated corridors where new construction would occur, for example, roads and pipeline corridors. The types of historic and cultural resource impacts resulting from operation of new nuclear units would likely be similar to those of existing nuclear power plants.

The Tradinghouse site contains an existing electric generating facility and transmission lines are available (Luminant 2007). It is possible that the transmission lines currently servicing the site could be used if a nuclear power plant was located at the Tradinghouse site. Therefore, potential impacts have already occurred and no new impacts would affect historic or cultural resources as a result of building and maintaining new transmission line corridors.

The TSDC predicts the average population growth rate will be 29.2 percent from 2010 to 2040 for the 7 counties surround the Tradinghouse site (TSDC 2009). The seven counties included Bell, Bosque, Coryell, Falls, Hill, Limestone, and McLennan counties. The average population growth rate could result in an increase in urbanization in the area. Urbanization includes increases in residential, commercial, industrial, and infrastructure development that could encroach on historic cultural resources near the geographic area of interest.

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the reconnaissance level information, the review team concludes that the cumulative impacts on historic and cultural resources of building and operating new nuclear units on the Tradinghouse site and urbanization would be SMALL. This impact level determination reflects no known cultural resources that could be affected. However, if the Tradinghouse site were to be developed, then cultural resource surveys may reveal important historic properties that could result in greater cumulative impacts.

9.3.4.8 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that impact air quality, including other Federal and non-Federal projects listed in Table 9-18. The geographic area of interest for the Tradinghouse site is McClellan and Waco counties.

The emissions related to building and operating a nuclear power plant at the Tradinghouse site alternative would be similar to those associated with the proposed location at CPNPP. The air quality attainment status for both McClellan and Waco counties as set forth in 40 CFR 81.344 reflects the effects of past and present emissions from all pollutant sources in the region. McClellan and Waco counties are not out of attainment of any NAAQ.

The atmospheric emissions related to building and operating a nuclear power plant at the CPNPP site in Somervell County, Texas, are described in Chapters 4 and 5. The criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of the criteria pollutants at the CPNPP site were evaluated and also determined to be SMALL.

Reflecting on the projects listed in Table 9-18, they are not expected to be significant with respect to emission of criteria air pollutants. The Tradinghouse Power Plant has been retired and would not contribute to air emissions during the development or operation of the Tradinghouse site. The industrial projects listed in Table 9-18 would have *de minimis* impacts, and it is therefore unlikely that the air quality in the region would degrade to the extent that the region is in nonattainment of NAAQs.

The air quality impact of the Tradinghouse site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned sources, that would have emissions during site development that would, in combination with emissions from the Tradinghouse site, result in degradation of air quality in the region.

Releases from operation of two units at the Tradinghouse site would be intermittent and made at low levels with little or no vertical velocity. The air quality impacts of other general emissions sources in the area are included in the baseline air quality status. The cumulative impacts from emissions from the Tradinghouse site and the aforementioned sources could be noticeable but not destabilizing. The cumulative impacts from emissions of effluents from the Tradinghouse site and the aforementioned sources could be noticeable but not destabilizing.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.5. The impacts of the emissions are not sensitive to location of the source. Consequently, the discussion in Section 7.5 is applicable to a nuclear power plant located at the Tradinghouse site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions of the project at the Tradinghouse site.

Cumulative impacts to air quality resources are estimated based on the information provided by Luminant and the review team's independent evaluation. Other past, present and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the Tradinghouse site and other projects could be noticeable but not destabilizing. The national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions from the Tradinghouse site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be SMALL for criteria pollutants and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the Tradinghouse site would be insignificant for both criteria pollutants and GHG emissions.

9.3.4.9 Nonradiological Health

The following impact analysis includes nonradiological health impacts from building activities and operations. The analysis also considers the other past, present, and reasonably foreseeable future actions that impact nonradiological health, including other Federal and non-Federal projects listed in Table 9-18. This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear plant at the Tradinghouse site. The Tradinghouse site, which Luminant already owns, is the site of a recently retired gas-generated power plant. Additionally, the Tradinghouse site would not require the use of a BDTF to treat blowdown water discharges.

For the analysis of nonradiological health impacts at the Tradinghouse alternative site, the geographic area of interest is considered to include projects within a 5-mi radius from the site's center based on the localized nature of the impacts. For impacts associated with transmission lines, the geographic area of interest is the transmission line corridor.

The building activities that have the potential to impact the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the transport of construction materials and personnel to and from the site. The operation-related activities that have the potential to impact the health of members of the public and workers includes exposure to etiological agents, noise, EMFs, and impacts from the transport of workers to and from the site.

Building Impacts

Nonradiological health impacts to construction workers and members of the public from building two nuclear units at the Tradinghouse site would be similar to those evaluated in Section 4.8 for the CPNPP site. The impacts include noise, vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. Applicable Federal and State regulations on air quality and noise would be complied with during the site preparation and building phase. The incidence of construction worker accidents would not be expected to be significantly different from the incidence of accidents estimated for the CPNPP site. The Tradinghouse site hosts a recently retired natural- gas- power generation plant, so that building impacts on the surrounding populations would likely be minimal.

The additional injuries and fatalities from traffic accidents involving transportation of materials and personnel for building of a new nuclear power plant at the Tradinghouse site would be similar to those evaluated in Section 4.8.3 for the CPNPP site and would represent a small fraction of the total traffic accidents. Anticipated construction would use about 5.6 percent of the current total construction workforce. Past actions in the geographic area of interest that have similarly impacted the public and workers from nonradiological resources include construction of the existing gas-fired plant. There are no major current or proposed future construction projects in the geographic area of interest that would cumulatively impact nonradiological health.

Operational Impacts

Nonradiological health impacts from operation of two nuclear units on occupational health and members of the public at the Tradinghouse site would be similar to those evaluated in Section 5.8 for the CPNPP site. Occupational health impacts to workers (e.g., falls, electric shock or exposure to other hazards) at the Tradinghouse site would likely be similar to those evaluated for workers at the new units at the CPNPP site.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. Luminant’s current safety and health programs promote safe work practices and respond to occupational injuries and illnesses. The same or a similar program would be expected for new units at the Tradinghouse site. Health impacts to workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be minimal.

Exposure to the public from water-borne etiological agents at the Tradinghouse site would be similar to the types of exposures evaluated in Section 5.8.1, and the operation of the new units at the alternative sites would not likely lead to an increase in water-borne diseases in the vicinity. Noise and EMF exposure would be monitored and controlled in accordance with applicable OSHA regulations. Effects of EMF on human health would be controlled and minimized by conformance with NESC criteria and adherence to the standards for transmission systems regulated by the PUCT. Nonradiological impacts of traffic associated with the operations workforce would be less than the impacts during building. Mitigation measures taken during building to improve traffic flow would also minimize impacts during operation of a new unit.

The existing transmission lines create nonradiological impacts from operations to the public and workers. The nonradiological impacts from the recently retired power plant would not overlap with any new impacts if the site were to be developed for a nuclear power plant. Continued operations of a park on the reservoir would have little impact. There are no past or present activities in the geographic areas of interest that would have nonradiological impacts to the public or workers similar to those discussed for the proposed nuclear units. In the future, these facilities, the proposed transmission line systems, and growth and future urbanization would have nonradiological impacts to the public and workers, and these impacts would be similar to those described for the proposed two new units at the CPNPP site.

The review team is also aware of the potential climate changes that could affect human health; a recent compilation of the state of the knowledge in this area (Karl et al. 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in any reservoir that would be used. The review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of water-borne diseases.

Summary

Based on the information provided by Luminant and the review team's independent evaluation, the review team expects that nonradiological health impacts from building and operation of two new units at the Tradinghouse site would be similar to the impacts evaluated for the CPNPP site. These impacts would be localized and managed through adherence to existing regulatory requirements. The review team concludes, therefore, that the cumulative nonradiological impacts of construction, preconstruction, and operation on health would be SMALL.

9.3.4.10 Radiological Health Impacts of Normal Operations

The following impact analysis includes impacts from building activities and operations for two nuclear units at the Tradinghouse alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact radiological health, including other Federal and non-Federal projects listed in Table 9-18. As described in Section 9.3.4, the Tradinghouse site is on a lake, approximately 8 mi east of Waco, Texas. The recently retired Tradinghouse Power Plant (two gas-fired units) is located adjacent to the site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the Tradinghouse site. There are no other major facilities that result in regulated exposures to the public or biota within the 50-mi radius of the Tradinghouse site. However, there are likely to be hospitals and industrial facilities within 50 mi of the Tradinghouse site that use radioactive materials.

The radiological impacts of building and operating the proposed two MHI US-APWR units at the Tradinghouse site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. These impacts are expected to be similar to those estimated for the CPNPP site. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Tradinghouse site. This conclusion is based on data collected from the REMP conducted around currently operating nuclear power plants.

Based on the information provided by Luminant and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed MHI US-APWRs and other existing and planned projects and actions in the geographic area of interest around the Tradinghouse site would be expected to be SMALL.

9.3.4.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the Tradinghouse alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that impact radiological health from postulated accidents, including other Federal and non-Federal projects and those projects listed in Table 9-18 within the geographic area of interest. As described in Section 9.3.4, the Tradinghouse site is located in McLennan County, Texas approximately 8 mi east of Waco, Texas. There are currently no nuclear facilities on the site. The geographic area of interest considers existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Tradinghouse site. Table 9-23 summarizes the nearby nuclear facilities.

Table 9-23. Nearby Nuclear Projects/Facilities Considered in the Cumulative Analysis at the Tradinghouse Site

Project Name	Summary of Project	Location	Status
Energy Projects			
Comanche Peak Nuclear Power Plant	Two large scale nuclear reactors	Within 70 mi of the Tradinghouse site	Currently operating

Existing facilities potentially affecting radiological accident risk within this geographic area of interest are the existing CPNPP Units 1 and 2. No other reactors have been proposed within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design basis accidents (DBAs) at the CPNPP site would be minimal for US-APWR DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The US-APWR design is independent of site conditions and the meteorology of the Tradinghouse and CPNPP sites are similar. Therefore, the NRC staff concludes that the environmental consequences of DBAs at the Tradinghouse site would be minimal. Because the meteorology, population distribution, and land use for the Tradinghouse alternative site are expected to be similar to the proposed CPNPP site, risks from a severe accident for a US-APWR reactor located at the Tradinghouse alternative site are expected to be similar to those analyzed for the proposed CPNPP site. These risks for the proposed CPNPP site are presented in Tables 5-23 and 5-24 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing nuclear power plants within the geographic area of interest, which are CPNPP Units 1 and 2, the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR 51, Appendix B, Table B-1). Because of the NRC's safety review criteria, it is expected that risks for any new reactors at the CPNPP site would be well below risks for current-generation reactors and meet the Commission's safety goals. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Tradinghouse alternative site would be SMALL.

9.3.5 Comparison of the Impacts of the Proposed Action and Alternative Sites

This section summarizes the review team's characterization of the cumulative impacts related to locating a two-unit US-APWR nuclear power facility at the proposed CPNPP site and at each of the alternative sites. The three sites selected for detailed review as part of the alternative sites environmental analysis included the Coastal, Pineland, and Tradinghouse sites in Texas (see

Figure 9-1). Comparisons are made between the proposed site and the alternative sites to evaluate if one of the alternative sites would be environmentally preferable to the proposed site. The NRC's determination is independent of the Corps' determination of a LEDPA pursuant to the CWA Section 404(b)(1) guidelines at 40 CFR Part 230. The Corps will conclude its analysis of both off-site and on-site alternatives in its Record of Decision.

The need to compare the proposed site with alternative sites arises from the requirement in Section 102(2)(c)(iii) of NEPA (42 USC 4332) that EISs include an analysis of alternatives to the proposed action. The NRC criteria to be employed in assessing whether a proposed site is to be rejected in favor of an alternative site is based on whether the alternative site is "obviously superior" or "environmentally preferable" to the site proposed by Luminant (Public Service Company of New Hampshire 1977). An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site (Rochester Gas & Electric Corp. 1978). The standard of obviously superior "...is designed to guarantee that a proposed site will not be rejected in favor of an alternate unless, on the basis of appropriate study, the Commission can be confident that such action is called for (New England Coalition on Nuclear Pollution 1978)."

The "obviously superior" test is appropriate for two reasons. First, the analysis performed by the NRC in evaluating alternative sites is necessarily imprecise. Key factors considered in the alternative site analysis, such as population distribution and density, hydrology, air quality, aquatic and terrestrial ecological resources, aesthetics, land use, and socioeconomics, are difficult to quantify in common metrics. Given this difficulty, any evaluation of a particular site must have a wide range of uncertainty. Second, Luminant's proposed site has been analyzed in detail, with the expectation that most adverse environmental impacts associated with the site have been identified. The alternative sites have not undergone a comparable level of detailed study. For these reasons, a proposed site may not be rejected in favor of an alternative site when the alternative site is marginally better than the proposed site, but only when it is obviously superior (Rochester Gas & Electric Corp. 1978). NEPA does not require that a nuclear plant be constructed on the single best site for environmental purposes. Rather, "...all that NEPA requires is that alternative sites be considered and that the effects on the environment of building the plant at the alternative sites be carefully studied and factored into the ultimate decision (New England Coalition on Nuclear Pollution 1978)."

Section 9.3.5.1 reviews the cumulative environmental impacts of building and operating a two-unit nuclear plant at the proposed CPNPP site. Cumulative impact levels from Chapter 7 (for the proposed CPNPP site), and the three alternative sites (from Sections 9.3.2, 9.3.3, and 9.3.4) are listed in Table 9-24. Sections 9.3.5.2 and 9.3.5.3 discuss the cumulative impacts of the proposed project located at the CPNPP site and at the alternative sites as they relate to a determination of environmental preference or obvious superiority.

