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NUREG-1910
Supplement 6

Environmental Impact Statement for the Reno Creek In Situ Recovery Project in Campbell County, Wyoming

Supplement to the Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities

Final Report

Office of Nuclear Material Safety and Safeguards

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) issues licenses for the possession and use of source material (hereafter referred to as an "NRC license") provided that proposed facilities meet NRC regulatory requirements and would be operated in a manner that is protective of public health and safety and the environment. Under the NRC environmental protection regulations in Title 10 of the *Code of Federal Regulations* (CFR) 10 CFR Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), issuance of a license to possess and use source material for uranium milling, as defined in 10 CFR Part 40, requires an environmental impact statement (EIS) or a supplement to an EIS.

In May 2009, the NRC issued NUREG–1910, the Generic Environmental Impact Statement for In Situ Leach Uranium Facilities (GEIS) (NRC, 2009). In the GEIS, the NRC assessed the potential environmental impacts from the construction, operations, aquifer restoration, and decommissioning of an in situ leach uranium recovery facility [also known as an in situ recovery (ISR) facility] located in four specified geographic regions of the western United States. As part of this assessment, the NRC determined which potential impacts would be essentially the same for all ISR facilities and which would result in varying levels of impact for different facilities, thus requiring further site-specific information to determine potential impacts. The GEIS provides a starting point for the NRC NEPA analyses for site-specific license applications for new ISR facilities, as well as for applications to amend or renew existing ISR licenses.

By letter dated October 3, 2012, AUC, LLC (AUC, referred to herein as the applicant) submitted a license application to NRC for a new NRC license for the Reno Creek ISR Project. The proposed Reno Creek ISR Project would be located in Campbell County, Wyoming, which is in the Wyoming East Uranium Milling Region identified in the GEIS. The NRC staff prepared this Supplemental EIS (SEIS) to evaluate the potential environmental impacts from the applicant proposal to construct, operate, conduct aquifer restoration, and decommission an ISR uranium facility at the proposed Reno Creek ISR Project area. This SEIS describes the environment potentially affected by the proposed project activities, and describes the applicant's environmental monitoring program and proposed mitigation measures. In conducting its analysis in this SEIS, the NRC staff evaluated site-specific data and information to determine whether the applicant's proposed activities and site characteristics were consistent with those evaluated in the GEIS. The NRC staff then determined relevant sections, findings, and conclusions in the GEIS that could be incorporated by reference, and areas that required additional analysis. Based on its environmental review, the preliminary NRC staff recommendation is that, unless safety issues mandate otherwise, environmental impacts of the proposed action (issuing an NRC license for the proposed Reno Creek ISR Project) are not so great as to make issuance of an NRC license an unreasonable licensing decision.

References

10 CFR Part 40. Code of Federal Regulations, Title 10, *Energy*, Part 40, "*Domestic Licensing of Source Material*." Washington, DC: U.S. Government Printing Office.

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "*Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*." Washington, DC: U.S. Government Printing Office.

NRC. NUREG–1910, "Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities." ML091480244 and ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. May 2009.

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BACKGROUND

By letter dated October 3, 2012, AUC submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a new source and byproduct materials license (hereafter referred to as an “NRC license”) for the Reno Creek In Situ Uranium Recovery Project, located in Campbell County, Wyoming. The applicant is proposing to recover uranium using the in situ leach (ISL) [also known as in situ recovery (ISR)] process. The proposed Reno Creek ISR Project would include processing facilities and sequentially developed wellfields. Proposed facilities would include a central processing plant, wellfields, Class I deep disposal wells for disposal of liquid wastes, and the attendant infrastructure (e.g., pipelines and access roads).

The Atomic Energy Act of 1954 (AEA), as amended by the Uranium Mill Tailings Radiation Control Act of 1978, authorizes the NRC to issue licenses for the possession and use of source material and byproduct material. These statutes require the NRC to license facilities, including ISR operations, in accordance with the NRC’s regulatory requirements, which protect public health and safety and the environment. Under the NRC environmental protection regulations in Title 10 of the *Code of Federal Regulations* (CFR) 10 CFR Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), preparation of an environmental impact statement (EIS) or supplement to an EIS is required for issuance of a license to possess and use source material and byproduct material for uranium milling [10 CFR 51.20(b)(8)].

In May 2009, the NRC staff issued NUREG–1910, the Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (herein referred to as the GEIS) (NRC, 2009). In the GEIS, the NRC assessed the potential environmental impacts from the construction, operations, aquifer restoration, and decommissioning of an ISR facility located in four specified geographic regions of the western United States. The proposed Reno Creek ISR Project would be located within the Wyoming East Uranium Milling Region identified in the GEIS. The GEIS provides a starting point for the NRC’s site-specific NEPA analysis for new ISR license applications, as well as for applications that amend or renew existing ISR licenses. This Supplemental EIS (SEIS) incorporates by reference information from the GEIS and also uses information from the applicant’s license application and other independent sources to fulfill the requirements set forth in 10 CFR 51.20(b)(8).

This SEIS includes the NRC staff analysis that considers and weighs the environmental effects of the Proposed Action (Alternative 1) and No-Action Alternative (Alternative 2), and mitigation measures to either reduce or avoid adverse effects. It also includes the NRC staff’s recommendation regarding the proposed action.

PURPOSE AND NEED FOR THE PROPOSED ACTION

The NRC regulates uranium milling, including the ISR process, under 10 CFR Part 40, “Domestic Licensing of Source Material.” AUC is seeking an NRC license to authorize commercial-scale in situ uranium recovery at the proposed Reno Creek ISR Project. The purpose and need for the proposed federal action is to provide an option that allows the applicant to recover uranium and produce yellowcake within the proposed project area. Yellowcake is the uranium oxide product of the ISR milling process that is used to produce various products, including fuel for commercially operated nuclear power reactors.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the AEA, as amended, or findings in the NEPA environmental analysis that would lead the NRC to reject a license application, the NRC has no role in a company's business decision to submit a license application to operate an ISR facility at a particular location.

THE PROJECT AREA

The proposed Reno Creek ISR Project would be located in Campbell County, Wyoming, within the Pumpkin Buttes Uranium District. The proposed project area would be located between the communities of Wright, Edgerton, and Gillette. The total land area of the proposed Reno Creek ISR Project is 2,451 hectares (ha) [6,057 acres (ac)] of mostly private land. Approximately 2,192 ha [5,417 ac] is privately owned land and 259 ha [640 ac] is State of Wyoming owned land. The subsurface mineral rights are owned by the federal and state governments and various private entities.

The proposed Reno Creek ISR Project would consist of processing facilities and sequentially developed wellfields. Planned facilities associated with the proposed project include buildings associated with a central processing plant; wellfields and their associated infrastructure (e.g., wells, header houses, and pipelines); Wyoming Department of Environmental Quality (WDEQ)-permitted Underground Injection Control (UIC) Class I deep disposal wells for disposal of liquid wastes; and access roads. The applicant estimated that the land surface area that would be affected by proposed ISR operations would be approximately 62 ha [154 ac].

IN SITU RECOVERY PROCESS

During the ISR process, an oxidant-charged solution, called a lixiviant, is injected into the production zone aquifer (uranium orebody) through injection wells. Typically, a lixiviant uses native groundwater (from the production zone aquifer), carbon dioxide, and sodium carbonate/bicarbonate, with an oxygen or hydrogen peroxide oxidant. As the lixiviant circulates through the production zone, it oxidizes and dissolves the mineralized uranium, which is present in a reduced chemical state. The resulting uranium-rich solution is drawn to production wells (i.e., recovery wells) by pumping and then transferred to a processing facility via a network of pipelines, which may be buried just below the ground surface. At the processing facility, the uranium is removed from solution (typically via ion exchange). The resulting barren solution is then recharged with the oxidant and reinjected to recover more uranium.

During production, the uranium recovery solution continually moves through the aquifer from injection wells to production wells. These wells can be arranged in a variety of geometric patterns depending on the location and orientation of the orebody, aquifer permeability, and operator preference. Wellfields are typically designed in a five-spot or seven-spot pattern, with each production well located inside a ring of injection wells (AUC proposes to use a five-spot pattern). Monitoring wells are installed in the production zone aquifer and surround the wellfield pattern area. Monitoring wells are screened (i.e., open to allow water to enter) in the appropriate stratigraphic horizon to detect the potential migration of lixiviant away from the production zone. Monitoring wells are also installed in the overlying and underlying aquifers to detect the potential vertical migration of lixiviant outside the production zone. The uranium that is recovered from the solution is processed, dried into yellowcake, packaged into NRC- and U.S. Department of Transportation (USDOT)-approved 208 L [55 gal] steel drums, and trucked offsite to a licensed conversion facility.

A UIC program regulates the design, construction, testing, operations, and closure of disposal wells at ISR facilities. Before ISR operations begin, the portion of the aquifer(s) designated for uranium recovery must be exempted from the underground source of drinking water (USDW) designation, in accordance with the Safe Drinking Water Act (SDWA). Once production is complete, the production zone groundwater is restored to NRC-approved groundwater protection standards, which are protective of the surrounding groundwater. The site is decommissioned according to an NRC-approved decommissioning plan and in accordance with NRC-approved standards. Once decommissioning is approved, the site may be released for public use.

ALTERNATIVES

The NRC environmental review regulations that implement NEPA in 10 CFR Part 51 require the NRC to consider reasonable alternatives, including the No-Action Alternative (Alternative 2), to a Proposed Action (Alternative 1). The alternatives are evaluated with regard to the four phases of a uranium-recovery operation: construction, operations, aquifer restoration, and decommissioning. The alternatives have been established based on the purpose and need statement described in SEIS Section 1.3. Under the No-Action Alternative, the applicant would not construct and operate an ISR facility within the proposed project area. Other alternatives considered at the proposed Reno Creek ISR Project but eliminated from detailed analysis include conventional mining and milling, conventional mining and heap leach processing, alternative lixiviants, alternative site locations, and alternative well completion methods. These alternatives were eliminated from detailed study because they either would not meet the purpose and need of the proposed project or would cause greater environmental impacts than the proposed action. This SEIS also discusses alternative wastewater disposal options (e.g., evaporation ponds and Class V wells) that were not included in the license application.

SUMMARY OF ENVIRONMENTAL IMPACTS

This SEIS includes the NRC staff analysis that considers and weighs the environmental impacts from the construction, operations, aquifer restoration, and decommissioning of ISR operations at the proposed Reno Creek ISR Project and for the No-Action Alternative. This SEIS also describes mitigation measures for the reduction or avoidance of potential adverse impacts that (i) the applicant has committed to in its NRC license application, (ii) would be required under other federal and state permits or processes, or (iii) are additional measures the NRC staff identified as having the potential to reduce environmental impacts but that the applicant did not commit to in its application. The SEIS uses the assessments and conclusions reached in the GEIS in combination with site-specific information to assess and categorize impacts.

As discussed in the GEIS and consistent with NUREG–1748 (NRC, 2003), the significance of potential environmental impacts is categorized as follows:

SMALL: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Chapter 4 of this SEIS provides the NRC evaluation of the potential environmental impacts from the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project. The significance of impacts from the ISR facility lifecycle is listed next, followed by a summary of impacts by environmental resource area and ISR phase.

Impacts by Resource Area and ISR Facility Phase

Land Use

Construction: Impacts would be SMALL. Approximately 62 ha [154 ac] of the proposed project area would be disturbed by the construction phase. Topsoil would be stripped and stockpiled to build surface facilities, develop the initial wellfields and the attendant infrastructure, and construct access roads. Livestock grazing and recreational activities would be excluded from fenced areas surrounding the central processing plant and wellfields. Existing wells, including 46 producing coalbed methane (CBM) wells and 2 producing oil wells, are not anticipated to be affected by construction activities. Construction activities would be conducted in conjunction with other project phases and are anticipated to take 1 to 2 years per wellfield (approximately 9 years in total for the entire project).

Operations: Impacts would be SMALL. Land use impacts during the operations phase would be limited to the wellfields and would be similar to or less than those during the construction phase. Wellfields would be sequentially developed resulting in the disturbance of approximately 55 ha [135 ac]. Land disturbance and access restrictions would result from drilling new wells and constructing additional header houses and pipelines. Livestock grazing and recreational activities would continue to be restricted from the central processing plant, surface impoundments, and wellfields. After approximately 1 to 2 years of initial site development and facility construction, there would be 11 years of wellfield and uranium recovery operations.

Aquifer Restoration: Impacts would be SMALL. Land use impacts would be similar to or less than those described for the operations phase. Land use impacts would decrease as fewer wells and pump houses are used and overall equipment traffic and use diminish. Access to wellfields and surface facilities would continue to be restricted. No additional land would be disturbed to construct facilities. Aquifer restoration activities would continue for 11 years.

Decommissioning: Impacts would be SMALL. Land use impacts during the decommissioning phase would be similar to those experienced during the construction phase. Decommissioning the buildings, wellfields, storage ponds, and access roads and removing potentially contaminated soil would result in a temporary, short-term (1 year) increase in land-disturbing activities. Upon completion of the plugging and abandonment of wells, the soil would be returned to areas in the wellfield where it had been removed and reseeded. Vegetation would become reestablished in reclaimed areas and the land would be returned to a condition that can support a variety of land uses. Decommissioning activities would continue for 8 years due to the phased approach of wellfield reclamation.

Transportation

Construction: Impacts would be SMALL. The proposed traffic from construction activities, if allocated completely to the individual road segments, would noticeably increase the existing traffic on State Highway 387, but would not substantially increase traffic on more heavily traveled road segments, such as State Highway 59 traveling from Gillette to Wright. Traffic on State Highway 387 is projected to increase by 8 percent, and truck traffic was projected to increase 1.1 percent. Combined auto and truck traffic on State Highway 59 was projected to increase by 2.1 percent north of Wright and by 1.7 percent south of Gillette. Considering (i) the phased approach of construction activities (approximately 1 to 2 years for each wellfield and 9 years in total for the entire project); (ii) the mitigation measures to reduce traffic impacts; and (iii) the relatively short segments of roads that would be impacted by traffic accessing the proposed project area, the NRC staff conclude that the increase in traffic volumes to the local county road system during construction would result in SMALL impacts. Additionally, based on the available capacity on the state highway road system in Campbell County, the NRC staff conclude that the potential traffic impacts to the state highway road system providing access to the proposed project area from nearby communities would be SMALL.

Operations: Impacts would be SMALL. The increase in traffic volumes would result in SMALL impacts to the local county road system and state highway road system servicing the proposed Reno Creek ISR Project. Commuting worker vehicles constitute the majority of road traffic for the operations phase. Additional truck shipments of byproduct material, processing chemicals, etc., would also slightly add to the traffic volume assessed during the construction phase. However, the two phases are comparable with less than 1 percent increase in auto traffic and less than 2 percent in truck traffic when compared to the construction phase. The potential radiological accident risk associated with yellowcake product shipments during the operations phase would be SMALL. Transport companies would have standing contracts with environmental emergency response contractors for spill cleanup. In addition, the applicant would develop a communication and emergency response plan with state and local authorities for all transport and emergency conditions (AUC, 2012). The NRC staff conclude that the consequences of such accidents would also be limited because the applicant has committed to develop emergency response and standard operating procedures (AUC, 2012, 2014) for yellowcake and other transportation accidents that could occur during shipment to or from the proposed Reno Creek ISR Project. The applicant also proposes to ensure its personnel and the carrier receive training on these emergency response procedures and that information about the procedures is provided to state and local agencies (AUC, 2012, 2014). Based on the low radiological risks from transportation accidents and the implementation of the applicant's additional safety practices, the overall impacts from the proposed transportation activities during the operations phase would be SMALL.

Aquifer Restoration: Impacts would be SMALL. Transportation impacts would be less than those estimated for the construction and operations phases because the need to transport yellowcake product, hazardous materials, and uranium-loaded resins between units would decrease as aquifer restoration progressed. The decrease in the supply shipments, waste shipments, and employee commuting (because fewer workers will be involved) would reduce the potential for spills or leakage from accidents.

Decommissioning: Impacts would be SMALL. Transportation impacts would be less than those during the construction and operations phases because the transport of yellowcake product and processing chemicals would end during decommissioning. The applicant estimated the number of worker trips per day to the site would be six. In addition, the applicant estimated that two vehicles would travel to and from the proposed project area daily for commercial delivery and pickup (AUC, 2014). Access roads would either be reclaimed or left in place for future use. Waste shipments would increase temporarily, but would still represent a small contribution to daily traffic. Fewer workers would be employed, further reducing the potential transportation impact during this phase.

Geology and Soils

Construction: Impacts would be SMALL. Earthmoving activities associated with construction of the central processing plant, access roads, wellfields, and pipelines will include topsoil clearing and land grading. The applicant estimates that approximately 24.9 ha/m [202 ac/ft] of salvageable topsoil is present and would be removed within the 62.4 ha [154.3 ac] of potential land disturbance. Topsoil removed during these activities would be stored and reused later to restore disturbed areas. The limited areal extent of the construction area, the soil stockpiling procedures, the implementation of best management practices (BMPs), the short duration of the construction phase, and mitigative measures such as reestablishment of native vegetation would further minimize the potential impact on soils.

Operations: Impacts would be SMALL. The operations phase would not remove rock matrix or structure and would not dewater production zone aquifers. Therefore, no significant matrix compression or ground subsidence is expected. The occurrence of potential spills during transfer of uranium-bearing lixiviant would be mitigated by implementing onsite standard procedures and by complying with the NRC requirements for spill response and reporting of surface releases and cleanup of any contaminated soils. The WDEQ would determine the suitability of deep geologic formations for Class I deep disposal wells for liquid waste before issuing an UIC permit.

Aquifer Restoration: Impacts would be SMALL. During aquifer restoration, the processes of groundwater sweep and groundwater transfer would not remove rock matrix or structure. The formation groundwater pressure within the extraction zone would be decreased during restoration as groundwater is removed to ensure the direction of groundwater flow is into the wellfields to reduce the potential for lateral migration of constituents. However, the change in groundwater pressure would not result in collapse of overlying rock strata as it is supported by the rock matrix of the formation. The potential impact to soils from spills and leaks will be comparable to that described for the operations phase. The NRC requirements for spill response and recovery and routine monitoring programs would also apply.

Decommissioning: Impacts would be SMALL. Disruption or displacement of soils would occur during dismantling of the facilities and reclamation of the land; however, the disturbed lands would be restored to their preextraction land use. Topsoil would be reclaimed and the surface regraded to the original topography.

Surface Waters and Wetlands

Construction: Impacts would be SMALL. The occurrence of surface water at the proposed Reno Creek site is limited, and surface water flow in channels is ephemeral. In addition, the applicant performed a wetland delineation survey and identified a total of 17.12 ha [42.23 ac] of wetlands consisting of eight wetland classes within the proposed project area. Because the applicant has committed to adopting measures to control erosion and sediment loading to surface water bodies, including implementation of stormwater BMPs (e.g., retention ponds) and compliance with state-issued permits, the NRC staff determine that impacts to surface water resources during the construction phase would be SMALL. Wyoming Pollutant Discharge Elimination System (WYPDES) permit issued by WDEQ would set limits to control the amount of pollutants that can enter surface water bodies.

Operations: Impacts would be SMALL. Because of the limited surface disturbances; low regional precipitation and minimal average seasonal runoff; installation of surface drainage features and spill containment structures; and implementation of BMPs (e.g. silt fencing), spill prevention, and control procedures, the NRC staff determine that the potential impact to surface water resources during operations at the proposed Reno Creek ISR Project would be SMALL and would be further reduced by the applicant's proposed mitigation measures. Additionally, processing facilities and chemical and fuel storage tanks would have secondary containment to contain potential spills.

Aquifer Restoration: Impacts would be SMALL. Impacts would be similar to those during the operations phase because the same infrastructure would be used and the same activities would be conducted. The applicant's WDEQ-approved WYPDES permit would be in place to mitigate impacts to surface water from erosion, runoff, and sedimentation. Aquifer restoration at the proposed Reno Creek ISR Project would involve treatment by reverse osmosis methods, with the resulting effluent disposed of through Class I deep disposal wells. Additionally, land surface disturbances may occur, but these would be minimal in comparison to disturbances during the construction phase. Therefore, potential sediment loading to surface water bodies would be significantly less than that expected during construction.

Decommissioning: Impacts would be SMALL. The impacts would be similar to those during the construction phase. Activities to clean-up, recontour, and reclaim the land surface during decommissioning would mitigate long-term impacts to surface water. The applicant's WDEQ-approved WYPDES permit would be in place to mitigate impacts to surface water from erosion, runoff, and sedimentation.

Groundwater

Construction: Impacts would be SMALL. The primary impact to groundwater during the construction phase would be from the consumptive use of groundwater, introduction of drilling fluids into the environment during well installation, and from surface spills of fuels and lubricants. The applicant would be required to obtain water appropriation use permits from WDEQ and the Wyoming State Engineer's Office prior to withdrawing water from aquifers. During well installation, drilling fluids (mud) would have the potential to impact surficial aquifers; however, all wells would undergo mechanical integrity tests of the casing and therefore ensure against well leakage prior to entering service. Impacts to groundwater from surface spills of fuels and lubricants would be mitigated by the applicant's implementation of BMPs and by following a spill prevention program that would require an immediate cleanup response to prevent soil contamination or infiltration to groundwater.

Operations: Impacts would be SMALL. The operations phase may impact near-surface (shallow) aquifers, production zone aquifers containing the orebodies and surrounding aquifers, and deep aquifers below the ore production zone used for the disposal of liquid wastes.

Shallow aquifers are separated from production zone and surrounding aquifers by aquitards (confining units) and, therefore, are not hydraulically connected to production zone and surrounding aquifers. In addition, the shallow aquifers in the vicinity of the proposed project do not serve as a water supply for domestic use or livestock. The impacts from spills and leaks would be SMALL. The applicant's leak detection and cleanup program would include rapid response and remediation to minimize impacts to soils and groundwater.

The applicant would monitor all domestic and stock wells within 2 km [1.2 mi] of the wellfields every 3 months during operations and replace these wells in the event of significant drawdown or degradation of water quality. Water levels in affected wells would recover with time after ISR operations and aquifer restoration activities are complete.

The applicant estimates that it would process 41,640 Lpm [11,000 gpm] of groundwater for uranium recovery operations. The establishment of an inward hydraulic gradient during wellfield operations along with the applicant-installed groundwater monitoring network to detect potential vertical and horizontal excursions would limit the potential for undetected lixiviant excursions that could degrade groundwater quality. Because the ore production zones are overlain and underlain by impermeable shale layers, this further ensures the hydraulic isolation of the ore production zones, which helps to limit potential groundwater contamination in surrounding aquifers. Because the applicant must initiate aquifer restoration in the production aquifers to return groundwater to Commission-approved background levels or to NRC-approved alternative water quality levels at the end of ISR operations, the NRC staff conclude that groundwater quality impacts to the production and surrounding aquifers as a result of ISR operations would be SMALL. Liquid wastes generated from operations at the proposed Reno Creek ISR Project would be disposed via Class I deep disposal wells. The groundwater in deep formations targeted for Class I deep well disposal must not be a potential underground source of drinking water. The NRC would require the Class I deep disposal waste to meet the NRC dose limits and waste disposal standards in 10 CFR Part 20, Subparts D and K. The applicant has received a WDEQ permit for four Class I deep disposal wells and has applied for an aquifer exemption from EPA (pending).

Aquifer Restoration: Impacts would be SMALL. Groundwater restoration would be initiated once a wellfield is no longer being used to produce uranium. Larger withdrawals would produce larger drawdowns in production aquifers during aquifer restoration, resulting in a greater impact on yields of nearby wells. As with operations, the applicant would monitor all domestic and stock wells within 2 km [1.2 mi] of the wellfields during aquifer restoration and replace these wells in the event of significant drawdown or degradation of water quality. Water levels in affected wells would recover to pre-operational levels in 1 year (on average) after ISR operations and aquifer restoration activities are complete. Natural recovery and the well monitoring measures established by the applicant would reduce impacts to nearby wells, ensuring the long-term environmental impact from consumptive use would be SMALL.

During aquifer restoration, hydraulic control for the former production zone would be maintained; this would be accomplished by maintaining an inward hydraulic gradient through a production bleed. During aquifer restoration activities, water would be pumped from the wellfield (without reinjection), resulting in an influx of “fresh” groundwater into the affected (mined) portion of the aquifer. The applicant estimates that during aquifer restoration, the groundwater restoration flow rate will be 3,785 L/min [1,000 gpm] from the wellfields in the groundwater treatment stage and 189 L/min [50 gpm] in the groundwater sweep stage. Disposal of liquid wastes via Class I deep disposal wells would occur as described for ISR operations. The goal of aquifer restoration would be to restore groundwater quality in the ore production zone to Commission-approved background conditions under 10 CFR Part 40, Appendix A, Criterion 5B(5). If the aquifer cannot be restored to background conditions, then the NRC would require that either the production zone be returned to maximum contaminant levels in 10 CFR Part 40, Appendix A, Table 5C or to NRC-approved alternate concentration limits. Post-restoration groundwater quality would be protective of public health and the environment.

Decommissioning: Impacts would be SMALL. The potential impact to groundwater quality during decommissioning and reclamation is comparable to that described in the construction phase. Groundwater consumptive use would be less than that of the operations and restoration phases. All monitoring and production wells would be plugged and abandoned in accordance with UIC program requirements. Wells would be filled with cement and clay to ensure groundwater does not flow through the abandoned wells. Abandoned wells would be properly isolated from the flow domain. The NRC would review and approve the wellfield restoration efforts to ensure that restoration standards were followed and public health and safety is protected.

Ecological Resources

Construction: Impacts would be SMALL. Construction disturbance under current development plans would require vegetative removal. Direct impacts from construction activities at the proposed project would include short-term loss of 54.28 ha [134.14 ac] of vegetation. Some habitat loss or alteration, displacement of wildlife, and mortality due to encounters with vehicles or heavy equipment would occur, though wildlife species would likely disperse from the area once construction commences. The applicant has committed to following recommended fencing and power line construction designs that would minimize impediments to game and avian movement. Mitigation would control the introduction and spread of undesirable and invasive, nonnative plants; reduce the likelihood of injury or mortality to wildlife. In addition, wetlands and ponds found in the proposed project area are seasonal in nature and do not provided a year-round source of surface water sufficient to maintain a population of aquatic species. Impacts to wildlife and habitat would be minimized with mitigation measures and the timely reseeding of disturbed areas following construction. Any trees with raptor nests would not be removed, and following U.S. Fish and Wildlife Service (FWS) seasonal noise, vehicular traffic, and human proximity guidelines would help to ensure the continued nesting success of area raptors. No federally threatened or endangered plant species or critical habitats are known to occur within the proposed project area. Impacts to federally listed threatened or endangered species would not noticeably affect species' populations because wildlife surveys for the proposed Reno Creek ISR Project did not identified federally listed threatened or endangered species within the proposed project area or the 1.6-km [1-mi] buffer area around the proposed project area (AUC, 2012).

Operations: Impacts would be SMALL. Ecological impacts due to noise, vehicles, structures, and the presence of humans would be similar to, but less than, those experienced during construction because fewer earthmoving activities would occur. The applicant would reseed disturbed areas with WDEQ-approved seed mixtures to restore habitat. Spill detection and response plans would reduce the potential impact to terrestrial and aquatic species. Fencing would further limit wildlife access to liquid waste holding ponds. Potential conflicts between birds and project-related activities would continue to be mitigated by implementing monitoring and mitigation plans.

Aquifer Restoration: Impacts would be SMALL. Impacts would be similar to those experienced during the operations phase with no major differences in type or degree of impact. The existing infrastructure would be used during this phase, and mitigation measures would continue to apply from the construction and operations phases.

Decommissioning: Impacts would be SMALL. Temporary disturbances to land and soils during decommissioning could displace vegetation and wildlife species that had recolonized the proposed project area since initiation of ISR activities. Shrubland vegetative communities would be more difficult to reestablish and achieve full site recovery. The applicant commits to continuing vegetation reestablishment efforts throughout the ISR facility life cycle. However, new vegetative growth could be affected by future grazing, droughts, or intense winters, thus reducing the rate of plant productivity and delaying full recovery, Revegetation and recontouring would restore habitat previously altered during construction and operations.

Air Quality

Construction: Impacts would be SMALL. Air emissions during the construction phase of the proposed project would consist primarily of combustion emissions from drill rigs and fugitive road dust. The magnitude of the pollutant concentrations from the construction phase combustion emissions are below National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) Class II regulatory thresholds. This also holds true for the peak year pollutant emission levels. The peak year accounts for when all four phases occur simultaneously and represents the highest amount of emissions the proposed project would generate in any one project year. Fugitive dust emissions, the primary source for the particulate matter PM_{10}, are spread out over a large area and tend to be generated sporadically. Due to the level and nature of these fugitive emissions, there is potential for intermittent impacts to localized areas in and around the proposed project area, particularly when vehicles travel on unpaved roads.

Operations: Impacts would be SMALL. Fugitive dust emission pollutant levels would be less than those experienced during construction. ISR facilities are not major point source emitters of regulated pollutants. Combustion emissions in this phase are basically evenly divided between light duty vehicles and construction and field equipment. The combustion and fugitive dust emissions would be below NAAQS and PSD Class II regulatory thresholds.

Aquifer Restoration: Impacts would be SMALL. Combustion emission and fugitive dust emission levels for the aquifer restoration phase are the lowest relative to the other three phases. For the aquifer restoration phase, combustion emissions are primarily from light duty vehicles and wind erosion can generate more fugitive dust emissions than travel on unpaved roads. The combustion and fugitive dust emissions would be below NAAQS and PSD Class II regulatory thresholds.

Decommissioning: Impacts would be SMALL. The decommissioning phase pollutant sources and emission levels closely match those from the operations phase. Therefore, the decommissioning phase would produce the same impact magnitude as the operations phase. The combustion and fugitive dust emissions would be below NAAQS and PSD Class II regulatory thresholds.

Noise

Construction: Impacts would be SMALL. Increased traffic, as well as use of drill rigs, heavy trucks, bulldozers, and other equipment to construct and operate the wellfields, drill wells, access roads, and build the central processing facility, would generate noise audible above ambient (background) levels. The sound from construction activities would return to background levels at a distance of approximately 305 m [1,000 ft]. The closest occupied offsite residence is approximately 2.0 km [1.25 mi] southeast of the proposed project boundary and therefore would not be directly impacted by noise generated during the construction phase of the proposed project. Administrative and engineering controls would be expected to maintain noise levels in work areas below Occupational Health and Safety Administration (OSHA) regulatory limits and be mitigated by use of personal hearing protection.

Operations: Impacts would be SMALL. Impacts from traffic-related noise would be similar to those during construction. Because wellfields would be developed and operated sequentially, potential noise impacts would be short term (1 to 2 years for each wellfield, commencing 9 to 12 months after construction begins and lasting approximately 11 years for the entire project). Noise impacts would be mitigated by using sound abatement controls on operating equipment. The central processing plant would generate indoor noise audible to workers. OSHA regulatory limits would be maintained and mitigated by use of personal hearing protection.

Aquifer Restoration: Impacts would be SMALL. Noise impacts would be similar to, or less than, those experienced during the operations phase. Pumps and other wellfield equipment contained in buildings would reduce the potential sound impact to an offsite individual. Because the aquifers in wellfields would be restored sequentially, potential noise impacts would be short term (1 to 2 years per wellfield, commencing in year 6 and lasting approximately 8 to 9 years for the entire project). The applicant has committed to reducing noise impacts by using sound abatement controls on operating equipment. Noise impacts from traffic would be SMALL because there would be fewer vehicular trips than during the operations phase.

Decommissioning: Impacts would be SMALL. Noise impacts would either be similar to, or less than, those experienced during the construction phase. Noise during this phase would be temporary, and when decommissioning and reclamation activities are complete, the noise levels would return to baseline. Noise impacts from traffic would be SMALL because there would be fewer shipments to and from the proposed project area as decommissioning progressed.

Historic and Cultural Resources

Construction: Impacts would be SMALL. The NRC's National Register of Historic Places (NRHP) eligibility determinations identified no historic properties in the proposed Reno Creek ISR Project area of potential effect. Therefore the construction phase would have no impact on known historic properties. Concurrence was provided by the Wyoming State Historic Preservation Office (WY SHPO) on October 11, 2016 (WY SHPO, 2016). However, as recommended by the Northern Arapaho Tribe and the NRC staff, the applicant would implement a voluntary avoidance and construction monitoring plan to mitigate potential effects to a site. In addition, the NRC would require the use of an inadvertent discovery plan as a license condition to address the potential identification of previously unrecorded historic and cultural resources during ISR facility construction. If an inadvertent discovery of historical or cultural resources is made, then work should cease and all appropriate state, tribal, and federal parties must be contacted. Any discovered artifacts would be inventoried and evaluated in accordance with 36 CFR Part 800.

Operations: Impacts would be SMALL. During the operations phase, fewer impacts on historic and cultural resources are anticipated in comparison to the ISR facility construction phase due to a reduction in ground disturbances. A key difference between the two phases with regard to historic and cultural resources is that during operations, access restrictions are present around active production units, new wells, header houses, and pipelines that limit inadvertent disturbance of cultural properties. If an inadvertent discovery of historical or cultural resources is made, then work should cease and all appropriate state, tribal, and federal parties must be contacted. Any discovered artifacts would be inventoried and evaluated in accordance with 36 CFR Part 800.

Aquifer Restoration: Impacts would be SMALL. Impacts to historical and cultural resources during the aquifer restoration phase would be similar to operations. The anticipated impacts to historic and cultural resources associated with this phase would be equivalent to, or less than, those attributed to ISR facility operations. Moreover, potential ground-disturbing activities occurring in this phase would likely be confined to areas having been disturbed through construction. The NRC's NRHP eligibility determinations for the proposed Reno Creek ISR Project found no sites listed in, or eligible for listing in, the NRHP. Aquifer restoration associated with the proposed project would have no visual or auditory impact to historic properties. However, the NRC would require the use of an inadvertent discovery plan as a license condition to address the potential identification of previously unrecorded historic and cultural resources during the aquifer restoration phase. If an inadvertent discovery of historical or cultural resources is made, then work should cease and all appropriate state, tribal, and federal parties must be contacted. Any discovered artifacts would be inventoried and evaluated in accordance with 36 CFR Part 800.

Decommissioning: Impacts would be SMALL. Decommissioning activities would be limited to previously disturbed areas within an ISR facility. Consequently, it is expected that impacts to any known historic or cultural properties which were inadvertently discovered during prior phases would have been mitigated prior to the decommissioning phase. The NRC's NRHP eligibility determinations for the proposed Reno Creek ISR Project found no sites listed in, or eligible for listing in, the NRHP. Therefore, no impacts to known historic or cultural resources are expected to occur during the decommissioning phase of the proposed Reno Creek ISR Project.

Visual and Scenic Resources

Construction: Impacts would be SMALL. During facilities construction, short-term (approximately 1 to 2 years for each wellfield for 9 years total over the life of the project) visual and scenic impacts would result from construction equipment and fugitive dust emissions. Temporary and short-term visual impacts during the construction period in each wellfield would result from header house construction, well drilling, and construction of access roads and electrical distribution lines. The applicant has committed to using dust suppression and selecting building materials and paint that complement the natural environment, which would reduce overall visual and scenic impacts of project construction.

Operations: Impacts would be SMALL. Visual impacts would be similar to, or less than, those experienced during construction. Less heavy machinery would be used, and standard dust control measures (e.g., water application and speed limits) would be implemented to reduce visual impacts from fugitive dust. Wellfields would be developed sequentially, and there would be no large expanse of land undergoing development at one time. The applicant has committed to painting buildings and other structures so that they blend in to the natural landscape.

Aquifer Restoration: Impacts would be SMALL. Visual impacts would be similar to, or less than, those experienced during the operations phase. Aquifer restoration activities would use in-place infrastructure; therefore, no modifications to either scenery or topography would occur. There would be less vehicular traffic, creating less of a visual impact. The applicant identified mitigation measures, such as dust suppression, which would be used to further reduce visual impacts.

Decommissioning: Impacts would be SMALL. Temporary impacts to the visual landscape would be comparable to those during the construction phase. Reclamation would return the visual landscape to baseline contours and would reduce the visual impact by removing buildings and the associated infrastructure. Implementation of applicant commitments regarding mitigation measures (e.g., dust suppression) would further reduce the visual impacts from decommissioning.

Socioeconomics

Construction: Impacts would be SMALL. Because of the small size of the construction workforce (80 workers) and because of the short duration of the ISR construction phase (approximately 1 to 2 years for each wellfield for 9 years total over the life of the project), the overall potential socioeconomic impact, including the effects of ISR facility construction on demographic conditions, income, housing, employment rate, local finance, education, and health and social services, would be SMALL.