9.3.5.1 Comparison of Cumulative Impacts at the Proposed and Alternative Sites

The following section summarizes the review team's independent assessment of the proposed and alternative sites. The team characterized the expected cumulative environmental impacts of building and operating new units at the CPNPP site and alternative sites. These impacts are summarized by resource area in Table 9-24.

Table 9-24. Comparison of Cumulative Impacts at the CPNPP site and Alternative Sites

Resource Area	CPNPP Site	Coastal Site	Pineland Site	Tradinghouse Site
Land-Use Impacts	MODERATE	LARGE	MODERATE	MODERATE
Water-Related Impacts				
Water Use	MODERATE to LARGE	MODERATE to LARGE	SMALL	MODERATE to LARGE
Water Quality	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE
Ecological Impacts				
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	SMALL
Aquatic Ecosystems and Wetlands	SMALL to MODERATE	MODERATE	SMALL	SMALL to MODERATE
Socioeconomic Impacts				
Physical	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Demography	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Taxes and Economy	LARGE (beneficial)	LARGE (beneficial)	LARGE (beneficial)	LARGE (beneficial)
Infrastructure and Community Services	SMALL to MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Environmental Justice	SMALL	MODERATE	MODERATE	MODERATE
Historic and Cultural Resources	SMALL	SMALL	MODERATE	SMALL
Air Quality	MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Nonradiological Health	SMALL to MODERATE	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL

The environmental resource areas listed in the following table have been evaluated using the NRC's three-level standard of impact significance: SMALL, MODERATE, or LARGE. These levels were developed using the CEQ guidelines and set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Full explanations for the specific cumulative impact characterizations are provided in Chapter 7 for the proposed site and in Sections 9.3.2, 9.3.3, and 9.3.4 for the alternative sites. The review team's impact category levels are based on professional judgment, experience, and consideration of controls likely to be imposed under required Federal, State, or local permits that would not be acquired until an application for a COL is under way. The considerations and assumptions were similarly applied at each of the alternative sites to provide a common basis for comparison. In the following discussion, the review team compares the impact levels between the proposed site, and each alternative site.

9.3.5.2 Environmentally Preferable Sites

As shown in Table 9-24, the cumulative impacts of building and operating two new units at the proposed site and the alternative sites vary across the impact categories. The resource areas for which the impact level at an alternative site is the same as that for the proposed site does not contribute to the alternative site being judged to be environmentally preferable to the proposed site. Therefore, these resource areas are not discussed further in determining whether an alternate site is environmentally preferable to the proposed site. The resource areas for which an alternative site has a different impact level than the proposed site are discussed further to determine if an alternative site is environmentally preferable to the proposed site. Where there is a range of impacts for a resource, the upper value of the impacts is used for the comparison. In addition, for those cases in which the cumulative impacts for a resource area are greater than SMALL, consideration is given to resource areas in which the impacts of the project at the specific site do not make any significant contribution to the cumulative impact level. As shown in Table 9-24, there are some differences in impacts among the sites.

The Coastal Site

The Coastal site is characterized in Table 9-24 as less favorable than the CPNPP site for the land use and socioeconomics resource areas. Conversely, the review team identified no resource areas in which the Coastal site was more favorable than the CPNPP site.

Conversion of the Coastal site from its present uses to building and operating two nuclear units would require up to 2500 ac of this greenfield site and would therefore involve greater land use impacts than at the CPNPP site. Building and operating a new nuclear plant at the Coastal site would create adverse socioeconomic impacts because (1) the site is a greenfield site without existing adequate road, rail and other infrastructure access; (2) there is a relatively small labor force in the area from which to draw construction and operations workers, thus large numbers of such workers would have to in-migrate into the area; and (3) the site is in a rural area that does not have the existing housing, infrastructure, and public services to support the in-migration of large numbers of workers and their families.

Based on the results and comparison of the impact characterizations shown in Table 9-24, the review team concludes that the Coastal site would not be environmentally preferable to the CPNPP site for two new nuclear generating units.

The Pineland Site

The Pineland site is characterized in Table 9-24 as less favorable than the CPNPP site for the socioeconomics and historic and cultural resources resource areas. Conversely, the review team identified the following resource areas in which the Pineland site was more favorable than the CPNPP site: water use, water quality, and aquatic and wetlands ecosystems.

Similar to Coastal site, the Pineland site is also a greenfield site. The Pineland site is located on a peninsula on the Sam Rayburn Reservoir, which would provide an abundant water supply with less potential for impacts to water quality than would the CPNPP site. Withdrawal of cooling water from the reservoir would not have more than a minor effect on the water levels in the reservoir. Aquatic species would be unlikely to be substantially affected by the loss of small areas of habitat potentially within the footprint of the proposed facilities. No wetlands have been identified on the peninsula; consequently, it is unlikely that there would be impacts to wetland resources at the Pineland site.

Because the Pineland site is in a rural area, it would have the same types of socioeconomic impacts as described above for the Coastal site. While prehistoric fossils and artifacts from the Paleo-Indian period are known to occur in the same county as the Pineland site, with one exception the impacts to historic and cultural resource impacts for a new plant located at the Pineland site would likely be similar to the impacts for a new plant at the CPNPP site. There are no existing transmission corridors connecting directly to the Pineland site; consequently, new transmission line corridors would be needed to connect the Pineland site to these existing lines. Several historic and cultural resource sites are located in this region and could be affected by the addition of new transmission line corridors.

The Pineland site and the CPNPP site are closely ranked in terms of environmental attributes; in comparing the impacts of the proposed action across different resource areas, both site areas would experience environmental effects, albeit different intensities in different resource areas. On balance, it was not clearly evident that the Pineland site is environmentally preferable.

Therefore, based on the results and comparison of the impact characterizations shown in Table 9-24, the review team concludes that the Pineland site would not be environmentally preferable to the CPNPP site for two new nuclear generating units.

The Tradinghouse Site

The Tradinghouse site is characterized in Table 9-24 as less favorable than the CPNPP site for the socioeconomics resource area. Conversely, the review team identified terrestrial ecosystems as the only resource area in which the Tradinghouse site was more favorable than the CPNPP site. A new nuclear plant constructed at the Tradinghouse site would obtain its water from the nearby Tradinghouse Creek Reservoir.

After construction and preconstruction activities are complete at the Tradinghouse site, terrestrial resources in the areas that are temporarily disturbed are expected to return to predominantly pre-development conditions. While some habitat would be lost to permanent project structures, the losses would be minimal due to the existing low habitat value present on the Tradinghouse site.

Although the Tradinghouse site is not a greenfield site, it would still have the same types of socioeconomic impacts as described above for the Coastal site. In addition, the use of the Tradinghouse site for a new nuclear plant could adversely affect or eliminate the recreational use of Tradinghouse Creek Reservoir, which hosts one public park and is popular with local anglers.

Although there are differences and distinctions between the cumulative environmental impacts of building and operating two new nuclear generating units at the proposed CPNPP site and the alternative sites, the review team concludes that these differences are not sufficient to determine that any of the alternative sites would be environmentally preferable to the proposed site for building of two new nuclear generating units.

Therefore, based on the results and comparison of the impact characterizations shown in Table 9-24, the review team concludes that the Tradinghouse site would not be environmentally preferable to the CPNPP site for two new nuclear generating units.

9.3.5.3 Obviously Superior Sites

None of the alternative sites were determined to be environmentally preferable to the proposed CPNPP site. Therefore, the NRC staff concludes that none of the alternative sites would be obviously superior to the CPNPP site. The Corps will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

9.4 System Design Alternatives

The review team considered a variety of heat dissipation systems and circulating water systems (CWS) alternatives. While other heat dissipation systems and water systems are used in conjunction with the project, the one most likely to dominate the environmental consequences of operation is the CWS that cools and condenses the steam for the turbine-generator. Other water systems, such as service water and ultimate heat sink cooling systems, are much smaller than the CWS. Consequently, the review team only considered alternative heat dissipation and water treatment systems for the CWS. The proposed CWS is a closed-loop system that uses new MDCT for heat dissipation (Luminant 2009a). The proposed system is discussed in detail in Chapter 3.

This section provides the review team's basis for its conclusions with respect to the evaluation of alternative heat dissipation systems, and if such systems may be environmentally preferable to the proposed system.

9.4.1 Heat Dissipation Systems

About two-thirds of the thermal power produced by a commercial light-water reactor is rejected as heat to the environment; one-third is converted into electrical power. Normal heat sink cooling systems transfer the rejected heat load into the atmosphere and/or nearby waterbodies, primarily as latent heat exchange (evaporating water) or sensible heat exchange (warmer air or water). Different heat-dissipation systems rely on different exchange processes. The following sections describe alternative heat dissipation systems considered by the review team for proposed Units 3 and 4 at the CPNPP site.

The impacts associated with the proposed heat dissipation system, a cooling reservoir, are discussed in Sections 4.2, 4.3, 5.2, and 5.3. Luminant proposes a cooling system designed to meet the cooling needs of proposed CPNPP Units 3 and 4 while minimizing the effects upon the operation of CPNPP Units 1 and 2. At the same time, the cooling system is expected to protect the waters of the Squaw Creek Reservoir (SCR), Lake Granbury, and the Brazos River. To meet these requirements, Luminant focused its analysis on closed-loop cooling systems and concluded that the use of MDCT was the best available technology that would result in the least environmental impact from the project. The review team determined in Chapter 4 that the impacts of building the proposed heat dissipation system would be SMALL for both hydrologic and ecological resources. The review team also determined in Chapter 5 that the impacts of operating the proposed heat dissipation system would be MODERATE and SMALL to MODERATE for hydrologic and ecological resources, respectively.

Heat dissipation systems, broadly categorized as once-through (or open) and closed-loop systems, differ in how heat is transferred; therefore, each system has a different set of potential environmental impacts. The once-through method involves the withdrawal of large quantities of cooling water, withdrawn from and returned to a large water source following its circulation through the main condenser. However, the water is withdrawn and returned with little consumption or water loss. For once-through systems, water loss comes from minimal evaporative loss downstream as the water cools (World Nuclear Association 2010).

Closed-loop cooling systems withdraw far less water by comparison, but water consumption is larger because the technology relies on evaporation. Approximately 70% of the circulating water volume in a closed-loop cooling system is consumed due to evaporation and blowdown discharges (World Nuclear Association 2010). Therefore, makeup water is continually required to replace the water lost. The volume of makeup water required due to blowdown loss is generally less than the volume need to replace evaporative losses.

Section 2.3.2.1 states that a total of 3,321,000 ac-ft was withdrawn from SCR for CPNPP Units 1 and 2 in 2006. Of this total, 19,900 ac-ft (0.6%) was consumed by evaporation and 3,301,000 ac-ft was discharged back to SCR. Section 3.4.2.1 discusses water use and treatment for CPNPP Units 3 and 4. The section notes that the expected withdraw rate for operation for Units 3 and 4 will be 100,500 ac-ft/yr from Lake Granbury with a consumption rate of 62,700 ac-ft/yr (62%). Therefore, while the proposed closed-loop cooling system for Units 3 and 4 will require only 3% of the water use (withdraw) rate of the current once-through system of CPNPP Units 1 and 2, the water consumption rate will be more than 3 times greater.

The scope of the review team's review is limited to reasonable alternative heat dissipation systems considered feasible for construction and operation at the proposed plant site and that (1) are not prohibited by Federal, State, regional, or local regulations, or Native American Tribal agreements; (2) are consistent with findings under the CWA; and (3) can be judged as practical from a technological standpoint with respect to the proposed dates of plant construction and operation. The review team evaluated the reasonable alternative heat dissipation systems considered feasible for construction and operation at the proposed site to determine if any of the alternatives could provide a reasonable reduction in overall environmental impact or offer solutions to potential adverse impacts predicted for the proposed heat dissipation system. If an environmentally preferable alternative is identified, then the review team compares the alternative to the proposed design to determine if it was obviously superior to the proposed heat dissipation system. This review includes the review team's independent evaluation of alternatives proposed by Luminant to mitigate impacts associated with construction and operation of the proposed heat dissipation system.

Multiple closed-cycle alternatives were evaluated by Luminant in the ER. Due to the limited available water supply for waste heat transfer from the reactor cooling system to the environment, the review team determined that the elimination of a once-through wet cooling option for CPNPP Units 3 and 4 is appropriate.

Only the following closed-loop heat dissipation systems were considered by Luminant as alternatives to the proposed MDCTs:

- Wet/dry cooling tower;
- Natural draft wet cooling tower; and,
- Dry cooling towers.

The review team did not identify other reasonable alternatives that could meet the needs of the project. The review team concluded that these alternatives meet the three criteria described above and (1) are not prohibited by law or regulation, (2) are consistent with any findings of the CWA, and (3) are technologically practical.

9.4.1.1 Dry Cooling Towers

Heat is transferred from heated water to cooler air in dry cooling towers by a sensible heat-transfer process by circulating water enclosed in piping and tubes with fins; the heat is transferred to air passing over the fins much like a radiator. Therefore, while water is used, there is no water loss by evaporation because the receiving air does not directly contact the water. Water use impacts are avoided with dry cooling tower alternatives as dry cooling systems use less than 10 percent of the water required for a wet-cooled plant (World Nuclear Association 2008).

A dry cooling system heat transfer is less efficient than a wet cooling system and much larger and mechanically complex cooling plants are required (World Nuclear Association 2008). According to the Cooling Technology Institute, the US DOE, and the California Energy Commission (CEC), a dry cooling system comes with energy and efficiency penalties and is not as cost-effective as a wet or evaporative system (Cooling Technology Institute 2009, DOE 2009b, CEC 2002). There is reduced generation efficiency with the use of dry cooling towers as they would use 1.5 to 10 percent of the power station's output (World Nuclear Association 2008, DOE 2009b). In another study, the incremental costs of using dry cooling towers at a 1200 MW(e) nuclear plant are approximately 22 percent to 25 percent greater than an all wet system (Choi and Glicksman 1979). The project proposed by Luminant is for 3200 net MW(e); should dry cooling be considered for the project, the net power produced would be reduced by the approximately 50 MW(e) needed to power forced air cooling systems and result in reduced generating efficiency.

Dry cooling towers could minimize water-related impacts from the cooling system operation because water losses through evaporation are minimized. While very little makeup water would be needed and no blowdown water would be generated, dry cooling systems require much larger cooling systems and result in loss in electrical generation efficiency due to energy demands to operate the large array of fans needed to move large volumes of air through the cooling system. In a dry cooling tower, the temperature of the water leaving the cooling tower can only approach the dry-bulb air temperature not the lower wet-bulb temperature approached in wet cooling tower. As such, in the summer month, the higher temperature of the water returning to the plant could result in significant loss in thermal plant efficiency. This loss in energy generation efficiency could translate into increased operational costs and either increased fuel cycle impacts (i.e., more fuel is needed to produce the equivalent net electrical power for distribution to the grid) or impacts in other resource areas, albeit displaced from the site area, i.e., air quality and socioeconomics, should the power shortfall be overcome by a fossil-fueled power generation facility.

In Sections 5.2 and 5.3, the review team concluded that the impacts associated with aquatic ecology and water quality for the construction and operation of the proposed wet cooling system were SMALL to MODERATE; this means that the impacts would be minimal to noticeable but would not destabilize important attributes of the resource. Impacts associated with water use for the construction and operation of the proposed wet cooling system were MODERATE; this means that the impacts would be noticeable but not destabilizing. In comparison, the CEC reported that in some other cases, the environmental impacts of dry cooling can be greater than the environmental impacts of wet systems (CEC 2002). The report identifies the facts that dry cooling towers are physically larger, can create a greater visual impact, reduced plant efficiency (results in higher fuel consumption), and generate more noise from air-cooled systems. However, because the cooling system would be built at an existing nuclear power plant site that already includes multiple structures, including two 69.9-meter high containment buildings, the aesthetic impacts from dry cooling towers would be minimal.

Power is consumed in operating heat dissipation systems. This reduction in power available from the project would need to be supplemented to meet the project purpose [i.e., 3200 MW(e)]. This could result in minor increases in fuel cycle impacts, if the power level would need to be increased, or in minor increases in air quality and socioeconomic impacts, which could be remote from the site area, if the power to be supplemented is from a fossil-fuel power plant. It is unlikely that the other resource areas would have noticeable changes in environmental effects using dry cooling. Consequently, even though dry cooling could avoid some of the water-related impacts, it is not apparent that the alternative is environmentally preferable to the proposed MCDTs because of the additional power needed to meet the project goals even if the attendant environmental impacts of such power production occur in a different location.

9.4.1.2 Combination Wet/Dry Cooling Tower System

A combination mechanical draft wet/dry cooling tower system uses both wet and dry cooling cells to limit consumption of cooling water, often with the added benefit of reducing the size of the visible plume. Heated water first passes through the dry portion of the cooling tower where heat is transferred to the air passing over tubes. The water then passes through the wet portion of the tower where it is sprayed into a moving air stream; additional heat is removed from the water by evaporation and sensible heat transfer. When ambient air temperatures are low, the dry portion of these cooling towers may be sufficient to meet cooling needs. However, whenever the dry portion of the system is used, it would result in a loss in generating efficiency that would also translate into increased fuel cycle impacts as described in the previous section and displaced environmental impacts, air quality impacts or socioeconomic impacts, or a combination of impacts; furthermore, some of these impacts may be displaced from the site area.

Reducing plume visibility is not a priority mitigation measure for reducing environmental impacts; the goal of operating a wet/dry cooling system would be to minimize water-related impacts. To minimize efficiency and energy penalties, the plant operator would use the wet/dry system to balance water impacts and energy demands. If efficiency and energy penalties can be reduced to an economically viable level (cost of cooling is less than the cost of water, water treatment, etc), then the dry cooling functions would dominate.

In Sections 5.2 and 5.3, the review team concluded that the impacts associated with aquatic ecology and water quality for the construction and operation of the proposed wet cooling system were SMALL to MODERATE; this means that the impacts would be minimal to noticeable but would not destabilize important attributes of the resource. Impacts associated with water use for the construction and operation of the proposed wet cooling system were MODERATE; this means that the impacts would be noticeable but not destabilizing. In comparison, during the operation of wet/dry cooling towers the impacts could be reduced when it is feasible to operate the dry portion to, for example, reduce water consumption during low flow periods. Using the dry portion at any time displaces some environmental impacts because the power demand would still need to be satisfied from some other power source.

Power is consumed in operating heat dissipation systems. This reduction in power available from the project would need to be supplemented to meet the project purpose [i.e., 3200 MW(e)]. To meet the shortfall in power supply when the dry portion is operated, an alternate power generating facility would have to be available on demand; the type of power source that could be brought online on demand would most likely be a natural gas generating facility with all of the associated environmental impacts similar, but scaled, to those discussed in Section 9.2.2.2. It is unlikely that the other resource areas would have noticeable changes in environmental effects using a combination wet/dry cooling system. Consequently, even though a combination wet/dry cooling system could avoid some of the water-related impacts, it is not apparent that the alternative is environmentally preferable to the proposed MCDTs because of the additional power needed to meet the project goals even if the attendant environmental impacts of such power production occur in a different location.

9.4.1.3 Wet Natural Draft Cooling Towers

Wet NDCT induce circulation through large (500 ft tall and 400 ft in diameter) towers by cascading warm water downward in the lower portion of the cooling tower. As heat transfers from the water to the air in the tower, the air becomes more buoyant and rises. This buoyant circulation induces more air to enter the tower through its open base to replace air that exits the tower through its open top. The size of the cooling towers results both in a large visual and land-use footprint and, when operating, an elevated visible plume. NDCTs take advantage of air circulation induced by the shape of the tower and density difference between the water inlet temperature created by the CWS and the cold water temperature from Lake Granbury to transfer heat from the water to the air. For the natural draft circulation to be effective at 20°F temperature difference between the warmed air and the ambient air temperature is needed. During the warmer times of the year, the 20°F temperature difference cannot reliably achieved given under the current thermal conditions and size of Lake Granbury to meet cooling tower design parameters (Luminant 2009b, 2009c). To increase the cooling capability of the waterbody, Lake Granbury would have to be expanded; this would result in significant land use and ecological impacts. It is unlikely that the other resource areas would have noticeable changes in environmental effects using a NDCT system. Therefore, based on the consideration of land use and ecological impacts, the review team concluded that expanding Lake Granbury or the SCR and building and operating a NDCT would not be an environmentally preferable alternative for the CPNPP site.

9.4.2 Circulating Water System

The CWS is an integral part of the heat dissipation system discussed in Section 9.4.1. The CWS provides the heat transfer medium between the main condenser and the heat dissipation system. The review team evaluated alternatives to the proposed intakes and discharges for the normal heat sink cooling system, based on the proposed heat dissipation system water requirements. The capacity requirements of the intake and discharge system are defined by the recommended heat dissipation system. For CPNPP Units 3 and 4, the proposed heat dissipation system is a closed-loop system that uses new MDCTs for heat dissipation.

The proposed system is considered feasible for construction and operation based on the existing experience of CPNPP Units 1 and 2 makeup water system that has worked well since 1990 (Luminant 2009a). The existing CWS at CPNPP is designed and operated to comply with TPDES and CWA 316(b) requirements. The proposed and alternative systems are considered technologically achievable and available.

9.4.2.1 Intake Alternatives

The proposed location of the intake structure is on the southwest bank of Lake Granbury. The impacts associated with the proposed intake system are discussed in Sections 4.2, 4.3, 5.2, and 5.3. CPNPP proposes to use a new water intake structure located adjacent to the existing makeup water intake structure on Lake Granbury as the intake system for the proposed units, upstream of the existing intake and pumping station for CPNPP Units 1 and 2 makeup water and more than a mile upstream of the De Cordova Bend Dam. The intake screens would be located approximately 110 ft from shore at a depth of approximately 34 ft at a location where the depth of the lake is approximately 40 ft (Luminant 2009a). In Chapter 4, the review team determined that the impacts of building the proposed intake structure would be minimal for both hydrologic and ecological resources. In Chapter 5, the review team determined that hydrologic alterations that would result from operation of CPNPP Units 3 and 4 would have MODERATE impacts on surface water resources and SMALL to MODERATE impacts on aquatic resources. These impact levels were associated with the consumptive use of water resources related to the heat dissipation systems. The proposed intake system would not significantly contribute to the MODERATE level of impact associated with surface water use or the SMALL to MODERATE level of impact associated with aquatic ecology.

Alternative intake designs that were considered by the review team include alternative intake locations (Luminant 2009b, 2009c). While intake options included both SCR and Lake Granbury as sources for CNPP Units 3 and 4 cooling water, SCR options had the disadvantage of further degrading the water supply situation in SCR (Luminant 2009b, 2009c). Alternative system designs considered by Luminant for Lake Granbury included:

- Shoreline intake structure with pump-wells behind conventional traveling screens equipped with Ristoph-type bucket fish handling and return system;
- Offshore-bottom mounted velocity cap intake with a shoreline pump-house (potentially also requiring traveling screens with fish return capability); and,
- Offshore-bottom mounted intake with passive, fine-mesh, screens with a shoreline pumphouse (not requiring traveling screens in the pump-house).

While Lake Granbury intake options require an intake structure and pump-house, the major benefit of using Lake Granbury as the source for cooling water is the minimal impact to the water supply and water quality in SCR. The existing intake structure on SCR for CPNPP Units 1 and 2 has been in operation for many years, and the impact to fish has been minimal to date (Luminant 2009a). Similarly, the proposed and alternative intake facilities on Lake Granbury would have a similar minimal environmental impact. It is unlikely that the other resource areas, beyond the ecological and the hydrologic resource areas would have noticeable changes in environmental effects with a different intake alternative. The review team reviewed the analysis of the intake alternatives (Luminant 2009b, 2009c) and determined that an alternative intake system is not environmentally preferable to the proposed system for the CPNPP site.

9.4.2.2 Discharge Alternatives

Luminant is proposing the use of a single discharge system for each unit. This system would consist of piping to Lake Granbury where cooling tower blowdown is discharged through a multi-port diffuser system (Luminant 2009d, 2009e). Each unit is designed with a 42-in diameter blowdown pipe that would run from the MDCTs to the outfall structure on Lake Granbury ending with a submerged 82-ft long multi-port discharge pipe diffuser (Luminant 2009d, 2009e). Each diffuser would be equipped with 18 nozzles; each nozzle would have a 4-in. diameter with a spacing of 4 ft 4 in., center-to-center distance (Luminant 2009d, 2009e).

The following possible alternative locations of discharge were considered as potential discharge locations in the ER (Luminant 2009a). Several of these options and a Zero Liquid Discharge option were also analyzed in Luminant (2009b).

- SCR – cannot support the thermal load of CPNPP Units 3 and 4 without affecting CPNPP Units 1 and 2;
- Brazos River downstream of Lake Granbury – has periods of limited flow and the thermal plume of blowdown from the proposed units has little dilution or dissipation in the receiving water in the river causing significant impact to the ecology along the river;
- Possum Kingdom Lake – would require pumping blowdown many miles from the CPNPP site, which could introduce environmental impacts that could otherwise be avoided along the ROWs for the pipeline as well as at the Lake;
- Squaw Creek – small stream with flow existing mainly from letdown from SCR dam that converges with the Brazos River resulting in the same potential ecological impact; and,
- Paluxy River – small river that converges with the Brazos River south of SCR at Glen Rose, TX; flows thorough Dinosaur Valley State Park; this could introduce environmental impacts that could otherwise be avoided, including the potential effects on natural heritage sites.

Discharging to the SCR or immediately below the dam into Squaw Creek would likely cause the greatest environmental impact because of the high total dissolved solids (TDS) issues in either SCR or downstream of the SCR dam. Discharges into Lake Granbury would likely have the least environmental impact and the greatest potential to meet water quality standards because discharges to the Brazos River would have to meet lower TDS limits (Luminant 2009b, 2009c).

The Zero Liquid Discharge option would result in no outfall for CPNPP Units 3 and 4 and avoids installation and discharge water quality issues. However, the option would require the disposal of significant volumes of solids (salts) that would be generated in the process of evaporating the cooling water – a far greater volume than would be generated at the proposed BDTF.

Two other discharge configurations were considered in the design selection process as alternatives to the multi-port pipe diffuser (Luminant 2009d, 2009e). These alternatives included the impact-type energy dissipater structure with a weir (low head dam) and a direct open pipe discharge into the lake. The impact-type dissipater structure alternative structure was not selected because a new off-shore concrete structure would be required and the energy dissipation in this type of system would be uncontrolled (Luminant 2009d, 2009e).

The direct open pipe discharge was not selected because flow velocity could not be controlled at the discharge end (Luminant 2009d, 2009e). These alternative discharge structures are not environmentally preferred, as they do not decrease the small effect of plume or potential physical scour problems. While the direct open pipe discharge system would be the least costly alternative to construct and operate, it could not achieve the required degree of mixing to ensure compliance with water quality standards (Luminant 2009d, 2009e). Therefore, the review team determined that none of the alternative discharge designs considered were environmentally preferable to proposed discharge design to Lake Granbury.