Operations: Impacts would be SMALL. Because of the small size of the operations workforce (92 workers), the migration of workers and their families to nearby towns would have a SMALL impact on demographics. The impact on housing would be SMALL because of available housing in the immediate area surrounding the proposed ISR facility. Operation of the proposed Reno Creek ISR Project would create new jobs, but because of the small workforce size and because most skilled workers would be drawn from areas outside of the region of influence, impacts on employment would not be noticeable. The local economy would experience a SMALL beneficial impact from the purchasing of local goods and services and an increase in sales and income tax revenues. An increased demand for schools would have a SMALL impact on education because the current school systems are not at full capacity and can accommodate more students. Increased demand for health and social services would have a SMALL impact.

Aquifer Restoration: Impacts would be SMALL. Impacts would be less than those experienced during the operations phase. Fewer workers would be required, which would reduce demand on housing, education, and health and social services.

Decommissioning: Impacts would be SMALL. Impacts would be less than those during the construction and operations phases because fewer workers would be required. Demand for housing, education, and health and social services would also be reduced.

Environmental Justice

All Phases: The percentage of minority populations living in affected block groups in the vicinity of the proposed Reno Creek ISR Project area in Campbell County Wyoming does not significantly exceed the percentage of minority populations recorded at the state and county level and is well below the national level. Furthermore, the percentage of low-income populations living in affected census tracts in the vicinity of the proposed project area does not significantly exceed the percentage of low-income populations recorded at the state or county level. Therefore, there would be no disproportionately high and adverse impacts to minority and low-income populations from the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project.

Public and Occupational Health

Construction: Impacts would be SMALL. Construction activities, including the use of construction equipment and vehicles, would disturb the topsoil and create fugitive dust emissions. Fugitive dust generated from construction activities would be short term (approximately 1 to 2 years for each wellfield for 9 years total over the life of the project), and the levels of radioactivity in soils at the proposed project area are low; therefore direct exposure, inhalation, and ingestion of fugitive dust would not result in a radiological dose to workers and the public. Construction equipment would be diesel powered and would exhaust particulate diesel emissions. The potential impacts and potential human exposures from these emissions would be SMALL, because of the short duration of the release and because the emissions would be readily dispersed into the atmosphere.

Operations: The radiological impacts from normal operations would be SMALL. Public and occupational exposure rates at ISR facilities during normal operations have historically been well below regulatory limits. Dose assessments using the MILDOS computer code indicate that the 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr] would not be exceeded at the proposed project boundary. Six occupants live in the four residences outside the proposed project boundary. The Leavitt residence would be the closest occupied offsite residence. The Leavitt residence is approximately 2.0 km [1.25 mi] southeast of the proposed project boundary. The remote location of the proposed Reno Creek ISR Project and the use of the proposed ISR technology coupled with the applicant procedures to minimize exposure demonstrate that the potential impact on public and occupational health and safety from facility operation would be SMALL. The radiological impacts from accidents would be SMALL for workers (if the applicant's radiation safety and incident response procedures in an NRC-approved radiation protection plan are followed) and SMALL for the public because of the facility's remote location. The nonradiological public and occupational health and safety impacts from normal operations and accidents, due primarily to risk of chemical exposure, would be SMALL if handling and storage procedures are followed.

Aquifer Restoration: Impacts would be SMALL. Impacts would be similar to, but less than, those during the operations phase. The reduction or elimination of some operational activities would further reduce the magnitude of potential worker and public health impacts and safety hazards.

Decommissioning: Impacts would be SMALL. Impacts would be similar to those experienced during construction. Soil and facility structures would be decontaminated, and lands would be restored to preoperational conditions.

Waste Management

Construction: Impacts would be SMALL. Small-scale and incremental wellfield development would generate small volumes of construction waste. Waste would primarily consist of building materials, piping, and other solid wastes. No byproduct material would be generated during construction. Nonhazardous solid waste would be disposed of at a nearby municipal solid waste landfill with available capacity to accommodate estimated construction-phase waste volumes. The applicant would dispose of drilling fluids in mud pits adjacent to drilling pads and anticipates obtaining WDEQ WYPDES permits to surface discharge well development water. In addition, the applicant has stated that it would likely be classified as a Conditionally Exempt Small Quantity Generator; and, as such, the applicant would transport its hazardous waste to a permitted hazardous waste facility for disposal.

Operations: Impacts would be SMALL. Liquid byproduct material, including production bleed, waste brine streams from elution and precipitation, resin transfer wash, laundry water, plant wash-down water, and laboratory chemicals would be disposed using Class I deep disposal wells. Class I deep disposal wells require (i) a WDEQ permit (which has been granted), (ii) an EPA aquifer exemption (pending), and (iii) compliance with permit conditions and the NRC dose limits and waste disposal standards in 10 CFR Part 20, Subparts D and K (both would limit potential impacts). Solids classified as byproduct material would be sent to a licensed facility for disposal. A preoperational agreement with a licensed facility to accept wastes the proposed project generates would avoid capacity impacts. Capacity is available for disposal of nonhazardous solid waste at regional municipal landfills. Capacity would be sufficient for disposal of low volumes of generated hazardous waste.

Aquifer Restoration: Impacts would be SMALL based on the type and quantity of waste expected to be generated and the available capacity for disposal. Waste disposal procedures would be the same as those during the operations phase, resulting in similar impacts. The applicant proposal includes adequate disposal capacity, and the applicant is required to comply with WDEQ Class I deep disposal well permit conditions, and NRC safety regulations. Although the wastewater volume could increase during aquifer restoration activities, this would be offset by the reduction in production capacity from completion of wellfield production and removal from service.

Decommissioning: Impacts would be SMALL. A preoperational agreement with a licensed disposal facility to accept solid byproduct material would ensure that sufficient disposal capacity would be available at the time of decommissioning. Safe handling, storage, and disposal of decommissioning wastes would be described in a required decommissioning plan for the NRC review before decommissioning activities began. Equipment and building materials that meet release criteria would be reused, recycled, or disposed as construction waste at a landfill. The location of the proposed Reno Creek ISR Project allows for both the Campbell County and Casper landfills to be feasible disposal options. However, the available local landfill capacity (Campbell County) alone may be insufficient to accommodate all decommissioning nonhazardous solid waste from the proposed Reno Creek ISR Project. The potential impacts on waste management resources would depend on the long-term status of the existing local landfill resources. Therefore, the applicant has indicated that municipal waste would be disposed of initially at the Campbell County facility. Should the landfill capacity be reached, the applicant would then have the waste sent to the Casper landfill. The disposal of any waste from the proposed Reno Creek ISR Project in either the Campbell County or Casper landfills would have a SMALL impact due to the projected operational life and available capacity of that landfill.

CUMULATIVE IMPACTS

Chapter 5 of this SEIS provides the NRC evaluation of potential cumulative impacts from the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project considering other past, present, and reasonably foreseeable future actions. Cumulative impacts from past, present, and reasonably foreseeable future actions were considered and evaluated in this SEIS, regardless of what agency (federal or nonfederal) or person undertook the action. The NRC staff determined that the SMALL impacts from the proposed Reno Creek ISR Project are not expected to contribute perceptible increases to the SMALL to MODERATE cumulative impacts, due primarily to ongoing uranium and oil and gas exploration activities, potential wind energy projects, and proposed infrastructure and transportation projects. Based on the currently available information and known flaws in the available information (BLM, 2015) regarding the far-field cumulative impacts on air quality , the

NRC staff acknowledge the possibility that impacts to air quality from foreseeable future actions could be as much as LARGE, to which the proposed Reno Creek ISR Project would contribute SMALL potential impacts.

SUMMARY OF COSTS AND BENEFITS OF THE PROPOSED ACTION

The proposed project would generate primarily regional and local costs and benefits. The regional benefits of building the proposed project would be increased employment, economic activity, and tax revenues in the region around the proposed site. Costs associated with the proposed Reno Creek ISR Project are, for the most part, limited to the immediate area surrounding the proposed project area. The NRC staff determined the benefit from constructing and operating the facility would outweigh the economic, environmental, and social costs.

COMPARISON OF ALTERNATIVES

For the No-Action Alternative, the applicant would not construct or operate ISR facilities at the proposed Reno Creek ISR Project area. As a result, no uranium ore would be recovered from the proposed site. This alternative would result in neither positive nor negative impacts to any resource area.

FINAL RECOMMENDATION

After weighing the impacts of the proposed action and comparing to the No-Action Alternative, the NRC staff, in accordance with 10 CFR 51.91(d), sets forth its NEPA recommendation regarding the proposed action (granting the request for an NRC license for the proposed Reno Creek ISR Project). Unless safety issues mandate otherwise, the NRC staff recommendation to the Commission related to the environmental aspects of the proposed action is that an NRC license be issued as requested. This recommendation is based on (i) the license application, including the ER and supplemental documents the applicant submitted and responses to the NRC staff requests for additional information; (ii) consultation with federal, state, tribal, and local agencies; (iii) the NRC staff independent review; and (v) the assessments summarized in this SEIS.

References

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ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
ACL	alternate concentration limit
ac	acres
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
AERMOD	atmospheric dispersion modeling system
ALARA	as low as reasonably achievable
ANSS	Advance National Seismic System
APE	area of potential effect
APLIC	Avian Power Line Interaction Committee
AUC	AUC, LLC
AUMs	animal unit months
BGEPA	Bald and Golden Eagle Protection Act
BLC	Board of Land Commissioners
BLM	U.S. Bureau of Land Management
BMP	best management practices
BNSF	Burlington Northern Santa Fe
CAB	Commission-approved background
CBM	coalbed methane
CEQ	Council of Environmental Quality
CESQG	Conditionally Exempt Small Quantity Generator
CFR	Code of Federal Regulations
cm	centimeters
CPP	central processing plant
CWA	Clear Water Act
dBA	decibels
DM&E	Dakota, Minnesota and Eastern Railroad
DOE	U.S. Department of Energy
EA	environmental assessment
EIS	environmental impact statement
EMS	emergency medical services
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESA	Endangered Species Act
FHWA	Federal Highway Administration
ft	feet
ft^2	square-foot
FWS	U.S. Fish and Wildlife Service

gal	gallon
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gases
GPS	global positioning system
GW	groundwater
HDPE	high density polyethylene
ha	hectares
IH	Interstate Highway
in	inches
IPaC	Information Planning and Conservation
ISL	in situ leach
ISR	in situ recovery
kg	kilograms
km	kilometers
kph	kilometers per hour
kV	kilovolt
L	liter
lb	pounds
Lpm	liters per minute
LQD	Land Quality Division
m	meter
m^2	square-meter
m^3	cubic meters
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
mg	milligram
mi	mile
MIT	mechanical integrity test
mph	mile per hour
mrem	millirem
mSv	millisievert
MW	megawatt
M_L	Richter magnitude scale
M_w	moment magnitude
NAAQS	National Ambient Air Quality Standards
NAIP	National Agricultural Imagery Program
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NLEB	Northern long-eared bat
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places

OA	Overlying Aquitard
OM Unit	Overlying Aquifer
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PEM	Palustrine Emergent
PHMA	Priority Habitat Management Area
PMTF	Permanent Mineral Trust Fund
PPE	personal protective equipment
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration
psi	per square inch
PVC	polyvinyl chloride
PZA	Production Zone Aquifer
RAC	Restoration Action Plan
RAI	request for additional information
RCRA	Resource Conservation and Recovery Act
RO	reverse osmosis
ROI	region of influence
ROW	right-of-way
RV	recreational vehicle
SDWA	Safe Drinking Water Act
SEIS	supplemental environmental impact statement
SER	Safety Evaluation Report
SERP	Safety and Environmental Review Panel
SGCN	Species of Greatest Conservation Need
SH	state highway
SM Unit	Shallow Water Table Unit
SMCLs	secondary maximum contaminant levels
SNAP	Supplemental Nutrition Assistance Program
STB	Surface Transportation Board
SWPPP	Storm Water Pollution Prevention Plan
T	ton
TANF	Temporary Assistance for Needy Families
TCP	Traditional Cultural Property
TDS	total dissolved solids
TEDE	total effective dose equivalent
TR	technical report
TSS	total suspended solids
UA	Underlying Aquitard
UCL	upper control limit
UDEQ	Utah Department of Environmental Quality
UIC	Underground Injection Control
UM Unit	Underlying Unit
UMTRCA	Uranium Mill Tailings Radiation Control Act
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers

USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USDW	underground sources of drinking water
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VRM	Visual Resource Management
WDAI	Wyoming Department of Administration and Information
WDEQ	Wyoming Department of Environmental Quality
WDOE	Wyoming Department of Education
WDOR	Wyoming Department of Revenue
WDWS	Wyoming Department of Workforce Services
WGFD	Wyoming Game and Fish Department
WIC	Women, Infants, and Children
wk	week
WOGCC	Wyoming Oil and Gas Conservation Commission
WSEO	Wyoming State Engineer's Office
WSGS	Wyoming State Geological Survey
WYDOT	Wyoming Department of Transportation
WYPDES	Wyoming Pollutant Discharge Elimination System
WY SHPO	Wyoming State Historic Preservation Office
yd^3	cubic yards
yr	year

SI* (MODERN METRIC) CONVERSION FACTORS

Approximate Conversions From SI Units				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
Length				
cm	centimeters	0.39	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
Area				
mm^2	square millimeters	0.0016	square inches	in^2
cm^2	square centimeters	0.155	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
Volume				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
m^3	cubic meters	0.0008107	acre-feet	ac-ft
ha-m	hectare-meters	8.107	acre-feet	ac-ft
Mass				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
t	metric ton	1.103	short tons (2000 lb)	T
Radiological Units				
Bq	becquerels	27.03	picocuries	pCi
GBq	gigabecquerels	0.027	curies	Ci
Sv	sieverts	100	rems	rem
mSv	millisieverts	100	millirems	mrem
Temperature (Exact Degrees)				
ºC	Celsius	1.8C + 32	Fahrenheit	°F

*SI is the symbol for the International System of Units. Appropriate rounding should be performed to comply with Section 4 of ASTM E380 (ASTM International. "Standard for Metric Practice Guide." West Conshohocken, Pennsylvania: ASTM International. Revised 2003).

1 INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) has prepared this Supplemental Environmental Impact Statement (SEIS) in response to an application that AUC, LLC (AUC, or the applicant) submitted on October 3, 2012, to develop and operate the proposed Reno Creek Uranium In Situ Recovery (ISR) Project (hereafter referred to as the proposed Reno Creek ISR Project), located in Campbell County, Wyoming (AUC, 2012). SEIS Figure 1-1 shows the geographic location of the proposed project. This site-specific SEIS is a supplement to the Generic Environmental Impact Statement (GEIS) for In Situ Leach Uranium Milling Facilities (hereafter referred to as the GEIS). This supplement was prepared in accordance with the process described in GEIS Section 1.8 (NRC, 2009) and as detailed in SEIS Section 1.4.1. The NRC's Office of Nuclear Material Safety and Safeguards (Division of Fuel Cycle Safety, Safeguards, & Environmental Review) prepared this SEIS, as required by Title 10, Energy, of the *U.S. Code of Federal Regulations* (CFR), Part 51. These regulations implement the requirements of the National Environmental Policy Act of 1969 (NEPA), as amended (Public Law 91-190), which requires that the Federal Government assess the potential environmental impacts of major federal actions that may significantly affect the human environment.

The GEIS (NRC, 2009) used the terms "in situ leach (ISL) process" and "11e.(2) byproduct material" to describe the uranium milling technology and the waste stream generated by the uranium recovery process, respectively. For the purposes of this SEIS, ISR is synonymous with ISL. To be consistent with the definition found in 10 CFR 40.4, this SEIS also uses the term "byproduct material" instead of "11e.(2) byproduct material" to describe the waste stream generated by this milling process.

1.2 Proposed Federal Action

On October 3, 2012, AUC submitted an application for an NRC source and material license (hereafter referred to as an "NRC license") to construct and operate an ISR facility at the proposed Reno Creek ISR Project area and to conduct aquifer restoration, site decommissioning, and site reclamation (AUC, 2012). Based on the AUC application, the NRC's federal action is to either grant or deny the license. The applicant's proposal is discussed in detail in SEIS Section 2.1.1.

1.3 Purpose and Need for the Proposed Action

The NRC regulates uranium milling, including the ISR process, under 10 CFR Part 40, Domestic Licensing of Source Material. AUC is seeking an NRC license to authorize commercial-scale ISR at the proposed Reno Creek ISR Project area. The purpose and need for the proposed federal action is to provide an option that allows the applicant to recover uranium and produce yellowcake at the proposed project area. Yellowcake is the uranium oxide product of the ISR milling process that is used to produce various products, including fuel for commercially operated nuclear power reactors.

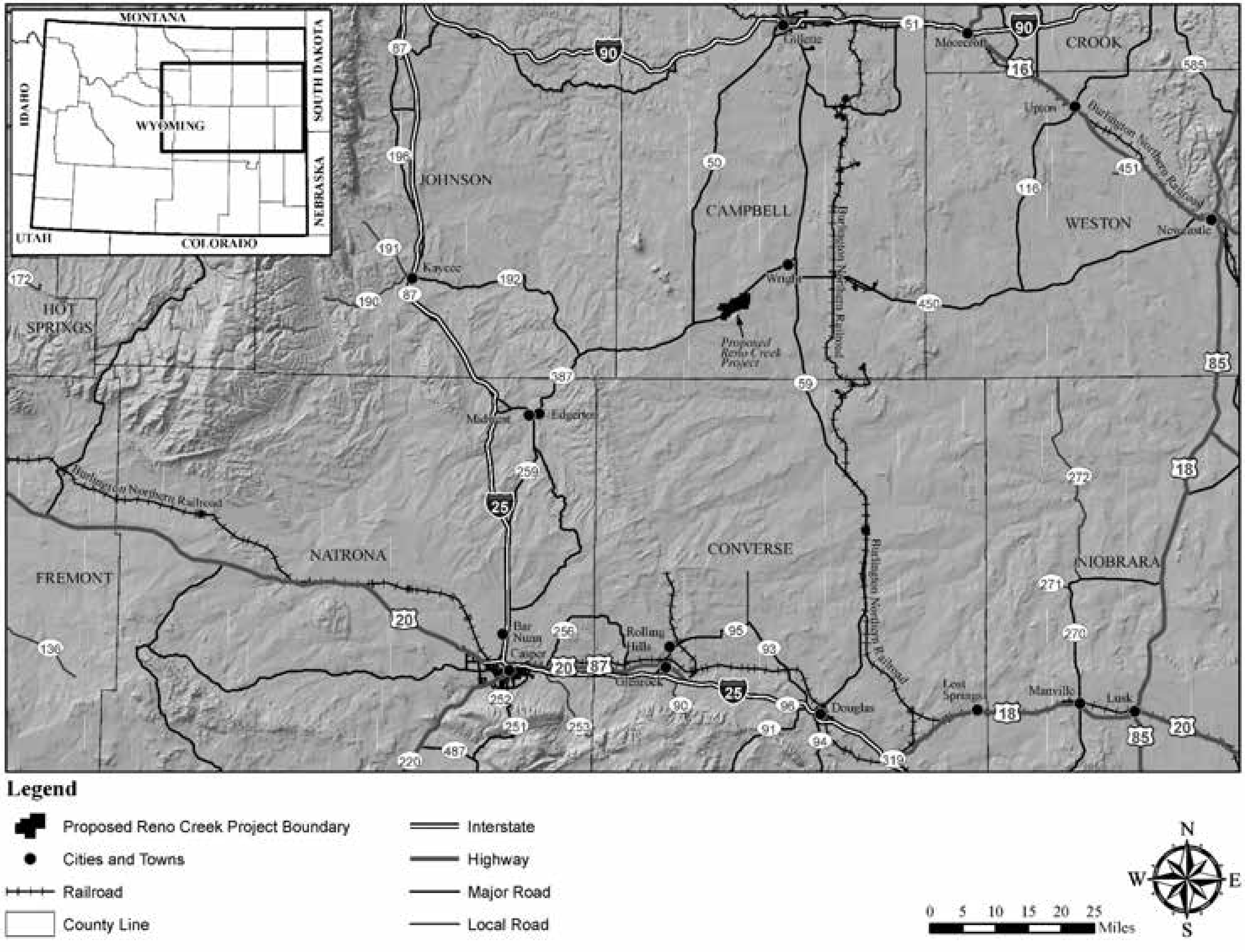

Figure 1-1. Location of the Proposed Reno Creek ISR Project (AUC, 2014)

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 (AEA), as amended, or findings in the NEPA environmental analysis that would lead the NRC to reject a license application, the NRC has no role in a company's business decision to submit a license application to operate an ISR facility at a particular location.

1.4 Scope of the Supplemental Environmental Impact Statement

The NRC staff prepared this SEIS to analyze the potential environmental impacts (i.e., direct, indirect, and cumulative impacts) of the proposed project and alternative to the proposed action. The scope of this SEIS considers both radiological and nonradiological (including chemical) impacts associated with the proposed action and its alternative. This SEIS also considers unavoidable adverse environmental impacts, the relationship between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources.

1.4.1 Relationship to the Generic Environmental Impact Statement

As discussed in SEIS Section 1.1, this SEIS supplements the GEIS, as published in May 2009. The final GEIS assessed the potential environmental impacts associated with the construction, operations, aquifer restoration, and decommissioning of an ISR facility that could be located in any of four specific geographic regions of the western United States. The proposed Reno Creek ISR Project would be located in the Wyoming East Uranium Milling Region, one of the regions considered in the GEIS. SEIS Table 1-1 summarizes the expected environmental impacts by resource area in the Wyoming East Uranium Milling Region, based on the GEIS analyses (NRC, 2009).

Table 1-1. In Situ Leach Generic Environmental Impact Statement Range of Expected Impacts in the Wyoming East Uranium Milling Region

Resource Area	Construction	Operations	Aquifer Restoration	Decommissioning
Land Use	S	S	S	S to M
Transportation	S to M	S to M	S to M	S
Geology and Soils	S	S	S	S
Surface Water	S	S	S	S
Groundwater	S	S to L	S to M	S
Terrestrial Ecology	S to M	S	S	S
Aquatic Ecology	S	S	S	S
Threatened and Endangered Species	S to L	S	S	S
Air Quality	S	S	S	S
Noise	S to M	S to M	S to M	S to M
Historical and Cultural Resources	S to L	S to L	S to L	S to L
Visual and Scenic Resources	S	S	S	S
Socioeconomics	S to M	S to M	S to M	S to M
Public Health and Safety	S	S to M	S	S
Waste Management	S	S	S	S

Source: NRC (2009)
S: SMALL Impact, M: MODERATE Impact, L: LARGE Impact

Scoping provides an opportunity for the public and other stakeholders to identify key issues and concerns they believe should be addressed in an Environmental Impact Statement (EIS). The NRC staff consider the GEIS scoping process to be sufficient for the purposes of defining the scope of this SEIS.

The NRC accepted public comments on the scope of the GEIS from July 24, 2007, to November 30, 2007, and held three public scoping meetings in Albuquerque and Gallup, New Mexico, and Casper, Wyoming, to aid in this effort. In addition, the NRC held eight public meetings to solicit comments on the draft GEIS after its publication in July 2008. Comments on the draft GEIS were accepted from July 28, 2008, until November 8, 2008. Public comments made during the scoping meetings and on the draft GEIS are available on the NRC website (http://www.nrc.gov/reading-rm/adams.html). The scoping summary report was provided in GEIS Appendix A, and GEIS Appendix G provides responses to public comments (NRC, 2009).

This SEIS was prepared to fulfill the requirement in 10 CFR 51.20(b)(8) and 43 CFR 3809 to prepare either an EIS or supplement to an EIS for the issuance of an NRC license for an ISR facility (NRC, 2009). The GEIS provides a starting point for the NRC NEPA analyses for site-specific license applications for new ISR facilities, as well as applications to amend or renew existing ISR licenses. As discussed in the GEIS, the GEIS provides criteria for each environmental resource area to assess the significance level of impacts (i.e., SMALL, MODERATE, or LARGE).

The NRC staff applied these criteria to the site-specific conditions at the proposed Reno Creek ISR Project. This SEIS tiers from or incorporates by reference the relevant GEIS information, findings, and conclusions concerning environmental impacts. The extent to which the NRC incorporates GEIS impact conclusions depends on the consistency between (i) the applicant's proposed facility, activities, and conditions at the proposed Reno Creek ISR Project and (ii) the general ISR facility description and activities in the GEIS and information or conclusions in the GEIS. The NRC determinations of potential environmental impacts and the discussion of which GEIS impact conclusions were incorporated by reference are discussed in SEIS Chapter 4. GEIS Section 1.8.3 describes the use of tiering and incorporation by reference in using the GEIS for environmental reviews of site-specific ISR license applications (NRC, 2009).

1.4.2 Public Participation Activities

As part of the preparation of this SEIS, the NRC staff met with federal, state, tribal, and local agencies and authorities in September 2013 during a site visit to the proposed Reno Creek ISR Project area (NRC, 2013a). The purpose of these meetings was to gather additional site-specific information to support the NRC staff's environmental review and to help the staff determine consistency between site-specific and local information and corresponding information in the GEIS. As part of information gathering, the NRC staff also contacted potentially interested Native American tribes and local authorities, entities, and public interest groups in person, by email, and by telephone. Additionally, in August 2013, the NRC staff advertised in five newspapers near the proposed project area (the High Plains, the Moorcroft Leader, the Gillette News Record, the Casper Star Tribune, and the Sundance Times) soliciting public comments on the proposed project; no comments were received.

The NRC published a Notice of Opportunity for Hearing on the proposed Reno Creek ISR Project license application in the *Federal Register* (FR) on August 5, 2013 (78 FR 47427). The

NRC did not receive any requests for hearings from stakeholders. The NRC also published a Notice of Intent to prepare this SEIS on August 21, 2013 (78 FR 51753).

1.4.3 Issues Studied in Detail

To meet its NEPA obligations related to its review of the proposed Reno Creek ISR Project license application, the NRC staff conducted an independent, detailed, and comprehensive evaluation of the potential environmental impacts from construction, operations, aquifer restoration, and decommissioning of an ISR facility at the proposed project area and from the No-Action Alternative. As discussed in GEIS Section 1.8.3, the GEIS (i) evaluated the types of environmental impacts that may occur from ISR facilities, (ii) identified and assessed generic impacts (the same or similar) at all ISR facilities (or those with unique facility or site characteristics), and (iii) identified the scope of environmental impacts that needed to be addressed in site-specific environmental reviews. Therefore, although all of the environmental resource areas identified in the GEIS would be addressed in site-specific reviews, certain resource areas would require a more detailed analysis, because the GEIS determined that a range in the significance of impacts (e.g., SMALL to MODERATE, SMALL to LARGE) could result, depending upon site-specific conditions (see SEIS Table 1-1).

Based on the GEIS analysis, this SEIS provides a more detailed analysis of the following resource areas:

- Land use
- Transportation
- Geology and Soils
- Water Resources
  - Surface Water
  - Groundwater
- Ecology
  - Vegetation
  - Wildlife
  - Protected Species and Species of Concern
- Air Quality
- Noise
- Visual and Scenic Resources
- Historic and Cultural Resources
- Socioeconomics
- Public and Occupational Health and Safety
- Waste Management

In addition, site-specific analyses of cumulative impacts and environmental justice concerns that were not part of the GEIS are presented in this SEIS. The NRC also considers the effects the proposed project could have on global climate change; the analysis estimates the potential effect of the facility’s greenhouse gas emissions, based on a 10-year licensing period.

1.4.4 Issues Outside the Scope of the SEIS

Some issues and concerns raised during the public scoping process on the GEIS (NRC, 2009, Appendix A) were determined to be outside the scope of the GEIS. These issues and concerns (e.g., general support or opposition for uranium milling, impacts associated with conventional uranium milling, comments regarding the alternative sources of uranium feed material, comments regarding energy sources, requests for compensation for past mining impacts, and comments regarding the credibility of NRC) are also outside the scope of this SEIS.

1.4.5 Related NEPA Reviews and Other Related Documents

A number of NEPA documents were reviewed and used in the development of this SEIS. The related NEPA reviews are described next.

NUREG–0706, Final Generic Environmental Impact Statement on Uranium Milling (NRC, 1980). This EIS provided a detailed evaluation of the impacts and effects of anticipated conventional uranium milling operations in the United States through the year 2000, including analysis of tailings disposal programs. NUREG–0706 concluded that the environmental impacts of underground mining and conventional milling would be more severe than using ISR technology. As described in SEIS Section 2.2.1, conventional mining and milling were considered, but eliminated from the detailed analysis at the proposed Reno Creek ISR Project [Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML032751663, ML0732751667, and ML032751669].

NUREG–1508, Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico (NRC, 1997). This EIS evaluated the use of ISR technology at the Church Rock and Crownpoint sites at Crownpoint, New Mexico. Alternative uranium mining methods were not evaluated, because the uranium ore located at the proposed sites was too deep to be extracted (i.e., mined) economically and the Final EIS concluded that underground mining would have more significant environmental impacts than ISR recovery (ADAMS Accession No. ML082170248).

NUREG–1910, Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities, Final Report (NRC, 2009). As previously discussed, this GEIS was prepared to assess the potential environmental impacts from the construction, operations, aquifer restoration, and decommissioning of an ISR facility located in any of four different geographic regions of the western United States, including the Wyoming East Uranium Milling Region where the proposed Reno Creek ISR Project would be located. The environmental analysis in this SEIS both tiers from and incorporates by reference the GEIS (ADAMS Accession No. Volume 1, ML091480244; Volume II, ML091480188).

Environmental Impact Statement for the Moore Ranch ISR Project in Campbell County, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 1), Final Report (NRC, 2010). The NRC prepared this SEIS as a supplement to the GEIS based on its review of an application from Energy Metals Corporation (now Uranium One) for an NRC license for the licensed but not yet constructed Moore Ranch ISR Project, which, like the proposed Reno Creek ISR project, is located in Campbell County, Wyoming. The licensed but not yet constructed Moore Ranch ISR project would encompass 2,877 hectares (ha) [7,110 acres (ac)] of privately owned and State of Wyoming lands. However, Uranium One estimated that only 61 (ha) [150 ac] would be disturbed as a result of the project (ADAMS Accession No. ML102290470).

Environmental Impact Statement for the Nichols Ranch ISR Project in Campbell and Johnson Counties, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 2), Final Report (NRC, 2011a). The NRC prepared this SEIS as a supplement to the GEIS based on its review of an application from Uranerz Energy Corporation for an NRC license for the Nichols Ranch ISR Project, which is located in Campbell and Johnson Counties, Wyoming. The Nichols Ranch ISR Project is currently operating and encompasses approximately 1,251 ha [3,091 ac] of privately owned land and approximately 113 ha [280 ac] of land managed by the U.S. Bureau of Land Management (BLM). The project consists of two noncontiguous mining units: the Nichols Ranch Unit would contain the central processing plant, and the Hank Unit would contain a satellite ion-exchange facility (ADAMS Accession No. ML103440120).

Environmental Impact Statement for the Lost Creek ISR Project in Sweetwater County, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 3), Final Report (NRC, 2011b). The NRC prepared this SEIS as a supplement to the GEIS based on its review of an application from Lost Creek ISR, LLC for an NRC license for the Lost Creek ISR Project located in Sweetwater County, Wyoming. The project is currently operating and covers approximately 1,708 ha [4,220 ac] with approximately 1,450 ha [3,583 ac] of federal owned, BLM-managed land and 259 ha [640 ac] of land owned by the State of Wyoming, Office of State Lands and Investment. Facilities associated with the project include a wellfield with production and monitoring wells; header houses; a central processing plant; an access road network; and pipeline system (ADAMS Accession No. ML11125A006).

Environmental Impact Statement for the Dewey–Burdock ISR Project in Fall River and Custer Counties, South Dakota, Supplement to the GEIS (NUREG–1910, Supplement 4), Final Report (NRC, 2014a). The NRC prepared this SEIS as a supplement to the GEIS based on its review of an application from Powertech (USA) Inc. for an NRC license for the licensed but not yet constructed Dewey–Burdock ISR Project located in Custer and Fall River Counties, South Dakota. The licensed but not yet constructed Dewey–Burdock ISR Project will consist of processing facilities and sequentially developed wellfields in two contiguous areas: the Burdock area and the Dewey area. The total land area of the licensed but not yet constructed Dewey–Burdock Project is 4,282 ha [10,580 ac]. Sections within the proposed project area are split estate, in which two or more parties own the surface and subsurface mineral rights. The surface rights are both publicly and privately owned. Approximately 4,185 ha [10,340 ac] of land is privately owned, and the remaining 97 ha [240 ac] of surface rights are owned by the U.S. Government and administered by BLM. The subsurface mineral rights are owned by various private entities and federally reserved by the U.S. Government (ADAMS Accession No. ML14024A477 and ML14024A478).

Environmental Impact Statement for the Ross ISR Project in Crook County, Wyoming, Supplement to the GEIS (NUREG–1910, Supplement 5), Final Report (NRC, 2014b). The NRC prepared this SEIS as a supplement to the GEIS based on its review of an application from Strata Energy, Inc. for an NRC license for the Ross ISR Project located in Crook County, Wyoming. The project is currently operating and covers approximately 696 ha [1,721 ac] with approximately 16 ha [40 ac] of federally owned, BLM-managed land and 127 ha [314 ac] of land owned by the State of Wyoming. Subsurface mineral rights are owned by private entities, the State of Wyoming and federally reserved by the U.S. Government. (ADAMS Accession No. ML14056A096).

1.5 Applicable Regulatory Requirements

NEPA established national environmental policy and goals to protect, maintain, and enhance the environment and provided a process for implementing these specific goals for those federal agencies responsible for an action. This SEIS was prepared in accordance with the NRC's NEPA-implementing regulations at 10 CFR Part 51 and other applicable regulations that were in effect at the time the document was being written. The GEIS's Appendix B summarized other federal statutes, implementing regulations, and executive orders that are potentially applicable to environmental reviews for the construction, operations, aquifer restoration, and decommissioning of an ISR facility. GEIS Sections 1.6.3.1 and 1.7.5.1 summarize the State of Wyoming's statutory authority pursuant to the ISR process, relevant state agencies that are involved in the permitting of an ISR facility, and the range of state permits that would be required (NRC, 2009).

1.6 Licensing and Permitting

The NRC has statutory authority through the AEA, as amended by the Uranium Mill Tailings Radiation Control Act, to regulate uranium ISR facilities. In addition to obtaining an NRC license, uranium ISR facilities must obtain the necessary permits from the appropriate federal, state, tribal, and local governmental agencies. The NRC licensing process for ISR facilities was described in GEIS Section 1.7.1. GEIS Sections 1.7.2 through 1.7.5 describe the role of the other federal, state, and tribal agencies in the ISR permitting process. SEIS Sections 1.6.1 and 1.6.2 summarize the status of the NRC licensing process at the proposed Reno Creek ISR Project site and the status of the applicant permitting, with respect to other applicable federal, tribal, and state requirements.

1.6.1 NRC Licensing Process

By letter dated October 3, 2012, the applicant submitted a license application to NRC for the proposed Reno Creek ISR Project (AUC, 2012). As discussed in GEIS Section 1.7.1, the NRC initially conducts an acceptance review of a license application to determine whether the application is complete enough to support a detailed technical review. The NRC staff accepted the proposed Reno Creek ISR Project license application for detailed technical review by letter dated June 18, 2013 (NRC, 2013b).

The NRC staff's detailed technical review of AUC's license application is composed of both a safety review and an environmental review. These two reviews are conducted in parallel (see GEIS, Figure 1.7-1). The focus of the safety review is to assess compliance with the applicable regulatory requirements at 10 CFR Part 20 and 10 CFR Part 40, Appendix A. The environmental review has been conducted in accordance with the regulations at 10 CFR Part 51.

The NRC's hearing process (10 CFR Part 2) applies to licensing actions and offers stakeholders a separate opportunity to raise concerns associated with proposed licensing actions. Regulations in 10 CFR Part 2 specify that a petition for review and request for hearing must include a showing that the petitioner has standing and that the Atomic Safety and Licensing Board Panel would rule on a petitioner's standing by considering (i) the nature of the petitioner's right under the AEA or NEPA to be made a party to the proceeding; (ii) the nature and extent of the petitioner's property, financial, or other interest in the proceeding; and (iii) the possible effect of any decision or order that may be issued in the proceeding on the petitioner's interest.

In accordance with the regulation, the NRC published a "Notice of Opportunity for Hearing" related to AUC's license application for the Reno Creek ISR Project on August 5, 2013 (78 FR 47427). The NRC did not receive a request for hearing.

1.6.2 Status of Permitting With Other Federal and State Agencies

In addition to obtaining an NRC license prior to conducting ISR operations at the proposed Reno Creek ISR Project, the applicant is required to obtain all necessary permits and approvals from other federal and state agencies to address (i) the underground injection of solutions and liquid effluent from the ISR process, (ii) the specific exemption of all or a portion of the ore zone aquifer from regulation under the Safe Drinking Water Act (SDWA), and (iii) the discharge of stormwater during construction and operation of the ISR facility. SEIS Table 1-2 lists the status of the required permits and approvals.

1.7 Consultation

Federal agencies are required to comply with consultation requirements in Section 7 of the Endangered Species Act of 1973 (ESA), as amended, and Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended. The GEIS took a programmatic look at the environmental impacts of ISR uranium mining within four distinct geographic regions and acknowledged that each site-specific review would include its own consultation process with relevant agencies. Section 7 (ESA) and Section 106 (NHPA) consultations conducted for the proposed Reno Creek ISR Project are summarized in SEIS Sections 1.7.1 and 1.7.2. A list of the consultation correspondence is provided in SEIS Appendix A. SEIS Section 1.7.3 describes the NRC coordination with other federal, tribal, state, and local agencies conducted during the development of this SEIS.

1.7.1 Endangered Species Act of 1973 Consultation

The ESA was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. ESA Section 7 recommends consultation with the U.S. Fish and Wildlife Service (FWS) to ensure that actions it authorizes, permits, or otherwise carries out will not jeopardize the continued existence of any listed species or adversely modify designated critical habitats.

By letter dated October 17, 2013, the NRC staff initiated consultation with FWS, requesting information on endangered or threatened species and critical habitat in the proposed Reno Creek ISR Project area (NRC, 2013c). The NRC received a response from the FWS Wyoming Field Office on March 6, 2015, that (i) listed the threatened and endangered species that may occur in the proposed project area and their designated and proposed critical habitat in the project area, (ii) provided recommendations concerning migratory birds, and (iii) made recommendations for the protection of eagles and other raptor species (FWS, 2015).

The NRC staff also met with the Wyoming Game and Fish Department (WGFD) on September 11, 2013, to discuss the potential impacts on ecological resources (terrestrial and aquatic) associated with the proposed Reno Creek ISR Project. Further details from the WGFD interactions can be found in SEIS Section 1.7.3.3.

Table 1-2. Environmental Approvals for the Proposed Reno Creek ISR Project		
Regulatory Agency	**Description**	**Status**
U.S. Nuclear Regulatory Commission	Source and Byproduct Materials License (10 CFR Part 40)*	**Application under review**–Submitted October 3, 2012
U.S. Army Corps of Engineers (USACE)	Nationwide Permit Authorization	**Proposed**–Nationwide permit preparation prior to disturbance
	Determination of Jurisdictional Wetland	**Approved**–Wetland delineation approved and forwarded to USACE in April 2012
U.S. Environmental Protection Agency (EPA)	Aquifer Exemption Permit for Class I Injection Wells (40 CFR Parts 144 and 146)†	**Pending**–approval from EPA for aquifer exemption. Aquifer reclassification application prepared by Wyoming Department of Environmental Quality (WDEQ) for review and approval by EPA. See WDEQ Permits. Wyoming has primacy for the Underground Injection Control (UIC) Program.
	Aquifer Exemption (Class III UIC Permit)	**Approved**–October 20, 2015.
WDEQ	Air Quality Permit	**Application under review**–Application must be approved prior to start of construction
	Mineral Exploration Permit	**Approved**–Drilling Notification #401, TFN #5 4/50, February 9, 2011
	Permit to Mine (Class III wells)	**Approved**–Permit Number 824, July 17, 2015
	UIC Class I Permit (Deep Disposal Well)	**Approved**–Permit Number 09-621, June 2015
	UIC Class V (WDEQ Title 35-11)	**Proposed**–Class V UIC permit for an approved site septic system during facility construction.
	Industrial/Mining Storm Water Wyoming Pollutant Discharge Elimination System (WYPDES) Permit (WDEQ Title 35-11)	**Proposed**–Industrial Stormwater WYPDES permit authorizing discharge associated with mineral and mining activities
	Construction Stormwater WYPDES Permit (WDEQ Title 35-11)	**Proposed**–Construction Stormwater WYPDES permit and Notice of Intent to be filed at least 30 days before construction activities begin, in accordance with WDEQ requirements
WDEQ and State Engineer's Office	Permit to appropriate groundwater for operational in situ recovery monitoring wells	**Proposed**–Permit to appropriate groundwater will be submitted prior to wellfield construction
	Permit to appropriate groundwater–Central Processing Plant domestic water supply well	**Proposed**–Permit to appropriate application will be submitted prior to construction
	Surface water reservoir permit for industrial use	**Proposed**–Surface water reservoir permit for lined retention pond
Wyoming Department of Transportation	District 4 Right-of-Way access permit for buried pipeline crossing State Highway 387	**Proposed**–Application will be submitted prior to start of construction
Campbell County Roads & Bridges	County road Right-of-Way access permit for buried pipeline crossing county roads	**Proposed** – Application will be submitted prior to construction

*Title 10 of the *Code of Federal Regulations*, Part 40
†Title 40 of the *Code of Federal Regulations*, Parts 144 and 146

1.7.2 National Historic Preservation Act of 1966 Consultation

Section 106 of the NHPA requires that federal agencies take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to comment on such undertakings. The Section 106 process seeks the views of consulting parties, including the federal agency, the State Historic Preservation Officer, Indian tribes and Native Hawaiian organizations, Tribal Historic Preservation Officers, local government leaders, the applicant, cooperating agencies, and the public. The NRC staff is complying with NHPA requirements performing the Section 106 evaluation in coordination with performing the NEPA environmental review in accordance with 36 CFR 800.8. By conducting the NHPA Section 106 evaluation through the NEPA process, the NRC staff will be able to assesses if there are historic properties adversely affected by the proposed project and potential ways to avoid, minimize, or mitigate adverse effects while identifying alternatives and preparing NEPA documentation.

The goal of consultation is to identify historic properties potentially affected by the undertaking, assess the effects of the undertaking on these properties, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. As detailed in 36 CFR Part 800.2(c)(1)(i), the role of the Wyoming State Historic Preservation Office (WY SHPO) in the Section 106 process is to advise and assist federal agencies in carrying out their Section 106 responsibilities. As part of the Section 106 consultation process for the proposed Reno Creek ISR Project, the NRC continues consultation with potentially affected Native American tribes and other consulting parties. These interactions are detailed in SEIS Section 1.7.3.5.

The NRC initiated consultation with the WY SHPO by a letter dated June 13, 2013, requesting information from the WY SHPO to facilitate the identification of historic and cultural resources that could be affected by the proposed Reno Creek ISR Project (NRC, 2013d). The NRC staff continued consultation efforts by a letter dated November 8, 2013, proposing to define the area of potential effect (APE) for both direct and indirect effects (NRC, 2013e). The NRC staff will continue to consult with the WY SHPO and other consulting parties throughout the environmental review process to evaluate the effects of the proposed project on cultural and historical resources.

1.7.3 Coordination With Other Federal, State, Local, and Tribal Agencies

The NRC staff interacted with federal, state, local, and tribal agencies during preparation of this SEIS to gather information on potential issues, concerns, and environmental impacts related to the proposed Reno Creek ISR Project. The consultation and coordination process has included discussions with Wyoming Department of Environmental Quality (WDEQ), FWS, Wyoming Game and Fish Department (WGFD), local organizations (e.g., Powder River Basin Resource Council and Campbell County Commissioners), as well as tribal governments.

1.7.3.1 Coordination With Bureau of Land Management

BLM is responsible for administering the National System of Public Lands and the federal minerals underlying these lands. BLM is also responsible for managing split estate situations where federal minerals underlie a surface that is privately held or owned by state or local government. In situations where BLM administers the surface rights, operators of mining claims, including ISR operations, must submit a plan of operations and obtain BLM approval before beginning operations beyond those for casual use. For the proposed project, BLM does not hold any surface rights within the proposed project area; therefore, the NRC staff was not required to coordinate with this federal agency.

1.7.3.2 Coordination with the Wyoming Department of Environmental Quality

The NRC staff met with the WDEQ staff in Sheridan and Casper, Wyoming, on September 10–12, 2013, to discuss the WDEQ's role in the NRC's environmental review process for uranium recovery facilities (NRC, 2013a). The WDEQ staff participating in this meeting included representatives from the Land Quality Division, Water Quality Division, and the Air Quality Division. Topics discussed during the meeting included the WDEQ air quality review and permitting as well as other required WDEQ permits.

1.7.3.3 Coordination With the Wyoming Game and Fish Department

The WGFD is responsible for controlling, propagating, managing, protecting, and regulating all game and nongame fish and wildlife in Wyoming under Wyoming Statute 23-1-301-303 and 23-1-401. Regulatory authority given to the WGFD allows for the establishment of hunting, fishing, and trapping seasons, as well as the enforcement of rules protecting nongame and state-listed species.

The NRC staff met with a representative of the Sheridan Regional WGFD office on September 11, 2013 (NRC, 2013a). As discussed in SEIS Section 1.7.1, the WGFD staff expressed concerns about Greater sage-grouse, migratory birds, raptors, big game, and small mammals that could be affected by the proposed Reno Creek ISR Project. Additional concerns WGFD expressed included the need for a traffic management plan that includes the travel of personnel to and from the site. WGFD also discussed the potential need for an amphibian and reptile survey but acknowledged that the absence of surface water at the site may negate the need to perform such a survey.

1.7.3.4 Coordination With the Powder River Basin Resource Council (PRBRC)

On September 11, 2013, the NRC staff met with the PRBRC to discuss their concerns and perspectives on potential environmental impacts of the proposed Reno Creek ISR Project (NRC, 2013a). PRBRC indicated that their main concerns included water quality, restoration standards, regional air quality, groundwater depletion, legacy issues from abandoned wells, and the frequency of excursions from other currently operating in situ uranium extraction facilities.

1.7.3.5 Coordination With Localities

On September 10, 2013, the NRC staff met with Campbell County Commissioners to elicit information and concerns pertaining to the proposed Reno Creek ISR Project. County Commissioners expressed their support of the oil and gas industry, as well as the uranium mining industry in the region (NRC, 2013a). This support was also stated in a letter from the Campbell County Commissioners, submitted to NRC on October 8, 2013 (ML13290A671).

1.7.3.6 Interactions With Tribal Governments

Executive Order 13175, *"Consultation and Coordination with Indian Tribal Governments,"* reaffirmed the federal government's commitment to a government-to-government relationship with Native American tribes, and directed federal agencies to establish procedures to consult and collaborate with tribal governments when new agency regulations would have tribal implications. The Order excludes "independent regulatory agencies, as defined in 44 U.S.C § 3502 (5)" from the requirements of the Order. However, according to Section 8, "Independent regulatory agencies are encouraged to comply with the provisions of this order." Although the NRC, as an independent regulatory agency, is explicitly exempt from the Order, the Commission remains committed to its spirit. In 2014, the NRC proposed a tribal policy statement which establishes principles to be followed by the NRC government-to-government interactions with American Indian and Alaska Native Tribes, and to encourage and facilitate Tribal involvement in the areas over which the Commission has jurisdiction (79 FR 71136). Other NRC guidance documents supplement working knowledge for NRC staff with Tribal outreach experience and provide practical guidance to NRC personnel who have had limited interactions with Native American Tribes.

The NRC also engages in tribal consultation when complying with the NHPA Section 106 regulatory requirements. The NRC staff initiated discussions with potentially affected tribes that possess potential religious, spiritual, and cultural interest and ties to the proposed Reno Creek ISR Project area. In January 2012, the NRC sent a letter to 22 tribes, notifying them of AUC's intent to submit a license application for the proposed Reno Creek ISR Project and soliciting input from these tribes (NRC, 2012). A list of the consultation correspondence is provided in SEIS Appendix A. The NRC then sent letters, dated February 22, 2013, and March 27, 2013 (NRC, 2013f), notifying tribes that the application for the proposed Reno Creek ISR Project has been received and was being reviewed for acceptance. The letter invited tribes to consult under Section 106 and requested comments or concerns regarding cultural resources at the proposed Reno Creek ISR Project area. The following tribes were notified about the undertaking and were asked to respond if they were interested in a consultation:

- Yankton Sioux Tribe
- Turtle Mountain Band of the Chippewa
- Three Affiliated Tribes
- Standing Rock Sioux Tribe
- Spirit Lake Tribe
- Sisseton-Wahpeton Oyate Tribe
- Santee Sioux Tribe
- Rosebud Sioux Tribe
- Oglala Sioux Tribe
- Northern Cheyenne Tribe
- Northern Arapaho Tribe
- Lower Brule Sioux Tribe
- Kiowa Indian Tribe
- Fort Peck Assiniboine and Sioux Tribe
- Fort Belknap Tribe
- Flandreau-Santee Sioux Tribe
- Crow Tribe (Apsaalooke)
- Crow Creek Sioux Tribe
- Chippewa Cree Tribe
- Cheyenne River Sioux Tribe
- Cheyenne and Arapaho Tribe
- Eastern Shoshone Tribe

Three tribes responded in writing that they would participate in a consultation for the project. These included Santee Sioux (Santee Sioux, 2013), Cheyenne and Arapahoe (Cheyenne and Arapahoe, 2013), and Standing Rock Sioux (Standing Rock Sioux, 2013) Tribes.

In December 2013, the NRC staff again reached out to potentially interested tribes and asked if they were interested in participating in the consulting process for the proposed Reno Creek ISR Project. The NRC staff were also developing a site visit plan for Spring 2014 for interested tribes that had previously responded. After the NRC staff made additional telephone calls and sent follow-up emails, nine tribes agreed to participate in the consultation process. In an email dated February 20, 2014, the Standing Rock Sioux Tribe (Standing Rock Sioux Tribe, 2014) opted out of the consultation process.

The NRC staff continued efforts to engage in consultation with tribes that might be affected by the proposed project. The staff made follow-up telephone calls and sent emails to further gather information related to identification efforts and to coordinate meetings with the tribes.

On March 12, 2014, the NRC staff held a tribal site visit and consultation meeting related to the Reno Creek ISR Project in Wright, Wyoming (NRC, 2013a). The group visiting the site included representatives from the Santee Sioux, Northern Arapaho, Northern Cheyenne, Crow Creek, Turtle Mountain Band of Chippewa, Cheyenne and Arapaho, Crow, and Spirit Lake tribes. After a tour of the proposed project area, the NRC staff and tribal representatives met to discuss cultural resources and properties at the proposed project, as well as the consultation process for the project and unique characteristics of the site. The NRC staff provided information regarding the defined area of potential effects, an overview of the uranium milling process, and tribal consultation under NHPA. In addition, the NRC staff requested input on the need for additional tribal surveys. The overall response from tribal representatives was that the proposed project area should be surveyed for properties that have cultural and religious significance.

In June and July 2014, the NRC staff opened the proposed project site for 3 weeks for tribes to perform surveys. During the 3 weeks, 12 tribes participated in traditional and religious surveys of the area. The NRC staff did not dictate a methodology or process but provided support in the form of transportation and technical expertise, where requested. A stipend, provide by the applicant, was paid to the tribes to offset the cost of the survey. The final survey concluded on July 14, 2014. The NRC staff requested that reports or significant information that the tribes wished to have considered in the NRC's recommendation to the WY SHPO should be provided to the NRC by August 31, 2014.

Following the meetings, site visit, and survey period, the NRC staff gathered information from tribes to use in its recommendation to the WY SHPO. After consulting with tribes, the NRC staff did not identify any sites as potentially eligible for listing as a historic property on the National Register of Historic Places, but did identify some sites that should be avoided, if possible because of their cultural significance to the consulting tribes. The NRC staff provided a draft report for comment to the WY SHPO. A letter dated September 26, 2016 was sent to the WY SHPO stating that upon concurrence with NRC's determination, consultation would be complete. Concurrence was provided by the WY SHPO on October 11, 2016 (WY SHPO, 2016).

The following tribes participated in the Cultural and Religious Property Survey described above:

June 16, 2014 Participants

- Northern Cheyenne Tribe
- Turtle Mountain Band of Chippewa
- Crow Tribe
- Flandreau Santee Sioux Tribe
- Santee Sioux Tribe

July 7, 2014 Participants

- Chippewa Cree Tribe
- Cheyenne River Sioux Tribe
- Fort Peck Assiniboine and Sioux Tribe
- Fort Belknap Tribe
- Yankton Sioux Tribe

July 14, 2014 Participants

- Yankton Sioux Tribe
- Cheyenne River Sioux Tribe
- Northern Arapaho Tribe
- Crow Creek Sioux Tribe

1.8 Structure of the Supplemental Environmental Impact Statement

As noted in SEIS Section 1.4.1 of this document, the GEIS evaluated the broad impacts of ISR projects in a four-state region where such projects are anticipated (NRC, 2009), but it did not reach site-specific decisions for new ISR projects. The NRC staff evaluated the extent to which information and conclusions in the GEIS could be incorporated by reference into this SEIS. The NRC staff also determined whether any new and significant information existed that would change the expected environmental impact beyond what was evaluated in the GEIS.

SEIS Chapter 2 describes the proposed project and alternative considered for the proposed Reno Creek ISR Project, SEIS Chapter 3 describes the affected environment, and SEIS Chapter 4 evaluates the environmental impacts of implementing the proposed project and the alternative. Cumulative impacts are discussed in SEIS Chapter 5, while SEIS Chapter 6 summarizes mitigation measures to reduce adverse environmental impacts at the proposed project. SEIS Chapter 7 describes the environmental measurement and monitoring programs proposed for the Reno Creek ISR Project. A cost-benefit analysis is provided in SEIS Chapter 8, and environmental consequences from the proposed action and alternative are summarized in SEIS Chapter 9.

1.9 References

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10 CFR Part 40. *Code of Federal Regulations*, Title 10, *Energy*, Part 40, "Domestic Licensing of Source Material."

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

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

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2 IN-SITU URANIUM RECOVERY AND ALTERNATIVE

This chapter describes the proposed federal action, which is to issue a U.S. Nuclear Regulatory Commission (NRC) source and byproduct material license (hereafter referred to as an “NRC license”) to AUC, LLC (hereafter referred to as AUC, or the applicant). AUC would use its NRC license, in conjunction with other licenses, for the construction, operations, aquifer restoration, and decommissioning of the Reno Creek In Situ Recovery (ISR) Project. This chapter also discusses alternatives to the proposed action, including the No-Action Alternative, as required under the National Environmental Policy Act of 1969 (NEPA).

Section 2.1 of this Supplemental Environmental Impact Statement (SEIS) describes the alternatives considered for detailed analysis, including the proposed action. Section 2.2 describes those alternatives that were considered but eliminated from detailed analysis. Section 2.3 compares the predicted environmental impacts of the proposed action and the No-Action Alternative. Section 2.4 sets forth the preliminary NRC staff recommendation on the proposed federal action. Section 2.5 provides the references cited for this chapter.

2.1 Alternatives Considered for Detailed Analysis

This SEIS evaluates the potential environmental impacts from two alternatives:

- The Proposed Action (Alternative 1), and
- The No-Action Alternative (Alternative 2).

The alternatives are evaluated with regard to the four phases of a uranium-recovery operation: construction, operations, aquifer restoration, and decommissioning. The alternatives have been established based on the purpose and need statement described in Section 1.3 of this SEIS.

The NRC staff used a variety of information sources for the analysis in this SEIS. These sources include (i) the application’s environmental report (ER) (AUC, 2012a) and technical report (TR) (AUC, 2012b); (ii) the applicant’s responses to the NRC staff’s requests for additional information (AUC, 2014a); (iii) the scoping and comments on NUREG–1910, Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (GEIS) (NRC, 2009); (iv) the information gathered during the NRC staff site visits in September 2013 (NRC, 2013); and (v) multidisciplinary discussions held among the NRC staff and various stakeholders.

2.1.1 The Proposed Action (Alternative 1)

Under the proposed action, the NRC would issue the applicant an NRC license. The applicant would use its NRC license in conjunction with other licenses for the construction, operations, aquifer restoration, and decommissioning of an ISR facility at the proposed Reno Creek ISR Project area. The proposed Reno Creek ISR Project area (also referred to as the proposed project area) is defined as the land within the applicant’s proposed license boundary. As described in the license application, the proposed project area is located in Campbell County, Wyoming. The applicant’s proposed project would include processing facilities and sequentially developed production units (15 total production units). Each production unit would have from one to seven wellfields, each equipped with its own header house. As uranium recovery activities cease at a production unit, the wellfield area would be restored and reclaimed while a new production unit and supporting infrastructure is developed. This approach to wellfield construction, operations, aquifer restoration, and decommissioning is referred to as a phased approach by the applicant (AUC, 2012a).

AUC proposes to use ISR methods to extract uranium from the sandy facies and clay/sand boundaries in the lower part of the Eocene Wasatch Formation in the Pumpkin Buttes Uranium District. The extracted uranium would be loaded onto ion-exchange resin at a central processing plant (CPP), which would be equipped with pressurized, down-flow ion-exchange columns, an elution circuit, a precipitation circuit, and yellowcake (a uranium oxide compound) drying and packing facilities. The CPP would be used to formulate the necessary solutions and processes for groundwater restoration after uranium recovery operations have ceased (AUC, 2012a).

The applicant plans to dispose of liquid byproduct material generated during uranium recovery operations in Wyoming Department of Environmental Quality (WDEQ)-permitted Class I Underground Injection Control (UIC) wells (hereafter referred to as Class I deep disposal wells), as discussed in SEIS Sections 2.1.1.1.2 and 2.1.1.1.6.

2.1.1.1 Proposed In Situ Recovery Facility

The proposed Reno Creek ISR Project would include buildings, infrastructure, wellfields, and methods of waste disposal, which are described in the following sections. For details on the general ISR process, see GEIS Chapter 2 (NRC, 2009). The applicant's proposed project schedule is shown in SEIS Figure 2-1.

2.1.1.1.1 Site Description

The proposed Reno Creek ISR Project would be located in Campbell County, Wyoming, between the communities of Wright, Edgerton, and Gillette (SEIS Figure 2-2). As described by the GEIS (NRC, 2009), the proposed project area would be located in the Wyoming East Uranium Milling Region. The proposed project area encompasses 2,451 hectares (ha) [6,057 acres (ac)] of mostly private land. The total land disturbed by the proposed project would be approximately 62 ha [154 ac]. The proposed project location contains all or portions of Sections 5–6 of Township 42 North, Range 73 West; all or portions of Sections 1 and 12 Township 42 North, Range 74 West; all or portions of Sections 21–22 and 27–34 of Township 43 North Range 73 West; and all or portions of Sections 35–36 of Township 43 North Range 74 West (SEIS Figure 2-3) (AUC, 2012a).

The proposed project area would be situated in the southern portion of the Powder River Basin (AUC, 2012a). The vegetation is semi-arid grassland and shrublands with some minimal grazing. Elevation within the proposed project area and its immediate surroundings is approximately 1,585 m [5,200 ft] above sea level. The proposed project area, as with most landscapes in the Powder River Basin, is characterized by flat to gently rolling topography with small ephemeral drainages. The proposed project area is on the divide between the Belle Fourche River and Cheyenne River Drainage Basins, straddling a subregional surface water divide for those two drainages. The primary land uses within the proposed project area are oil and gas production, coalbed methane (CBM) production, livestock grazing, and wildlife habitat. Within the surrounding 8 km [5 mi] land area, the surface land use is mostly livestock grazing.

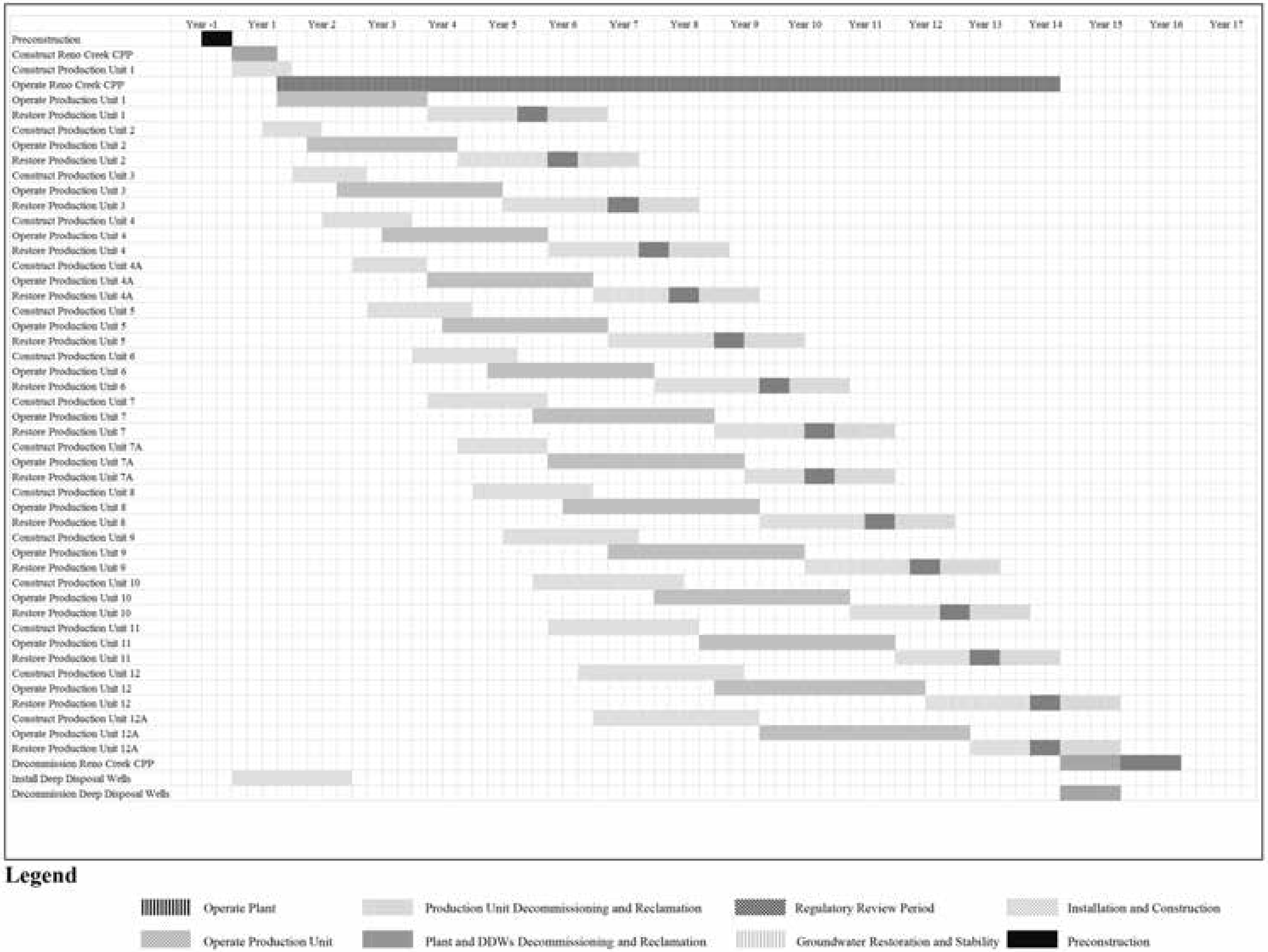

Figure 2-1. Proposed Reno Creek ISR Project Schedule (AUC, 2014a)

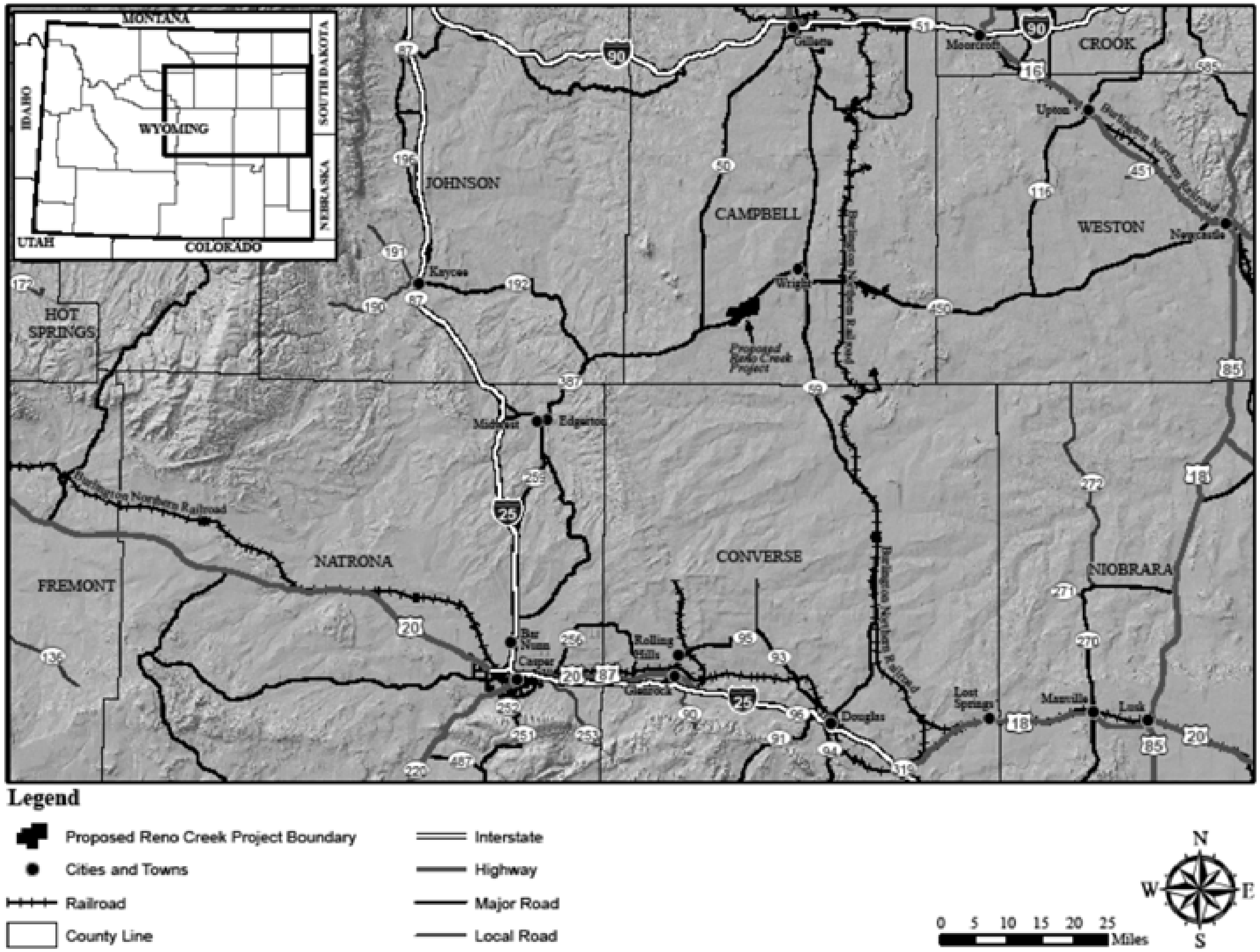

Figure 2-2. Proposed Reno Creek ISR Project General Location Map (AUC, 2014a)

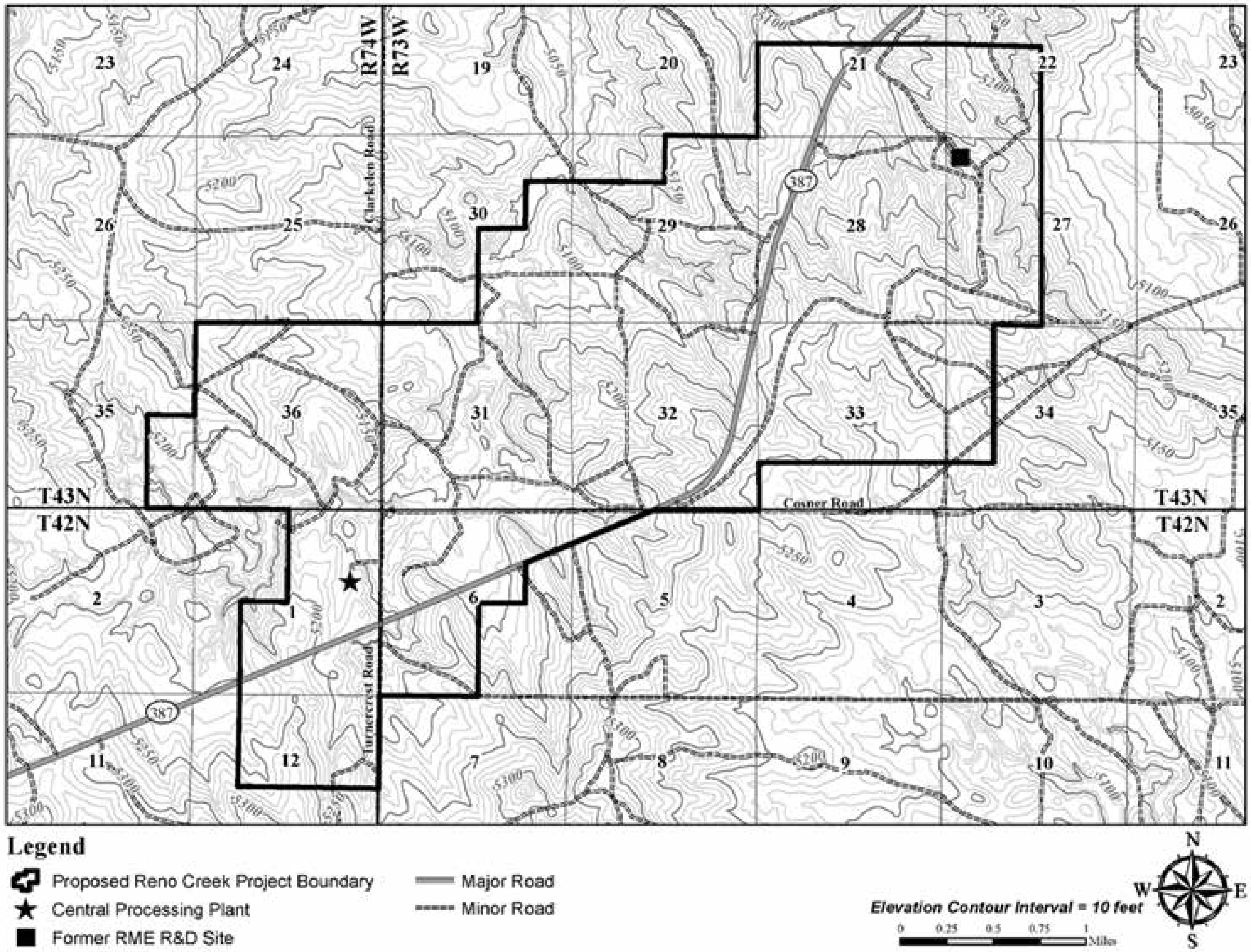

Figure 2-3. Proposed Reno Creek ISR Project Boundary (AUC, 2014a)

Material shipments and employee commutes to and from the proposed Reno Creek ISR Project area would be primarily along State Highway 387, which connects Interstate 25 (I-25) to the west and State Highway 59 to the east (SEIS Figure 2-2). Highway 387 runs east to west from Wright to I-25. The City of Gillette is located approximately 65 km [41 mi] north of the proposed project area and has two transportation routes available to access the proposed project area: State Highways 50 and 59. Highway 50 originates in Gillette, runs to the south, and connects with Highway 387 approximately 7.2 km [4.5 mi] west of the proposed Reno Creek ISR Project area. Highway 59 connects with Highway 387 at Wright, located approximately 12 km [7.5 mi] northeast of the proposed project area. While I-25 is a federal interstate and designed for high-volume, high-speed traffic, Highways 387, 50, and 59 are rural two-lane, opposing traffic, asphalt-paved highways. Additionally, county roads 22 (Clarkelen Road) and 25 (Cosner Road) also run through the proposed project area (AUC, 2012a).

2.1.1.1.2 Construction Activities

As described in GEIS Section 2.3, the general construction activities associated with ISR facilities are (i) drilling wells; (ii) clearing and grading associated with road construction; (iii) excavating and building foundations and surface impoundments; (iv) assembling buildings; (v) trenching; and (vi) laying pipelines (NRC, 2009). The facilities that would be constructed as part of the proposed Reno Creek ISR Project are the CPP and associated infrastructure, such as wellfields, pipelines, power lines, header houses, ponds, and access roads, and ancillary buildings (AUC, 2012a). Surface facilities, underground infrastructure, and access roads at the proposed Reno Creek ISR Project area would be designed and built using standard construction techniques. Construction vehicles would include bulldozers, drilling rigs, water trucks, forklifts, pickup and flatbed trucks, and other support vehicles. Construction-related activities at the proposed project would continue throughout much of the life of the project, as wellfields are sequentially developed and additional wells, underground piping, and surface structures are added and then subsequently decommissioned.