9.4.2.3 Water Supplies

The review team considered alternative sources for both normal heat sink cooling water and service water.

Water Reuse

Sources of water for reuse can be developed either from the plant itself or from other local water users. Sanitary waste water treatment plants generally used by communities with modest sized populations are the most ubiquitous source of water for reuse. Based on the discussion in Section 2.5.2.6 of this EIS, the total amount of wastewater generated by local sanitary waste water treatment plants would not be a sufficient source of water for use the proposed new reactors. Agricultural processing, industrial processing, and oilfield production can also provide significant supplies of water for reuse. Additional treatment (e.g., tertiary treatment, chlorination) may be required to provide water of appropriate quality for the specific plant need. Population is very low and there is little industry around the CPNPP site. Consequently, the review team determined that no sources of water for reuse at the CPNPP site in sufficient quantities were available. Therefore, the review team concluded that water reuse was not a reasonable alternative for water supply at the CPNPP site.

Groundwater

Luminant's plan presented in the ER reduces usage of groundwater at the site. Based on the discussion in Section 2.3.1.2, groundwater near the site would not be suitable as a water source for the proposed new nuclear units. As a result, groundwater was not selected as a possible alternative water source (Luminant 2009), and the review team concluded that groundwater use was not a reasonable alternative for water supply at the CPNPP site.

Surface Water

Only surface waterbodies were considered for normal heat sink cooling water and service water. The review team concluded that the Lake Granbury reservoir is the only viable water supply for service water and heat dissipation for CPNPP Units 3 and 4. Other nearby water resources are either too small or they are potentially more environmentally sensitive. Therefore, the review team concluded that no other surface water resources would provide a reasonable alternative for water supply at the CPNPP site.

Dredging of Lake Granbury was also considered as an alternative to enhance water volume and to improve the fisheries habitat and water quality characteristics of the lake. The review team relied upon information from the BRA for its assessment of potential impacts to water supplies and to Lake Granbury, in particular. While the BRA analyzed strategies to increase water availability from the Brazos River, dredging Lake Granbury was not included in the information available from the BRA.

Review of the potential effects of resuspended sediments due to the proposed dredging operations indicates that this alternative would likely yield significant adverse effects with few long-term net benefits. This is primarily due to the impacts attributable to the resuspension of sediment into the water column. Research has been conducted by the USACE, the USFWS, and the National Oceanic and Atmospheric Administration to describe the potential impacts of sediment dredging activities (e.g., for the maintenance of intra-coastal transportation canals) (see Burks and Engler 1978; Cappuyns and Swennen 2005; Cappuyns et al. 2004; and Eimers et al. 2003). Results of these studies indicate that resuspension of bottom sediments from their anoxic state can release common elements (i.e., metals) into solution, adjust pH levels, and consume dissolved oxygen through biological or chemical oxygen demand cycles. Resuspension of sediment would release decaying material that had accumulated in bottom sediments into the water column. The decay process would consume oxygen, which in turn would affect pH and ion mobility. Dredge spoils would not be suitable for use as construction fill. They can be considered "waste" with the potential to release common constituents when disposed of in oxygenated (terrestrial) environments.

Therefore, it is not likely that the dredging of sediment from Lake Granbury would yield improvements to water quality characteristics and would likely not yield beneficial changes to fisheries habitat. The long-term benefits of any such dredging on the volume of water available in Lake Granbury would require detailed study by the BRA. The review team considered available literature studies regarding the effects of dredging to aquatic systems. These studies indicate that the dredging alternative may yield a negative environmental impact; consequently, dredging is not addressed further in this EIS.

9.4.2.4 Water Treatment

Both inflow and effluent water may require treatment to ensure that plant water needs and effluent water standards are achieved. Luminant proposes to add chemicals to plant water to meet appropriate water quality process needs. The chemical additives would be required to maintain the appropriate chemistry in the cooling towers to preclude biofouling. The effluent water chemistry is regulated by the TCEQ through the TPDES permitting process. Mechanical treatment may be a viable option for scale and biofilm removal. Other alternatives to manage biofouling, such as ultraviolet treatment, are also feasible. These alternatives, while feasible, would not eliminate the need for some chemical treatment. Chemical treatment is a reliable and well-established engineering practice that has been shown to provide minimal impacts in a variety of settings.

Water quality is a concern in this watershed area. The Brazos River system and the lakes associated with the river exhibit a highly variable TDS content (Luminant 2009a). Because blowdown water contains solids and salts, discharge of the blowdown must comply with site TPDES permits. Sections 3.3.2.1 and 3.3.4.1of this EIS provide a description of the proposed BDTF to produce a clean permeate stream, which would then be blended with the remaining untreated blowdown and routed to Lake Granbury via two new pipelines and underwater diffusers in the lake. The impacts of the proposed BDTF to land use, water quality, and terrestrial ecology range from minimal to noticeable and are described in Sections 5.1.1, 5.2.3, and 5.3.1 of this EIS. Possible alternatives to the proposed BDTF include: reusing both treated and untreated blowdown water; diluting blowdown from the CWS with additional makeup water; and, increase the number of cycles of concentration from 2.4 to 5.0 (Luminant 2009a).

The option of reusing treated and untreated blowdown water would eliminate the need to construct a discharge structure to reduce water quality effects in Lake Granbury. However, the option would require the disposal of the amount of solids (salts) that are generated in the process of evaporating the cooling water – a far greater volume than would be generated by the proposed BDTF.

The option of increasing the makeup water supply to the system to dilute blowdown from the CWS would eliminate the need for a BDTF and the impacts associated with it. However, the alternative would require additional water usage and would increase the impacts described in Section 5.2.2 of this EIS.

Increasing the number of cycles from 2.4 to 5.0 cycles of concentration would reduce the amount of water needed for makeup and the amount of blowdown discharged to Lake Granbury. However, this method would require additional chemical usage and potentially produce a waste concentration higher than water quality stream standard set by the TCEQ (Luminant 2009a).

Other water treatment of the CWS water includes biocides, algaecides, pH adjusters, corrosion inhibitors, scale inhibitors, and silt dispersants. These additives in the blowdown water could impact water quality. The treatment of the blowdown water would be required to remove chemicals, salts and TDS to meet TPDES discharge limits and to ensure that the water quality in the lower part of Lake Granbury is not impacted. Any water treatment depends on the final (post-construction) TPDES permit requirements.

The effluents from cooling tower blowdown are specifically regulated in 40 CFR Part 423 by the EPA to protect the environment. In the State of Texas, this regulatory authority is administered by the TCEQ. The review team did not identify an environmentally preferable alternative to CPNPP's proposed chemical water treatment.

9.4.3 Conclusion

The review team considered alternative systems designs including three alternative heat dissipation systems and alternative intake, discharge, and water supply systems. As discussed in the above sections, the review team did not identify an alternative that was environmentally preferable to the proposed plant systems design.

9.5 References

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10.0 Conclusions and Recommendations

This chapter provides a discussion of the conclusions reached in earlier parts of this environmental impact statement (EIS), as well as recommendations. Section 10.1 summarizes the impacts of the proposed action, Section 10.2 summarizes the proposed project's unavoidable adverse impacts with an accompanying table, and Section 10.3 discusses the relationship between the short-term use of resources and long-term productivity of the human environment. Section 10.4 summarizes the irretrievable and irreversible use of resources, and Section 10.5 summarizes the alternatives to the proposed action. Section 10.6 discusses benefits and costs. Section 10.7 includes the U.S. Nuclear Regulatory Commission (NRC) staff's recommendation, and Section 10.8 provides the references.

The NRC received an application from the Luminant Generation Company LLC (Luminant) for combined construction permits and operating licenses (combined licenses or COLs) for Comanche Peak Nuclear Power Plant (CPNPP) Units 3 and 4 at the CPNPP site. The CPNPP site is located about 45 mi southwest of Fort Worth, Texas, and about 5 mi north of Glen Rose, Texas. The location of the proposed Units 3 and 4 is approximately 0.5 mi northwest of the existing CPNPP Units 1 and 2. The CPNPP site and the existing facilities are owned by Luminant. Luminant is currently the licensed operator of the existing Units 1 and 2, and would also be the owner and licensed operator of the proposed Units 3 and 4. In its application, Luminant specified the U.S. Advanced Pressurized-Water Reactor (US-APWR) as the proposed reactor design for Units 3 and 4.

As part of the permitting process for CPNPP Units 3 and 4, Luminant plans to submit a joint application to the U.S. Army Corps of Engineers (Corps) Fort Worth District and the Texas Commission on Environmental Quality (TCEQ) for activities associated with the alteration of any floodplain, waterway, tidal wetland, or nontidal wetland in Texas.

The proposed actions related to the Units 3 and 4 application are (1) the NRC issuance of COLs for construction and operation of two new nuclear units at the CPNPP site in Hood and Somervell Counties, Texas; and (2) the Corps' issuance of a permit pursuant to Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Appropriation Act.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.), directs that an EIS is required for major Federal actions that significantly affect the quality of the human environment. Section 102(2)(C) of NEPA requires that an EIS include information about the following:

- the environmental impacts of the proposed action;
- any adverse environmental effects that cannot be avoided should the proposal be implemented;
- alternatives to the proposed action;
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

The NRC has implemented NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. In 10 CFR 51.20, the NRC requires preparation of an EIS for issuance of a COL to construct and operate a nuclear power plant. Subpart C of 10 CFR Part 52 contains the NRC regulations related to COLs.

The environmental review described in this EIS was conducted by a team consisting of NRC staff, its contractor's staff at the Oak Ridge National Laboratory and the Information Systems Laboratories, Inc., and staff from the Corps. During the course of preparing this EIS, the review team reviewed the Environmental Report (ER) submitted by Luminant (Luminant 2009a) and supplemental documentation from Luminant in response to requests by NRC staff and the Corps for additional information; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NUREG-1555, *Environmental Standard Review Plans* (NRC 2000). Additionally, the review team followed guidance provided in Revision 1 of the NRC Staff Memorandum *Addressing Construction and Preconstruction, Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011). In addition, the NRC considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

Included in this EIS are (1) the results of the review team's preliminary analyses, which consider and weigh the environmental effects of the proposed actions; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's preliminary recommendation regarding the proposed action based on its environmental review.

As a cooperating agency, the Corps has participated in the environmental review and EIS preparation. The proposed action includes impacts on waters of the United States. For proposed actions requiring a Section 404 CWA permit for the discharge of dredged and/or fill material into waters of the United States, regulations promulgated by the U.S. Environmental Protection Agency (EPA) require the Corps to limit its authorization to the least environmentally damaging practicable alternative. The Corps will document its conclusion of the review process, including the requirement for compensatory mitigation, in accordance with 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources, in its permit-decision document, or Record of Decision.

Environmental issues are evaluated using the three-level standard of significance—SMALL, MODERATE, or LARGE—developed by the NRC using guidelines from the Council on Environmental Quality (CEQ) (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections. During its environmental review, the review team considered planned activities and actions that Luminant indicates it and others would likely take should Luminant receive the requested COLs. In addition, Luminant provided estimates of the environmental impacts resulting from the building and operation of two new nuclear units on the proposed site.

10.1 Impacts of the Proposed Action

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" to those activities that fall within its regulatory authority in 10 CFR 51.4. Many of the activities required to build a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term “preconstruction.” Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Because the “preconstruction” activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities require permits from the Corps, as well as from other Federal, State, and local agencies.

Chapter 4 describes the relative magnitude of impacts related to preconstruction and construction activities with a summary of impacts in Table 4-15. Impacts associated with operation of the proposed facilities are discussed in Chapter 5 and are summarized in Table 5-28. Chapter 6 describes the impacts associated with the fuel cycle, transportation, and decommissioning. Chapter 7 describes the impacts associated with preconstruction and construction activities and operation of Units 3 and 4 when considered along with the cumulative impacts of other past, present, and reasonably foreseeable future projects in the geographic region around the CPNPP site. Chapter 9 of this EIS includes the review team’s review of alternative sites and alternative power generation systems.

10.2 Unavoidable Adverse Environmental Impacts

Section 102(2)(C)(ii) of NEPA requires that an EIS include information on any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of the NRC action and the Corps’ action that cannot be avoided and for which no practical means of mitigation are available.

10.2.1 Unavoidable Adverse Impacts during Construction and Preconstruction

Chapter 4 discusses in detail the potential impacts from construction and preconstruction of the proposed Units 3 and 4 at the CPNPP site and presents mitigation and controls intended to lessen the adverse impacts. Table 10-1 presents the adverse impacts associated with construction and preconstruction activities to each of the resource areas evaluated in this EIS, and the mitigation measures that would reduce the impacts. Those impacts remaining after mitigation is applied are identified in Table 10-1 as the unavoidable adverse impacts.

The impact determinations in Table 10-1 are for the combined impacts of construction and preconstruction; however, the impact determinations for NRC-authorized construction are the same for all resources, except for land use and terrestrial ecology. For impact determinations that differ for the combined construction and preconstruction activities and the NRC-authorized activities, the impacts from the NRC-authorized activities are also identified in Table 10-1.

The unavoidable adverse environmental impacts are identified in Table 10-1 and are primarily attributable to preconstruction activities involving the initial land disturbance from clearing the land, filling areas of wetlands (probably less than 1 ac) and intermittent streams (about 0.3 mi), and building new transmission lines and pipeline corridors. All construction and preconstruction activities for CPNPP Units 3 and 4, including ground-disturbing activities, would occur within the existing CPNPP site boundary and along the existing and new transmission line and pipeline rights-of-way (ROWs). According to Luminant, the area that would be affected as a result of constructing and operating permanent facilities is approximately 675 ac, including areas disturbed on a short-term basis as a result of temporary activities and facilities and laydown areas. The construction of new make-up water and blowdown discharge pipelines between

Lake Granbury and the CPNPP site, including a new intake structure and a new discharge structure at Lake Granbury, would also result in land disturbance as well as permanent loss of aquatic habitat within the footprints of the submersed structures. Additional areas would be disturbed on a short-term basis as a result of temporary activities related to the building of facilities.