The proposed Reno Creek ISR Project area encompasses 2,451 ha [6,057 ac]. The applicant estimates that the total land disturbed by the proposed project would be approximately 62 ha [154 ac]. These estimates include proposed project facilities, pipeline installation, access roads, and impoundments. As wellfields and supporting infrastructure are developed and constructed over the life of the project, the total disturbed area would vary slightly between short-term and long-terms uses. Short term disturbance would be small in time duration and could include trunklines, drill pits and pads, and topsoil storage. Long-term disturbance would include the fenced area around the CPP, backup pond, and deep disposal well pad (AUC, 2012a).

The applicant has committed to salvage and manage topsoil from building sites, permanent storage areas, access roads, and chemical storage areas prior to construction, in accordance with WDEQ regulations (WDEQ, 2000). Additionally, to reduce the potential effect of soil erosion, the surface would be graded, stormwater would be routed, and stockpiled topsoil would be seeded with a temporary seed mix to protect it from erosion. Within the 62 ha [154 ac] of disturbance, approximately 24.9 ha-m [202 ac-ft] of salvageable topsoil is present (AUC, 2012a).

Central Processing Plant Facility

The proposed Reno Creek ISR Project would include a CPP facility, which would comprise a CPP building (hereafter referred to as the CPP) housing the processing equipment, drying and packaging equipment, onsite laboratory, and groundwater restoration water treatment equipment, as well as ancillary buildings such as a warehouse, a maintenance building, a reagent and liquid materials storage facility, an administration building, and a parking area (SEIS Figure 2-4). The CPP major circuits and systems would include a pressurized down-flow ion-exchange system; elution columns; and the yellowcake filtering, drying, and packaging system. Tanks at the main plant would contain various liquids, including barren lixiviant, barren eluant, yellowcake precipitation, washing, dewatering, process chemicals, and yellowcake slurry. Designated areas would also be provided for hydrocarbon storage (e.g., fuel or oil) and hazardous material storage (e.g., used oil) (AUC, 2012a).

> **What is Lixiviant?**
> A solution composed of native ground water and chemicals (typically bicarbonate) added during the ISR operations. Lixiviant is then pumped underground to mobilize (dissolve) uranium from a uranium-bearing ore zone, or the ore body.
>
> **What is Eluant?**
> Eluant is a processing solution composed of fresh water, soda ash and salt that is used during the eluation stage of an ISR uranium recovery process to strip uranium from uranium loaded ion-exchange resins.
>
> **What is Yellowcake?**
> Yellowcake (uranium oxide) is the product of the uranium-recovery and milling process; early production methods resulted in a bright yellow compound, hence the name "yellowcake." However, the color can vary from yellow to orange to dark green (blackish) depending on drying temperature.
>
> Source: NRC, 2009

The CPP building would be located in the southeast quarter of the northeast quarter of Section 1, T42N, R74W (SEIS Figure 2-3) and would be approximately 106 m × 61 m wide [350 ft × 200 ft]. The total disturbed area of the CPP and adjacent structures is estimated at 6.2 ha [15.5 ac]. The CPP, adjacent buildings, and storage pond would be fenced to exclude livestock and wildlife and control access to the proposed project area (AUC, 2012a).

The entire perimeter of the CPP building floor would be surrounded by containment curbs and sloped to direct precipitation runoff away from the building foundation in all directions to a stormwater conveyance system. Additionally, the backup storage pond and all exterior chemical and fuel tanks are either self-contained or would have a means of secondary containment. Secondary containment methods include cement curbs, berms, and CPP walls (AUC, 2012b).

Bulk storage tanks for the processing chemicals, such as sulfuric and/or hydrochloric acid, would be located outside the CPP building in cross-linked high-density polyethylene flat-bottom tanks. The storage tanks would be placed in concrete secondary containment basins, designed to contain 110 percent of the tank volume, and would be designed to withstand a 25-year, 24-hour storm event. Sodium hydroxide solution used during the precipitation process would be stored in a flat-bottom tank located in the processing plant. This 50 percent sodium hydroxide solution would be stored in a fiberglass tank with a vent pipe routed to the outside and above the CPP. A secondary containment berm would be constructed within the plant to contain potential spills to the immediate area. As noted in NUREG–1910 (NRC, 2009), all ISR facilities have concrete curbed floors with drains and sumps to control and retain liquid from spills and wash-downs. The berm would be constructed to a height of 15.3 centimeters (cm) [6 inches (in)]. The sodium hydroxide would be transported using conventional polyvinyl chloride (PVC) piping from the fiberglass storage vessel into the CPP precipitation tanks.

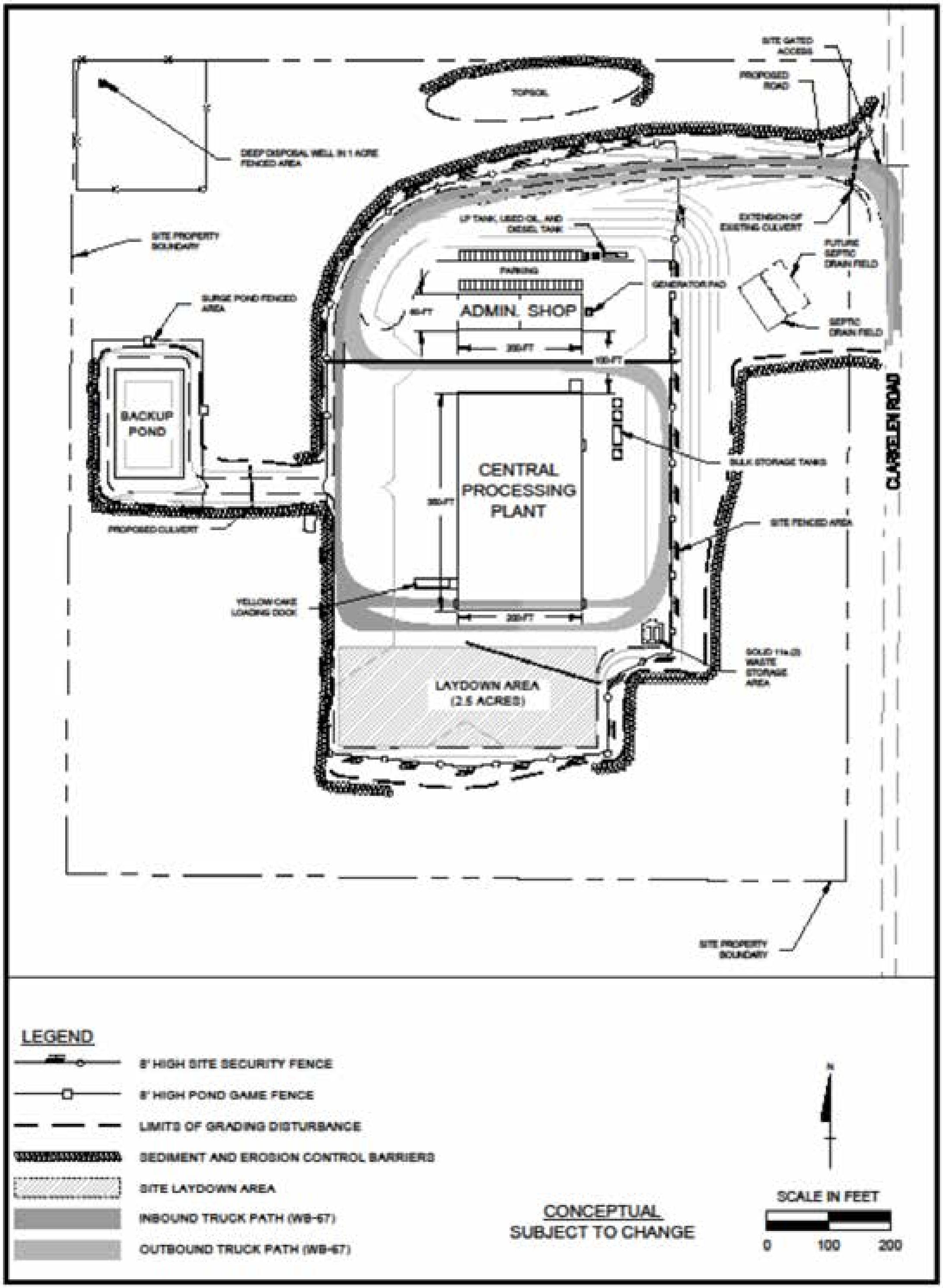

Figure 2-4. Proposed Reno Creek ISR Project CPP Facility Layout (AUC, 2014a)

Carbon dioxide would be stored outside the CPP. The carbon dioxide storage system would consist of one 50-ton bulk liquid carbon dioxide pressure vessel tank supplied and maintained by the carbon dioxide supplier. Floor level ventilation and carbon dioxide monitoring at low points would be performed to protect workers from undetected leaks of carbon dioxide within the CPP. Oxygen would be stored either near the central plant or within wellfields. The oxygen storage system would consist of 30-ton bulk liquid oxygen pressure vessel(s), which would be centrally located to service multiple production units. Because oxygen is combustible, design and installation of the oxygen storage facility would be performed by the oxygen supplier and meet applicable industry standards (AUC, 2012b).

Sodium carbonate and sodium chloride are used for regeneration of ion-exchange resins. Soda ash and carbon dioxide would be used to prepare sodium carbonate for injection in the production unit. Dry storage and handling systems would be designed to industry standards to control the discharge of dry material because the primary hazard is inhalation (AUC, 2012b).

Other substances stored near the proposed Reno Creek ISR Project CPP would include petroleum products (gasoline, diesel) and propane. Due to the flammable and/or combustible nature of these materials, all bulk quantities of these substances would be stored outside of the CPP. All gasoline and diesel storage tanks would be located above ground and within secondary containment structures designed and constructed to meet U.S. Environmental Protection Agency (EPA) requirements (AUC, 2012a).

Access Roads

As described in SEIS Section 2.1.1.1.1, the main highway that would be used to access the proposed Reno Creek ISR Project area is Wyoming State Highway 387. Access throughout the proposed project area is available via Campbell County-maintained gravel roads and private two-track gravel roads established from CBM development and agricultural activity. The applicant commits to utilizing existing access roads; although primary, secondary, and tertiary roads may be improved or constructed (AUC, 2012a).

Within the proposed Reno Creek ISR Project area, preexisting roads also would be used to the fullest extent possible to provide access to the proposed facility structures and wellfields and to limit the construction of new roads. Secondary roads would be constructed to provide access to other proposed facilities (such as header houses) and wellfields not currently accessible by existing roads. The applicant would secure approvals from private landowners, as well as any required county permits, prior to constructing any access roads within the proposed project area. Although construction of access roads within the proposed project area would be kept to a minimum, it is estimated that 9.4 ha [23.3 ac] of secondary and tertiary infrastructure roads would be constructed (AUC, 2012a).

Wellfields

The proposed locations of wellfields for the proposed Reno Creek ISR Project are shown in SEIS Figure 2-5. Historical drilling, conducted by the applicant and previous owners, has demonstrated that commercially extractable uranium ore bodies at the proposed project area are located in the medium- to coarse-grained sand facies of the Eocene-aged Wasatch

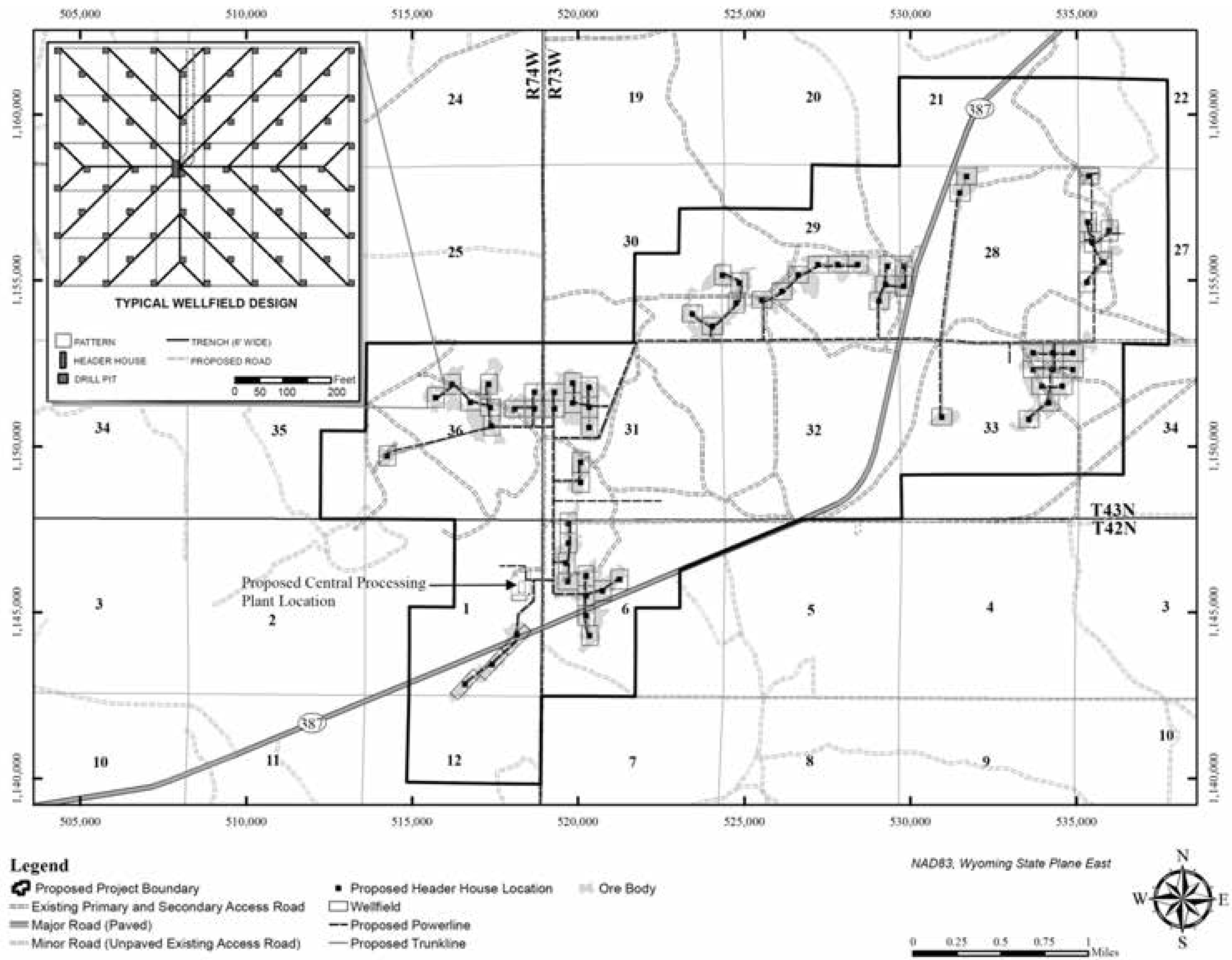

Figure 2-5. Proposed Reno Creek ISR Project – Conceptual Wellfield Layout (AUC, 2014a)

Formation. The geology, hydrology, and characteristics of the uranium mineralization at the proposed Reno Creek ISR Project area are detailed in SEIS Sections 3.4 and 3.5. The estimated mineable resource within the proposed project area is 7.12 million kilograms (kg) [15.7 million pounds (lb)] of U_3O_8 (yellowcake) with an average grade of 0.065 percent (AUC, 2012a).

The applicant proposes a phased approach in which they would sequentially construct and operate a series of up to 15 production units (see SEIS Figure 2-1). The year in which the highest number of wellfields are active may occur during year nine of the proposed project lifespan, at which time up to nine wellfields may be operating (AUC, 2014a). Consistent with a phased approach, the construction of subsequent wellfields would begin during the operational stage of the initial wellfields in the area. Each production unit would have from one to seven wellfields, each of which would be equipped with its own header house (in total approximately 67 header houses). A typical wellfield is approximately 152 m by 183 m [500 ft by 600 ft]. Each header house is a small 33-square-meter (m^2) [360-square-foot (ft^2)] single-story metal building with a basement or sump. A disturbance area around each header house is necessary to provide an adequate area for operations and maintenance vehicles. Two types of wells would be constructed at the proposed Reno Creek ISR Project: dual-purpose injection/production wells and monitoring wells. When used to introduce lixiviant into the uranium mineralization, a dual-purpose well is considered an injection well; when used to extract uranium-bearing solutions, it is considered a production well. Monitoring wells would be used to identify and assess impacts of ongoing operations and detect groundwater excursions. Additionally, all wells in a production unit would be completed such that they can be used as either injection or production wells. Injection and production well patterns would typically follow the conventional five-spot pattern, consisting of a production well surrounded by four injection wells. However, in order to recover uranium effectively and complete groundwater restoration, more or fewer injection wells may be associated with each production well, depending on the ore configuration. The dimensions of the patterns vary, depending on the configuration of the mineralized zone, ore grade, and accessibility, but the injection wells would typically be between 23 and 37 m [75 and 120 ft] apart (AUC, 2012a).

Prior to finalizing the design of wellfields, the applicant would conduct closely spaced and localized delineation drilling to refine information on the location, grade, thickness, and production capability of the ore. To estimate and manage ore production, geologic and geophysical data from the drill holes would be analyzed by the applicant's Safety and Environmental Review Panel (SERP)[1] to determine the depth of the mineralized zone and confining units, identify and locate potential barriers to groundwater flow caused by clay stringers, and determine the thickness and grade of ore deposits. Geophysical logging would include single-point resistance, spontaneous potential, and neutron and natural gamma geophysical logs. Deviation logs would also be completed to better determine the drift between the surface and the bottom of the drill hole, allowing for a more precise estimation of the ore body and identification of future production well locations (see the section on *Wellfield Hydrogeologic Data Packages*) (AUC, 2012b).

[1]The Safety and Environment Review Panel is a licensee's review board with a minimum of three individuals: one member with a required expertise in management, one member with required expertise in operations or construction capable of implementing any changes, and one radiation safety officer or equivalent. A licensee cannot modify mandatory license conditions without a license amendment; however, the SERP can review and approve changes to project operations as long as changes do not change basic health and safety procedures and requirements or change basic potential environmental impacts assessed as part of the licensing process.

The initial layout of the wellfields would require that preliminary production and monitoring well locations be determined after an adequate amount of the deposit area has been drilled. This may require delineation holes to be drilled in a grid as small as 30 m [100 ft] for the first phase. However, if the need arises, additional drilling in a grid as small as 15 m [50 ft] for the second phase may be required to further map the ore body and determine production well locations. This delineation drilling would identify optimum locations for monitoring wells in the production zone and overlying aquifers. The last phase of delineation is drilling pilot holes for injection and recovery wells. This review is to confirm whether the holes intersect a pattern containing sufficient resources to economically recover uranium. These logs also help determine the screen interval and if the hole proves to be economical. If it is determined that a pilot hole is not sufficient for economic recovery, the hole would not be cased. Instead, it would be plugged and abandoned in accordance with the procedures outlined in WDEQ regulations (WDEQ, 2012).

Injection and Production Wells

The applicant plans to construct wellfields consisting of a series of injection and production wells laid out in varying geometric-shaped patterns, depending on the configuration of the mineralized zone, ore grade, and accessibility across target uranium mineralization zones. As previously described, in order to recover uranium effectively and to complete groundwater restoration, all production unit wells would be completed so that they can be used as either injection or production wells. The dimensions of the patterns may vary slightly, but the injection wells typically would be between 23 to 37 m [75 to 120 ft] apart (AUC, 2012a).

With 15 production units each having between one and seven wellfields, all equipped with header houses, the applicant expects that each header house would serve between 15 to 30 production wells and 25 to 50 injection wells (production and injection wells are also referred to collectively as production unit wells), depending on the design of each wellfield (AUC, 2012a).

The wells would be "cased" by lowering a pipe into the borehole after drilling to prevent the sides of the borehole from caving, prevent loss of drilling fluids into porous formations, and prevent unwanted fluids from entering the borehole. The base of the well casing at all injection and production wells would extend to or below the confining unit overlying the mineralized zone. The screened interval of injection and production wells would be completed only across the targeted ore zone. Since wells would be dual-use wells, wellfield flow patterns could be changed to improve uranium production at the proposed project area. Dual-use wells also result in more effective restoration of groundwater quality during the aquifer restoration phase of the ISR process (see SEIS Section 2.1.1.1.4) (AUC, 2012a).

The EPA Underground Injection Control (UIC) Program is responsible for regulating construction, operations, permitting, and closure of injection wells that place fluids underground. The types of injection wells regulated by the EPA UIC Program are defined in detail in 40 CFR 144.6. Injection wells considered in the impact analyses in this SEIS are briefly described below:

Class I (Industrial and Municipal Waste Disposal Wells) are used to inject hazardous and nonhazardous wastes into deep, isolated rock formations that are typically thousands of meters [feet] below the lowermost underground source of drinking water (USDW).

Class II (Oil- and Gas-Related Injection Wells) are used to inject fluids associated with oil and natural gas production.

Class III (Mining Wells) are used to inject fluids to dissolve and extract minerals such as uranium, salt, copper, and sulfur.

Class V wells are used to inject fluids that are not defined as hazardous waste or radioactive waste by the UIC regulations. Most are used to dispose of wastes into or above USDWs.

The applicant plans to utilize a five-spot square pattern where injection wells would be at the corners of a 30-m [100-ft]-wide square, and a production well would be placed in the center of the square. Based on the results of delineation drilling, the applicant may elect to space the injection wells closer for more efficient uranium production, thus increasing the overall number of wells needed for the uranium extraction process (AUC, 2012a).

Production and injection wells would be connected to manifolds in a wellfield header house; header houses distribute injection fluid (i.e., lixiviant) to injection wells and collect production solution (i.e., pregnant lixiviant or uranium-bearing solution) from production wells. The header house would include manifolds, valves, flow meters, pressure meters, and booster pumps. Oxygen would be incorporated into the lixiviant at the header house before it is injected into the production formation. Typically, one header house would serve up to 15 to 30 production wells and 25 to 50 injection wells. Additional header houses would be constructed as the wellfield expands (AUC, 2012a).

A WDEQ-administered UIC program regulates the design, construction, testing, operations, and closure of injection wells. Injection wells for uranium extraction are classified under UIC as Class III wells; these wells are located in the aquifer(s) containing the uranium that would be recovered.

The proposed operation requires the applicant to obtain a Wyoming UIC permit from WDEQ to use Class III injection wells. In order for ISR operations to occur, the uranium-bearing production aquifer must be exempted as an underground source of drinking water (USDW) through the Wyoming UIC program, in accordance with the Safe Drinking Water Act (SDWA) and pursuant to Title 40 of the *Code of Federal Regulations* (CFR) Part 146. A USDW is defined as an aquifer or its portion that (1) supplies any public water system or that contains a sufficient quantity of groundwater to supply a public water system and (a) currently supplies drinking water for human consumption or (b) contains fewer than 10,000 mg/L [10,000 ppm] total dissolved solids; and that (2) is not an exempted aquifer. An aquifer or aquifer portion that meets the criteria for a USDW may be determined to be an “exempted aquifer” if (i) it does not currently serve as a source of drinking water and (ii) it cannot now and will not in the future serve as a source of drinking water because it is mineral, hydrocarbon, or geothermal energy producing, or it can be demonstrated by a permit applicant as part of a permit application for a Class III operation to contain minerals that, considering their quantity and location, are expected to be commercially producible. The applicant, therefore, must obtain an aquifer exemption from EPA before initiating ISR operations. An aquifer exemption is identified and requested by WDEQ and approved by EPA. Once exempted, the defined aquifer(s) or its portion would no longer be protected as a USDW under the SDWA. The Class III aquifer exemption has been approved and is in place; therefore, the defined aquifer or its portion are no longer protected as a USDW under the SDWA.

Monitoring Wells

The applicant has proposed installing production zone monitoring wells at the periphery of each production wellfield area (SEIS Figure 2-6). This perimeter monitoring well “ring” would be utilized for early detection of horizontal excursions from within the sand unit or aquifer where production is occurring. An excursion at a monitoring well is declared when the concentrations

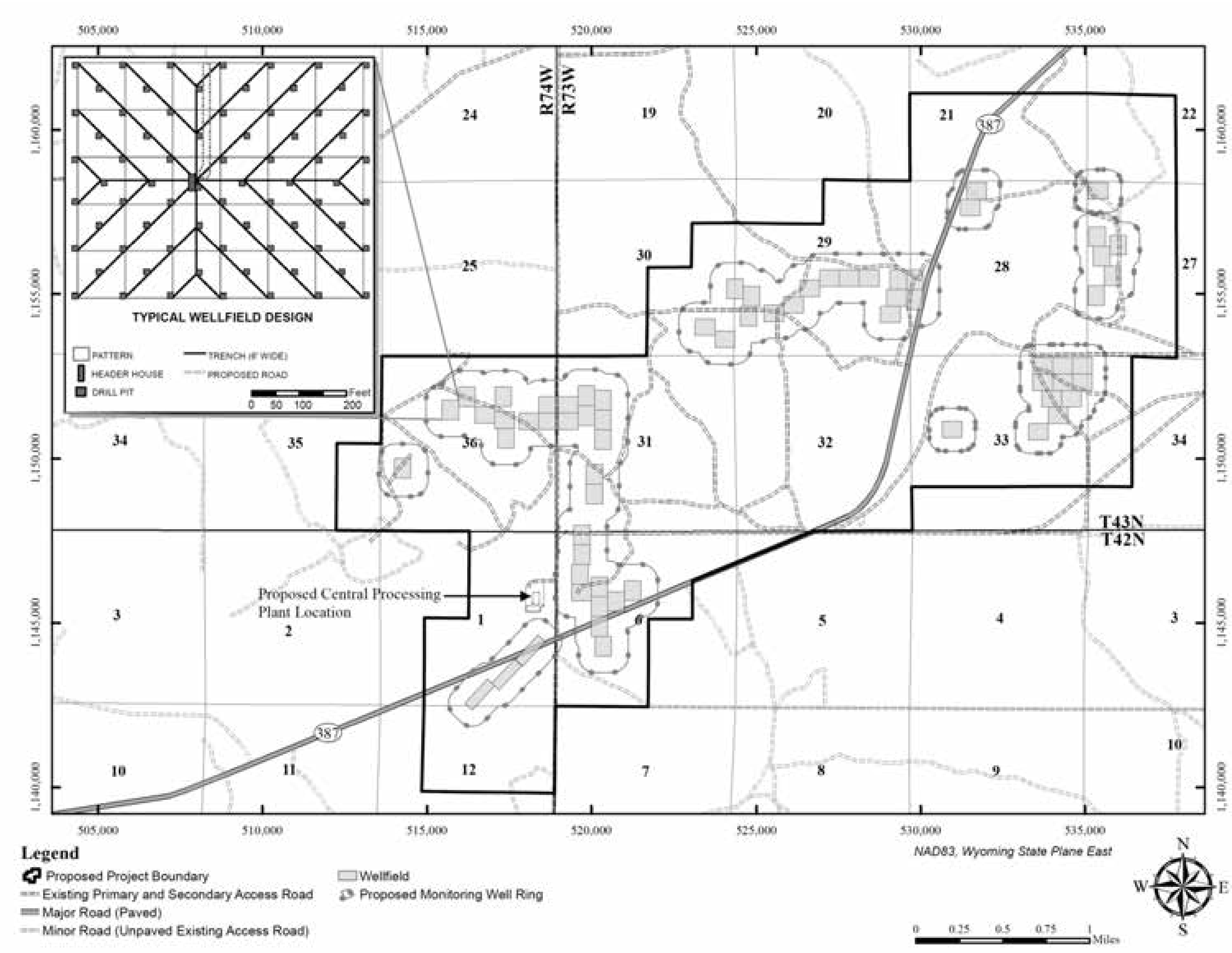

Figure 2-6. Proposed Reno Creek ISR Project – Conceptual Monitoring Wells Layout (AUC, 2014a)

of certain indicator parameters exceed upper control limits (UCLs) established by the license and verified by the NRC or the state. The purpose of the monitoring well ring is to ensure that groundwater quality in aquifers outside exempted zones is not affected by ISR operations.

The applicant has committed to installing perimeter-monitoring well rings within the production zone aquifer, outside the production pattern area in a ”ring” around the wellfield area, and in the overlying aquifer within the production well pattern area at a minimum density of one well per every 1.6 ha [4 ac] of pattern area. Four samples would be collected from each overlying and perimeter ring monitoring well at least 2 weeks apart for constituents of concern. (AUC, 2012b)

The applicant has already installed 21 monitoring wells with the production zone aquifer to evaluate the groundwater hydrology and collect baseline water quality data. Ten of the 21 wells were installed within the mineralized portions of the production zone aquifer and were sampled four times (once per quarter) over a year. Several of these wells were also used as observation wells for the four regional pump tests (AUC, 2014a).

Production zone monitoring wells would be installed before production activities begin; required groundwater sampling and hydrologic tests would be conducted on samples taken from the monitoring wells. Thirty-nine groundwater monitoring wells have already been installed to characterize the regional groundwater chemistry.

Wellfield Hydrogeologic Data Packages

The applicant’s pump test data would be included in wellfield hydrogeologic data packages, which would be submitted for review and evaluation by the SERP. The wellfield hydrogeologic data package would describe the wellfield, including (i) production and injection well patterns and location of monitoring wells; (ii) documentation of wellfield geology (e.g., geologic cross sections and isopach maps of production zone sand and overlying and underlying confining units); (iii) pumping test results; (iv) sufficient information to demonstrate that perimeter production zone monitoring wells adequately communicate with the production zone; and (v) data and statistical methods used to compute Commission-approved background water quality (AUC, 2012b).

With the exception of the first wellfield package, which would be submitted for review to the NRC, the SERP would review the wellfield hydrogeologic test results and documentation to ensure that monitoring wells are hydrologically connected to the injection and production wells. The wellfield hydrogeologic data package and written SERP evaluation would be maintained onsite and available for NRC review.

Well Construction, Development, and Testing

The applicant intends to use standard mud rotary drilling techniques and equipment to construct production, injection, and monitoring wells. Wells would be drilled to the bottom of the target completion interval with a small rotary drilling unit. Industry practice is to use bentonite or polymer drilling mud with pH-adjusted water and mixed to control viscosity. A temporary mud pit, to contain the drilling mud, would be excavated adjacent to the drill site. During excavation of mud pits, topsoil would be separated from the subsoil with a backhoe. The subsoil would be deposited next to the mud pit, and the topsoil would be stored at a separate location until the well site is restored. Residual cuttings and drilling fluids are typically held in the mud pit after drilling and construction activities are completed (NRC, 2009). Depending on state and local regulations, such mud pits are backfilled and graded or are alternatively emptied and cleaned, and residual solids and liquids are transported and disposed of offsite (NRC, 2006). At the proposed Reno Creek ISR Project area, mud pits that contain drilling fluids and cuttings would be backfilled and graded according to WDEQ regulations (AUC, 2012a). After well drilling is completed, the applicant proposes to redeposit the excavated subsoil in the mud pit, followed by topsoil application and grading, in accordance with WDEQ regulations.

All production, injection, and monitoring wells would be cased and cemented to prevent fluids from migrating into or between USDWs. The applicant has committed to construct all injection, production, and monitoring wells using methods approved by WDEQ and in compliance with WDEQ construction requirements for casing types. A schematic for a completed well is shown in SEIS Figure 2-7. Before an injection, production, or monitoring well enters service, the applicant would perform mechanical integrity tests (MIT) using pressure-packer tests (AUC, 2012b). The mechanical integrity of wells is tested to verify that the well casing would not fail, which could cause water loss and fluid migration across confining units during injection, production, and monitoring operations (NRC, 2009). MITs are performed by sealing a casing bottom with a plug, a downhole packer, or other suitable sealing device. The casing is then filled with water, and the top of the casing is sealed with a threaded cap or mechanical seal. The well casing is then pressurized predominantly with water and to a lesser extent with air, and the mechanical integrity of the well casing is monitored by a calibrated pressure gauge. Internal casing pressure is increased to 120 percent of the maximum allowable injection pressure of the well. A well should maintain 90 percent of this pressure for 10 minutes to pass the MIT. If obvious leaks are present or the pressure drops by more than 10 percent during a 10-minute period, the seals and fittings on the packer system must be checked and reset and another test is conducted. A well casing that maintains a high level of pressure demonstrates acceptable mechanical integrity, and the well would be qualified for service at the facility (AUC, 2012b).

To ensure the continued integrity of the wellfields, the applicant would test the mechanical integrity of all active injection and production wells at least once every 5 years or after any rework that may need to be performed on the well. The applicant would document the details of the MITs (specifically, the well designation, date of test, test duration, and beginning and ending pressures), and the individual conducting the test would sign the test report. MIT results would be maintained onsite and would be available for NRC inspection. MIT results would also be reported quarterly to WDEQ, in accordance with the WDEQ UIC regulations.

Pipelines

As part of the underground infrastructure at ISR facilities, a network of process pipelines and cables are typically installed connecting (i) the CPP and the header houses for transferring lixiviant; (ii) the header houses and wellfields for injecting and recovering lixiviant; and (iii) the CPP and wastewater disposal facilities (e.g., Class I deep disposal wells) (NRC, 2009). The piping and metering system for production and injection solutions at the proposed Reno Creek ISR Project would require buried trunk lines to connect the operating wellfield areas with the CPP and its related wellfields to transport liquid waste streams to the wastewater disposal facility (i.e., Class I deep disposal wells). The total estimated disturbance area resulting from the main trunk line and deep disposal pipeline would be approximately 8.9 ha [22 ac]. Surface disturbing activities associated with pipeline construction would include topsoil stripping, trenching, backfill, topsoil replacement, and reseeding. Pipeline corridors would be restored and reseeded, typically within the same construction season. Whenever possible, surface

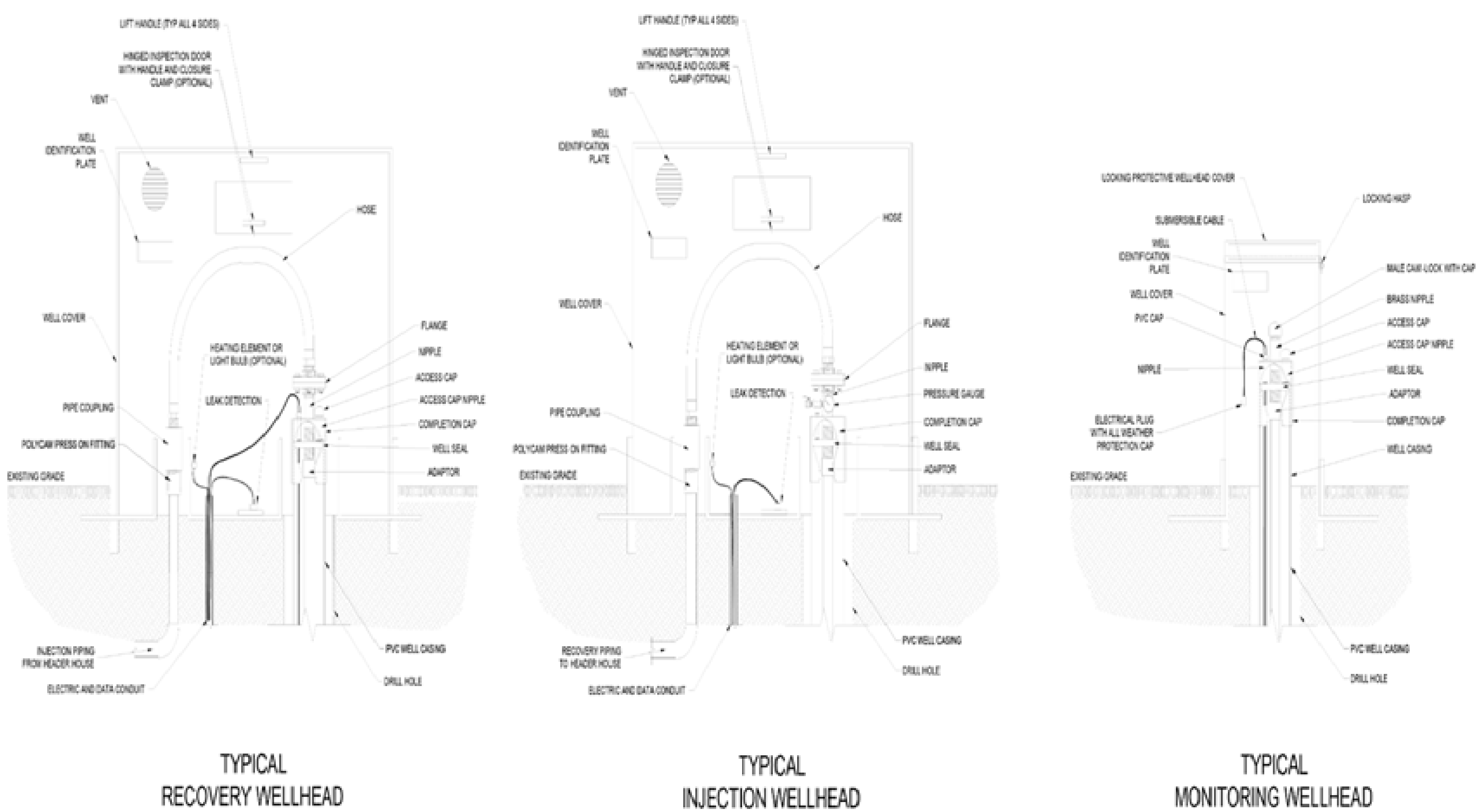

Figure 2-7. Schematic of Typical Production, Injection, and Monitoring Wellhead Construction (AUC, 2015)

disturbance would be minimized by locating pipelines near access roads and utilities (AUC, 2012a).

High density polyethylene (HDPE), polyvinyl chloride (PVC), or steel pipe with heat-welded joints would be used to connect the wells, header houses, and processing facilities; the piping would be buried below grade to prevent freezing. Trenches containing pipelines are typically backfilled with native soil and graded to surrounding ground topography (NRC, 2009). The same procedure used in mud pit excavation during well construction would be used to preserve topsoil. Topsoil would be stored separately from subsoil and replaced on the subsoil after the pipeline ditch is backfilled (AUC, 2012b).

At the header house, the piping would be connected to manifolds equipped with control valves, flow meters, check valves, pressure sensors, oxygen and carbon dioxide feed systems (injection only), and programmable logic controllers. Sensors would measure and record pipeline pressures to monitor for potential leaks and spills resulting from failure of fittings and valves. Electrical power to the header houses would be delivered by overhead power lines and buried cable. Electrical power to individual wells would be delivered by buried cable from the header house. As the wellfield expands, additional header houses would be constructed and connected to one another via buried header piping. The header piping is designed to accommodate injection and production flow rates. The only exposed pipes at the proposed project area would be at the CPP, wellheads, and wellfield header houses (AUC, 2012a).

Liquid Waste Disposal Systems

The applicant plans to dispose of liquid byproduct material generated during uranium recovery operations using Class I deep disposal wells. Project-generated liquid byproduct material would include bleed water from the production wells, groundwater generated during aquifer restoration, process solutions (e.g., resin transfer water and brine generated from the elution and precipitation circuits), and plant washdown water (AUC, 2012a). Additionally, the use of small onsite wastewater systems (e.g., a septic field) must be approved by WDEQ. The Class I disposal well permit has been approved by WDEQ, and details about the permitting processes and applicable requirements for Class I deep disposal wells are described in SEIS Section 2.1.1.1.6.

Class I Deep Disposal Well

The applicant has been authorized by the WDEQ to drill, complete, and operate four deep Class I disposal wells and proposes to inject up to 606 Lpm [160 gpm] of liquid byproduct material (AUC, 2012a,b) into a discharge zone that has been defined by WDEQ permit as within the Teckla Sandstone member of the Cretaceous-age Teckla Sandstone member of the Lewis Formation and Teapot Sandstone of the Mesaverde Formation (WDEQ, 2015a). The permitted Class I deep disposal well discharge zones vary in depths between 2,130 and 2,400 m [7,000 and 7,860 ft] below the ground surface (WDEQ, 2015a). The proposed locations of these Class I deep disposal wells are shown in SEIS Figure 2-8.

The Class I deep disposal well design and construction must meet WDEQ regulations, and applicable permit conditions. For disposal using a Class I well, the WDEQ permit prohibits injection of any material defined as hazardous waste, as defined by Resource Conservation and Recovery Act (RCRA) regulations in 40 CFR 261.3 or WDEQ regulations (WDEQ, 2013a).

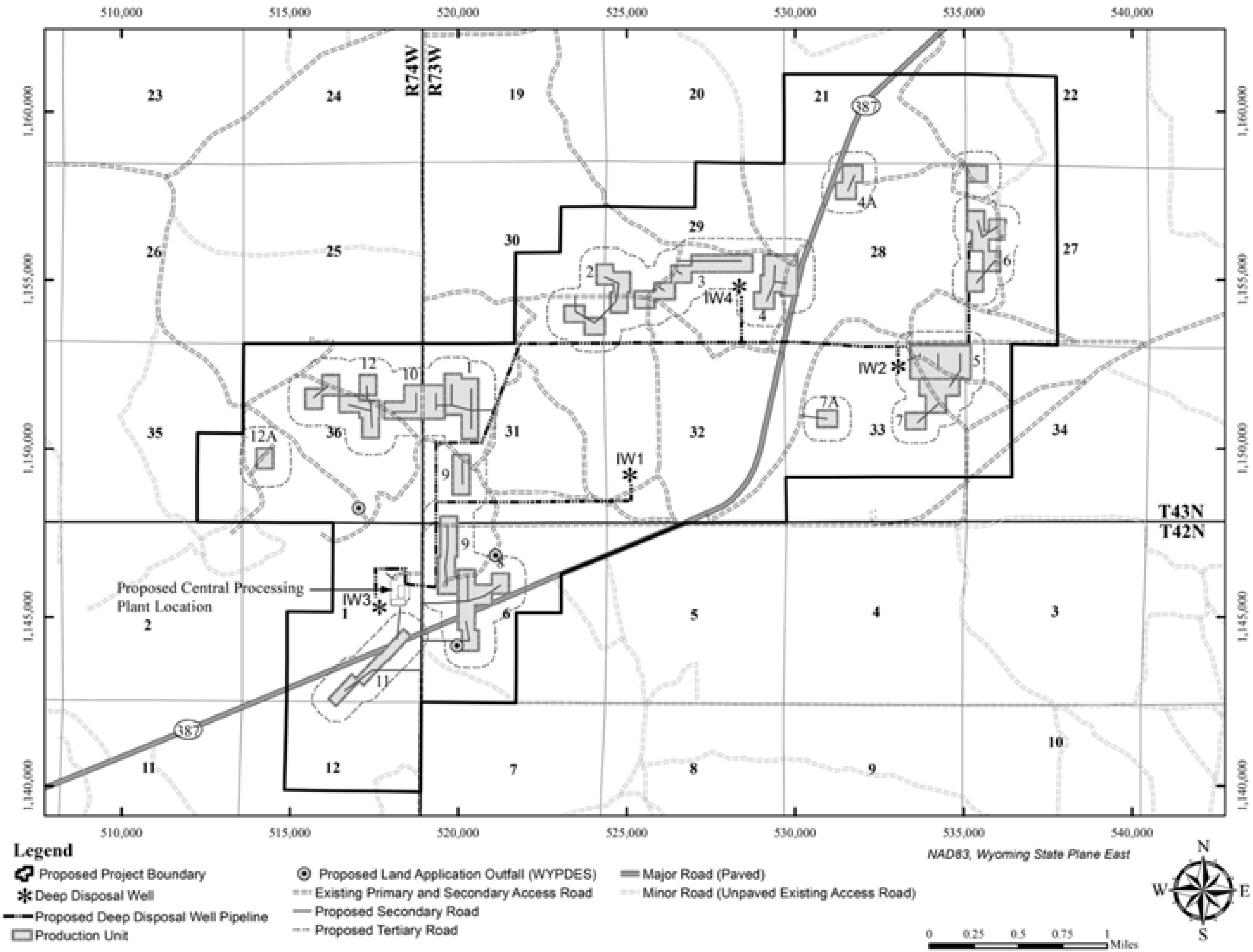

Figure 2-8. Location of Proposed Class I Deep Disposal Wells (AUC, 2016)

Additionally, if a license were granted, the NRC dose limits and waste disposal standards in 10 CFR Part 20, Subparts D and K would apply. The proposed deep disposal well design is shown in SEIS Figure 2-9. In this design, a cemented steel casing extends from the base of the well to the surface; an internal tubing string is fit with the casing; and a packer seals the casing, just above the point of injection. Fluid is injected through the tubing and through the packer and exits into the injection zone by perforations in the casing (see SEIS Figure 2-9). Pressure on the fluid-filled annulus between the tubing and well casing must be continuously maintained and monitored to detect leakage of the injection tubing or well casing. The constant pressure on the annulus would be maintained at a minimum of 14.06 kg/cm^2 [200 pounds per square inch (psi)]. Both the annulus and injection pressure would be monitored to prevent injected waste fluid from migrating into overlying formations. Operational procedures include MIT of the casing to ensure against well leakage and reporting of MIT test results to WDEQ, as described in SEIS Section 2.1.1.1.2.

The proposed facilities for managing liquid byproduct material include a temporary storage tank and surface impoundment (i.e., pond) for backup storage before injection into deep disposal wells. As described in SEIS Section 2.1.1.2.1, this pond would be designed following NRC requirements (NRC, 2003a, 2008; 10 CFR Part 40, Appendix A, Criterion 5). The backup storage pond design for the proposed project would occupy approximately 0.2 ha [0.5 ac] (AUC, 2012a) of land surface and have a storage capacity of 1990 cubic meters (m^3) [525,000 gallons (gal)] (AUC, 2012b).

The applicant proposes to construct two backup storage ponds that would occupy a total of 0.4 ha [1.0 ac]. Based on the design of the backup storage ponds, the applicant may need to acquire the necessary construction approval from EPA to ensure compliance with 40 CFR Part 61, Subpart W. All ponds would be designed to store the amount of water discharged to them while maintaining adequate freeboard (i.e., distance from the water level to the top of the embankment). Grading and control structures, such as collector ditches and berms, would be used to prevent surface runoff for events up to and including a 50-year rainfall event from entering the ponds (AUC, 2012a). The backup storage ponds would be constructed with a lining system consisting of the following: (i) a 0.09 cm [36 mils] high density polyethylene (HDPE) or polypropylene primary liner; (ii) a similar 0.09 cm [36 mils] secondary liner; (iii) foundation material below the secondary liner; (iv) a drainage layer between the primary and secondary high density polyethylene (HDPE) liners; and (v) a leak detection sump and access port system (AUC, 2012b). Ponds would be fenced to restrict and control access. The backup storage pond would be inspected on a daily, weekly, quarterly, and annual basis. Daily inspections would include visual inspections of the piping, liner slopes, other earthwork features, pond freeboard, and any water accumulation in leak detection systems. Weekly inspections would include visual inspection of the entire pond area, including perimeter fencing and inspection reports. Quarterly inspections would include sampling of designated groundwater leak detection wells. Annual inspections would include a survey of the embankment and review of the previous year’s inspection reports. If inspections reveal damage or defects that could result in leakage, this information would be reported to the NRC within 48 hours, and appropriate repairs would be implemented. Significant water found in the standpipes of the leak detection system would be sampled immediately for conductivity, to determine whether the water in the detection system is from the pond. If analysis confirms a leak, the pond would be taken out of service and drained sufficiently to repair the leak within 60 days. Draining would involve transferring contents to a spare pond until repairs are completed. The leak would be reported to the NRC within 48 hours followed by a written report within 30 days. Reporting to the WDEQ would be done in accordance with applicable state requirements and permit conditions.

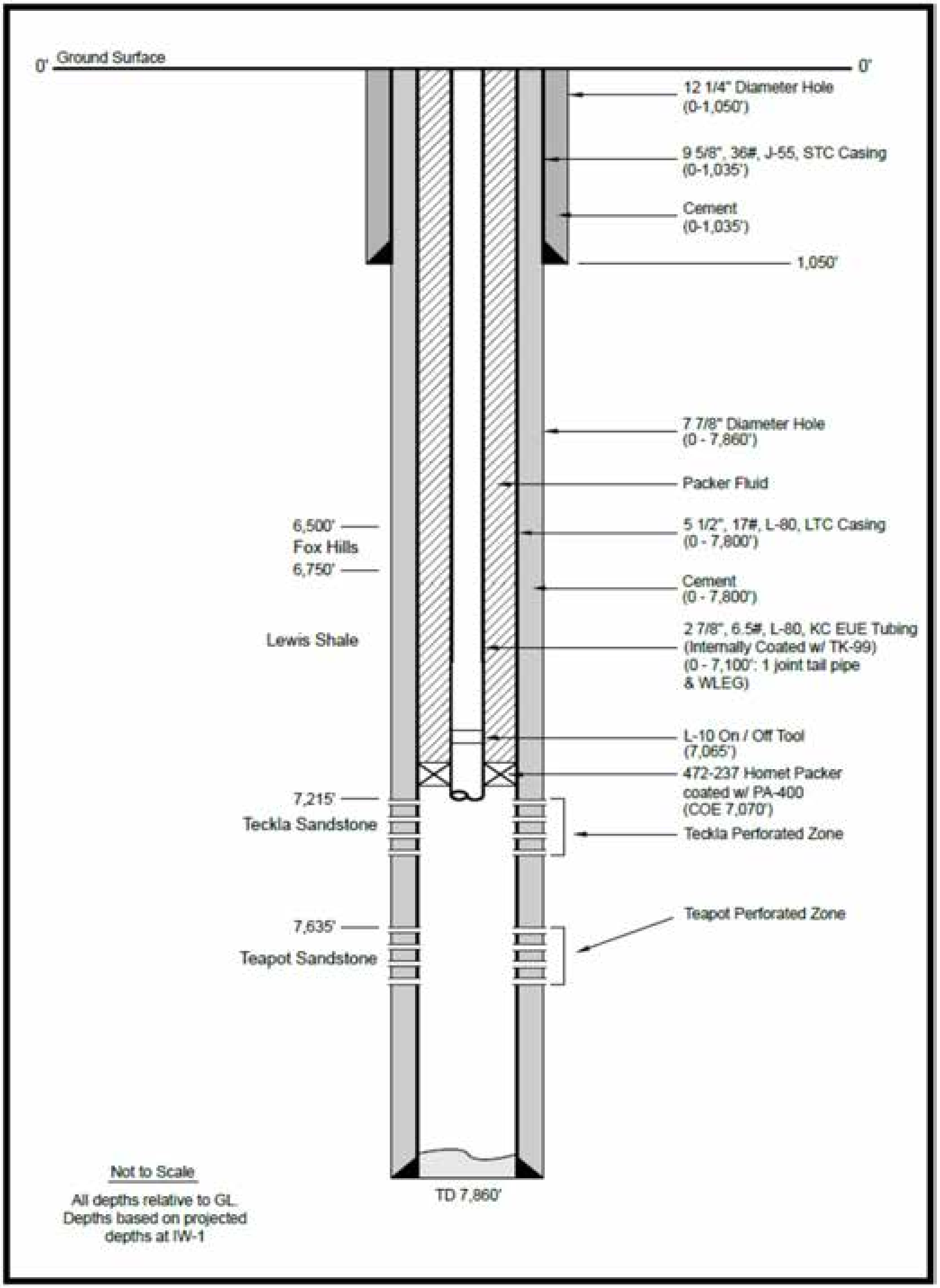

Figure 2-9. Schematic of the Design of Class I Deep Disposal Well (AUC, 2016)

Schedule

Using a phased approach to construction, the applicant estimates that constructing the buildings, initial wellfields, and waste disposal systems for the proposed Reno Creek ISR Project would take approximately 9 years (SEIS Figure 2-1). Wellfields would be developed sequentially, along with supporting infrastructure, including header houses and pipelines. The construction of subsequent wellfields would begin during the operational stage of the initial wellfields in the area.

The applicant estimates that 80 workers would be directly involved in the construction phase of the proposed project (AUC, 2014a). Workers are expected to come from the nearby towns of Wright, Edgerton, or Gillette, Wyoming.

2.1.1.1.3 Operation Activities

As discussed in GEIS Section 2.4, uranium extraction by the ISR process involves two primary operations. First, uranium mobilization occurs in underground aquifers when lixiviant (the leaching solution) is injected into the orebody and uranium-laden solutions are recovered (NRC, 2009). The uranium-laden solutions, referred to as pregnant lixiviant, are then pumped from the production wells into ion-exchange systems within surface facilities, where uranium is recovered and prepared for shipment (NRC, 2009). The applicant proposes to conduct operations at the proposed Reno Creek ISR Project consistent with the description in the GEIS (AUC, 2012a). These activities are further described in the following sections.

Uranium Mobilization

Uranium mobilization would consist of the following steps: (i) injection of lixiviant into the production zone, (ii) oxidation and formation of uranium-bearing aqueous complexes underground, and (iii) extraction (production) and transport of the pregnant lixiviant to the processing facility. The uranium mobilization steps and excursion monitoring of lixiviant are described next.

Lixiviant Chemistry

The applicant proposes to add lixiviant, consisting of varying concentrations of carbon dioxide, sodium carbonate and/or sodium bicarbonate, hydrogen peroxide and/or oxygen to the groundwater acquired from onsite wells to promote the dissolution and mobilization of uranium (AUC, 2012a, b). The oxygen in the lixiviant oxidizes the uranium from the relatively insoluble, reduced tetravalent state (U^{4+}) to the more soluble, oxidized hexavalent state (U^{6+}). The carbon dioxide in the lixiviant provides a source of carbonate and bicarbonate ions that react with the oxidized uranium to form either dissolved uranyl tricarbonate complexes [$UO_2(CO_3)_3^{-4}$] or uranyl dicarbonate complexes [$UO_2(CO_3)_2^{-2}$]. The relative abundance of each dissolved uranyl carbonate complex is a function of pH and total carbonate strength. GEIS Table 2.4-1 summarizes typical lixiviant chemistry (NRC, 2009). As noted in GEIS Section 2.4.1.1, the principal geochemical reactions caused by the lixiviant are (i) oxidation and subsequent dissolution of uranium and other metals from the orebody and (ii) their subsequent extraction (NRC, 2009).

Lixiviant Injection and Production

Lixiviant would be pumped down injection wells to the mineralized zones hosted in sandstones in the Wasatch Formation, where it would oxidize and dissolve uranium from the formations. The uranium-bearing solution would migrate through the pore spaces in the sandstone and would be recovered by production wells. The applicant has estimated that between 91 and 182 production wells and between 152 and 304 injections wells would be installed annually over the 11-year operational life of the proposed project (AUC, 2012a). The applicant estimates maximum pumping rates of 41,640 Lpm [11,000 gpm] (AUC, 2012b). Uranium-enriched pregnant lixiviant would be pumped from production wells to the CPP for uranium extraction by ion-exchange. The resulting barren lixiviant would then be refortified with oxygen and carbon dioxide and reinjected into the wellfield to dissolve additional uranium. This process would continue until further uranium recovery is uneconomical (AUC, 2012a).

Production wells are normally positioned to pump pregnant lixiviant from a number of injection wells. As described in SEIS Section 2.1.1.1.2, square well patterns would be utilized to access all economically recoverable portions of the uranium orebody. As described in GEIS Section 2.4.3, the production wells at an ISR facility extract slightly more water than is reinjected into the host aquifer to create a net inward flow of groundwater into the wellfield, which minimizes the potential movement of lixiviant and its associated contaminants out of the wellfield. This excess water, referred to as production bleed, is liquid byproduct material that must be properly managed (NRC, 2009).

The typical production bleed would be between 0.5 and 1.5 percent and would be adjusted, as necessary, to maintain the wellfield cone of depression (i.e., a net inward flow of groundwater into the wellfield) (AUC, 2012a). Production bleed rates would be controlled by withdrawing a small portion of the barren solution from the ion-exchange circuit, which would then be disposed of via Class I deep well disposal.

Excursion Monitoring

GEIS Section 2.4.1.4 describes how ISR operations potentially affect the groundwater quality near a site if lixiviant moves from the production zone, resulting in either a vertical or lateral excursion (NRC, 2009). The applicant proposes to implement an operational groundwater monitoring program that meets the NRC requirements found in 10 CFR Part 40, Appendix A, Criteria 7 and 7A. This program would be designed to detect and correct any condition that could lead to the unintended spread of lixiviant, either horizontally or vertically outside of the production zone, which could lead to an excursion (AUC, 2012b). As described in GEIS Section 2.4.3, excursions may be caused by improper water balance between injection and production rates, undetected high permeability strata or geological faults, improperly abandoned exploration drill holes, discontinuities within the confining units, poor well integrity, or unintentional disruption (fracturing) of the ore zone or confining units (NRC, 2009). The applicant’s proposed excursion monitoring program includes monitoring (i) flow rates; (ii) operating pressures of injection, production, and monitoring wells; and (iii) the flow rates and operating pressures of the main pipelines leading to and from the CPP.

The applicant proposes to sample the monitoring wells for chloride, conductivity, and total alkalinity. The data would be compared to the UCLs for these constituents (AUC, 2014a). The applicant would establish UCLs after background water quality is established for the monitoring wells in a particular wellfield, as described in SEIS Section 3.5.2. The water level in each monitoring well would also be measured and recorded prior to each sampling event. Water level and analytical monitoring data for the UCL parameters would be retained onsite for NRC review.

An excursion occurs when two or more excursion indicators in a monitoring well exceed their UCLs (NRC, 2003b). If the concentration of two or three excursion indicators exceeds established UCL concentrations during a sampling event, a second sample would be taken within 48 hours after results of the first analysis are received and reviewed (AUC, 2012b). If an excursion is not confirmed by a second sample, a third sample would be taken within 48 hours after the second set of sampling data are received. If the second or third samples produce results where two or more excursion indicators exceed the UCL concentrations, the well producing these results would be placed on excursion status and corrective action would be required. The first sample results would be considered in error if the second and third samples do not confirm the results from the first sample.

If an excursion is detected, the applicant would be required to notify the NRC within 24 hours by telephone or email and in writing within 7 days; corrective actions should begin immediately. Corrective actions would include increasing sampling frequency to weekly, increasing the pumping rates of production wells in the area of the excursion to increase the net bleed, and pumping individual wells to enhance recovery of solutions. If these actions do not retrieve the excursion within 60 days, the applicant would suspend injection of lixiviant into the production zone adjacent to the excursion until the excursion is retrieved and the UCL parameters are no longer exceeded. Within 60 days of a confirmed excursion, the applicant would be required to file a written report to the NRC describing the event and the corrective action taken (NRC, 2003b).

Uranium Processing

Uranium would be recovered from the pregnant lixiviant and processed into yellowcake in a multistep process (NRC, 2009). The steps include (i) loading uranium complexes onto ion-exchange resin; (ii) eluting (recovering) uranium complexes from the resin; and (iii) precipitating, drying, and packaging uranium. SEIS Figure 2-10 shows the general flow of the uranium processing steps for the proposed Reno Creek ISR Project area.

Ion Exchange

Recovery of uranium from the pregnant lixiviant solution would be accomplished via an ion-exchange process. Pregnant lixiviant would be pumped from the wellfields into the ion-exchange columns (total of 22 onsite), which contain uranium specific ion-exchange resin beads (Dowex 21K XLT or equivalent) (AUC, 2012a). As the lixiviant flows through the resin beads, the dissolved uranium complexes in the solution would attach to the resin beads by displacing a chloride ion or bicarbonate ion. The resin would be considered loaded when uranium complexes occupy most of the available sites on the resin beads. The proposed ion-exchange systems are designed to operate in pressurized downflow mode. The barren lixiviant leaving the ion-exchange system would normally contain less than 2 mg/L [2 ppm] uranium (NRC, 2009).

After the barren lixiviant leaves the ion-exchange vessels, the production bleed would be removed and routed to the liquid waste system for Class I deep well disposal. Carbon dioxide

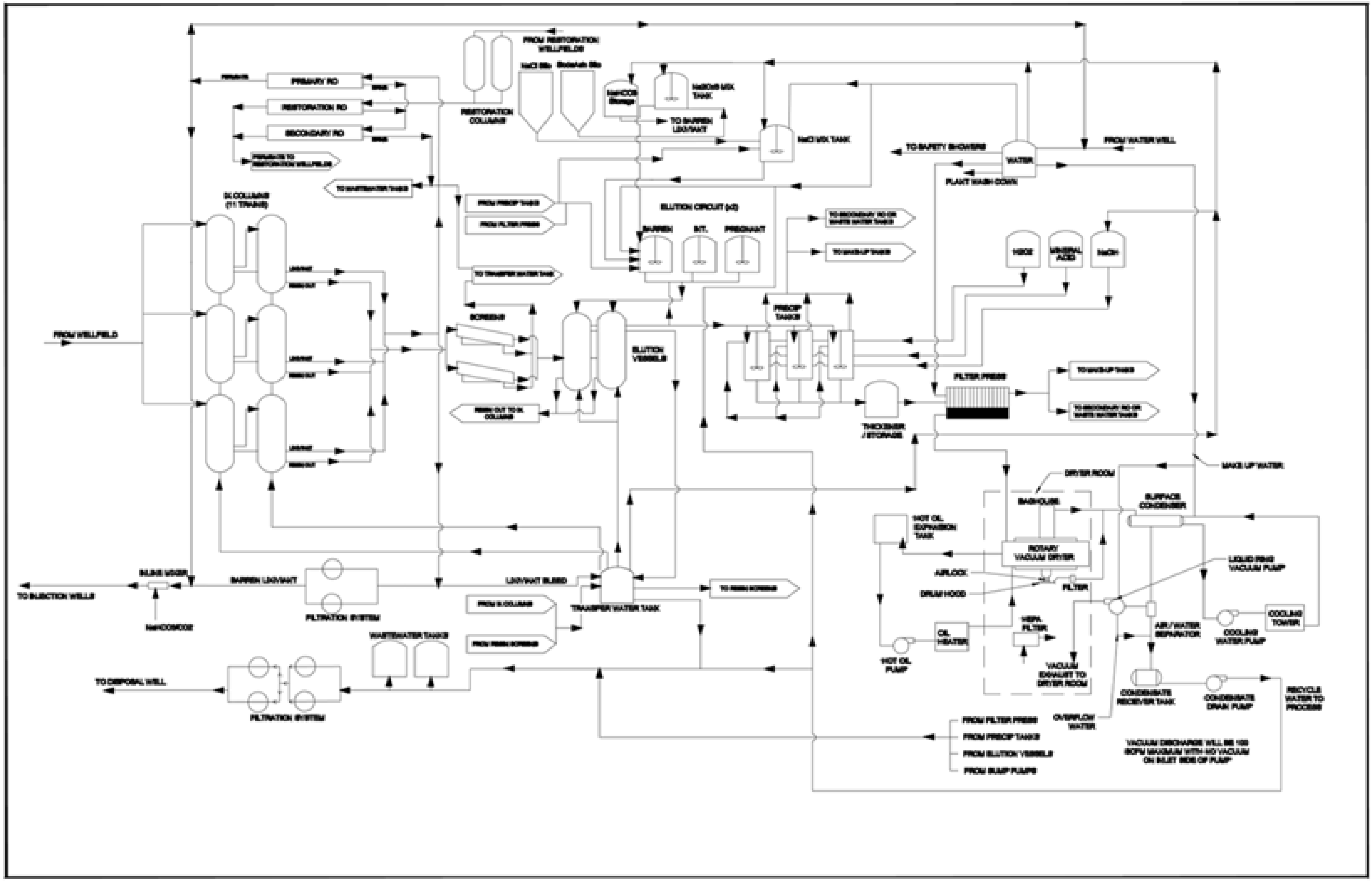

Figure 2-10. Proposed Reno Creek ISR Project – Conceptual Flow Diagram (AUC, 2012b)

would then be added to the barren lixiviant to return the carbonate/bicarbonate concentration to the desired level. The lixiviant solution would then be pumped back to the wellfield, where oxygen would be added prior to reinjection into the wellfields to repeat the leaching cycle.

Elution

GEIS Section 2.4.2.2 describes the elution circuit at ISR facilities (NRC, 2009). At the proposed Reno Creek ISR Project CPP, resin transfer out of the ion-exchange vessels into the elution circuit would be accomplished via resin-transfer piping. The resin would be hydraulically removed from the compartments and screened for debris and other particulates before transfer into the elution vessels.

An elution process removes the uranyl dicarbonate and uranyl tricarbonate ions from the resin and restores the resin to its chloride form for reuse. Fresh eluant would be prepared by combining saturated chloride (salt) solution and saturated sodium carbonate (soda ash) solution with water, forming a solution that is approximately 10 percent sodium chloride and 2 percent sodium carbonate. The elution process involves recycling eluant passing through the resin elution vessel to maximize the removal of uranium from the uranium-loaded resins. The applicant estimates the proposed process would remove a considerable percentage of the uranyl carbonate complexes from the resin (AUC, 2012b).

Precipitation, Drying, and Packaging

GEIS Section 2.4.2.3 describes precipitation, drying, and packaging at ISR facilities (NRC, 2009). The proposed precipitation and drying process at the proposed Reno Creek ISR Project central plant uses rich eluate, which has been transferred from the rich eluate tank to a precipitation tank (SEIS Figure 2-10). Precipitation and drying would be initiated by adding sulfuric or hydrochloric acid to the rich eluate in the precipitation tank to break down the carbonate portion of the dissolved uranyl carbonate complex. The proposed process uses hydrogen peroxide to precipitate out the uranium as uranium peroxide (UO_4). Next, sodium hydroxide is added to adjust the pH before the precipitated uranyl peroxide or yellowcake slurry settles. After settling, the yellowcake slurry is pumped to a gravity thickener (GEIS Figure 2.1–10). The thickened slurry is pumped to a filter press to remove excess water. The yellowcake slurry is washed with fresh water to remove impurities, especially chloride, and air dried to further reduce the moisture content.

After air drying is complete, the next step of the proposed process moves the filtered yellowcake slurry to a rotary vacuum dryer housed in a separate room of the central plant. The dryer would be operated under a vacuum to reduce the ability of water-soluble uranium oxides and other compounds to form and to pull solids and water vapor toward the center of the system, which helps to prevent unwanted releases. Vapor is pulled from the dryers by sealed liquid ring vacuum pumps and filtered through baghouse filters located on the tops of the dryers; this removes particles larger than 1 micron [3.9×10^{-5} in] in size. The vapor exiting the baghouses would be cooled using condensers to remove water vapor and any remaining smaller sized particulates. Any water in the condensers would be collected and pumped to the solids removal tank in the wastewater system.

Following the drying stage, the yellowcake would be packaged in approved 208-liter (L) [55-gal] steel drums and stored within a restricted storage area until shipment offsite (AUC, 2012b).

Packaged yellowcake would be shipped offsite via truck to licensed uranium conversion facilities for further processing. Conversion facilities are currently located in Metropolis, Illinois, and Port Hope, Ontario, Canada. The applicant projects a maximum annual production of 907,185 kg/year (yr) [2 million lb/yr] of yellowcake (as U_3O_8) over the 11-year projected operational life of the proposed Reno Creek ISR Project (AUC, 2012a).

Management of Production Bleed and Water Balance

As stated in GEIS Section 2.4.3, uranium mobilization would produce excess water that must be properly managed (NRC, 2009). The production wells at any ISR facility extract slightly more water than is reinjected into the host aquifer, which creates a net inward flow of groundwater into the wellfield. This excess water, referred to as production bleed, is liquid byproduct material that must be properly managed. At the proposed Reno Creek ISR Project, the applicant proposes to use the process described in SEIS Section 2.1.1.1.3. As part of normal operations, the production bleed is diverted from the ion-exchange circuit after the uranium is recovered, but before the lixiviant is recharged.

The applicant estimates that, at full production, wellfields in the proposed Reno Creek ISR area would operate at an average production flow rate of 41,640 Lpm [11,000 gpm] (AUC, 2012b). The production bleed would be approximately 0.5 to 1.5 percent with an average bleed rate of 1.0 percent of the production flow rate, or approximately 416 Lpm [110 gpm] (AUC, 2012b). The bleed rate would be adjusted as necessary to maintain the wellfield cone of depression. The applicant proposes to treat the production bleed using a single stage of reverse osmosis (RO) followed by reinjection of the treated water back to the production aquifer while directing a portion of the treated water to CPP processes (AUC, 2012b). The applicant proposes to dispose of the resulting concentrated wastewater (i.e., RO brine) as liquid byproduct material in Class I deep disposal wells.

Other liquid waste streams, including spent elution circuit bleed, liquids from process drains, groundwater generated during aquifer restoration, and washdown water, would be produced as part of the proposed Reno Creek ISR Project and these waste streams would be handled as liquid byproduct material in the same manner as the production bleed.

Schedule

The applicant currently plans to develop 15 wellfields (SEIS Figure 2-1). The applicant anticipates that production activities in the initial wellfields would commence 9 to 12 months after construction begins (SEIS Figure 2-1). Wellfield operations would continue for 11 years as additional wellfields are completed along the uranium roll front deposits. The applicant estimated that 92 workers would be directly involved in the operations phase of the proposed Reno Creek ISR Project (AUC, 2014a).

2.1.1.1.4 Aquifer Restoration Activities

GEIS Section 2.5 described aquifer restoration activities within wellfields that ensure water quality in surrounding aquifers would not be adversely affected by the uranium recovery operations (NRC, 2009). At the end of the uranium recovery process, constituents that were mobilized by the lixiviant remain in the production aquifer. The primary goal of aquifer restoration is to return groundwater quality within the production zone of wellfields to the preoperational water quality conditions or to standards consistent with NRC requirements at

10 CFR Part 40, Appendix A, Criterion 5B(5) (AUC, 2012a). Groundwater quality in the exempted ore-bearing aquifer is to be restored, in accordance with 10 CFR Part 40, Appendix A, Criterion 5B(5), to (i) a Commission-approved background (CAB) concentration; (ii) the maximum contaminant levels (MCLs) listed in 10 CFR Part 40, Appendix A, Table 5C, for constituents listed in Table 5C and if the background level of the constituents fall below the listed value; or (iii) an alternate concentration limit (ACL) established by the Commission, if the constituent background level and the values listed in Table 5C are not reasonably achievable. The ACL development is described in SEIS Appendix B. These groundwater quality standards would be implemented, as part of the aquifer restoration phase, to ensure public health and safety. The applicant would also be required to provide financial sureties to cover the costs of both planned and delayed restoration programs, in accordance with 10 CFR Part 40, Appendix A, Criterion 9. The NRC reviews financial sureties annually.

Under the Federal UIC program (40 CFR Parts 144 and 146), the exempted production aquifer(s) would no longer be protected under the SDWA as a source of drinking water. The UIC criteria for the exemption of an aquifer that might otherwise be defined as a USDW are found at 40 CFR Part 146.4. These criteria include whether the aquifer is currently a USDW, whether the water quality is such that it would be economically or technologically impractical to use the water to supply a public water system, and whether the aquifer contains minerals that are expected to be commercially producible. An aquifer exemption is identified and requested by WDEQ and approved by EPA. Wyoming's rules for in situ mining require that the exempted aquifer be restored to its pre-mining class of use after the operations are complete (WDEQ, 2013b). This requirement is more stringent than EPA's rules, which only require that groundwater protection standards be met at the aquifer-exemption boundary (i.e., contaminants cannot migrate from an exempted aquifer to the surrounding USDW).

Before beginning wellfield operations, the applicant must determine background water quality by sampling and analyzing water quality indicator constituents in the mineralized zone(s) and underlying and overlying aquifers where present across each wellfield (AUC, 2012b). The applicant would establish target restoration goals [CAB concentrations per 10 CFR Part 40, Appendix A, Criterion 5B(5)] as a function of the average background water quality and the variability in each parameter, based on statistical methods (AUC, 2012b). SEIS Section 3.5.2.2 describes these background water quality parameters and methods to be used to establish groundwater restoration targets for the proposed Reno Creek ISR Project.

An excursion at a monitoring well is declared when the concentrations of certain indicator parameters exceed UCLs established by the license and verified by the State and NRC. The purpose of the monitoring well ring is to ensure that groundwater quality in aquifers outside exempted zones is not impacted by ISR operations. Background water quality samples obtained from monitoring wells placed in the ore-bearing aquifers, as well as the underlying and overlying aquifers (where present), would be used to define excursion parameters and UCLs. UCLs must be established before ISR operations begin because they are used to control and manage any excursions that may occur during the ISR operations and restoration phases. Groundwater monitoring for selected constituents, throughout the life of the proposed project, is discussed in SEIS Sections 7.2.5 and 7.3.1.