The water-use impacts during construction and preconstruction activities would be associated with dewatering of the site, which would depress the groundwater table in the general vicinity, and with use of surface water from the Somervell County Water District (SCWD) for process water (including the water used in the concrete batch plant) and fire protection and for potable water and sanitary needs during construction. Impacts to water quality during construction and preconstruction would be primarily limited to those associated with surface water runoff from the site; however, such impacts would be mitigated by implementation of BMPs and through the Stormwater Pollution Prevention Plan (SWPPP).

The impacts to terrestrial ecology would be associated with the disturbance of a total of 570 ac of terrestrial habitat including temporary and permanent losses of Ashe juniper (*Juniperus ashei*), mixed hardwood, and grassland habitat. A significant portion of this area (445 ac) would remain disturbed on a long-term basis. The building of new transmission line and pipeline corridors would result in the disturbance of additional terrestrial habitat.

The impacts to aquatic ecology would be associated with loss of about 0.12 ac of habitat in Lake Granbury for the building of the intake and discharge structures. Additionally, 0.3 mi of intermittent stream and less than 1 ac of wetlands adjacent to SCR would be lost during construction of the facilities associated with the proposed new units. Finally, about 5.5 ac of stream would affected by culvert installation in the ROWs. Implementation of BMPs is expected to prevent other impacts from runoff during building activities.

The socioeconomic impacts of construction include an increase in local traffic from construction workers, and possible demand pressure on the local housing market if workers concentrate in Hood or Somervell counties. No unusual resource dependencies on minority and low-income populations in the region were identified. In addition, no environmental pathways related to preconstruction or construction activities were found that would lead to adverse and disproportionate impacts on minority and low-income populations.

The review team did not identify any cultural resources that would be affected by building the proposed units. Luminant has agreed to follow procedures to minimize impacts if historic or cultural resources are discovered during ground-disturbing activities associated with building the proposed Units 3 and 4.

Atmospheric and meteorological impacts include fugitive dust from land disturbing and building activities that can be mitigated by the dust-control plan. Nonradiological health impacts to members of the public from construction, including public and occupational health, noise and transportation of materials, equipment and personnel, would be minimized through Luminant's controls and measures associated with compliance to Federal, State, and local regulations, permits and authorizations.

Radiological health impacts to members of the public from building of the proposed unit would be below annual exposure limits set to protect the general public. Radiological doses to construction workers at Units 3 and 4 from the adjacent operating units are expected to be well below regulatory limits.

Table 10-1. Unavoidable Adverse Environmental Impacts during Construction and Preconstruction

Resource Area	Adverse Impacts	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	MODERATE (NRC-authorized construction impact is SMALL)	Comply with requirements of applicable Federal, State, Tribal, and local permits. The impact level could be reduced by designating Dinosaur Valley State Park and all areas visible from the park as well as Fossil Rim Wildlife Center property as exclusion areas in the routing study that would be conducted for the proposed transmission line to Whitney Switch.	Approximately 675 ac would be committed to the project throughout preconstruction and construction, of which 125 ac would be available for use after construction is complete. Offsite transmission and pipelines would commit approximately 1217 ac. Installation of proposed transmission lines and erection of steel lattice support towers could adversely affect land uses.
Water Use	SMALL	Obtain a Clean Water Act (CWA) Section 401 certification prior to site-preparation activities.	Dewatering systems would depress the water table in the general vicinity, but the impacts would be localized and temporary.
Water Quality	SMALL	Implement best management practices (BMPs) and a site-specific Stormwater Pollution Prevention Plan (SWPPP). Comply with Federal and State permits and implementation of BMPs.	Onsite and offsite water bodies would receive stormwater runoff during building phase. Inadvertent spills that seep into aquifers.
Ecological (Terrestrial)	SMALL to MODERATE (NRC-authorized construction impact is SMALL)	Implement BMPs. Attempt to route Whitney transmission line away from Dinosaur Valley State Park and Fossil Rim Wildlife Center and any other areas of suitable habitat to avoid habitat of federally listed black-capped vireo and golden-cheeked warbler. Revegetate temporarily disturbed areas.	A total of 675 ac of terrestrial habitat would be disturbed, of which approximately 125 ac would be revegetated (550 ac of terrestrial habitat disturbed on a long-term basis). New transmission and pipeline rights-of-way (ROWs) would modify an additional 1217 ac of terrestrial habitat.
Ecological (Aquatic and Wetlands)	SMALL	Implement BMPs such as vegetation buffers, sediment fencing, retention basis, and turbidity curtains to prevent sediment impacts from runoff and disturbance of lake sediments during construction.	Loss of less than about 1 ac of wetlands and 0.3 mi of intermittent stream onsite. Total of about 5.5 ac of streams affected by culvert installation in ROWs. Loss of habitat (about 0.12 ac total) in Lake Granbury where intake and discharge structures would be built.

Table 10-1. (contd)

Resource Area	Adverse Impacts	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Socioeconomic			
Economic Impacts	None	None	None
Community Services and Infrastructure	SMALL to MODERATE	Provide funds to local communities to expand services; stagger shifts and require carpooling to reduce impacts of traffic on local roads; coordinate with TxDOT to implement additional measures to reduce impacts of traffic on local roads.	Impacts of population growth on community services (water and wastewater, solid waste, police, fire, and medical services, social services, and education). Impacts of additional traffic on level of service and safety on local roads.
Environmental Justice	SMALL	None	None
Historic and Cultural	SMALL	Inadvertent discovery procedures are in place to minimize impacts to potential onsite historic and cultural resources.	None
Air Quality	SMALL	Comply with Federal, State, and local regulations governing construction activities and construction vehicle emissions. Implement actions to reduce fugitive dust.	Equipment emissions and fugitive dust from operation of earth-moving equipment are sources of air pollution, but impacts would be temporary.
Nonradiological Health	SMALL	Adhere to permits and authorizations issued by State and local agencies.	Temporary public health impacts from exposure to fugitive dust and vehicular emissions, noise, and increased occupational injuries and traffic fatalities during the building phase.
Radiological Health	SMALL	Doses to construction workers would be maintained below NRC public dose limits.	Small radiological dose to construction workers from the two operating units would be less than NRC public dose limits.
Nonradiological Wastes	SMALL	Develop sediment and erosion control plans; stabilize disturbed land to prevent erosion; adhere to local, State and Federal permits and regulations regarding the classification and disposition of wastes.	Erosion from construction activities and disposal of construction debris and wastes may impact water quality. Consumption of landfill space for the disposition of such wastes would occur.

Solid, liquid, and gaseous wastes would be generated when building Units 3 and 4. These wastes would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste would ensure compliance with the CWA and TCEQ air and water quality standards.

The NRC staff concludes that the potential unavoidable adverse impacts from NRC-authorized construction activities would be SMALL. Nearly all such unavoidable adverse impacts would be attributable to preconstruction activities.

10.2.2 Unavoidable Adverse Impacts during Operation

Chapter 5 provides a detailed discussion of the potential impacts from operation of the proposed Units 3 and 4 at the CPNPP site. Table 10-2 presents the adverse impacts associated with operation of the two proposed units to each of the resource areas evaluated in this EIS and the mitigation measures that would reduce the impacts. Those impacts remaining after mitigation is applied are identified in the table as the unavoidable adverse impacts.

The unavoidable adverse impacts from operations for land use would be minimal and are associated with land being unavailable for other uses until after decommissioning of the two existing and two proposed CPNPP units.

Water-related impacts during operation would be mitigated through Luminant's adherence to BMPs, the SWPPP, and State permits for water withdrawal and discharge. Unavoidable adverse impacts to hydrological water-use during operation as a result increase water use by the proposed new units would be noticeable but would not destabilize important attributes. Water-quality impacts during operation would be minimal (except possibly during low flow or drought conditions) and would be limited to potential increases in naturally occurring total dissolved solids (TDS) and chlorides above ambient concentrations in surface water bodies, and potential surface and groundwater contamination from inadvertent spills.

Unavoidable adverse impacts to terrestrial ecology resources would include increased risks of bird and bat collisions with structures or overhead transmission lines, wildlife avoidance due to noise, continued maintenance, disturbance of habitats within transmission corridors, and potential impacts of salt deposition on vegetation near the proposed blowdown treatment facility (BDTF). Assuming that BMPs are followed, terrestrial ecology impacts during operation would be minor. Changes to the shoreline vegetation on Lake Granbury and Possum Kingdom as a result of the operation of the proposed new units would be noticeable. Aquatic impacts would be minimal to substantial during operation. While the design of the intake structure on Lake Granbury would have minimal effects to aquatic organisms from impingement, entrainment, and entrapment, impacts on aquatic and wetlands biota and habitat could be substantial as a result of hydrological alterations to the Brazos River system, specifically including Lake Granbury and Possum Kingdom Lake (PKL).

Adverse impacts to socioeconomic resources likely would be similar in character to those during the building phase but much smaller due to the smaller project-related population and the fact that much of the mitigation of housing and infrastructure shortages would have occurred in response to the larger impacts during the building period. Socioeconomic impacts would primarily include increased traffic, some damage to roads, an increase in the demand for housing and public services, along with increased employment opportunities and an increase in tax revenue to support the increase in service demand. Additionally, operating CPNPP Units 3 and 4 could reduce Possum Kingdom's water level and would have a noticeable impact on recreational use of the lake.

Unavoidable adverse environmental justice impacts would be minimal based on the distribution and composition of the region's minority and low-income populations and because the review team found no evidence of unique characteristics or practices among current minority or low-income populations that would make them differentially affected by operations activities. No unusual resource dependencies of minority or low-income populations in the region were identified.

No adverse impacts to historic or cultural resources during plant operations would be expected due to the procedures to be followed if historic or cultural resources are discovered during operation activities associated with the proposed Units 3 and 4.

It is expected that air-quality impacts would be negligible and that pollutants emitted during operations would be insignificant. Nonradiological and radiological health impacts would be minimal. Nonradiological health impacts to members of the public from operation, including etiological agents, noise, electromagnetic fields, occupational health and transportation of materials and personnel would be minimal through controls and measures by Luminant associated with compliance with Federal and State regulations.

Radiological doses to members of the public from operation of proposed Units 3 and 4 would be below NRC and EPA standards. Doses to workers from operation of proposed Units 3 and 4 would also be below NRC limits and would be maintained As Low As Reasonably Achievable (ALARA). The radiation protection measures designed to maintain doses to members of the public below NRC and EPA standards would also ensure that doses to biota other than humans would be well below the guidelines of the National Council on Radiation Protection and Measurements (NCRP) and the International Atomic Energy Agency (IAEA).

10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Section 102(2)(C)(iv) of NEPA requires that an EIS include information on the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The local use of the human environment by the proposed project can be summarized in terms of the unavoidable adverse environmental impacts of construction and operation and the irreversible and irretrievable commitments of resources. With the exception of the consumption of depletable resources as a result of plant construction and operation, these uses may be classed as short-term. The principal short-term benefit of the plant is represented by the production of electrical energy. The economic productivity of the site, when used for this purpose, would be extremely large compared to the productivity from agriculture or from other probable uses for the site.

The maximum long-term impact to productivity would result if the plant is not immediately dismantled at the end of the period of plant operation, and consequently the land occupied by the plant structures would not be available for any other use. However, the enhancement of regional productivity resulting from the electrical energy produced by the plant is expected to result in a correspondingly large increase in regional long-term productivity that would not be equaled by any other long-term use of the site. In addition, most long-term impacts resulting from land-use preemption by plant structures can be eliminated by removing these structures or by converting them to other productive uses. Once the plants cease operation and are shut down, they would be decommissioned according to NRC regulations. Once decommissioning is complete and the NRC license is terminated, the site would be available for other uses.

Table 10-2. Unavoidable Adverse Environmental Impacts from Operations

Resource Area	Adverse Impact	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land use	SMALL to MODERATE	Reduce or compensate for the effects of salt drift by using a salt fence and unidirectional arrangement of misters to reduce salt drift, providing salt-tolerant vegetation to affected land owners, providing compensation for corrosion of metal property, or (as a last resort) purchase of affected residential properties.	Operation of the blowdown treatment facility (BDTF) could adversely affect nearby residential property due to salt drift. Additional land in the region would likely be required for waste disposal uses due to the quantity of salt waste generated by the proposed project. Land would not be available for other uses until after decommissioning of the entire CPNPP site, including the proposed two new units.
Water Use	MODERATE	None	Increased surface water use from Lake Granbury because of the addition of Units 3 and 4.
Water Quality	SMALL to MODERATE	Implement BMPs and Stormwater Management Plan and maintain compliance with State permit limits and requirements. Monitor groundwater in the vicinity of the BDTF ponds to provide early detection of impacts to groundwater quality from pond overflows, spills, and salt drift.	Increased naturally occurring total dissolved solids (TDS) and chlorides above ambient concentrations and potential to contaminate surface and groundwater through inadvertent spills.
Ecological (Terrestrial)	MODERATE	Use salt fence and unidirectional arrangement of misters to reduce salt drift on adjoining terrestrial habitat. Consider relocating existing transmission line away from evaporation ponds. Implement BMPs to limit potential impacts from vegetation control, road maintenance, and other corridor activities. Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service recommend that Luminant consider relocating existing transmission line away from evaporation ponds.	Impacts to vegetation due to the BDTF due to salt deposition could occur. Transmission line maintenance would prevent forest succession. New project features, especially the evaporation pond under an existing transmission line, would represent an incremental increase in the risk of bird collisions. Impacts due to cooling system operation to shoreline vegetation on Lake Granbury and Possum Kingdom Reservoir would be noticeable

Table 10-2. (contd)

Resource Area	Adverse Impact	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Ecological (Aquatic and Wetlands)	SMALL to MODERATE	Manage water releases from PKL and Lake Granbury to maintain higher base flows and to periodically provide episodic high flows that would better simulate the natural in-stream flow regime of the river.	Changes in biota abundance, species diversity, and habitat availability the aquatic community of the Brazos River system (including PKL and Lake Granbury) as a result of hydrological changes due to increased water withdrawals and losses and associated alterations in water management in the Brazos River Basin.
Socioeconomic			
Physical Impacts	SMALL	Implement BMPs and comply with Federal, State, and local regulations.	None
Demography	SMALL	None	None
Economic Impacts	None	None	None
Community Services and Infrastructure	SMALL to MODERATE	None	Operating CPNPP Units 3 and 4 could reduce Possum Kingdom's water level by as much as 14.8 ft during drought conditions and would have a noticeable impact on recreational use of the lake, especially on the ability to use boat ramps and boat docks.
Environmental Justice	SMALL	None	None
Historic and Cultural Resources	SMALL	Formal inadvertent discovery procedures are in place to minimize impacts to potential onsite historic and cultural resources	None
Air Quality	SMALL	Comply with Federal, State, and local air quality permits and regulations	Plumes and drift deposition from cooling towers
		Implement existing CPNPP industrial safety program	Occupational injuries and illnesses

Table 10-2. (contd)

Resource Area	Adverse Impact	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Nonradiological Health	SMALL to MODERATE	Adhere to permits and authorizations issued by State and local agencies	Discharge thermal plume could encourage growth of etiological agents in Lake Granbury
		Finding low-noise-producing pump motors, mounting the motors on sound-dampening material, relocating the motors away from the water, or enclosing the pump motors in a sound-absorbing structure.	Noise from onsite systems (including cooling towers) would be about 55 dBA at exclusion area boundary
		Conform with Federal codes	Electrical shock from energized equipment and transmission lines
		Stagger arrival and departure times, as well as outage schedules, to minimize impacts to transportation routes	Accidents associated with transportation of operation and outage workers
Radiological Health	SMALL	Doses to members of the public would be maintained below NRC and EPA standards; workers' doses would be maintained below NRC limits and As Low As Reasonably Achievable (ALARA); mitigative actions instituted for members of the public would also ensure that doses to biota other than humans would be well below National Council on Radiation and Measurements (NCRP) and International Atomic Energy Agency (IAEA) guidelines	Small radiation doses to members of the public below NRC and EPA standards; ALARA doses to workers; and biota doses less than NCRP and IAEA guidelines
Nonradiological Wastes	SMALL	Maintain compliance with National Pollutant Discharge Elimination System (NPDES) permit requirements; adhere to local, State and Federal permits and regulations regarding the classification and disposition of wastes.	Consumption of landfill space for disposition of wastes (especially the anticipated large quantities of salt residue from the BTDF) would occur, as would the consumption of fuels for the transportation and disposition of these wastes.

The NRC staff concludes that the negative aspects of plant construction and operation as they affect the human environment would be outweighed by the positive long-term enhancement of regional productivity through the generation of electrical energy.

10.4 Irreversible and Irretrievable Commitments of Resources

Section 102(2)(C)(v) of NEPA requires that an EIS include information on any irreversible and irretrievable commitments of resources that would occur if the proposed action is implemented. The term "irreversible commitments of resources" refers to environmental resources that would be irreparably changed by the building or operation activities authorized by the Corps permit or NRC licensing decisions where the environmental resources could not be restored at some later time to the resource's state before building or operation. "Irretrievable commitments of resources" refers to materials that would be used for or consumed by the proposed new units in such a way that they could not, by practical means, be recycled or restored for other uses. The environmental resources summarized in this section are discussed in Chapters 4, 5, and 6. Irretrievable commitments of resources during building of the proposed new units generally would be similar to that of any major construction project.

10.4.1 Irreversible Commitments of Resources

Irreversible commitments of environmental resources resulting from construction, preconstruction, and operation of Units 3 and 4, in addition to the materials used for the nuclear fuel, include those discussed in the following subsections.

10.4.1.1 Land Use

The review team considers that the proposed preconstruction activities would result in the loss, through infilling, of approximately 1 ac of wetland habitat and about 0.3 mi of intermittent streams. This loss would be irreversible. Land committed to the disposal of radioactive and nonradioactive wastes is committed to that use and cannot be used for other purposes. The land used for Units 3 and 4, with the exception of any filled wetlands, is not irreversibly committed because once Units 3 and 4 cease operations and the plant is decommissioned in accordance with NRC requirements, the land supporting the facilities could be returned to other industrial or nonindustrial uses.

10.4.1.2 Water Use

Approximately 62,700 ac-ft/yr of water from Lake Granbury would be lost through consumptive use (i.e., evaporative cooling) during operation of CPNPP Units 3 and 4. The use of these water resources could likely be restored after decommissioning of the proposed reactors. Thus, no irreversible loss of hydrologic resources would be expected.

10.4.1.3 Ecology

Construction, preconstruction, and operation activities would cause temporary and long-term changes to both the aquatic and terrestrial biota at the plant site and facilities. These activities would change the abundance and distribution of local terrestrial flora and fauna on the CPNPP site. However, despite localized permanent loss of habitat associated with the construction footprint for Units 3 and 4, because enough suitable habitat exists elsewhere in the area, such changes would not result in adverse impacts on the regional populations. The majority of terrestrial and aquatic habitat losses are due to preconstruction activities. No irretrievable loss of terrestrial, aquatic, or wetland habitats would be expected on the site or in conjunction with the development of new transmission line and pipeline ROWs as a result of operations and any impacts as a result of operations would cease when the plant ceases operations. Terrestrial, aquatic, and wetland habitats likely could be restored after decommissioning of the proposed reactors.

10.4.1.4 Socioeconomic Resources

The review team expects that no irreversible socioeconomic commitments would be made to socioeconomic resources since they would be reallocated for other purposes once the plant is decommissioned.

10.4.1.5 Historic and Cultural Resources

The review team does not expect irreversible commitments to historic and cultural resources to occur during construction, preconstruction, and operations of the proposed CPNPP Units 3 and 4. Inadvertent discovery procedures are in place to minimize potential impacts.

10.4.1.6 Air and Water

Dust and other emissions such as vehicle exhaust would be released to the air during construction and preconstruction. During operations, vehicle exhaust emissions would continue and other air pollutants and chemicals, including very low concentrations of radioactive gases and particulates, would be released from the facility to the air and surface water. Because these releases would conform to applicable Federal and State regulations, their impact to the public health and the environment would be limited. The review team expects no irreversible commitment to air or water resources because all Unit 3 and 4 releases would be made in accordance with duly issued permits.

10.4.2 Irretrievable Commitments of Resources

Irretrievable commitments of resources during the building of the proposed new units generally would be similar to that of any major construction project. A study by the U.S. Department of Energy (DOE 2004) on new reactor construction estimated that approximately 12,239 yd^3 of concrete, 3107 tons of steel reinforcement (i.e., rebar), 13,000,000 ft of cable, and 275,000 ft of piping would be required for the reactor building of a typical new 1300 MW(e) nuclear power plant. Historical records of operating reactors suggest a total of approximately 182,900 yd^3 of concrete and 20,512 tons of structural steel would be required to construct the reactor building, major auxiliary buildings, turbine generator building, and turbine generator pedestal (DOE 2005). Therefore, about twice these amounts would be needed for the proposed CPNPP Units 3 and 4, and considerably more would be required for all the other site structures.

The review team expects that the use of construction materials in the quantities associated with those expected for Units 3 and 4 at the CPNPP site, while irretrievable, would be of small consequence with respect to the availability of such resources.

The main resource that would be irretrievably committed during operation of the new nuclear units would be uranium. The availability of uranium ore and existing stockpiles of highly enriched uranium in the United States and Russia that could be processed into fuel is sufficient (OECD, NEA, and IAEA 2008), so that the irreversible and irretrievable commitment would be negligible.

10.5 Alternatives to the Proposed Action

Alternatives to the proposed actions are discussed in Chapter 9. Alternatives considered are the no-action alternative, energy production alternatives, system design alternatives, and alternative sites. For the purposes of the Corps' evaluation, onsite alternatives are also addressed in Section 9.5.

The no-action alternative, as described in Section 9.1, refers to a scenario in which the NRC would deny Luminant's request for the COLs or the Corps would take no action or deny the Section 404 CWA permit. If such actions were to occur, the construction and operation of two new nuclear units at the CPNPP site in accordance with 10 CFR Part 52 would not occur and the predicted environmental impacts associated with the project would not occur. If no other power plant were built or electrical power supply strategy implemented to take its place, the electrical capacity to be provided by the project would not become available, and the benefits (electricity generation) associated with the proposed action would not occur and the need for power would not be met.

Alternative energy sources are described in Section 9.2. Alternatives that would not require additional generating capacity are described in Section 9.2.1. Detailed analyses of coal-fired and natural-gas-fired alternatives are provided in Section 9.2.2. Other energy sources are discussed in Section 9.2.3. A combination of energy alternatives is discussed in Section 9.2.4. The NRC staff concluded that none of the alternative energy options were both (1) consistent with Luminant's objective of building baseload generation units, and (2) environmentally preferable to the proposed action.

Alternative sites are discussed in Section 9.3. The cumulative impacts of building and operating the proposed facilities at the alternative sites are compared to the impacts at the proposed CPNPP site in Section 9.3.5. Table 9-24 contains the review team's characterization of cumulative impacts at the proposed and alternative sites. Based on this review, the NRC staff concludes that while there are differences in cumulative impacts at the proposed and alternative sites, none of the alternative sites would be environmentally preferable or obviously superior to the proposed CPNPP site. The NRC staff's determination is independent of the Corps' determination of a Least Environmentally Damaging Practicable Alternative pursuant to CWA Section 404(b)(1) guidelines. The Corps will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

In Section 9.4, the NRC staff considered alternative systems designs including three alternative heat dissipation systems and alternative intake, discharge, and water supply systems. The NRC staff identified no alternative that was environmentally preferable to the proposed plant systems design.

10.6 Benefit-Cost Balance

NEPA (42 U.S.C. 4321 et seq.), as amended, implemented by Executive Orders 11514 (35 FR 4247) and 11991 (42 FR 26967) and the CEQ's Guidelines (40 CFR Parts 1500-1508), requires that all agencies of the Federal Government prepare detailed environmental statements on proposed major Federal actions that can significantly affect the quality of the human environment. A principal objective of NEPA is to require each Federal agency to consider, in its decision-making process, the environmental impacts of each proposed major action and the available alternative actions, including alternative sites that can achieve the purpose and need for the action. In particular, Section 102 of NEPA requires all Federal agencies to the fullest extent possible:

> "(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations." (42 USC 4321)

However, neither NEPA nor CEQ requires the totality of costs and benefits of a proposed action be quantified in terms of dollars or any other common metric.

The intent of this section is not to identify and quantify all of the potential societal benefits of the proposed actions and compare these to a monetized estimate of the potential costs of the proposed actions. Instead, this section focuses on monetized values for only those activities closely related to the building and operation of the proposed new units. For other benefits and costs of such magnitude or importance that their inclusion in this analysis can inform the NRC's and Corps' decision-making processes, the review team quantified assessments. This section compiles and compares the pertinent analytical conclusions reached in earlier chapters of this EIS. It gathers all of the expected impacts from building and operations of the proposed Units 3 and 4 and aggregates them into two final categories: the expected environmental costs and the expected benefits to be derived from the approval of the proposed actions. The benefit-cost balancing for the NRC action will be based on a balancing of the benefits and costs of construction and operation.

Although the analysis in this section is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, this section will identify potential societal benefits of the proposed actions and compare these to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed actions. It is not possible to quantify and assign a value to all benefits and costs associated with the proposed actions. The analysis attempts to identify, quantify and provide monetary values for benefits and costs when reasonable estimates are available. The purpose is to inform the COL process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed actions outweigh the aggregate costs.

General issues related to Luminant's financial viability are outside the scope of NRC's EIS process and, thus, are not considered in this EIS. Issues related to Luminant's financial qualifications will be addressed in the NRC's safety evaluation report.

Section 10.6.1 discusses the benefits associated with the proposed actions, and Section 10.6.2 discusses the costs associated with CPNPP Units 3 and 4. These analyses are supported by the information and data provided in Tables 10-3 and 10-4. In accordance with NUREG-1555, internal costs of the proposed project are presented in monetary terms. Internal costs include all of the costs included in a total capital cost assessment: the direct and indirect cost of construction and preconstruction plus the annual costs of operation and maintenance. Section 10.6.3 summarizes the overall benefit-cost balance.

10.6.1 Benefits

The most apparent benefit from a power plant is that it generates power and provides thousands of residential, commercial, and industrial consumers with electricity. Maintaining an adequate supply of electricity in any given region has social and economic importance because adequate electricity is the foundation for economic stability and growth and fundamental to maintaining our current standard of living. Because the focus of this EIS is on the proposed expansion of the CPNPP site's generating capacity, this section focuses primarily on the relative benefits of the proposed Comanche Peak option rather than the broader, more generic benefits of electricity supply. The benefits associated with construction and operation of the proposed project are listed in Table 10.3.

10.6.1.1 Monetary Benefits

The following subsections consider the monetary benefits of constructing and operating CPNPP Units 3 and 4.