Groundwater Restoration Methods

The applicant proposes a phased approach to groundwater restoration, and it is anticipated that two to three production units would be in various stages of active restoration or stability monitoring at one time (AUC, 2012b). The active groundwater restoration phase would include the following methods: (i) groundwater transfer, (ii) groundwater sweep (targeted or selective), and (iii) RO treatment with permeate injection and reductant addition.

The applicant intends to combine these methods selectively to improve groundwater restoration efficiency, reduce consumptive use of groundwater, and decrease the time to restore a given production unit. This can be accomplished because the applicant would install the infrastructure necessary to accomplish groundwater restoration concurrently with uranium recovery operations. To ensure that a production unit would be able to begin groundwater restoration, additional restoration pipelines would be installed along with production pipelines, as necessary. The pumps used for production would remain in the wells for use in restoration.

In order to maximize the volume of treated water (i.e., permeate) and minimize brine (liquid byproduct material) production, the applicant would use two stages of RO treatment (primary and secondary, as needed). The applicant estimates applying a second stage of RO would reduce the brine quantity by an additional 40 to 50 percent compared to a single-phase RO system (AUC, 2012b). Additionally, the interference from groundwater restoration with ongoing uranium recovery operations would be kept to a minimum by maximizing the quantity of permeate reinjected into wellfields undergoing RO treatment. The restoration circuit would be designed to handle the anticipated flow of about 3,979 Lpm [1,050 gpm]. The RO system would consist of two units in series. The first RO unit would produce approximately 75 to 80 percent of the flow as high-quality permeate and 20 to 25 percent of the flow as a concentrated brine solution. Concentrated brine would then be pumped to the secondary RO unit, which would produce approximately 60 percent permeate and 40 percent brine. Additional feed water to the secondary RO unit may include brine from the production RO unit, CPP process waste water, and groundwater sweep fluids. Permeate from each of the RO units would be combined and would be injected into the wellfields undergoing active groundwater restoration. The resultant brine from this treatment would be injected into the Class I deep disposal wells. For concurrent production and aquifer restoration activities, the applicant estimates the maximum liquid byproduct material flow rate to the Class I deep disposal wells would be 545 Lpm [144 gal/min] (AUC, 2012b).

The applicant has indicated that they may decide not to employ the groundwater sweep stage at some production units. Based on the NRC staff's review of the applicant's water balance (AUC, 2012b), this would eliminate 189 Lpm [50 gpm] of feed water to the restoration circuit and would result in a decrease of wastewater produced at the secondary RO unit by 64 Lpm [20 gpm]. The resultant wastewater flow rates from the secondary RO unit to the Class I deep disposal wells would be approximately 488 Lpm [122 gpm] for concurrent production and groundwater restoration.

Restoration Monitoring and Stabilization

During aquifer restoration, lixiviant injection stops and groundwater transfer, sweep, and/or treatment are used to attempt to restore the production aquifer groundwater quality to original background levels. Stopping lixiviant injection reduces the potential for an excursion and reduces the frequency of sampling the monitoring wells. The applicant's restoration monitoring program for the proposed project would include taking samples from monitoring wells and overlying aquifer wells every 60 days during the restoration phase of operations (AUC, 2012b). The restoration target monitoring well samples would be analyzed to determine whether water quality has been restored, consistent with 10 CFR Part 40, Appendix A, Criterion 5B(5). Water levels in wells would be measured prior to sampling. If unforeseen conditions, such as snowstorms, flooding, or equipment malfunctions, make monitoring impossible for 65 days, the applicant would be required to report this condition to the NRC. The applicant would maintain hydraulic control of each wellfield through the end of aquifer restoration. Verification of hydraulic control would be performed through water level measurements in perimeter monitoring wells (AUC, 2012b). Aquifer restoration would be complete when the applicant demonstrates that water quality conditions have been restored in accordance with 10 CFR Part 40, Appendix A, Criterion 5B(5) requirements. These standards are either CAB water quality; water quality equivalent to the MCLs provided in the table in 10 CFR Part 40, Appendix A, Criterion 5C; or an ACL the NRC established in accordance with Criterion 5B(6). The NRC process for reviewing and approving ACLs is found in SEIS Appendix B.

After the NRC concluded the production wellfield area was restored, the applicant would implement a groundwater stability monitoring program for a minimum of 12 months. The results of the monitoring program would determine whether the approved standards for each constituent have been met and whether any adjacent nonexempt aquifers are affected. Over the 12-month minimum stability monitoring period, there would be an initial sampling event at the beginning of the stability monitoring period. Subsequent sampling events are described in detail below:

- Perimeter monitoring wells in the production zone and monitoring wells in the overlying and underlying aquifers would continue to be sampled once every 60 days for the UCL indicator excursion parameters of chloride, total alkalinity, and conductivity. The applicant would contact NRC if any of the wells could not be monitored within 65 days of the last sampling event due to unforeseen conditions, such as snowstorms, flooding, or equipment malfunctions.

- Quarterly, the production zone wells would be sampled and analyzed for the water quality parameters listed in SEIS Table 7-1. The criteria to establish successful stability are as follows: for each sampling event, the mean concentration of each water quality parameter must meet the target restoration goal established for that parameter. If the analytical results from the stability monitoring program meet the target restoration goals and do not exhibit significant increasing trends, the applicant would (i) submit supporting documentation to the NRC showing that the restoration parameters have remained at or below the restoration standards and (ii) request that the wellfield be declared restored.

Schedule

The applicant anticipates that restoration of the first wellfields would commence in year 6 and continue until year 14 or 15. As additional wellfields are brought into production, the applicant would restore each wellfield as soon as reasonably practicable following production. The applicant estimates that 52 workers would be directly involved in aquifer restoration activities. Most workers would come from Wright, Edgerton, and Gillette, Wyoming (AUC, 2014a).

2.1.1.1.5 Decontamination, Decommissioning, and Reclamation Activities

Decommissioning of the proposed Reno Creek ISR Project would require an NRC-approved decommissioning plan. All decommissioning activities would be carried out in accordance with 10 CFR Part 40 and other applicable regulatory standards. GEIS Section 2.6 (NRC, 2009) describes the general processes for the decontamination, decommissioning, and reclamation of an ISR facility. NRC regulations require a licensee to submit a detailed decommissioning plan for NRC review and approval at least 12 months before final decommissioning is planned. The decommissioning plan for the proposed Reno Creek ISR Project would include the necessary plans for proposed project closure, including all decommissioning and surface reclamation activities. The NRC evaluates a proposed decommissioning plan, and if approved, the plan becomes an amendment to the license. Only after receiving NRC approval of a plan may a licensee initiate the decommissioning process. Unless the Commission approves an alternative schedule for completion of decommissioning, pursuant to 10 CFR 40.42(i), the licensee would be required by 10 CFR 40.42(h)(1) to complete decommissioning as soon as practicable but no later than 2 years after approval of the decommissioning plan.

Before the property is released for unrestricted use, the licensee would conduct a comprehensive radiation survey to establish that the levels of various constituents are within limits identified in 10 CFR Part 40, Appendix A (AUC, 2012b). The goal of decontamination, decommissioning, and reclamation activities would be to return disturbed lands to unrestricted use, consistent with preoperational conditions or expected post-operations use. To achieve this goal, the applicant would (i) plug and abandon wells; (ii) establish appropriate cleanup criteria for structures; (iii) survey soils and structures to identify residual contamination, (iv) decontaminate items to be released for unrestricted use; (v) remove contaminated equipment and materials for disposal at a licensed facility; (vi) perform final status surveys to verify cleanup of soils; and (vii) reclaim disturbed lands, including reapplication of stockpiled soils and revegetation of disturbed areas, in accordance with WDEQ regulations and permits (AUC, 2012b).

Radiological Surveys and Contamination Control

After completing aquifer restoration of each production unit, the applicant proposes, in accordance with an NRC-approved decommissioning plan, to conduct radiological surveys of the proposed Reno Creek ISR Project area to identify any areas that contain solid byproduct material that exceed the applicable regulatory limits at 10 CFR Part 40, Appendix A, Criterion 6(6) (AUC, 2012b). The NRC would require decommissioning surveys of soils, structures, and equipment. The results of these surveys would be used to determine whether decontamination or remediation is needed and how to disposition contaminated soils, structures, or other materials.

The applicant has committed to remediating land areas, as necessary, to meet the limit at 10 CFR Part 40, Appendix A, Criterion 6(6) (AUC, 2012b). The most likely areas of contaminated soils would be wellfield surfaces, process building areas, storage yards, transportation routes for uranium recovery products or contaminated materials, and pipeline runs. Areas near deep Class I disposal wells would also be surveyed and decontaminated, as necessary. NRC would review and approve survey and sampling results. Soils that contain byproduct material in excess of the NRC limit would be removed and disposed, as solid byproduct material, at a licensed disposal facility. Pond liners and leak detection systems that have come in contact with solid or liquid byproduct material are designated as byproduct material and would be removed and disposed of in a licensed disposal facility. The applicant has the option to decontaminate these components and survey them for unrestricted release, but this is not the anticipated practice due to cost.

Wellfields

Wellfield decommissioning and surface reclamation would be initiated when NRC determines that the groundwater in a wellfield has been adequately restored and that the water quality is stable (NRC, 2009). Decontamination and decommissioning of wellfields would include abandoning wells; removing piping, tanks, ancillary buildings, and equipment; remediating surface soils, as necessary, to meet the radiological standards provided in 10 CFR Part 40, Appendix A, Criterion 6; and revegetating disturbed areas (AUC, 2012b). To prevent adverse impacts to groundwater quality, all production, injection, and monitoring wells, as well as all drill holes, would be abandoned in place, according to WDEQ regulations (WDEQ, 2013b), unless a well is needed for continued monitoring of another production unit, or retention of the well for future use has been requested and approved (AUC, 2012b). Well abandonment would require plugging wells with a WDEQ-approved cement mixture or bentonite and cement grout mixture (AUC, 2012b). Prior to abandonment, wells would be opened to remove debris and equipment (e.g., tubing, pumps, and screens) to prevent obstacles from interfering with plugging operations. The wellhead casing would be removed to a minimum depth of 0.6 m [2 ft] below the ground surface (AUC, 2012b) and set in a cement plug on each well or borehole that is plugged and abandoned (AUC, 2012b).

Wellfield reclamation would involve removing surface and subsurface equipment, including injection and production feed lines, header houses, electrical and control distribution systems, well boxes, wellhead equipment, and buried piping. NRC decommissioning guidelines require surveying all piping, equipment, buildings, and wellhead machinery for contamination prior to release. Some reusable equipment may be moved to new production wellfield areas. When the final production wellfield area is reclaimed, all contaminated piping, wellheads, and associated equipment that is not salvageable would be removed to an NRC-approved disposal facility. A final gamma survey of the proposed project area would identify contaminated earthen materials requiring removal (AUC, 2012b). As final steps, the wellfield surface would be recontoured, where necessary, and revegetated (AUC, 2012b).

Process Buildings and Equipment and Other Structures

After groundwater is restored in all production wellfield areas, the CPP and ancillary facilities would be decommissioned in accordance with an NRC-approved decommissioning plan. All processing equipment associated with the CPP would be dismantled and either sold to another NRC-licensed facility or decontaminated in accordance with NRC regulations and guidance documents. Facilities and equipment that cannot be decontaminated would be disposed of at an NRC-approved facility. Decontaminated facilities and equipment would be reused, sold, or removed and disposed of offsite. After the dismantling and removal of buildings is completed, the former building sites would be contoured to blend in with the surrounding terrain. Gamma surveys of land areas supplemented by lab analysis for radium-226 and natural uranium for areas with elevated survey readings would be conducted to verify that radiation levels are within acceptable limits (AUC, 2012b).

Engineered Structures and Access Roads

After final decontamination and decommissioning of the proposed project area is complete, proposed project area access and wellfield access roads would be reclaimed (AUC, 2012a). If landowners prefer, roads may be left in place for their private use, if approved by the WDEQ. Where the access roads are reclaimed, they would be ripped as necessary to relieve compaction, and gravel would be removed from road surfaces. Culverts would also be removed, and premining drainage patterns would be reestablished. In addition to being graded, all roads and ditches would be recontoured to blend in with the surrounding terrain; topsoil would be reapplied uniformly onto road surfaces prior to revegetation.

Final Contouring and Revegetation

Once the proposed Reno Creek ISR Project is complete, the applicant proposes to return all disturbed lands to their preproduction uses for livestock grazing and as wildlife habitat. Disturbed lands would be restored to blend with the contour of adjoining topography. Topsoil removed and stored during construction would be reapplied during reclamation. Revegetation of the proposed project area is the final state of reclamation and would involve seeding the area with a seed mixture, based on discussions with the WDEQ and area landowners (AUC, 2012a). The success of revegetation would be evaluated based on WDEQ (WDEQ, 2014). The WDEQ would determine when revegetation is complete and when the conditions for bond release have been met (AUC, 2012a).

Schedule

The applicant estimates that decommissioning of the CPP would take 1 year to complete (AUC, 2012b) (SEIS Figure 2-1). There would be some overlap between wellfield decommissioning and the groundwater restoration activities, as shown in SEIS Figure 2-1. Wellfield decommissioning is proposed to continue for 10 years and proceed sequentially as production and restoration activities are completed in each wellfield. The applicant estimates that 90 workers would be directly involved in the reclamation and decommissioning phases of the proposed project (AUC, 2012a). The applicant expects that the majority of these workers would come from towns such as Gillette and Casper, which are located 66 km [41 mi] and 100 km [63 mi], respectively, from the proposed project area (AUC, 2012a).

2.1.1.1.6 Effluents and Waste Management

All phases of the proposed project (i.e., construction, operations, aquifer restoration, and decommissioning) would generate effluents and waste streams that must be handled and disposed of properly. This section describes the types and volumes of effluents or wastes the applicant estimates would be generated during the life of the proposed Reno Creek ISR Project, and definitions of the liquid and solid wastes that would be generated. The proposed disposal option and locations for liquid and solid wastes are described in SEIS Section 3.13. The potential impacts of generating and disposing of these types of waste are detailed in SEIS Section 4.14. Nonradiological air quality and air emission impacts are described in SEIS Sections 3.7 and 4.7, and potential radiological air emission impacts are discussed in SEIS Section 4.13. Transportation of waste materials for offsite disposal is described in SEIS Section 2.1.1.1.7. Regional transportation conditions are found in SEIS Section 3.3, and the potential impacts on transportation are detailed in SEIS Section 4.3.

Gaseous or Airborne Particulate Emissions

Gaseous or airborne particulate emissions generated during the life of the proposed Reno Creek ISR Project would primarily consist of fugitive dusts, combustion engine exhaust, radon gas emissions from various stages of the processing system, and uranium particulate emissions from yellowcake drying (AUC, 2012a). Radiological and nonradiological emissions are discussed separately. Appendix C of this SEIS and the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a,b) include additional details concerning nonradiological air emissions for the proposed project, including the air emission inventory and air dispersion modeling.

Nonradiological Emissions

Nonradiological emissions are classified into two main categories: (i) fugitive dust and (ii) combustion emissions. Combustion emissions are further categorized into nongreenhouse gases and greenhouse gases. Nonradiological emissions are presented for each project phase (some of which would occur simultaneously), as well as for the peak year, which represents the highest amount of emissions the proposed project would generate in any one project year.

For the proposed Reno Creek ISR Project, all four phases are active, though not at 100 percent, during the peak year. For the proposed project, year six serves as the peak year. SEIS Appendix C, Section C–3.1.4 provides additional information concerning the peak year concentrations. The construction phase is categorized into CPP (i.e., facilities) construction and wellfield construction. Facilities construction is completed in project year one, with the exception of the drilling of the deep injection wells, which are used for liquid waste disposal. Activities for drilling the deep disposal wells and the associated emissions are evenly divided between project years one and two. Wellfield construction occurs during project years one through nine. The air emission inventory presented in this section of the SEIS incorporates mitigation, as further described in SEIS Section 4.7 and in Appendix C, Section C–3.1.6.

The primary fugitive dust emission sources would be from vehicular travel on unpaved roads and wind erosion on disturbed land. SEIS Table 2-1 presents the estimated annual mass flow rate (i.e., the amount of pollutant generated in a year) for fugitive dust associated with the proposed project. Vehicles contributing to the onsite fugitive dust estimates presented in SEIS Table 2-1 include construction equipment, drilling equipment, trucks transporting materials and product, and commuter traffic. The amount of travel on unpaved roads (i.e., activity level), and, therefore, the amount of fugitive dust generated, varies over the lifespan of the project. The amount of fugitive emissions from wind erosion is a function of the amount of disturbed land. The estimated annual wind erosion levels do not vary much over the span of the project. The values in SEIS Table 2-1 for the individual phases represent the 100 percent activity level for that phase. The peak year value in SEIS Table 2-1 includes contributions from construction–wellfield, operations, groundwater restoration, decommissioning/reclamation, and wind erosion.

Combustion emissions primarily come from mobile sources, although stationary sources would contribute some emissions. Mobile sources, as presented in SEIS Table 2-2, include construction equipment, drilling equipment, trucks transporting materials and product, and commuter traffic. The number of hours the mobile sources are active varies over the lifespan of the project; therefore, the amount of combustion emissions also varies. The values in SEIS Table 2-2 for the individual phases represent the 100 percent activity level for that phase. For purposes of this SEIS, point or stationary source emissions would be limited to the equipment identified in SEIS Table 2-3 and are assumed to be constant over the project life span, except for project year one, which produces the lowest levels of stationary emissions.

The NRC staff has determined that any emissions from bulk storage facilities would be negligible. The WDEQ requires bin vents for solids storage tanks and scrubbers for acid

Table 2-1. Estimated Mass Flow Rates (Metric Tons* Per Year) for Fugitive Dust Associated With the Proposed Project			
Category		**Particulate Matter PM[‡] $_{2.5}$**	**Particulate Matter PM_{10}**
Phase[†]	Construction – Facilities	2.10	19.05
	Construction – Wellfield	9.18	89.49
	Operation	1.83	16.22
	Groundwater Restoration	2.17	18.45
	Decommissioning/Reclamation	3.44	34.36
Peak Year[§]		10.48	102.17

Source: Modified from AUC (2014a, b)
*To convert metric tons to short tons, multiply by 1.10231
[†]The values for the individual phases represent emission levels from dust generated from travel on unpaved roads associated with a 100 percent activity level for that phase and include contributions from dust generated from travel on unpaved roads and wind erosion from disturbed lands.
[‡]PM = Particulate matter. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller..
[§]Peak year includes contributions from Construction – Wellfield, Operations, Groundwater Restoration, Decommissioning/Reclamation, and Wind Erosion. The individual phases were not active at the 100 percent activity level during the peak year. Therefore, the peak year values are not the same as the total for the phases at the 100 percent activity level.

Table 2-2. Estimated Mass Flow Rates (Metric Tons* Per Year) for Various Pollutants From Mobile Source Combustion Emissions Associated With the Proposed Project						
	Construction					
Pollutant	**Facilities**	**Wellfield**	**Operation**	**Groundwater Restoration**	**Decommissioning Reclamation**	**Peak Year[†]**
Carbon Monoxide	7.56	35.17	3.14	1.47	2.68	38.32
Hazardous Air Pollutants	0.29	1.44	0.24	0.11	0.19	1.68
Nitrogen Oxides	7.93	34.52	4.87	2.00	5.03	39.39
Particulate Matter PM[‡] $_{2.5}$	0.46	1.99	0.28	0.12	0.31	2.27
Particulate Matter PM_{10}	0.47	2.05	0.29	0.12	0.32	2.34
Sulfur Dioxide	1.22	5.46	0.71	0.34	0.63	6.17
Total Hydrocarbons	2.19	18.70	5.41	2.58	3.62	24.09

Source: Modified from AUC (2014a,b)
*To convert metric tons to short tons, multiply by 1.10231
[†]Peak year includes contributions from construction – wellfield, operations, groundwater restoration, and decommissioning/reclamation. The individual phases were not active at the 100 percent activity level during the peak year. The values in this table for the individual phases do represent the 100 percent activity level. Therefore, the peak year values are not the same as the total for the phases at the 100 percent activity level.
[‡]PM = Particulate matter. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.

Table 2-3. Estimated Peak Year Emission Mass Flow Rates (Metric Tons* Per Year) for Various National Ambient Air Quality Standard Pollutants From All Sources for the Proposed Project				
Pollutant	**Fugitive Dust Sources**	**Mobile Emission Sources**	**Stationary Emission Sources**	**Peak Year**
Carbon Monoxide	0	38.32	0.73	39.04
Nitrogen Oxides	0	39.39	1.26	40.65
Particulate Matter $PM^{\dagger}_{2.5}$	10.48	2.27	0.06	12.81
Particulate Matter PM_{10}	102.17	2.34	0.06	104.57
Sulfur Dioxide	0	6.17	0.00‡	6.17

Source: Modified from AUC (2014a, b)
*To convert metric tons to short tons, multiply by 1.10231
†PM = Particulate matter. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.
‡This emission value of 0.00 metric tons per year means that emissions were below this level but does not necessarily mean that none of the pollutant was emitted.

vapors. Fuel tank emissions are on the order of kilograms [pounds] per year (AUC, 2014a). Emissions from bulk storage facilities are not included in the emission inventory tables.

The air impact analysis in SEIS Section 4.7 includes atmospheric dispersion modeling system (AERMOD) dispersion modeling, which was used to predict National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) pollutant concentrations.

The NAAQS and PSD-allowable increments are described in SEIS Section 3.7.2. SEIS Table 4-9 presents the AERMOD modeling results with respect to the NAAQS, while SEIS Table 4-10 presents the results with respect to the PSD-allowable increments. The peak year emission estimates were used as input for the AERMOD modeling, since this represents the highest amount of emissions for a single project year, which corresponds to the highest impact on air quality. SEIS Table 2-3 contains the peak year estimates, which combines the emissions from the fugitive (SEIS Table 2-1), mobile (SEIS Table 2-2), and stationary sources (SEIS Table 2-4). Some of these sources do not operate continuously and do not generate emissions at a constant rate over an entire year. To provide a more accurate depiction of short-term impacts (i.e., 1-hour, 3-hour, or 24-hour time periods), the Reno Creek AERMOD analysis utilized relevant hourly emission rates for sources that do not operate continuously. Appendix B of the Ambient Air Quality Modeling Protocol and Results (AUC, 2014b) provides the details concerning the emission rates associated with the AERMOD modeling. The values in SEIS Table 2-3 reveal that certain source categories generate the majority of emissions for certain pollutants. Appendix C of the applicant's ER identifies the contribution (i.e., percent) of the various source categories to the various pollutants for the peak year. For example, fugitive dust sources generate 81.8 percent of the proposed project's $PM_{2.5}$ emissions and 97.7 percent of the PM_{10} emissions. The mobile combustion emission sources generate the majority of carbon dioxide (98.1 percent), nitrogen dioxide (96.9 percent), and sulfur dioxide (100 percent) emissions. The highest level of emissions that the stationary sources contribute to any single pollutant is for nitrogen oxide at 3.1 percent.

The air quality analysis in SEIS Section 4.7 examines air impacts by individual phases, in addition to the peak year. Pollutant concentrations for individual phases were not directly modeled in AERMOD. Instead, the individual phase pollutant concentrations were calculated from the peak year pollutant concentrations that were directly modeled in AERMOD. This

Table 2-4. Estimated Mass Flow Rates* (Metric Tons† per Year) for Various Pollutants From Stationary Source Combustion Emissions Associated With the Proposed Project‡

Pollutant	Stationary Emission Source				Total
	Vacuum Dryers	Main Heater	Furnace	Radiant Heaters	
Carbon Monoxide	0.35	0.20	0.02	0.16	0.73
Hazardous Air Pollutants	0.00	0.00	0.00	0.00	0.00
Nitrogen Oxides	0.61	0.34	0.03	0.27	1.26
Particulate Matter PM§ $_{2.5}$	0.04	0.02	0.00	0.02	0.06
Particulate Matter PM_{10}	0.04	0.02	0.00	0.02	0.06
Sulfur Dioxide	0.00	0.00	0.00	0.00	0.00
Total Organic Compounds	0.05	0.03	0.00	0.02	0.10
Volatile Organic Compounds	0.00	0.00	0.00	0.00	0.00

Source: Modified from AUC (2014a,b)
* Mass flow rates of 0.00 metric tons per year in this table mean that emissions were below this level, but does not necessarily mean that none of the pollutant was emitted.
†To convert metric tons to short tons, multiply by 1.10231
‡Except for project year one, stationary emission are assumed to be constant over the project lifespan.
§PM = Particulate matter. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.

calculation was based on the relative amount of emissions from the peak year compared to the 100 percent activity emission level for each phase. SEIS Appendix C Section C–3.1 provides additional information regarding these calculations.

Combustion exhaust estimates for greenhouse gas emissions fall into three source categories. The first category consists of facility sources, which are further categorized into stationary sources and facility fugitive emissions from the uranium recovery process. The second category consists of mobile sources, as previously discussed. The third category consists of indirect emissions from electricity consumption (i.e., emissions associated with the production of the electricity that the proposed project consumes). SEIS Table 2-5 presents the carbon dioxide gas emission estimates for the proposed project for the peak year. Stationary source emissions are assumed to be constant over the project life span, except for project year one, which produces the lowest levels of stationary emissions. Facility fugitive emissions from the uranium recovery process occur during the operations phase when relatively small amounts of carbon dioxide are released when acidifying pregnant eluate prior to precipitation of uranyl peroxide. These fugitive emission estimates are based on process assumptions and production rates. The value in SEIS Table 2-5 presents the estimated carbon dioxide emissions from the uranium recovery process for the maximum production rate of 907,185 kg [2,000,000 lb] of yellowcake (AUC, 2012a). Annual carbon dioxide emissions from mobile sources range from 491 to 4,063 metric tons [541 to 4,479 short tons]. The indirect emissions from electricity consumption also vary based on activity levels.

Table 2-5. Estimated Amount (Metric Tons*) of Carbon Dioxide† Emissions for the Peak Year From All Sources	
Source	**Mass (Metric Tons) of Carbon Dioxide Emitted in Peak Year**
Mobile	4,063
Stationary – Combustion Emissions	1,208
Stationary – Uranium Recovery Process	685
Electricity Consumption	35,763
Peak Year Total	41,719

Source: Source: Modified from AUC (2014a,b)
*To convert metric tons to short tons, multiply by 1.10231
†All sources are expressed in carbon dioxide except for electricity consumption, which is expressed in carbon dioxide equivalents.

The value in SEIS Table 2-5 presents the maximum annual estimated indirect emissions associated with the proposed project. Carbon dioxide constitutes the majority of greenhouse gas emissions. Some methane and nitrous oxide emissions would occur. Chlorofluorocarbon and hydrochlorofluorocarbon greenhouse gas emissions are not expected from the proposed project. The Ambient Air Quality Modeling Protocol and Results (AUC, 2014b) present additional details concerning the greenhouse gas emission estimates. SEIS Appendix C Section C–2.2 provides a brief summary of the Clean Air Act permitting program. The applicant has submitted the air quality permit application to WDEQ and approval is pending (see Table 1-2). Information concerning the relationship between the WDEQ regulatory determination and the NRC's SEIS analyses is provided in SEIS Section 4.7.1 and SEIS Appendix C, Section C–2.1.

Radiological Emissions

Radon gas emissions are most likely to occur during the operations and aquifer restoration stages of the proposed project, as detailed in SEIS Section 4.13. Radon releases may occur in the wellfield when the pregnant lixiviant is brought to the surface from the ore zone aquifer. Radon gas release could also occur when the downflow ion-exchange columns are taken offline for resin transfer and opened to the atmosphere. Radon gas would disperse quickly into the air. The use of general area and local ventilation systems would control radon buildup within the onsite facilities (AUC, 2012b). General area ventilation would involve a combination of forced air and natural ventilation of work areas in process buildings. Local ventilation for process vessels, where radon releases are more likely, would involve ducting or piping radon from the point of release through fans that exhaust to the outside, where the radon would disperse quickly into the air (AUC, 2012b).

The magnitude of project-wide radon gas emissions during the proposed Reno Creek ISR Project would vary each year of the proposed schedule, depending on the degree of radon-emitting processing activities that would occur at any point in time. Considering the applicant's breakdown of estimated radon gas releases for a single production unit operating at full capacity, the NRC staff determined the proposed facility lifecycle phase contributions are 0.004 percent from construction, 72 percent from operations, and 28 percent from aquifer restoration. Therefore, the highest estimated annual radon gas emissions would occur in the year when the most production units are simultaneously operating. The applicant estimated a maximum annual release of 28.6 TBq [772 curies] of radon gas in year nine of the proposed Reno Creek ISR Project (AUC, 2014), considering the proposed operations schedule showing concurrent radon-generating activities (SEIS Figure 2-1), the size of operating production units, the percentage of the total production unit that is operating, and the process-specific maximum annual radon gas release rates. The applicant calculated the potential dose impacts from radon releases from all concurrent radon-generating activities for each proposed year of operations using the MILDOS code. Dose estimates were calculated for 16 compass directions and 5 receptors within 10 km [6.2 mi] of the CPP (AUC, 2012b). The applicant's dose calculations are discussed further and compared with applicable NRC regulatory limits in the impact analysis in SEIS Section 4.13.

An additional potential source for airborne particulate emissions is the yellowcake dryer, which would be located at the proposed central plant. The applicant proposes to use vacuum dryer technology for yellowcake drying operations at the CPP (AUC, 2012b). NUREG–1569 (NRC, 2003a) provides guidance for evaluating air emissions at in situ leach (ISL) facilities (referred to in this document as ISR facilities), and indicates that dust emissions produced in the drying stage are negligible when a vacuum dryer is used to dry yellowcake. A vacuum dryer utilizes a heat source contained in a separate, isolated system, which ensures that no radioactive materials are trapped in the heating system or the exhaust it generates, as detailed in NUREG/CR–6733 (Mackin et al., 2001). The applicant's proposed dryer contains a drying chamber where yellowcake slurry is added and is subjected to vacuum pressure (AUC, 2012b, 2014a). The dryer would retain all yellowcake dusts that could be produced during loading and unloading operations. The proposed dryer is designed so that moisture from the yellowcake is the only source of vapor in the system. Vapor exiting the dryer is filtered through a baghouse filter above the dryer, which removes particulates down to a size of approximately 1 micron [3.9×10^{-5} in]. Vapor exiting the baghouse filter is then cooled using a condenser to remove water vapor and remaining small particulates (AUC, 2012b, 2014a). Water from the condenser would be collected and recycled back to the process. The overhead baghouse system collects dust in the baghouse filter and returns it to the drying chamber. While dryer system stack monitoring would not be conducted, based on the effectiveness of controls already included in the proposed vacuum dryer technology, the applicant proposes routine in-plant air monitoring with sample collection and analysis on a monthly basis, as described in Regulatory Guide 8.25 (AUC, 2012a, b). Monitoring results must be submitted to the NRC in semiannual reports. Additionally, the dryer system would be instrumented to operate automatically and to shut down if malfunctions such as heating or vacuum system failures occur (AUC, 2012b).

Liquid Wastes

The applicant expects to generate liquid wastes during all phases of uranium recovery at the proposed Reno Creek ISR Project. These wastes include drilling fluid, well development and well test waters, stormwater runoff, waste petroleum products and chemicals, sanitary wastewater, production bleed, process solutions and laboratory chemicals, plant washdown water, and restoration water. Process solutions include process bleed, elution and precipitation brines, resin transfer wash, and filter backwash water. The NRC classifies wastewater generated during or after the uranium extraction phase of the proposed project operations as byproduct material; however, stormwater runoff, domestic sewage, waste petroleum, and hazardous waste are not byproduct material. Byproduct material does not meet the definition of solid waste in 40 CFR 261.4(a)(4) and, therefore, is not regulated as hazardous waste under RCRA regulations.

Liquid byproduct material generated by the proposed Reno Creek ISR Project would contain chemical and radiological constituents, including uranium and radium. Detailed information on expected wastewater constituents and estimated concentrations are provided in license application documentation (AUC, 2012b, 2014b).

> These terms define the various types of solid and liquid wastes generated at the Reno Creek ISR Project:
>
> **Liquid wastes**
>
> Liquid byproduct material: All liquid wastes resulting from the proposed action, except for sanitary wastewater and well development and testing wastewater
>
> Sanitary wastewater: Ordinary sanitary septic system wastewater; this wastewater is not hazardous waste and not byproduct material wastewater
>
> Well development and testing wastewaters: Wastewater produced during well development and pumping tests; this water is not hazardous waste or byproduct material and would not require treatment before disposal
>
> **Solid wastes**
>
> Solid byproduct material: All solid wastes resulting from the proposed action that satisfy the 10 CFR 40.4 definition of byproduct material
>
> Nonhazardous solid waste: Solid waste that is not hazardous waste, including domestic or municipal wastes (trash), construction/demolition debris, septic solids, and radioactive facilities and equipment resulting from the proposed action that meet the criteria for unrestricted release specified in the NRC license (NRC, 1993)
>
> Hazardous waste: RCRA or state-defined hazardous waste that is not byproduct material, and includes universal hazardous wastes

The applicant proposed Class I deep disposal wells for managing liquid byproduct material. As described in SEIS Chapter 1, the proposed waste management option requires the applicant to obtain all applicable federal and State of Wyoming permits, in addition to an NRC license, before it operates the facility. Alternative wastewater disposal options are described in SEIS Section 2.1.1.2. However, the applicant did not propose using these alternative options.

The applicant's proposed Class I deep disposal wells involves drilling wells at the proposed project area to dispose of liquid byproduct material. A typical deep disposal well design is shown in SEIS Figure 2-9. The applicant has been authorized by the WDEQ to drill, complete, and operate four Class I deep disposal wells, and thereby inject radionuclide-bearing liquid waste streams into the Cretaceous-age Teckla Sandstone member of the Lewis Formation and Teapot Sandstone of the Mesaverde Formation (WDEQ, 2015a). The permitted Class I deep disposal well discharge zones vary in depth between 2,130 and 2,400 m [7,000 and 7,860 ft] below the ground surface (WDEQ, 2015a). The Class I deep disposal well design and construction must meet WDEQ requirements (WDEQ, 2015b) and applicable permit conditions (WDEQ, 2015a). The WDEQ permit prohibits injection of any material defined as hazardous waste, as defined by EPA RCRA regulations in 40 CFR 261.3 or Wyoming regulations (WDEQ, 2013a). Additionally, if an NRC license was granted, the NRC would require compliance with the NRC dose limits and waste disposal standards in 10 CFR Part 20, Subparts D and K.

The applicant has proposed to manage liquid byproduct material by Class I deep disposal wells using a system of treatment, storage, and injection into the wells. During the production and aquifer restoration phases, the applicant proposes to manage liquid byproduct material by treating the wastewater streams by ion exchange and RO and reusing the treated water in the CPP during production or reinjecting the treated water back into the aquifer undergoing restoration (see SEIS Section 2.1.1.1.4). During the production phase, the applicant would then combine the contaminants removed by RO with lower volume operational wastewater streams and then transfer the combined wastewater to the Class I deep disposal wells for final disposal. During the aquifer restoration phase, the applicant proposes an additional round of RO to further concentrate the aquifer restoration RO brines (and any production brines produced during the period when production overlaps with aquifer restoration) prior to disposal of the brines in the Class I deep disposal wells. The additional treated water produced by the second round of RO would be injected back into the aquifer undergoing restoration. The applicant's Class I deep disposal well monitoring program includes monitoring of injection pressure at the wellhead, the fluid-filled annulus pressure between the casing and injection tubing string, and injection zone pressure.

The applicant has committed to monitoring air particulate, radon, surface soil, sediment, vegetation, surface water, and groundwater to identify the presence of NRC- and WDEQ-regulated constituents. Monitoring results must be reported to the NRC semiannually (see SEIS Chapter 7). As part of the decommissioning phase, the NRC would require radiological surveys of potentially affected areas to ensure that the soil concentration limits in 10 CFR Part 40, Appendix A, Criterion 6-(6) are met. If soil concentration limits are exceeded, the NRC would require the removal of contaminated materials, which could add to the total amount of material for disposal at a licensed facility. In addition, the applicant proposes to dispose of any pond liners and solids accumulated in backup storage ponds as solid byproduct material (AUC, 2012a), as described in SEIS Section 2.1.1.1.6.

The amount of liquid byproduct material produced by the proposed project varies by ISR lifecycle phase, disposal option, and aquifer restoration method. The applicant estimated the maximum flow of liquid byproduct material produced at any time by considering concurrent uranium recovery operations and aquifer restoration activities. For disposal in the proposed Class I deep disposal wells, the applicant's maximum calculated after-treatment liquid byproduct material production is 545 Lpm [144 gal/min] (AUC, 2012b).