Table 10-3. Monetary and Nonmonetary Benefits from Constructing and Operating CPNPP Units 3 and 4

Net Electrical Generating Benefits		
Generating Capacity [MW(e)]	3200	
Annual Electricity Capacity (MW-h), assuming .95 capacity factor	About 26,630,000	
Taxes and Revenue		
Sales Tax	Construction (cumulative over seven years)	Operating per year
A sales tax of 8.25 percent is levied on eligible sales in most of the study area. Of this, 6.25 percent is levied by the state and up to 2 percent additional is levied by other qualifying jurisdictions.	91–105 million	3,754,000
Property Taxes by Jurisdiction 2006 ($)		
Hood County	25,785	5595
Tolar	111	37
Granbury ISD	56,202	18,734
Tolar ISD	45,219	15,073
Hood County Library District	765	255
Hood County total	128,082	39,649
Somervell County	15,370,812	5,124,604
Glen Rose	105	35
Somervell County Water District	5,646,612	1,882,099
Glenn Rose ISD	52,065,513	17,355,171
Somervell County total	73,083,042	24,361,909
Improvements to Local Facilities		
Road repairs and improvements and bridge repairs and improvements in the vicinity of CPNPP		
Socioeconomics		
Increased tax revenue supports incremental public services to meet need due to worker influx and supports other improvements to public infrastructure and social services. The increased revenue could spur future growth and development. Increased employment opportunities for local workers would likely occur.		
Effects on Regional Productivity		
Construction workers	About 5000 workers employed during construction, 70% of whom live locally	
Operational workers	About 500 people employed during operation of whom about 50% live locally	
Indirect jobs[(a)]	A temporary incremental increase in indirect jobs up to 1680 at construction peak and 530 permanent indirect jobs during operation	

Table 10-3. (contd)

Electric Reliability		
Enhances electric reliability through fuel source diversity and high projected capacity factors		
Electricity Price Volatility		
Dampens potential for system-wide price volatility owing to relatively small cost share for nuclear fuel		
Hazardous Wastes		
Compared with fossil-fueled plants, particularly coal-fired plants, nuclear plants produce significantly less nonradioactive hazardous effluents and waste products		
Aesthetics		
With the exception of a steam and vapor plume, nuclear plants do not produce negative viewshed aesthetics that are associated with fossil-fueled plants		
Avoided Air Pollutant Emissions, English Tons per Year[(b)]		
	Luminant estimates for 3180-MW plants[(c)]	
Pollutant	Gas-fired	Coal-fired
SO_2	253	3933
NO_x	2676	2610
CO	1115	3625
CO_2	8,200,000	35,000,000
PM_{25}	142	18,886
PM_{10}	NIA	4344

(a) Regional Input-Output Model System (RIMS) construction multiplier of 1.48 and operating multiplier of 2.41 used to calculate indirect jobs.
(b) Assumes use of current standard air pollution mitigation technology.
(c) Estimates based on information presented in Section 9.2.3.

Table 10-4. Internal and External Costs of Constructing and Operating CPNPP Units 3 and 4

Cost Category	Cost
Internal	
Overnight capital costs per kilowatt ($)	3600–4000
Construction costs (two units based on industry studies) ($)	11.5–12.8 billion
Operation cost per kWh, in cents (two units, based on industry studies)	3.2–7.4
Fuel costs per kWh in cents	1.3-1.7
Decommissioning cost	Approximately 0.1 to 0.2 cents per kWh.
External	
Land and land use	MODERATE. Approximately 675 ac would be committed to the project throughout preconstruction and construction, of which 125 ac would be available for other use after construction is complete. Offsite transmission and pipelines would commit approximately 1217 ac. During project operations, offsite land uses, including private property, could be affected by salt drift from the proposed BDTF and the disposal of waste salts (Sections 4.1 and 5.1).
Water Use and Water Quality	MODERATE for water use. There are costs associated with providing water from Lake Granbury and Wheeler Branch Reservoir for various needs during construction and operation. SMALL to MODERATE for water quality. Discharges to Lake Granbury from the proposed units could decrease the water quality during periods of low flow or drought. Relatively small levels of non-hazardous and/or radioactive effluents are introduced into SCR or Lake Granbury (Sections 5.2 and 5.2).
Terrestrial and aquatic ecology	MODERATE for terrestrial ecology. Some wildlife mortality during preconstruction and construction is anticipated; however, these costs are expected not to affect long-term populations of terrestrial and aquatic biota. A total of 675 ac of terrestrial habitat would be disturbed, of which approximately 125 ac would be revegetated. New transmission and pipeline ROWs would modify an additional 1217 ac of terrestrial habitat. Impacts to vegetation due to the BDTF and to salt deposition could occur. Transmission line maintenance would prevent forest succession. New project features, especially the evaporation pond under an existing transmission line, would represent an increase in the risk of bird collisions (Section 4.3 and 5.3). SMALL to MODERATE for aquatic ecology. Water availability changes could cause increased mortality of rare species in the affected water bodies; the impact may be substantial (Section 4.3 and 5.3).
Radioactive effluents and emissions	SMALL. Radioactive waste and minor amounts of radioactive air emissions are generated. Relatively small levels of radioactive effluents are introduced into SCR. Effects of these effluents on SCR are negligible (Sections 4.9 and 5.9).

Table 10-4. (contd)

Cost Category	Cost ($)
External	
Hazardous and radioactive waste	SMALL. Management and disposal of small amounts of hazardous wastes pursuant the Resource Conservation Recovery Act, 42 U.S.C. 6901 et seq. Storage, packaging for shipment, and disposal of low-level radioactive waste and high-level radioactive spent nuclear fuel. Commitment of geological resources for disposal of radioactive spent fuel (Sections 4.9, 4.10, 5.9, and 5.10).
Air emissions	SMALL. Air emissions from gas and diesel generators, auxiliary boilers and equipment, and vehicles that have a negligible impact on workers and local residents. Cooling tower drift deposits some salt on the surrounding vicinity, but the level is unlikely to result in any measureable impact on plants and vegetation. Cooling tower produces atmospheric plume discharge. Impacts are negligible (Sections 4.7 and 5.7).
Materials, energy, and uranium	SMALL. Irreversible and irretrievable commitments of materials and energy, including depletion of uranium.
Potential nuclear accident	SMALL. The costs of potential nuclear accidents could be substantial; however, the probability of such accidents is very low. Therefore, the overall probably-weighted costs of potential nuclear accidents are negligible (Section 5.11).
Socioeconomic	SMALL to MODERATE. Construction of CPNPP may pose additional costs to public and social services in the area. Construction-related costs tend to be temporary and conclude with the completion of the building phase of the project. Operations-related costs tend to be much smaller and continue for the life of the project. There may be some mismatches between jurisdictions experiencing increased revenues and increased public service demands (Sections 4.4 and 5.4).

Tax Payments

Luminant would make tax payments and ad valorem tax payments to the State of Texas, as well as several school districts and other special taxing districts within Somervell and Hood Counties. Regional taxes and the political structure within the CPNPP region are discussed in Section 2.5.2.2 of this EIS. Taxes related to construction and preconstruction of the proposed CPNPP Units 3 and 4 are discussed in Section 4.4.3 of this EIS. Section 5.4.3 of this EIS discusses regional and annual taxes related to the operation of the proposed new nuclear units. The primary Economic Impact Area (EIA) would be the six-counties in which more than 96 percent of the current CPNPP workforce resides: Somervell, Hood, Bosque, Erath, Johnson, and Tarrant Counties. Table 10-3 provides further details on taxes and revenues during construction and operation of the proposed new units.

Building activities and purchases at CPNPP Units 3 and 4 and personal expenditures made by construction and operations workers would generate several types of taxes, including income taxes on corporate profits, wages, and salaries; sales and use taxes on corporate and employee purchases; real property ad valorem taxes related to the CPNPP facilities; and personal property taxes associated with employees.

The review team expects that the amount of ad valorem taxes paid would increase each year as building progresses and property improvements are completed. Local tax revenues, especially from ad valorem taxes and sales and use taxes, would increase in the EIA. These increased tax revenues would be particularly beneficial for the local jurisdictions in Somervell and Hood counties. During the operations period, local tax revenues, especially from ad valorem taxes and sales and use taxes would likely remain high in Somervell County and, to a lesser extent, Hood County.

Local and State Economy

The in-migration of construction workers will create indirect jobs in the area and increase the amount of income used to purchase goods and services. Section 4.4.3 discusses the economic benefits in the EIA related to construction of the proposed project. Based on Bureau of Economic Analysis multipliers, every construction job at CPNPP could provide an additional 0.48 indirect jobs to the economies of Somervell and Hood Counties. During peak construction, the proposed project is expected to employ about 5000 workers. Operations workers contribute to the local economy during the overall lifetime of the facilities once construction is complete. Subsection 5.4.3 discusses the economic benefits in the EIA related to operating the proposed project starting in 2017. Every operations job is expected to provide an additional 1.41 indirect jobs to the 50-mi region. Operations are expected to require approximately 248 full-time workers per unit and would generate about 250 direct jobs and 602 indirect jobs.

10.6.1.2 Non-Monetary Benefits

The following subsections consider the non-monetary benefits including technical benefits from construction and operation of CPNPP.

Net Electrical Generating Benefits. Chapter 8 describes the need for power. As discussed in Chapter 8, over time there is a growing baseload demand and there are decreasing electric power reserve margins within the Electric Reliability Council of Texas (ERCOT) region. Each turbine generator at CPNPP has a rated and design net output of approximately 1600 MW(e) for each unit with a thermal output of 4451 MW(t) (Section 3.2). Assuming an average capacity factor of 95 percent, the plant average annual electrical-energy generation over a 3-year average is approximately 26,630,000 MW-h (3200 x 8760 x .95).

Fuel Diversity, Dampened Price Volatility, and Enhanced Reliability. Energy diversity is fundamental to the objective of achieving a reliable and affordable electric power supply system and should reduce the risk of future fuel disruptions, price fluctuations, and adverse consequences that result from changes in regulatory practices (EEI 2006). Maintaining fuel diversity means maintaining a balance of fuel mixes. High natural gas prices and intense, recurring periods of price volatility experienced in recent years have been driven, at least in part, by demand for natural gas used in the electric generation sector. At present the U.S. imports large quantities of crude oil and petroleum products from a world oil market characterized by regional instability. In contrast, the U.S. has sizable domestic uranium reserves (ENS 2010). The proposed project would reduce reliance on the world oil market. Nuclear plants provide forward price stability that is not available from generating plants fueled with natural gas. Although nuclear plants are capital-intensive to build, the operation costs are stable and dampen the price volatility from volatile fuel prices elsewhere in the electricity market (NEI 2005). For example nuclear power plants are generally not subject to fuel price volatility like natural gas and oil power plants. In addition, uranium fuel constitutes only 3 percent to 5 percent of the cost of a kilowatt-hour of nuclear-generated electricity. Doubling the price of uranium increases the cost of electricity by about 9 percent; while doubling the price of gas would add about 66 percent to the price of electricity, and doubling the cost of coal would add about 31 percent to the price of electricity (WNA 2010).

Air Pollution and Emissions Avoidance. Coal-fired plants generate most of the power industry's emissions (USHR 2006). In contrast, beyond steam and water vapor, modern nuclear reactors produce minimal air emissions, and thus avoid local and regional air quality impacts. For example, smog is a form of air pollution produced by the photochemical reaction of sunlight with volatile organic compounds (VOCs) and nitrogen oxides that have been released into the atmosphere (AHD 2000). Major sources of nitrogen oxides and VOCs that produce ozone include emissions from industrial facilities, electrical utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents (EPA 2007). Substituting nuclear power for fossil fuel-generated power would therefore reduce these forms of pollution.

Section 9.2 analyzes coal- and gas-fired alternatives to the proposed project. The beneficial impacts of avoided air pollutant emissions from building CPNPP Units 3 and 4 instead of equivalent fossil fuel plants are summarized in Table 10-4. Some of the benefits of reduced emissions from nuclear power generation are offset by emissions related to the uranium fuel cycle, see Section 5.7 (e.g., emissions from mining and processing the fuel). However, similar types of emissions are associated with mining and production of coal and, to some extent, drilling for natural gas. Therefore, a nuclear generating facility the size of CPNPP Units 3 and 4 provides substantial emissions avoidance over coal- or gas-powered generation alternatives.

Waste Products. Nuclear plants typically do not produce the volumes of nonradioactive hazardous effluents and waste products that are associated with fossil fuel plants, particularly coal fired plants. Coal fired plants produce a large volume of ash waste, which must be either stored of or disposed of, and which can pose threats to local environments if containment is breached.

10.6.2 Costs

This subsection describes the internal and external costs associated with construction and operation of CPNPP. "Internal" generally refers to the monetary costs associated with a project; "external" refers to the non-monetary environmental costs of constructing and operating the CPNPP Units 3 and 4. These costs are outlined in Table 10.4 and are described in more detail in the following subsections.

10.6.2.1 Internal Costs

This subsection describes the monetary costs of constructing and operating CPNPP. Internal costs include capital costs of the plant and transmission lines; operating costs (staffing, maintenance, fuel); and decommissioning costs.

Construction. This subsection describes projected internal monetary costs related to construction of CPNPP Units 3 and 4 based on published literature. Many cost studies with a wide range of cost estimates are available. The following seven studies are among the most authoritative sources because of the depth of their analyses; other studies tend to draw on these as sources.

- Organization for Economic Co-operation and Development (OECD) study of projected electricity generating costs (OECD 2005).
- Massachusetts Institute of Technology (MIT) study on the future of nuclear power (MIT 2003) and its update (MIT 2009).
- University of Chicago (UC) study on the economic future of nuclear power (UC 2004).
- Energy Information Administration (EIA) annual energy outlook (EIA 2006).