The applicant proposes to dispose of sanitary wastewater from restrooms and lunchrooms into onsite septic systems. The applicant would be required to obtain a UIC Class V permit from the WDEQ to construct the onsite septic systems (AUC, 2012b, Table 10-1). The applicant also proposes to collect and route stormwater for discharge to surface water (AUC, 2012a). The applicant would be required to obtain a Wyoming Pollutant Discharge Elimination System (WYPDES) permit to discharge stormwater to surface water from the State of Wyoming. The applicant would dispose of drilling fluids in mud pits adjacent to drilling pads and anticipates obtaining WDEQ WYPDES permits to surface discharge well development water (AUC, 2012a) from constructed wellfields. The permit would require reporting of flow, pH, radium-226 (Ra-226), uranium, total dissolved solids, and total suspended solids to the WDEQ (AUC, 2012b).

Solid Wastes

As described in GEIS Section 2.7.3, all phases of the operational lifecycle of an ISR facility generate solid wastes (NRC, 2009). Solid byproduct material includes spent resin, empty chemical containers and packaging, pipes and fittings, tank or storage pond sediments, contaminated soil from leaks and spills, and contaminated construction and demolition debris. Nonhazardous solid waste includes septic solids, municipal solid waste (general trash), and other solid wastes. Solid hazardous waste includes waste oil, cleaning solvents, expired laboratory reagents, used batteries, and light bulbs.

Solid byproduct material that does not meet the NRC criteria for unrestricted release must be disposed of at a licensed disposal site, in accordance with the requirements of 10 CFR Part 40, Appendix A, Criterion 2. The applicant estimates that the proposed Reno Creek ISR Project facility would produce 76 m^3 [100 yd^3] of solid byproduct material annually. Assuming an

11-year operational period, the NRC staff calculated total solid byproduct material accumulation from the proposed operations as 842 m^3 [1,100 yd^3]. The applicant plans to store this waste temporarily onsite. The applicant proposes to transport solid byproduct material offsite to a licensed facility for disposal in accordance with U.S. Department of Transportation (USDOT) requirements using shipment capacities of approximately 15 m^3 [20 yd^3] (AUC, 2012a). Using this solid byproduct material generation and shipment capacity information for both disposal options, the NRC staff estimated that five shipments of operational solid byproduct material would occur per year.

The applicant estimated the total amount of solid byproduct material that would be generated from decommissioning activities is 3,060 m^3 [4,000 yd^3](AUC, 2012a). This estimate applies to removal of structures and equipment that include fluid trunk lines, pipelines, well piping and equipment, buildings, constructed ponds, pond liners, plant equipment, ion-exchange resin, affected soils, and disposal wells. The applicant anticipates that decommissioning of facilities would take 1 year (AUC, 2012a); therefore, the annual solid byproduct waste generation estimate for decommissioning is the same as the total reported above. At the time of application, the applicant does not have an agreement in place with a licensed site to accept its solid byproduct material for disposal. If an NRC license is granted, an NRC license condition would require the applicant to have a solid byproduct material disposal agreement in place before operations begin. The applicant has evaluated the following facilities as potential sites for disposal of solid byproduct material: (i) the Pathfinder Mines Corporation Facility in Shirley Basin, Wyoming; (ii) the White Mesa site in Blanding, Utah; and (iii) the EnergySolutions site in Clive, Utah. These byproduct material disposal sites are detailed in SEIS Section 3.13. SEIS Section 4.14 describes the impacts of solid byproduct material disposal.

During all phases of the proposed project, the applicant expects to produce nonhazardous solid waste. This waste could be composed of municipal waste (facility trash), septic solids, and other materials, such as construction debris, uncontaminated equipment and demolition debris, hardware, and packing materials. The applicant proposes to collect nonhazardous solid waste at designated onsite areas and dispose of this material at the Campbell County landfill in Gillette, Wyoming, or another permitted nonhazardous solid waste facility, if additional capacity is needed (AUC, 2012a, 2014a). SEIS Section 3.13 provides additional descriptions of the local solid waste facilities. The applicant estimates that the proposed project would generate approximately 1,590 m^3 [2,080 yd^3] of nonhazardous solid waste annually during the construction phase {AUC, 2012a, Table 4-13 [40 yd^3/week (wk) × 52 wk/yr]}. During the operational period, the applicant estimates that less than 1,190 m^3 [1,560 yd^3] of nonhazardous solid waste would be generated annually {AUC, 2012a, Table 4-13 [30 yd^3/wk × 52 wk/yr]}. The applicant estimated the total amount of nonhazardous solid waste that would be generated during the proposed one-year decommissioning period as 1,530 m^3 [2,000 yd^3]. The applicant's nonhazardous solid waste estimates for decommissioning include plant building materials and equipment and wellfield equipment that do not contain radioactive materials or that meet NRC limits for unrestricted release.

The applicant's proposal describes the hazardous waste that would be generated as waste oil, cleaning solvents, expired laboratory reagents, fluorescent light bulbs, and used batteries (AUC, 2012b, Table 4-13). The applicant estimated that the proposed Reno Creek ISR Project would generate a sufficiently small quantity of hazardous waste that would allow classification as a Conditionally Exempt Small Quantity Generator (CESQG) under RCRA and Wyoming regulations (AUC, 2012a). A CESQG must (i) determine whether its waste is hazardous; (ii) not generate more than 100 kg [220 lb] per month of hazardous waste or, except with regard to spills, more than 1 kg [2.2 lb] of acutely hazardous waste; (iii) not accumulate more than 1,000 kg [2,205 lb] of hazardous waste onsite at any time; and (iv) treat or dispose of its hazardous waste in a treatment storage or disposal facility that meets the requirements specified in 40 CFR 261.5. If the facility fails to meet any of these four criteria, it would lose CESQG status. Without CESQG classification, it would be fully regulated as either (i) a small-quantity generator of more than 100 kg [220 lb], but less than 1,000 kg [2,205 lb] of nonacute hazardous waste per calendar month, or (ii) a large-quantity generator of 1,000 kg [2,205 lb] or more of nonacute hazardous waste per calendar month. Any hazardous waste generated by the proposed project must be disposed of in accordance with applicable local, state, and federal regulatory requirements.

2.1.1.1.7 Transportation

The applicant would use trucks to transport construction equipment and materials, operational processing supplies, yellowcake product, and waste materials. The applicant has committed to complying with all applicable USDOT and NRC packaging and transportation requirements for shipments of hazardous chemicals and radioactive materials (AUC, 2012a). During all phases of the facility lifecycle, both temporary and permanent workers would commute to and from the facility and generate additional traffic on local roads. In addition, shipments of nonhazardous solid wastes and hazardous wastes would originate at the proposed project area for disposal at licensed disposal facilities during all phases of the facility lifecycle. The applicant estimates that two trips per week to the Campbell County municipal landfill would be required to dispose of nonhazardous solid wastes generated at the proposed project area (AUC, 2012a). The applicant estimates that one trip per month to a hazardous disposal or recycling facility would be necessary to dispose of solid and liquid hazardous wastes generated at the proposed project area (AUC, 2012a).

The applicant would use trucks to ship the supplies and equipment to be used to construct facilities and production units at the proposed project area. As stated previously, the applicant proposes phased development of production units. After the processing facilities are constructed, the remaining production unit construction activities and associated transportation would occur over a number of years (SEIS Figure 2-1). During the construction period, the applicant estimated 27 commuting round-trips per day by workers, based on a commitment to implement a carpooling policy (AUC, 2014a). In addition, the applicant estimated that two commercial vehicles would travel to and from the proposed project area daily during the construction period to deliver and pickup supplies and equipment (AUC, 2014a). The applicant's estimate of construction-related traffic is presented in SEIS Table 2-6.

During operations, the applicant estimated 30 commuting round-trips per day by workers, based on implementation of a carpooling policy and two vehicle round-trips per day for delivery and pickup of packages and office supplies (AUC, 2014a). In addition, the applicant estimated truck traffic associated with shipments of process chemicals and fuels, yellowcake, and waste products during ISR operations (AUC, 2012a). The estimates of operations truck traffic are provided in SEIS Table 2-6 and discussed next.

Proposed process chemical and fuel shipments to the Reno Creek ISR facility include sodium chloride (NaCl), sodium carbonate ($NaCO_3$), sodium hydroxide (NaOH), hydrochloric acid (HCl), sulfuric acid (H_2SO_4), hydrogen peroxide (H_2O_2), carbon dioxide (CO_2), oxygen (O_2), diesel fuel, gasoline, and bottled gases (AUC, 2012a).

Table 2-6. Estimated Daily Vehicle Round-Trips for the Proposed Reno Creek ISR* Project	
ISR Phase and Transportation Purpose	**Average Daily Vehicle Round-Trips**
Construction	
Employee Commuting	27
Equipment and Supplies	2
Nonhazardous Waste Shipments	0.4
Hazardous Waste Shipments	0.05
Operations	
Employee Commuting	30
Delivery and Pickup	2
Processing Chemical Shipments	3.3
Fuel Shipments	1
Yellowcake Shipments	0.2
Solid Byproduct Material Shipments	0.02
Nonhazardous Waste Shipments	0.4
Hazardous Waste Shipments	0.05
Aquifer Restoration	
Employee Commuting	16
Delivery and Pickup	2
Solid Byproduct Material Shipments	0.02
Nonhazardous Waste Shipments	0.4
Hazardous Waste Shipments	0.05
Decommissioning	
Employee Commuting	6
Delivery and Pickup	2
Solid Byproduct Material Shipments	0.38 to 0.77
Nonhazardous Waste Shipments	0.4
Hazardous Waste Shipments	0.05

Source: AUC, 2012a, 2014a
*ISR = In Situ Recovery

The applicant estimates that chemical shipments would total approximately 1,217 per year or an average of 3.3 shipments per day (AUC, 2012a). The applicant estimates that during operations approximately one shipment of fuel (diesel, gasoline, and propane) would be transported to the proposed project area each day.

The CPP would be designed to process up to 0.9 million kg [2 million lb] of U_3O_8 (yellowcake) per year (AUC, 2012a). The applicant proposes to ship yellowcake product from the CPP to a conversion facility located in Metropolis, Illinois (AUC, 2012a). The estimated shipment distance from the proposed project area to Metropolis, Illinois is approximately 2,027 km [1,260 mi] (AUC, 2012a). The applicant proposes loading yellowcake into sealed 210-L [55-gal] drums and shipping by certified carrier. Based on the proposed production rate of 0.9 million kg [2 million lb] of yellowcake per year, the applicant estimates that approximately one yellowcake shipment per week would occur (AUC, 2012a).

Shipments of solid byproduct waste material would originate at the proposed project area for disposal at licensed disposal facilities during plant operations. The applicant estimates that 76 m^3 [100 yd^3] of solid byproduct materials would be generated per year (AUC, 2012a). Using

15.3-m^3 [20-yd^3] roll-off bins, approximately five shipments per year would be made to licensed disposal facilities.

During the aquifer restoration phase, the applicant estimated 16 round-trips by workers commuting daily based on implementation of a carpooling policy (AUC, 2014a). In addition, the applicant estimated that two vehicles would travel to and from the proposed project area daily for commercial delivery and pickup (AUC, 2014a). Solid byproduct material shipments are estimated to remain unchanged (five shipments per year) during aquifer restoration. The applicant's estimate of aquifer restoration-related traffic is presented in SEIS Table 2-6.

During the decommissioning phase, the applicant proposes to decommission and dismantle structures and equipment and to reclaim land surfaces. The applicant estimated six round-trips by commuting workers would occur daily, based on implementation of a carpooling policy (AUC, 2014a). The applicant also estimated two vehicle round-trips per day for commercial delivery and pickup (AUC, 2014a). The applicant expects that waste materials, which would include solid byproduct material (e.g., contaminated facilities and equipment, pond liners, and excavated soils), nonradiological and nonhazardous solid waste, and hazardous solid waste, would be shipped offsite to licensed disposal facilities. The applicant estimates that the frequency of solid byproduct material shipments would increase during decommissioning to between 100 and 200 shipments per year. Nonhazardous solid waste shipments are estimated to remain unchanged (two trips per week) during decommissioning. Hazardous waste shipments are also expected to remain unchanged (one trip per month) during decommissioning. The applicant's estimate of decommissioning-related traffic is presented in SEIS Table 2-6.

2.1.1.1.8 Financial Surety

The NRC regulations at 10 CFR Part 40, Appendix A, Criterion (9) require applicants to assure that sufficient funds would be available to carry out decommissioning; reclamation of disturbed areas; waste disposal; dismantling and disposal of all facilities, including buildings and wellfields; and groundwater restoration by independent third parties (NRC, 2009). The NRC regulations require the applicant to establish financial surety arrangements to cover such costs before operations begin at the proposed Reno Creek ISR Project. The applicant must also maintain these surety arrangements until the NRC determines that the applicant has complied with its reclamation plan.

WDEQ has primacy for the proposed Reno Creek ISR Project area and would calculate the surety bond for the portions of the proposed project area over which it has jurisdiction, including facility decommissioning of the CPP, process and retention ponds, radioactive and byproduct storage facilities, wellfields, groundwater restoration, radiological surveys, and environmental monitoring. WDEQ would have a separate bond covering the plugging and abandonment of injection wells.

The surety bond for the proposed Reno Creek ISR Project would be independently calculated by the NRC. The NRC requires annual revisions to the applicant's surety bond as proposed project area conditions change over the project life and to ensure that funds are available for decommissioning of existing and planned operations and existing and planned construction. The NRC reviews financial surety arrangements and decommissioning plans in detail as part of its review for the safety evaluation report. For additional information on financial surety requirements, see 10 CFR Part 40, Appendix A, Criterion (9), and GEIS Section 2.10.

2.1.1.2 *Additional Liquid Waste Disposal Options*

Liquid byproduct material is expected to be generated during the operations and aquifer restoration phases of the proposed Reno Creek ISR Project. The applicant is required to manage and dispose of liquid byproduct material, in compliance with applicable state and federal regulations, as established by license and permit. SEIS Section 2.1.1.1.6.2 describes the characteristics and quantities of the proposed liquid byproduct material streams and the proposed approach to dispose of this material using Class I deep disposal wells. Although the applicant has been authorized by the WDEQ to drill, complete, and operate four Class I deep disposal wells (SEIS Section 2.1.1.1.6) (WDEQ, 2015a), the aquifer exemption that is also necessary to operate the Class I deep disposal wells is pending.

Historically, ISR facilities have also used evaporation ponds (NRC, 2015a), land application (NRC, 2015b), and discharge to surface waters (NRC, 2009; NRC, 1998a) to manage and dispose of liquid byproduct material. The following subsections describe these alternative wastewater disposal options that were previously described in the GEIS. SEIS Table 2-7 compares the characteristics of the proposed Class I deep disposal well option with several additional wastewater disposal options (NRC, 2009). Potential environmental impacts of the waste management options are analyzed in SEIS Section 4.14.

2.1.1.2.1 *Class V Disposal Well*

With a Class V disposal well, the techniques employed for disposing of liquid byproduct material would be similar to using a Class I deep disposal well, as described previously in SEIS Section 2.1.1.1.6. The primary differences would be the nature of the permit (WDEQ, 2015c), the need for additional wastewater treatment, and possibly the depth of the well. For disposal using a Class V well, the effluent would have to meet WDEQ regulations that prohibit injection of any material defined as hazardous waste (WDEQ, 2013a) or as radioactive waste pursuant to EPA UIC regulations at 40 CFR 144.3. Additionally, the effluent would be limited to the class of use standards for the receiver (WDEQ, 2015b) or any primary drinking water standard found in 40 CFR Part 141 (as of June 6, 2001), whichever is more stringent (WDEQ, 2015a). A Class V permit may require an applicant to implement a monitoring plan to ensure that the injected material would be confined to the authorized injection zone (WDEQ, 2015c). The effluent would also have to meet NRC dose limits, waste disposal standards, and effluent limits in 10 CFR Part 20, Subparts D and K and Appendix B. For these reasons, an applicant would need to treat the wastewater. Similar to surface water discharge and land application (see SEIS Section 2.1.1.2.3), the liquid wastewater would be treated using a combination of methods including ion-exchange, RO, and possibly radium-settling to decrease the levels of uranium, radium, and other contaminants in the wastewater. The land disturbance footprint, therefore, would be greater than for the proposed Class I deep disposal well that would not require treatment facilities, but less than needed for evaporation ponds (see SEIS Section 2.1.1.2.2) or land application (both would require additional impoundments, and land application would need irrigation areas). Furthermore, treatment facilities would generate additional solid byproduct material that would require disposal at a licensed facility, and the applicant would need to decommission the additional contaminated storage facilities (tanks, impoundments) or radium-settling basins and sludges when these operations end (NRC, 2003a). A Class V well could also be used to dispose of RO permeate (treated wastewater) to reduce the volume of wastewater injected in a Class I deep disposal well and therefore reduce the consumptive use of groundwater.

Table 2-7. Comparison of Other Liquid Wastewater Disposal Options With the Proposed Class I Deep Disposal Well

	Proposed Class I Deep Disposal Well	Class V Disposal Well	Evaporation Ponds	Land Application	Discharge to Surface Waters
Land Size/ Footprint	2.0 hectares (ha) [5.0 acres (ac)] Applicant estimate of surface area occupied or restricted from other use by four wells (1 ac/well) and backup storage pond (0.5 ac) (AUC, 2012a).	28 ha [69 ac] Land area of 28 ha [69 ac] or more may be needed for radium-settling basins, storage ponds, and backup ponds, based on scaling Dewey–Burdock impoundment surface disturbance (NRC, 2014b, Table 4.2-1) by a factor of 2.1 to account for the increase in Reno Creek liquid byproduct material.	40.5 ha [100 ac] Individual pond: 0.4 to 2.5 ha [1 to 6.25 ac], max 16.2 ha [40 ac] Pond system: about 40 ha [100 ac]	1,010 ha [2,495 ac] Land area of 894 ha [2,209 ac] for application areas and an additional 116 ha [286 ac] for associated impoundment systems, including radium-settling basins, storage ponds, and backup ponds, based on scaling Dewey–Burdock impoundment surface disturbance (NRC, 2014b, Table 4.2-1) by a factor of 2.1 to account for the increase in Reno Creek liquid byproduct material	64 ha [158 ac] Land area of 28 ha [69 ac] for associated impoundment systems (assumed by the NRC staff to have similar facility needs as Class V Disposal well). Additional evaporation pond system 34 ha [83 ac] may be needed to store water treatment residuals (reverse osmosis brine). Separate storage facilities may be needed to maintain separate waste streams for process wastewater which is approximately 9 percent of the liquid byproduct stream. Scaling impoundment estimate by 9 percent adds 2.5 ha [6.2 ac].

Table 2-7. Comparison of Other Liquid Wastewater Disposal Options With the Proposed Class I Deep Disposal Well (Continued)

	Proposed Class I Deep Disposal Well	Class V Disposal Well	Evaporation Ponds	Land Application	Discharge to Surface Waters
Relevant Regulations and Permits	Title 10 of the *Code of Federal Regulations* (CFR) Part 20, Subparts D and K Underground Injection Control (UIC) Class I permit and aquifer exemption [Wyoming Department of Environmental Quality (WDEQ); EPA approval of aquifer exemption] National Emission Standards for Hazardous Air Pollutants (NESHAP) Construction Approval (40 CFR Part 61, Subpart W) (EPA)	10 CFR Part 20, Subparts D and K and Appendix B UIC Class V permit (WDEQ) NESHAP Construction Approval (40 CFR Part 61, Subpart W) (EPA)	10 CFR Part 40, Appendix A Wyoming State Engineer's Office Surface Impoundment Permit NESHAP Construction Approval (40 CFR Part 61, Subpart W) (EPA) Contract for solid byproduct material disposal (liners, sludges)	10 CFR Part 20, Subparts D and K and Appendix B 10 CFR Part 40, Appendix A, Criterion 6(6) NESHAP Construction Approval (40 CFR Part 61, Subpart W) (EPA) WYPDES permit (WDEQ)	10 CFR Part 20, Subparts D and K and Appendix B NESHAP permit (40 CFR Part 61) WYPDES permit (WDEQ) No release of process wastewater to navigable waters standard in 40 CFR Part 440.34(b)(1)
Construction Requirements	Land clearing and excavation equipment for pad, mud pits, and roads Drilling rig	Land clearing and excavation equipment for pad, mud pits, radium-settling basins, treatment facilities, and roads Drilling rig	Land clearing and excavation equipment to prepare surface for pond(s), and roads Construction equipment to construct pond liner(s)	Land clearing and excavation equipment for roads, radium-settling basins, treatment facilities	Land clearing and excavation equipment for roads, treatment facilities

Table 2-7. Comparison of Other Liquid Wastewater Disposal Options With the Proposed Class I Deep Disposal Well (Continued)

	Proposed Class I Deep Disposal Well	**Class V Disposal Well**	**Evaporation Ponds**	**Land Application**	**Discharge to Surface Waters**
Wastewater Storage Prior to Disposal	Applicant proposes a storage tank and a backup storage pond for surge capacity	Storage/surge tank(s) Radium-settling basins, treatment facility if needed to reduce radium, uranium, and other contaminant concentrations	No additional storage needed; evaporation pond provides necessary storage prior to disposal	Storage/surge tank(s) Radium-settling basins, treatment facility if needed to reduce radium, uranium, and other contaminant concentrations	Radium-settling basins, treatment facility if needed to reduce radium, uranium, and other contaminant concentrations
Wastewater Treatment	No additional treatment is required but may add antifouling agent to reduce scaling in well. Applicant proposes reverse osmosis for high-volume waste streams to conserve water	Treatment by ion exchange, radium settling, and reverse osmosis, as needed, to meet limits. Effluent must meet 10 CFR Part 20, Appendix B effluent limits and WDEQ UIC permit limits. May add antifouling agent to reduce scaling in well.	No additional treatment is required (optional)	Treatment by ion exchange, radium settling, and reverse osmosis, as needed, to meet U.S. Nuclear Regulatory Commission (NRC) and WDEQ requirements and other WDEQ permit and NRC license conditions	Treatment by ion exchange and reverse osmosis to meet NRC and WDEQ requirements (e.g., WYPDES discharge permit)

Table 2-7. Comparison of Other Liquid Wastewater Disposal Options With the Proposed Class I Deep Disposal Well (Continued)

	Proposed Class I Deep Disposal Well	**Class V Disposal Well**	**Evaporation Ponds**	**Land Application**	**Discharge to Surface Waters**
Decommissioning	Applicant proposes to remove backup storage pond liners and sludges Applicant proposes to plug and abandon wells in accordance with WDEQ and Wyoming State Engineer's Office requirements	Radium-settling basin liners and sludges, treatment of building debris to be disposed of as solid byproduct material, additional transportation of wastes to licensed disposal facility Plug and abandon well in accordance with WDEQ and Wyoming State Engineer's Office requirements	Pond liners and sludges to be disposed of as solid byproduct material; additional transportation of wastes to licensed disposal facility	Radium-settling basin liners and sludges, removed equipment, including trunklines to be disposed of as solid byproduct material, additional transportation of wastes to licensed disposal facility Application soils to be disposed of as solid byproduct material if limits exceeded Additional transportation of wastes to licensed disposal facility	Removal of storage pond liners and sludges, treatment of building debris to be disposed of as solid byproduct material, additional transportation of wastes to licensed disposal facility
Environmental Benefits	Isolation from accessible environment. Low exposure to individuals at surface. Smallest footprint, no additional decommissioning wastes. No added transportation impacts for wastes. No additional waste streams created. Minimal and temporary visual impacts from drilling	Wastewater treated to 10 CFR Part 20, Appendix B and WDEQ UIC permit effluent limits	Containment during storage, waste volume reduction (liquid waste form reduced to a solid prior to final disposal)	Wastewater treatment to reduce uranium, radium, and other constituents Limited construction needed for land application area	Wastewater treated to meet 10 CFR Part 20, Appendix B and WYPDES permit effluent limits

Table 2-7. Comparison of Other Liquid Wastewater Disposal Options With the Proposed Class I Deep Disposal Well (Continued)

	Proposed Class I Deep Disposal Well	Class V Disposal Well	Evaporation Ponds	Land Application	Discharge to Surface Waters
Climatic Influences	Deeper drilling requires larger rig, longer rig time, higher diesel emissions [carbon dioxide (CO_2) emission estimate for one deep well was approximately 1,000 × typical production well]†	Deeper drilling requires larger rig, longer rig time, higher diesel emissions (CO_2) emission estimate for one deep well was approximately 1,000 × typical production well† Additional equipment emissions from constructing wastewater storage and treatment facilities	Additional equipment emissions from constructing evaporation ponds	Additional equipment emissions from constructing wastewater storage and treatment facilities	Additional equipment emissions from constructing wastewater storage and treatment facilities
Health and Safety Issues	Potential pipeline leaks	Potential leaks from wastewater storage and treatment facilities Additional waste volume during decommissioning	Potential leaks from evaporation ponds Additional waste volume during decommissioning	Potential leaks from wastewater storage and treatment facilities Additional waste volume during decommissioning	Potential leaks from wastewater storage and treatment facilities Additional waste volume during decommissioning

†Ratio of calculated CO_2 emissions for a single deep well of 308 t/yr [340 T/yr] and single production well of 0.29 t/yr [0.32 T/yr] is 1,062. Emissions estimates are from Table D.3-1 in NRC (2011). The single production well emissions estimate of 0.29 t/yr [0.32 T/yr] was calculated from the reported total wellfield drilling estimate in Table D.3-1 of 154 t/yr [170 T/yr] divided by the number of wells in the wellfield (525) that is reported in Table D.2-1 of the same reference.
Source: Modified from NRC (2009) or where other references are specified and to include site-specific information

2.1.1.2.2 *Evaporation Ponds*

One commonly used option for disposal of liquid byproduct material involves pumping liquids into one or more ponds and allowing natural solar radiation to reduce the volume through evaporation. The waste streams are not always treated prior to being discharged into evaporation ponds, and radionuclides and other metals are concentrated as the liquids evaporate. The basic design criteria for an evaporation pond system are contained in 10 CFR Part 40, Appendix A, Criteria 5A and 5E. The NRC regulations set standards for the location of the pond(s) and the design and construction of the necessary clay or geosynthetic liner systems and embankments for the ponds (NRC, 2003a, 2008). The NRC regulations also establish criteria for pond inspection and maintenance. The NRC guidance in Regulatory Guide 3.11 (NRC, 2008) recommends considering applicable EPA regulations including the requirements of 40 CFR 264.221, in any impoundment design.

The effectiveness of evaporation ponds depends on evaporation rates and how quickly liquid byproduct material is generated. The evaporation rate varies seasonally and is dependent on temperature and relative humidity; the rate is highest during warm, dry conditions and is lower during cool, humid conditions. When the evaporation rate is low or seasonal conditions reduce evaporation, the operator can increase the size and the surface area of the evaporation ponds to augment evaporation.

Evaporation ponds are commonly used at facilities that employ a combination of waste disposal options. Historically, the area of individual evaporation ponds at uranium ISR facilities has ranged from 0.04 to 2.5 ha [0.1 to 6.2 ac] (NRC, 1997, 1998a,b; Sanford Cohen and Associates, 2008). The total footprint of the evaporation pond system for all liquid byproduct material streams at an ISR facility has been estimated to be as high as 40 ha [100 ac] (NRC, 1997). Based on the applicant’s estimated pretreatment wastewater flow rates at the proposed Reno Creek ISR Project (i.e., the production bleed and restoration flow described in SEIS Sections 2.1.1.1.3 and 2.1.1.1.4) and the applicant’s measured evaporation rate of 122 cm/yr [48 in/yr], if a pond system were employed as the only liquid byproduct material disposal option it would need to be several times larger than the GEIS estimate of 40 ha [100 ac] for evaporation ponds (SEIS Table 2-7). If a pond system was combined with two-stage RO treatment to reduce the volume of wastewater (as with the proposed project) then a smaller pond system of approximately 34 ha [83 ac] would likely be sufficient to accommodate the wastewater flow rates estimated by the applicant.

The applicant would design, construct, and monitor a leak detection system and conduct routine inspections as described in NRC guidance to identify and repair leaks that might occur in the evaporation pond system (NRC, 2008). The NRC guidance recommends that an applicant’s design incorporate sufficient freeboard (the distance from the water level to top of the embankment) of about 1 to 2 m [3 to 6 ft], depending on the size of the individual pond, so that precipitation or wind-driven waves would not overtop the embankment (NRC, 2008). In addition, sufficient reserve capacity in the evaporation pond system must be maintained to allow the entire contents of one or more ponds to be transferred to other ponds, in the event of a leak requiring corrective action and liner repair (NRC, 2009). When necessary, an applicant would install perimeter fencing to ensure safety. These requirements would be written as conditions in an NRC license, and enforcement would be managed through the NRC inspection program.

The applicant might need to demonstrate that radionuclides, such as radon, released to the air from ponds met 40 CFR Part 61 requirements and in particular the provisions of Subpart W that incorporate the requirements of 40 CFR Part 192 (NRC, 2008; Sanford Cohen and Associates, 2008). In developing the impoundment design, the applicant would also need to consider EPA surface impoundment regulations in 40 CFR Part 264 (NRC, 2008).

Because ponds are open to the air, dust and dirt can blow into ponds and the concentrations of dissolved solids may increase due to evaporation, resulting in the precipitation of salts from the solution. Ponds may require periodic cleaning to maintain good repair and the necessary freeboard; additionally, accumulated salts and solids may need to be disposed of as solid byproduct material at a licensed disposal facility. Similarly, when the operations and aquifer restoration phases end, pond liners and any accumulated materials would need to be disposed of as solid byproduct material. To provide an example of decommissioning waste volume, the volume of solid byproduct material that would be generated during decommissioning and reclamation of storage ponds occupying 0.78 ha [1.91 ac] was estimated by a previous ISR facility license applicant as 867 m^3 [1,134 yd^3] (LCI, 2008, 2010).

During the winter months in Wyoming, where temperatures are generally below freezing, ponds could ice over, thereby reducing evaporation to zero. To maintain year-round liquid disposal capability using evaporation ponds at the proposed Reno Creek ISR Project, the applicant would likely need to have either sufficient storage capacity or at least one other disposal option available. Based on a comparison with the proposed waste disposal option, the applicant currently does not consider evaporation ponds a preferable liquid waste disposal option for the proposed Reno Creek ISR Project (AUC, 2012a). This is due to unfavorable climatic conditions at the proposed project area; notably, the short period of high temperatures, long periods of subfreezing temperatures, potential bird impacts, large surface area, and the potential for windblown overspray releases from ponds or dust deposition into ponds that reduce efficiency of evaporation and require cleanouts.

2.1.1.2.3 Land Application

Land application is a disposal technique that uses agricultural irrigation equipment to apply wastewater on a relatively large area of land to enhance evaporation. Previously licensed ISR facilities have proposed land application (NRC, 1995; 1998b; 2014a) and land application has been implemented at a few of these ISR facilities.

Liquid byproduct material would need to be treated to meet NRC dose limits, waste disposal standards, and effluent limits in 10 CFR Part 20, Subparts D and K and Appendix B and WDEQ requirements imposed by a WYPDES permit (NRC, 2003a). Water, soils and vegetation would be monitored on a regular basis established by license conditions to ensure soil loadings and vegetation concentrations remain within permit limits (NRC, 1995).

Pretreatment of liquid wastes using ion-exchange columns, RO, and precipitation of barium/radium sulfate is typically incorporated into this process to decrease uranium and radium levels. This pretreatment is necessary to meet regulatory release limits and minimize the potential buildup of radionuclides in surface soils and vegetation. Despite pretreatment, liquid waste disposal by land application typically requires large areas to remain below release requirements. For example, the Crow Butte facility near Crawford, Nebraska, has identified about 40 ha [100 ac as available for land application, if needed (NRC, 1998b), the Highland Uranium Project in Converse County, Wyoming, identified two land application sites, each about 22 ha [54 ac] (NRC, 1995), and the Dewey-Burdock Project near Edgemont, South Dakota identified 426 ha [1052 ac] for land application (NRC, 2014b). Depending on how an applicant would treat the wastewater prior to land application, this disposal option might have additional land requirements related to constructing radium-settling basins and storage reservoirs (NRC, 1995). These facilities would add to the required footprint for this disposal option. For example, radium settling basins are typically on the order of 0.1 to 1.6 ha [0.05 to 4 ac] (NRC, 1995, 1997, 1998a); purge reservoirs for temporary storage of treated wastewater can be much larger, with a surface area on the order of 4 ha [10 ac] or more, depending on the terms of the necessary permit (NRC, 1998a).

An additional National Emission Standards for Hazardous Air Pollutants review by EPA may be required to determine that radionuclides such as radon released to the air from this option meet the requirements of 40 CFR Part 61. The NRC staff calculations for land application over an area of 42 ha [104 ac], assuming average wastewater concentrations of 37 Bq/m^3 [1 pCi/L] for radium and 1 mg/L [1 ppm] for uranium, resulted in potential doses below regulatory limits (NRC, 1997). Similarly, representative calculations for 7 years of land application to an area of 18.5 ha [46 ac] with an assumed wastewater application rate of 1,514 Lpm [400 gpm] estimated a radon flux of 1.3 pCi/m^2-sec, not much more than an assumed background of 1 pCi/m2-sec (NRC, 2003a). More recently, the land application radon release estimate from the previously licensed Dewey Burdock ISR Project was less than 2 percent of the total estimated radon release from combined operations and aquifer restoration (NRC, 2014b).

During decommissioning, the additional land application structures, equipment, access roads, and land areas would need to be surveyed, removed, or reclaimed. These activities would increase the volume of decommissioning materials, including solid byproduct material and nonhazardous solid waste that would need to be transported to offsite disposal facilities. For example, the annual amount of solid byproduct material from decommissioning an ISR facility utilizing land application was estimated to be about 790 m^3 [1,034 yd^3] (NRC, 2014b).

2.1.1.2.4 Surface Water Discharge

Another disposal option used at licensed ISR facilities (NRC, 2009; NRC, 1998a) is the discharge of treated wastewater to surface water. Effluent would need to meet the NRC dose limits, waste disposal standards, and effluent limits in 10 CFR Part 20, Subparts D and K and Appendix B and the provisions of 10 CFR Part 40, Appendix A. The regulations at 10 CFR 20.2007 require compliance with other applicable federal, state, and local regulations. This includes the WDEQ WYPDES permitting requirements for surface water discharge (WDEQ, 2015d).

WDEQ permitting regulations incorporate by reference EPA effluent discharge regulations for ISR facilities at 40 CFR Part 440, Subpart C. EPA regulations at 40 CFR 440.34 prohibit new ISR facilities from discharging process waste water to navigable waters of the United States. Additionally, WDEQ surface discharge permitting regulations consider surface waters of the state to be waters of the United States under the Clean Water Act. Therefore, the NRC staff expects the prohibition on discharge of ISR process wastewater to navigable waters of the United States would extend to all natural surface waters at the proposed Reno Creek ISR Project area. According to EPA, process wastewater does not include discharges from wells (within or surrounding in situ mines) used to restore aquifers after all actual mining activity (i.e., extraction of the ore, or pregnant lixiviant from the in situ process) has been completed (47 FR 54598). EPA added that such discharge would be from an inactive mine area and the effluent limitations, guidelines, and standards of performance would not be directly applicable (47 FR 54598). Therefore, the NRC staff assumes surface water discharge of treated ISR aquifer restoration water is permissible under the EPA standards, provided the discharge water is not comingled with process wastewater and a discharge permit is obtained. A WYPDES permit, if granted by the WDEQ, would specify any necessary permit conditions including effluent limits to ensure water quality standards are maintained.

Pretreatment of the liquid byproduct using ion exchange columns, RO, and barium/radium sulfate precipitation is typically used by ISR facilities to decrease uranium, radium, and other constituent levels in wastewater. The NRC staff assume that these treatment methods would be applied to reduce wastewater constituent levels below the permitted discharge limits. Like the Class V disposal well and land application wastewater disposal option, this treatment might require additional land for the construction of radium-settling basins and storage reservoirs (NRC, 2003a). Discharge of treated aquifer restoration wastewater would also require additional facilities to isolate aquifer restoration wastewater streams from process wastewater streams to comply with the EPA process wastewater discharge prohibition in 40 CFR 440.34. An evaporation pond system may also be needed to store water treatment residuals (RO brine). The staff estimates the storage and treatment facilities would occupy an additional 36 ha [89 ac] of land relative to the storage and treatment facilities needed for the Class V disposal well option. The applicant would also need to control solid byproduct material remaining at storage facilities and within tanks, impoundments, and radium-settling basins until the proposed project area and facilities are decommissioned (NRC, 2003a).