- Southern Nuclear Operating Company (Southern 2008).
- Tennessee Valley Authority (TVA) study of projected Bellefonte costs (TVA 2008).
- The Keystone Center Study (KC 2007)

Capital costs are incurred during construction when actual outlays for equipment, construction, and engineering are expended. Capital costs represent about 60 percent of total nuclear energy generation costs (OECD 2005). Capital costs are reported as overnight costs, which do not include interest or inflation factors, but do include engineering, procurement and construction costs, owner's costs, and contingencies. Owner's costs typically include the costs of site work and preparation, cooling water intake structures, and cooling towers; import duties on components; insurance; spare parts costs; development costs; project management costs; owners' engineering, state and local permitting, legal fees; and operations staffing and training.

In the first four studies (excepting the MIT update), estimates of overnight capital costs for constructing a nuclear reactor range from $1100 to $2500 per kW, with $1500 to $2000 per kW (in 2002 dollars) being the most representative range. Many factors account for the range in values: the specific technology and assumptions about the number of like units built, allocations of first-of-a-kind costs, site location and parity adjustments to allow comparison between countries, and allowances for contingencies are common examples. These cost estimates are based on nuclear plant construction outside the U.S. Construction costs overseas have generally been less than the most recent domestic construction, suggesting that the industry has learned how to reduce costs. An assumption in these studies is that the overseas experience can be applied domestically (UC 2004).

The Keystone study estimated that actual construction costs would fall in the range of $3600 to $4000 per kW (in 2007 dollars, including financing costs, for a 5- to 6-year construction period) (KC 2007). Considering the cost range from this study and a combined installed capacity of 3250 MW (e), the total "capital cost" for the CPNPP Units 3 and 4 could range from $11.3 to $12.5 billion.

For the remaining three studies:

- TVA estimated its per kW cost of construction for two new proposed AP1000 units at its Bellefonte site in Alabama between $2850 and $3200 per kW (TVA 2008), which, if applied to proposed Units 3 and 4 at CPNPP [installed capacity of 3200 MW(e)], would yield an overnight capital cost of $9.1 to $10.2 billion.
- Southern Nuclear Operating Company estimated the overnight cost of construction for two AP1000 units at its Vogtle site in Georgia between $3200 and $3500 kW (Southern 2008), which, if applied to proposed Units 3 and 4 at CPNPP, would yield an overnight capital cost of $10.2 billion to $11.2 billion.
- The MIT Update (MIT 2009) estimated the overnight construction cost at $4000 per kW in 2007 dollars (about $4100 per kW in 2008 dollars) or about $12.8 billion for 3200 MW(e) in 2008 dollars.

All of these estimates include the cost of both preconstruction and construction activities. Thus, they overestimate the costs of the proposed NRC action and provide a conservative estimate of the costs for the benefit-cost analysis.

Actual project cost for CPNPP Units 3 and 4 would depend on such things as

- actual duration of construction,
- actual interest rates during construction,
- transmission upgrades or improvements that may be required to support the project, which are not included in these calculations, and

- Allowed cost recovery during construction.

Relative construction costs for the proposed site and alternative plant and transmission systems are discussed in Section 9.4. For example, the cost of constructing a system that uses a mechanical draft cooling tower (MDCT) is $232 million less than a natural draft cooling tower, $86 million less than an MDCT open cycle, and $338 million less than an air-to-air system (in 2007 dollars, Table 9.4-3).

Based on this review the NRC review team has determined the $11.3 to $12.5 billion cost for constructing the proposed units at CPNPP, the valued contained in Luminant's application (Luminant 2009a) was reasonable and applied that estimate in this EIS.

Operation. Operational expenses are incurred throughout the life of the plant and include costs for operations and maintenance (O&M), fueling, and decommissioning (MIT 2003). These costs are frequently expressed as levelized cost of electricity, which is the lowest price per kilowatt-hour of producing electricity that covers operating costs, annualized capital costs, and a reasonable profit. According to the OECD study (OECD 2005), O&M costs reported in the United States include operation, site monitoring, maintenance, engineering support staff, administrative staff, waste management and disposal, general expenses, insurance, support to regulatory bodies, and safeguards. The same study reports that fuel cycle costs include the costs involved with fuel preparation (mining, processing, enrichment, and fabrication), and those involved with handling spent fuel (transportation, encapsulation, and disposal). The UC study (UC 2004) lists fixed O&M costs at $60 per kW and variable O&M costs at $2.10 per MWh (in 2003 dollars). Fuel costs are listed at $4.35 per MWh. The OECD study (OECD 2005) reports O&M costs at $8.50 per MWh (in 2003 dollars) and fuel costs at $4.70, with a discount rate of 10 percent. The MIT study (MIT 2003) reported O&M and fuel costs combined at $13 per MWh, in 2002 dollars. Escalating these values to 2007 dollars results in estimates of O&M costs of $9.90 per MWh and fuel costs of $6.21 per MWh. The Keystone Study (KC 2007) provides O&M and fuel costs in 2007 dollars. According to this study, fixed O&M costs may be expected to range from $19 to $27 per MWh, with variable O&M costs at $5 per MW (~ $24 to $32 per MWh total). The Keystone study also reports nuclear fuel costs (in 2007 dollars) ranging from $13 to $17. Combining the earlier studies with the recent Keystone study yields a range of estimated O&M cost and fuel costs of $16 to $37 per reactor, in 2007 dollars. The updated MIT Study produced a value of $8.4 MWh. The NRC staff has determined that the range of costs contained in Luminant's application of $32 to $74 per MWh is reasonable and has used these values in this EIS. (Luminant 2009a). This converts to 3.2–7.4 cents per kWh.

Decommissioning. The NRC has requirements for licensees at 10 CFR 50.75 to provide reasonable assurance that funds will be available for the decommissioning process. Because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the localized cost of electricity generated by a nuclear power plant. Decommissioning costs are about 9 to 15 percent of the initial capital cost of a nuclear power plant. However, when discounted, they contribute only a few percent to the investment and even less to the generation cost. In the United States, they account for 0.1 to 0.2 cents per kWh, which is no more than 5 percent of the cost of the electricity produced (WNA 2010).

10.6.2.2 External Costs

The impacts of building and operating proposed CPNPP Units 3 and 4 have been identified and analyzed in Chapters 4 and 5, and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned. Such impacts cannot be universally monetized. Chapter 6 similarly addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of nuclear units at the CPNPP site. A summary of project internal and external costs is shown in table 10-4. Because Table 10-4 includes cost from preconstruction activities, it overestimates the costs for the proposed NRC action.

Unlike generation of electricity from coal and natural gas, normal operation of a nuclear power plant does not result in significant emissions of criteria air pollutants (e.g., oxides of nitrogen or sulfur dioxide), methyl mercury, or greenhouse gases associated with global warming and climate change. Combustion-based power plants are responsible for at least 70 percent of the sulfur dioxide, at least 21 percent of nitrogen oxides, and 51 percent of the mercury emissions from industrial sources in the United States (EPA 2009) and 40 percent of the carbon dioxide (DOE/EIA 2008). Eighty-two percent of the electric power industry's emissions are from coal fired plants (DOE/EIA 2008). Chapter 9 of this EIS analyzes coal- and natural gas-fired alternatives to building and operating the proposed Units 3 and 4. Air emissions from these alternatives and nuclear power are summarized in Chapters 4, 5, and 9.

As mentioned previously, Table 10-4 summarizes the external costs (i.e., environmental impacts) associated with the preconstruction, construction, and operation of Units 3 and 4. Table 4-11 summarizes the impacts from construction and preconstruction. Impacts from construction and preconstruction to land use, water use and quality, aquatic ecology, historic and cultural resources, air quality, radiological and nonradiological health, and nonradiological waste would all be SMALL. Because the overall impact to these resources from the proposed project in its entirety would be SMALL, the NRC-authorized action of the project (i.e., construction as defined in 10 CFR 51.4) would also be SMALL.

For land use, the impact from construction and preconstruction activities would be MODERATE. However, the impact of the NRC-authorized action would be SMALL. For terrestrial ecology, the combined construction and preconstruction impacts would be SMALL to MODERATE. The NRC-authorized activities' impact to terrestrial resources would be SMALL.

The review team determined that the overall impact and NRC-authorized action's impact to resources of socioeconomics would be SMALL to MODERATE and include resources such as: physical impacts, demography, infrastructure and community services. Additionally, the overall impact and NRC-authorized action's impact to environmental justice would be SMALL to MODERATE.

Table 5-28 summarizes the impacts from the operation of the proposed new nuclear units at the CPNPP site. For land use, water use, and terrestrial ecology, the impacts of operating two new units on the site would be MODERATE. For water quality, aquatic ecology, and recreation the impacts associated with operating the proposed new units would be SMALL to MODAERATE. The socioeconomic physical, demography, transportation, housing public services, and education impacts from operating the two proposed nuclear units would be SMALL. Additionally, the impacts associated with operating the proposed new units on environmental justice, historical and cultural resources, air quality, nonradiological and radiological health, nonradioactive waste, and impacts associated with postulated accidents would be SMALL.

10.6.3 Summary of Benefits and Costs

Luminant's business decision to pursue expansion of the CPNPP site's capacity by adding two additional nuclear reactors is an economic decision based on private financial factors. Overall, this analysis has found that the planning and execution of the construction activity outlined by Luminant should provide significant benefits at minimal costs. The principal benefit would be the additional power generation resources. The overall benefit-cost balance, based upon the proposed plant, would not be significantly improved by the selection of an alternative site or by use of an alternative generating system.

Table 10-3 and Table 10-4 include summaries of the internal and the external costs of the proposed activities at the CPNPP site, as well as the identified benefits. The tables include references to the other sections of this EIS when impact assessments or more detailed analysis are available for specific topics.

On the basis of the assessments in this EIS, the construction and operation of the proposed CPNPP Units 3 and 4 would accrue benefits that outweigh the project's associated economic, environmental, and social costs. For the NRC proposed action (NRC-authorized construction and operation) the accrued benefits would also outweigh the costs of construction, preconstruction, and operation of Units 3 and 4.

10.7 Staff Conclusions and Recommendations

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued. The NRC staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be addressed in the NRC staff's safety evaluation report that is anticipated to be published in 2012.

The NRC staff's recommendation is based on (1) the ER submitted by Luminant (Luminant 2009a); (2) consultation with Federal, State, Tribal, and local agencies, (3) the review team's own independent review, (4) the NRC staff's consideration of public scoping comments, and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and in the EIS. In addition, in making its recommendation, the NRC staff determined that none of the alternative sites assessed is obviously superior to the CPNPP site.

The NRC's determination is independent of the Corps' determination of a Least Environmentally Damaging Practicable Alternative pursuant to CWA Section 404(b)(1) Guidelines. The Corps will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

10.8 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

33 CFR Part 332. Code of Federal Regulations, Title 10, *Navigation and Navigable Waters*, Part 332, "Compensatory Mitigation for Losses of Aquatic Resources."

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NRC FORM 335
(12-2010)
NRCMD 3.7

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER
(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG-1943, Vol. 1

2. TITLE AND SUBTITLE

Environmental Impact Statement for Combined Licenses (COLs) for Comanche Peak Nuclear Power Plant, Units 3 and 4: Final Report

3. DATE REPORT PUBLISHED

MONTH	YEAR
May	2011

4. FIN OR GRANT NUMBER

5. AUTHOR(S)

See Appendix A of this Report

6. TYPE OF REPORT

Technical

7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

Division of Site and Environmental Reviews/Office of New Reactors/U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Division of Site and Environmental Reviews/Office of New Reactors/U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

10. SUPPLEMENTARY NOTES

Docket Nos. 52-034 and 52-035

11. ABSTRACT *(200 words or less)*

This environmental impact statement (EIS) has been prepared to satisfy the requirements of the National Environmental Policy Act of 1969, as amended. This EIS has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Luminant Generation Company LLC (Luminant), acting for itself and as agent for the Nuclear Project Company LLC (subsequently renamed Comanche Peak Nuclear Power Company LLC), for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the Luminant application are (1) NRC issuance of COLs for two new nuclear power reactor units (Units 3 and 4) at the Comanche Peak Nuclear Power Plant (CPNPP) site in Hood and Somervell Counties, Texas, and (2) U.S. Army Corps of Engineers (Corps) issuance of a permit to perform certain construction activities on the site. The Corps is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

After considering the environmental aspects of the proposed action, the NRC staff's recommendation to the Commission is that the COLs be issued as requested. This recommendation to the Commission is based on (1) the application, including the environmental report (ER) submitted by Luminant and Luminant's responses to the NRC and Corps staff's request for additional information (RAIs); (2) consultation with Federal, State, Tribal, and local agencies; (3) the NRC and Corps staff's independent review; (4) the NRC and Corps staff's consideration of public comments; and (5) the assessments summarized in the EIS, including the potential mitigation measures identified in the ER and this EIS. the Corps will issue its Record of Decision based, in part , on the EIS.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Comanche Peak Nuclear Power Plant Units 3 and 4
National Environmental Policy Act/NEPA
Final Environmental Impact Statement/DEIS
Combined License/COL
New Reactors

13. AVAILABILITY STATEMENT

unlimited

14. SECURITY CLASSIFICATION

(This Page)
unclassified

(This Report)
unclassified

15. NUMBER OF PAGES

16. PRICE

Printed on recycled paper

Federal Recycling Program

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS

NUREG-1943, Vol. 1
Final

Environmental Impact Statement for the Combined Licenses (COLs) for Comanche Peak Nuclear Power Plant Units 3 and 4

May 2011