2.1.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the NRC would not approve the license application for the proposed Reno Creek ISR Project. The No-Action Alternative would result in the applicant not constructing or operating the proposed Reno Creek ISR Project. No buildings, access roads, wellfields, pipelines, or liquid waste disposal systems would be constructed. No uranium would be recovered from the subsurface orebodies; therefore, injection, production, and monitoring wells would not be installed to operate the facility. No lixiviant would be introduced into the subsurface, and no facilities would be constructed to process extracted uranium or store chemicals. Because no uranium recovery activities would occur, neither aquifer restoration nor decommissioning activities would occur. No liquid effluents or solid wastes would be generated. The No-Action Alternative is included to provide a basis for comparing and evaluating the potential impacts of the other alternative (the proposed action).

2.2 Alternatives Eliminated From Detailed Analysis

As required by NEPA regulations, the NRC staff consider alternatives to issuing the applicant a license. The range of alternatives was determined by considering the purpose and need for the proposed action and the private party's objective in extracting uranium from a particular orebody. In a site-specific environmental review, the identification of reasonable alternatives depends on the proposed action, as well as site conditions. This section describes alternatives to the proposed action that were considered by the NRC but not subjected to detailed analysis for the reasons described in the following sections. SEIS Sections 2.2.1 and 2.2.2 describe different mining techniques and associated milling alternatives for the proposed project site. SEIS Section 2.2.3 discusses the use of different lixiviant chemistry. SEIS Section 2.2.4 describes alternative site locations for the CPP within the proposed project area. SEIS Section 2.2.5 details the use of alternative well completion methods at the proposed project site.

2.2.1 Conventional Mining and Milling

Uranium ore deposits may be accessed either by open pit surface mining or by underground mining techniques. Open pit mining is used to extract shallow ore deposits—generally deposits less than 168 m [550 ft] below ground surface (EPA, 2008a). To access shallow deposits, the topsoil is removed and stockpiled for later site reclamation, while the overburden (the remainder of the material overlying the deposit) is removed via mechanical shovels and scrapers, via trucks or loaders, or by blasting (EPA, 1995, 2008a). The depth to which an orebody is surface mined depends on the ore grade, the nature of the overburden, and the ratio of overburden to be removed to one unit of ore extracted (EPA, 1995).

Underground mining techniques vary, depending on the size, depth, orientation, and grade of the orebody; the stability of the subsurface strata; and economic factors (EPA, 1995, 2008b). In general, underground mining involves sinking a shaft near the orebody and then extending levels horizontally from the main shaft at different depths to access the ore. Ore and waste rock are removed through shafts by elevator or by using trucks to carry these materials up inclines to the surface (EPA, 2008a).

In addition, when the open pit or underground workings are established, the mine may need to be dewatered to allow the extraction of the uranium ore. Dewatering is accomplished by either pumping water directly from the open pit or pumping interceptor wells to lower the water table (EPA, 1995). The mine water usually requires treatment prior to discharge because it becomes contaminated with radioactive constituents, metals, and suspended and dissolved solids. Discharge of these mine waters may have subsequent impacts to surface water drainages and sediments, as well as to near-surface sources of groundwater (EPA, 1995).

Following the completion of mining, either by open pit or underground techniques, the mine would be reclaimed. Stockpiled overburden is reintroduced into the mined area, either during or following extraction operations, and topsoil is reapplied in an attempt to reestablish topography consistent with the surroundings. When dewatering ceases, the water table may rebound and fill portions of the open pit and underground workings. Historically, uranium mines have had negative impacts on local groundwater supplies, and the waste materials from the mines have contaminated lands surrounding the mines (EPA, 2008b).

Ore extracted from an open pit or underground mine is processed in a conventional mill. As discussed in GEIS Appendix C (NRC, 2009), ore processing at a conventional mill involves a series of steps (handling and preparation, concentration, and product recovery). While conventional milling techniques recover approximately 90 percent of the uranium content of the feed ore (NRC, 2009), the process generates substantial wastes, known as tailings, because roughly 95 percent of the ore rock is disposed of as waste (NRC, 2006). The conventional mill process also consumes large amounts of water. For example, the water usage estimate for the proposed Pinon Ridge Mill in Colorado is approximately 534 Lpm [141 gpm] (EFRC, 2009).

Tailings are disposed of in lined impoundments; the NRC reviews the design and construction of impoundments to ensure safe disposal of the tailings (NRC, 2009). Reclamation of the tailings pile generally involves evaporation of liquids in the tailings and settlement of the tailings over time. The tailings pile is then covered with a thick radon barrier and earthen material or rocks for erosion control. The area surrounding the reclaimed tailings piles would be fenced off in perpetuity and the site transferred to either a state or federal agency for long-term care

(EIA, 1995). The costs associated with final mill decommissioning and tailings reclamation can run into the tens of millions of dollars (EIA, 1995).

In the final GEIS on uranium milling (NRC, 1980), NRC evaluated the potential environmental impacts of conventional uranium milling operations in a programmatic context, including the management of mill tailings. This GEIS evaluated the nature and extent of conventional uranium milling as part of the development of regulatory requirements for the management and disposal of mill tailings and for mill decommissioning. The impacts from operating a conventional mill are significantly greater than for operating an ISR facility. A conventional mill requires a large amount of land; approximately 300 ha [741 ac] would be affected by construction and milling operations, and related activities would use approximately an additional 150 ha [370 ac] (NRC, 1980). The deposition of windblown tailings could further restrict land use near the tailings. In conventional mill modeling, levels of contamination extend several hundred meters [feet] beyond the model site boundary evaluated in the GEIS for conventional milling. Because of these factors, conventional milling was eliminated from detailed analysis in the SEIS.

2.2.2 Conventional Mining and Heap Leaching

Heap leaching is discussed in GEIS Appendix C. For low-grade ores, heap leaching is a viable alternative. Heap leaching is typically used when the orebody is small and situated far from the milling site. After extraction by conventional open pit or underground mining, the low-grade ore is crushed to approximately 2.6 cm [1 in] in size and mounded above grade on a prepared pad. A sprinkler or drip system positioned over the top continually distributes leach solution over the mound. Depending on the lime content of the ore, an acid or alkaline solution is used. The leach solution trickles through the ore and mobilizes the uranium, as well as other metals, into solution. The solution is collected at the base of the mound by a manifold and is then processed to extract the uranium. The uranium recovery from heap leaching ranges from 50 to 80 percent, resulting in a final tailings material of around 0.01 percent U_3O_8 (yellowcake) content. When heap leaching is complete, the depleted materials are solid byproduct material that must be placed in a conventional mill tailings impoundment, unless the NRC grants an exemption for disposal in place. The impacts from heap leaching may be less than those associated with conventional milling; however, the impacts from open pit or underground mining are substantial. For these reasons, which are the same as those listed in SEIS Section 2.2.1, this alternative is not subjected to detailed analysis in the SEIS.

2.2.3 Alternative Lixiviants

Alternative lixiviant chemistry was considered for the operations phase of the applicant’s proposed project. Alternative chemistry includes acid leach solutions and ammonia-based lixiviants (AUC, 2012a). Acid-based lixiviants, such as sulfuric acid, dissolve heavy metals and other solids associated with uranium in the host rock and other chemical constituents that require additional remediation and have greater environmental impacts. At a small-scale research facility in Wyoming, acid-based solutions were used to test their effectiveness as a lixiviant in the ISR process. During operations, significant problems developed. The mineral gypsum precipitated on the well screens and in the aquifer, which plugged the wells and reduced the efficiency of the wellfield restoration. Aquifer restoration had limited success, because of the gradual dissolution of the precipitated gypsum, which resulted in increased salinity and sulfate levels in the affected groundwater (Uranium One, 2009). Because it is technically more difficult to restore acid mine sites, the use of an acid-based lixiviant was eliminated from detailed analysis in the SEIS.

Ammonia-based lixiviants have been used at ISR operations in Wyoming. However, operational experience has shown that ammonia tends to adsorb onto clay minerals in the subsurface and then slowly desorbs from the clay during restoration. This requires that a much larger volume of groundwater be removed and processed during aquifer restoration (Mudd, 2001). Because of the greater consumptive use of groundwater to meet groundwater restoration requirements, the use of an ammonia-based lixiviant was eliminated from detailed analysis.

2.2.4 Alternative Location of the Central Processing Plant

Prior to preparation of this license application, AUC considered two potential locations for the CPP in the proposed Reno Creek ISR Project area. The first location was the former pilot plant site for Rocky Mountain Energy (AUC, 2012a). This site is located primarily in the northwest quarter of Section 27, T43N, R73W. The second location is in the northeast quarter of Section 1, T42N, R74W (see AUC, 2012a; SEIS Figure 2-3). After evaluating the potential impacts of both CPP locations, the former pilot plant site was rejected on the basis of the following factors:

- Access to this site would require the development of a main access road measuring nearly 1 mile from Hwy 387, plus the construction of a new highway intersection.
- The access road would require greater soil and vegetation disturbance, potentially increasing the environmental and ecological footprints during the project’s lifespan.
- The longer access road may increase fugitive dust potential from vehicular traffic.
- The former pilot plant site would require utilities (e.g., gas and power lines) to be constructed over a greater distance.
- Landowners within the proposed project area have communicated that they prefer not to lease land for use as a CPP. A CPP would operate for numerous years, whereas a wellfield would operate for a shorter time and would be returned to the landowner upon decommissioning.
- Oil and gas firms have occupied ground between the former pilot plant site and the highway, and would create competing land uses, and thus, additional logistical concerns. Traversing oil recovery and storage sites may also create challenging radiation-management issues.
- The former pilot plant site is closer to a residence, which could result in a higher radiological dose potential.
- The former pilot plant site has more varied topography, so leveling the site for construction of the CPP and ancillary facilities would require more earthwork and surface disturbance.
- There is known mineralization beneath this site, which might require layout reconfiguration of the wellfield and related infrastructure.

- This site is positioned on a hill, which would have higher visibility from Hwy 387.

- Initial construction costs may be substantially greater than those for the proposed site (AUC, 2014b).

Because of these factors, an alternative location for the CPP was eliminated from detailed analysis in the SEIS.

2.3 Comparison of the Predicted Environmental Impacts

NUREG–1748 (NRC, 2003b) categorizes the significance of potential environmental impacts, as follows:

- SMALL: The environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource considered.

- MODERATE: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

- LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

Chapter 4 presents a detailed evaluation of the environmental impacts from the proposed action and the No-Action Alternative on resource areas at the proposed Reno Creek ISR Project. SEIS Table 2-8 compares the significance level (SMALL, MODERATE, or LARGE) of potential environmental impacts of the proposed action and the No-Action Alternative. For each resource area, the NRC staff identifies the significance level during each phase of the ISR process: construction, operations, aquifer restoration, and decommissioning.

The predicted environmental impact to each resource area for the proposed project can also be found in the Executive Summary.

2.4 Preliminary Recommendation

After weighing the impacts of the proposed action and comparing to the No-Action Alternative, the NRC staff, in accordance with 10 CFR 51.91(d), sets forth its NEPA recommendation regarding the proposed action. Unless safety issues mandate otherwise, the NRC staff recommendation to the Commission regarding the environmental aspects of the proposed action is that a source and byproduct material license for the proposed action be issued as requested. This recommendation is based on (i) the license application, which includes the ER and supplemental documents, and the applicant's responses to the NRC staff's requests for additional information; (ii) consultation with federal, state, tribal, and local agencies; (iii) independent NRC staff review; and (iv) the assessments summarized in this SEIS.

Table 2-8. Summary of Impacts for the Proposed Reno Creek ISR Project		
	Land Use	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Transportation	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Geology and Soils	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Water Resources-Surface Water	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Water Resources-Groundwater	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Ecology	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Air Quality	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Noise	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE

Table 2-8. Summary of Impacts for the Proposed Reno Creek ISR Project (Continued)		
	Historic and Cultural Resources	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Visual and Scenic Resources	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Socioeconomics	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Environmental Justice	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Public and Occupational Health	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE
	Waste Management	
	Proposed Action–Alternative 1	**No-Action–Alternative 2**
Construction	SMALL	NONE
Operation	SMALL	NONE
Aquifer Restoration	SMALL	NONE
Decommissioning	SMALL	NONE

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3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

The proposed Reno Creek In Situ Recovery (ISR) Project would be located in Campbell County, Wyoming, in the Wyoming East Uranium Milling Region as defined in the Generic Environmental Impact Statement (GEIS) for In Situ Leach Uranium Milling Facilities (hereafter referred to as the GEIS) (NRC, 2009). The proposed Reno Creek ISR Project area (also referred to as the proposed project area) is defined as the land within the applicant's proposed license boundary. The proposed Reno Creek ISR Project would be located between the communities of Wright, Edgerton, and Gillette, Wyoming [supplemental environmental impact statement (SEIS) Figure 2-2]. The proposed project area encompasses 2,451 hectares (ha) [6,057 acres (ac)] of mostly private land. The total land disturbed by the proposed project would be approximately 62 ha [154 ac].

This chapter describes the existing environmental conditions of the proposed Reno Creek ISR Project. The resource areas described in this section include land use, transportation, geology and soils, water resources, ecology, noise, air quality, historic and cultural resources, visual and scenic resources, socioeconomics, public and occupational health, and current waste management practices. The descriptions of the affected environment are based upon information provided in the applicant's environmental report (AUC, 2012a) and responses to U.S. Nuclear Regulatory Commission (NRC) requests for additional information (RAIs) (AUC, 2014a,b) and supplemented by additional information identified by the NRC staff. The information in this chapter forms the basis for assessing the potential impacts (see SEIS Chapter 4) of the proposed project and alternative (see SEIS Chapter 2).

3.2 Land Use

Existing land uses within the proposed project area include oil and gas production, coalbed methane (CBM) production, transportation, livestock grazing, and wildlife habitat (AUC, 2012a). Surface ownership within the project area consists of 2,192 ha [5,417 ac] of privately owned land and 259 ha [640 ac] of State of Wyoming owned land (AUC, 2012a).

Private and state-owned land within and surrounding the proposed project area is used primarily for agricultural purposes (e.g., rangeland for livestock grazing and cropland) (SEIS Figure 3-1). Four residential sites are located within 8 km [5 mi] of the project boundary (SEIS Table 3-1 and Figure 3-1). Six occupants live in the four residences outside the project boundary (SEIS Table 3-1). The Leavitt and Leavitt Ranch Hand residences are the closest occupied offsite residences. The Leavitt residence is approximately 2.0 km [1.25 mi] southeast of the proposed project boundary (see SEIS Figure 3-1) and within 3.2 km [2 mi] of production units 5 and 7, as depicted in SEIS Figure 2-4. The Leavitt Ranch Hand residence is approximately 2.7 km [1.7 mi] east of the proposed project boundary and approximately 3.2 km [2 mi] from production unit 6, as depicted in SEIS Figure 2-4.

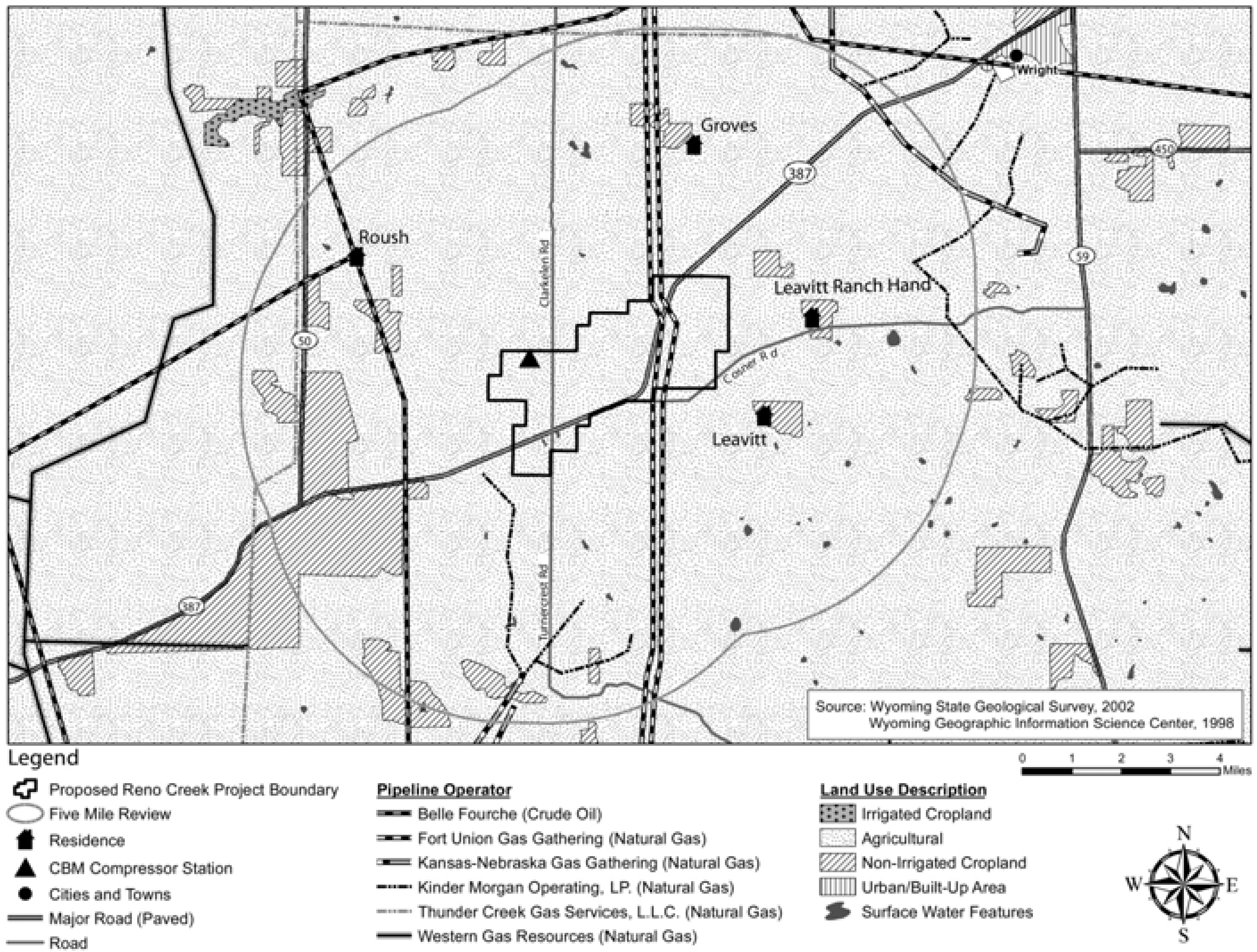

Figure 3-1. Land Use and Residences Within 8 km [5 mi] of the Proposed Reno Creek ISR Project Area (AUC, 2014a)

Table 3-1. Residences Within an 8.0 km [5-mi] Radius of the Proposed Project Boundary			
Residence Name	**Status**	**Number of Occupants**	**Location***
Roush	Occupied	2	T43N, R74W, Section 21
Leavitt	Occupied	1	T42N, R73W, Section 2
Leavitt Ranch Hand	Occupied	2	T43N, R73W, Section 25
Groves	Occupied	1	T43N, R73W, Section 4
Source: AUC, 2014a *T = Township; R = Range; N = North, W = West			

Property rights on the proposed project area are held by the Federal Government, the State of Wyoming, and various private landowners. GEIS Section 3.1.2.2 describes the concept of a split estate, where different entities own the surface rights and subsurface rights (such as the rights to develop minerals) for a piece of land (NRC, 2009). At the proposed Reno Creek ISR Project area, this divided ownership pattern occurs where the Federal Government owns subsurface mineral rights to portions of land whose surface rights are owned by private landowners (SEIS Figure 3-2). Within the proposed Reno Creek ISR Project area, the Federal Government owns 1,165 ha [2,879 ac] of federal mineral estate (SEIS Table 3-2). On the remainder of the proposed project area, subsurface rights are held in unity with the surface rights by private landowners and the State of Wyoming. The applicant owns 157 unpatented lode mining claims associated with 1,047 ha [2,587 ac] of federal mineral estate within the proposed project area. In addition, the applicant holds state mineral leases on the 259 ha [640 ac] of state mineral ownership within the proposed project area and two private mineral leases totaling 269 ha [666 ac] within the proposed project area (SEIS Table 3-2). The applicant has surface use agreements with all landowners who hold surface ownership, including leases on state-owned land, for the whole area of the proposed project (AUC, 2012a).

3.2.1 Land Use Classification

Most of the land within the proposed project area is classified as agricultural land (SEIS Figure 3-1 and SEIS Table 3-3). Agricultural land is defined as noncultivated land with potential for mixed agricultural use, such as rangeland for livestock grazing, haying for forage crops, and wildlife habitat. No commercial crop production takes place within the proposed project area. Land use within 8 km [5 mi] of the proposed project area is predominantly rangeland used for livestock grazing, with some areas classified as cropland. All cropland within 8 km [5 mi] of the proposed project boundary is nonirrigated. The U.S. Department of Agriculture (USDA) National Agriculture Statistics Service estimated 79,670 head of cattle and 27,597 sheep and lambs in Campbell County in 2012 (USDA, 2012). In 2012, Campbell County had 744 farms and ranches totaling 1,164,692 ha [2,878,017 ac]. Of the land in farms and ranches, 93.7 percent was classified as pasture/rangeland (USDA, 2012).

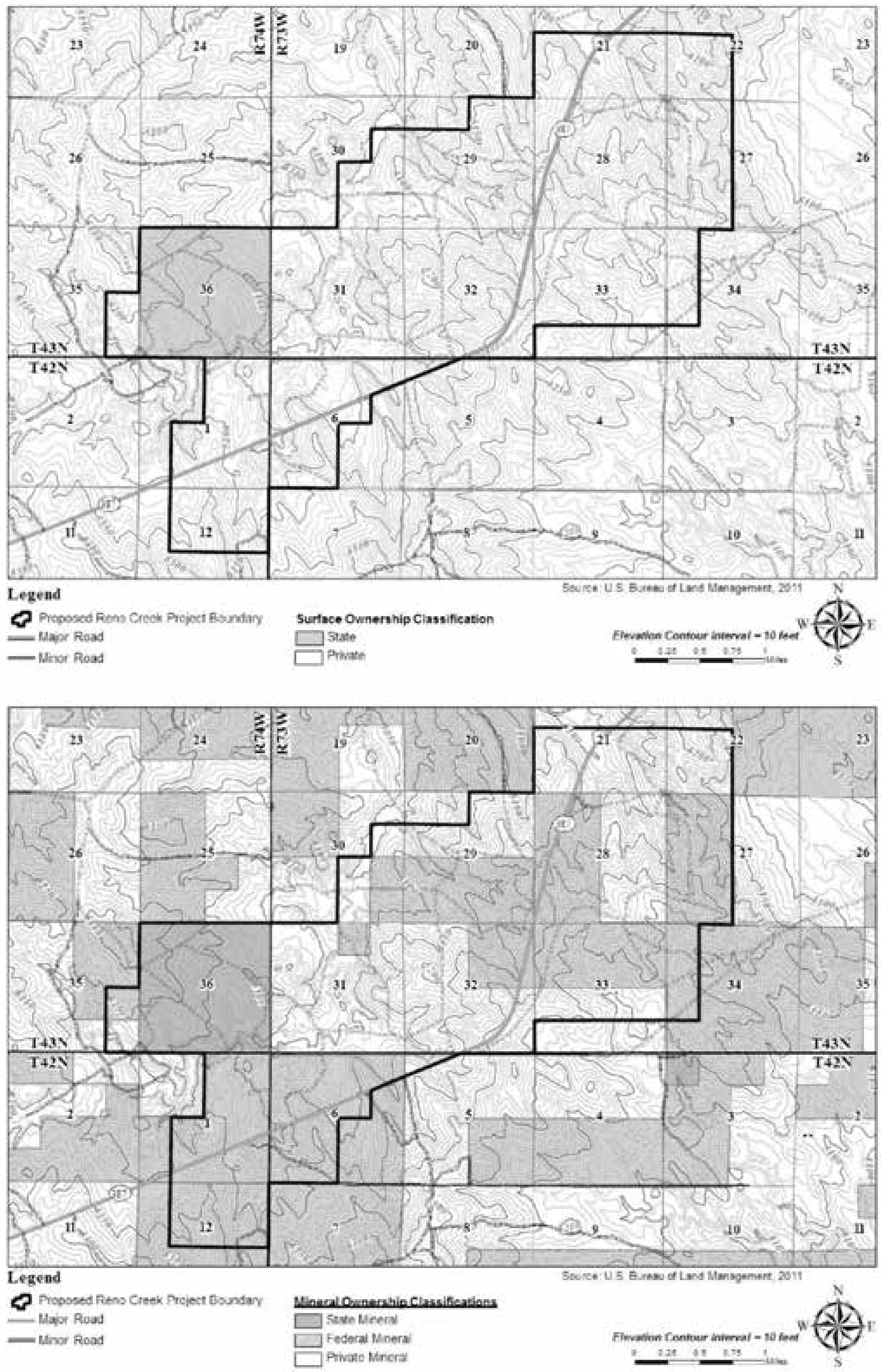

Figure 3-2. Surface and Mineral Ownership for the Proposed Reno Creek ISR Project Area (AUC, 2014a)

Table 3-2. Distribution of Surface and Mineral Ownership Within the Proposed Reno Creek ISR Project Area						
	Surface Ownership		**Mineral Ownership (AUC)**		**Mineral Ownership (Others)**	
Ownership Type	**ha [ac]**	**Percent of Project Area**	**ha [ac]**	**Percent of Project Area**	**ha [ac]**	**Percent of Project Area**
Private	2,192 [5,417]	89.4	269 [666]	33.5	758 [1,872]	87.3
State	259 [640]	10.6	259 [640]	16.5	[0]	0
Federal (Lode Claims)	0	0	1,047 [2,587]	50.0	118 [292]	12.7
Total	2,451 [6,057]	100	1,575 [3,893]	100	876 [2,164]	100
Source: AUC, 2014b						

Table 3-3. Land Use Inside and Surrounding the Proposed Reno Creek ISR Project Area		
Land Use Classification	**Project Area ha [ac] (Percent of Total)**	**Within 8 km [5 mi] of the Project Boundary ha [ac] (Percent of Total)**
Agricultural Land	2,436 ha [6,020 ac] (99.4%)	38,875 ha [96,061 ac] (92.3%)
Nonirrigated Cropland	0.0 ha [0.0 ac] (0.0%)	3,077 ha [7,604 ac] (7.3%)
Reservoirs	3.4 ha [8.4 ac] (0.2%)	97.7 ha [241.4 ac] (0.2%)
Transportation	9.7 ha [24 ac] (0.4%)	53.3 ha [131.6 ac] (0.1%)
Industrial	2.0 ha [5.0 ac] (0.1%)	2.0 ha [5.0 ac] (0.1%)
Source: AUC, 2014a		

3.2.2 Hunting and Recreation

There are hunting and recreation opportunities within Campbell County and surrounding counties. However, hunting and recreational activities are limited within the proposed project area because a majority of the land is privately owned. Access to hunting and other recreational activities on privately owned land requires permission of the landowner. State-owned land within the proposed Reno Creek ISR Project area is accessible via County Road 22 (Clarkelen Road) and provides dispersed recreational activities, such as hunting. Large game hunting in the area includes pronghorn antelope and mule deer (see SEIS Section 3.6). The proposed project area spans two Wyoming Game and Fish Department (WGFD) pronghorn and mule deer Herd Units: the Pumpkin Buttes Unit north of State Highway 387 and the North Converse Unit south of State Highway 387. Other hunting opportunities in the vicinity include small game such as cottontail rabbits and white-tailed jackrabbits.

Local recreational attractions include Thunder Basin National Grassland, Fort Reno historic site, and the historic Bozeman Trail. The Thunder Basin National Grassland offers activities such as biking, camping, hunting, hiking, horseback riding, and off-road vehicle use. Although the Thunder Basin National Grassland exists within the proposed project area, the lands within and surrounding the proposed project area are privately owned. As noted previously, hunting and recreational activities on privately owned land require permission of the landowner.

The Fort Reno site is 61 km [38 mi] northwest of the proposed project area and is under private ownership. The Bozeman Trail, much of which is under private ownership, passes 19 km

[12 mi] west of the project area. In addition to the local recreation attractions, communities (Gillette, Wright, Kaycee, Midwest, and Edgerton) within 80 km [50 mi] of the proposed project area provide a variety of recreational activities. Municipal and private campgrounds in these communities offer activities such as fishing, hiking, hunting, off-road vehicle use, horseback riding, biking, and picnicking. Other recreational areas provided in these communities include golf courses, rodeo grounds, parks, recreation centers, and swimming pools.

3.2.3 Minerals and Energy

The proposed project area would be located in the Powder River Basin (PRB), which contains major deposits of coal, CBM, uranium, and oil and gas. The closest coal mines to the proposed project area would be the North Antelope, Rochelle, and Thunder Basin coal mines, approximately 26 km [16 mi] to the east. There is extensive CBM production within and surrounding the proposed project area. Within 3.2 km [2 mi] of the proposed project boundary, there are 324 wells used for CBM production. Forty-six producing CBM wells are located within the proposed project boundary. Existing gas pipeline and infrastructure associated with CBM development within and surrounding the proposed project area are shown in SEIS Figure 3-3.

Several licensed and proposed ISR facilities are located within the Pumpkin Buttes Uranium District. The closest operational ISR facility to the proposed Reno Creek ISR Project area is at the Willow Creek–Christensen Ranch site, located approximately 27 km [17 mi] northwest. Several licensed and proposed ISR facilities are also located within the Southern Powder River Basin Uranium District south of the proposed project area in Converse County, Wyoming. These ISR facilities are within 80 km [50 mi] of the proposed project area. Licensed and proposed ISR sites within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project are listed in SEIS Table 3-4.

There is extensive oil and gas production surrounding the proposed project area. Locations of wells and associated oil and gas fields are shown in SEIS Figure 3-4. A review of records from the Wyoming Oil and Gas Conservation Commission (WOGCC) indicates that there are 144 wells associated with oil and gas production within an 8-km [5-mi] radius of the proposed project boundary. Of these wells, 47 are currently producing oil or gas and 9 are active injector wells. Producing oil and gas fields, producing formations, and total well depths are listed in SEIS Table 3-5. Two producing oils wells and two permanently abandoned wells are located within the proposed Reno Creek ISR Project area (see SEIS Figure 3-4). The producing wells are in the northeast part of the proposed project area in the K-Bar Field. Additional information about abandoned boreholes and wells can be found in SEIS Section 3.4.1.2 (*Artificial Penetrations*).

3.2.4 Utilities and Transportation

Overhead power lines associated with CBM development exist within the proposed project area. In addition, large scale oil and gas pipelines occur within and outside the proposed project area (see SEIS Figure 3-1). Smaller pipelines and utilities associated with CBM operations exist within the proposed project area (see SEIS Figure 3-3).

State Highway 387 is the primary route connecting nearby communities to the proposed project area (see SEIS Figure 3-1). Private access roads extend from State Highway 387 to access agricultural land, oil and gas, and CBM facilities in the proposed project area. State

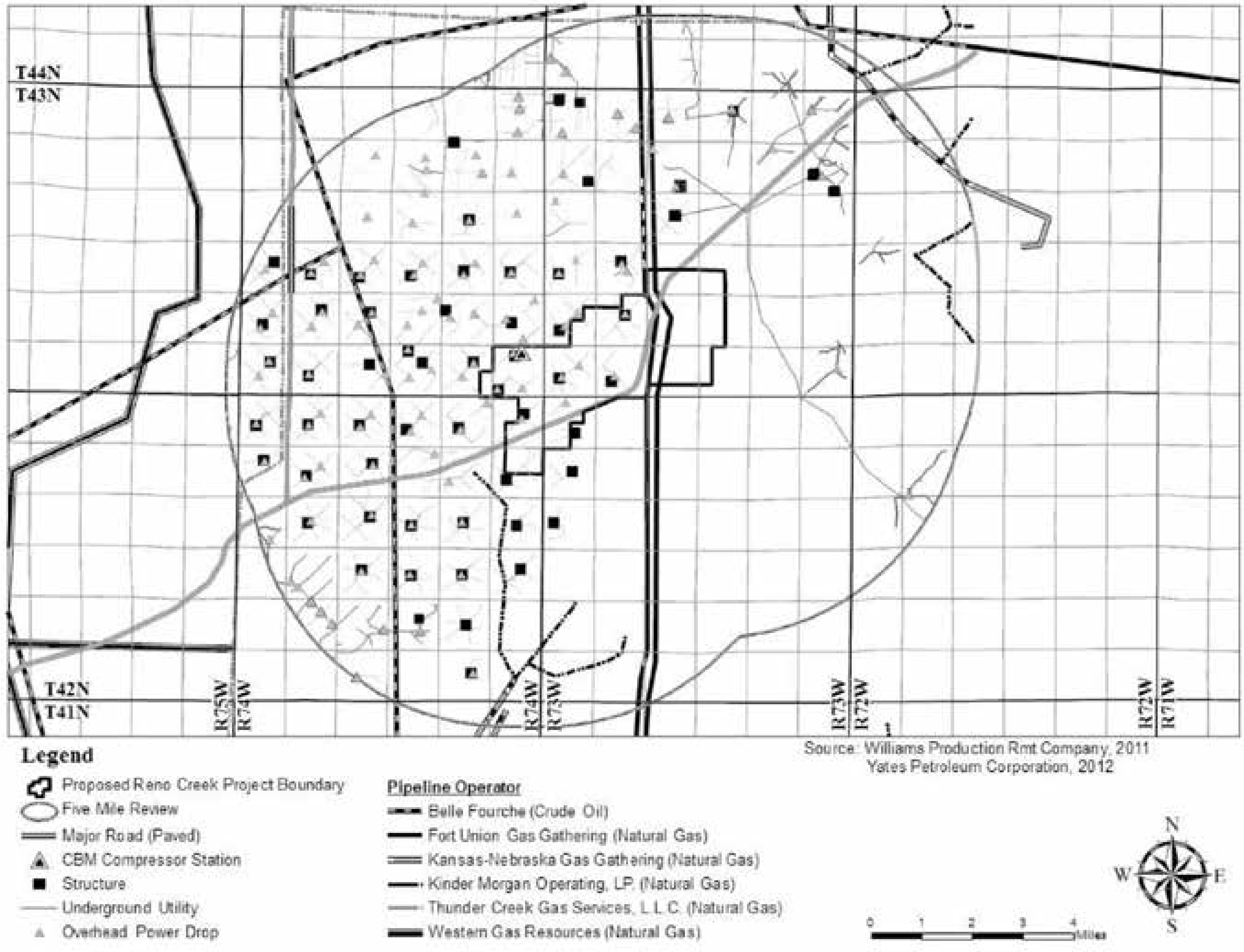

Figure 3-3. Existing CBM Infrastructure Within 8 km [5 mi] of the Proposed Reno Creek ISR Project Area (AUC, 2014a)

Table 3-4. Licensed and Proposed ISR Projects Within 80 km [50 mi] of the Proposed Reno Creek ISR Project Area

Project	Company/ Owner	Uranium District	County	Status	Approx. Distance km [mi]	Direction
Smith Ranch–Highland Ranch	Power Resources, Inc.	Southern Powder River Basin	Converse	Licensed	61 [38]	South
Moore Ranch	Uranium One Americas, Inc.	Pumpkin Buttes	Campbell	Licensed	13 [8]	SW
Nichols Ranch	Uranerz Energy Corp.	Pumpkin Buttes	Campbell and Johnson	Licensed	24 [15]	WNW
Willow Creek	Uranium One Americas, Inc.	Pumpkin Buttes	Johnson	Licensed	35 [22]	NW
North Butte	Power Resources, Inc.	Pumpkin Buttes	Campbell	Licensed	26 [16]	NW
Ruth	Power Resources, Inc.	Pumpkin Buttes	Johnson	Licensed	25 [16]	WSW
Ruby Ranch	Power Resources, Inc.	Pumpkin Buttes	Campbell	Proposed	10 [6]	NW
Collins Draw	Uranerz Energy Corp.	Pumpkin Buttes	Campbell	Letter of Intent 2008	19 [12]	West
Reynolds Ranch	Cameco Resources, Inc.	Southern Powder River Basin	Converse	Licensed	58 [36]	South
Ludeman	Uranium One Americas, Inc.	Southern Powder River Basin	Converse	Proposed	80 [50]	South
Allemand-Ross	Uranium One Americas, Inc.	Southern Powder River Basin	Converse	Proposed	32 [20]	SSW

Sources: NRC (2014); AUC (2012a)

Highway 387, Clarkelen Road, and Cosner Road provide access to nearby residences outside the proposed project area.

3.3 Transportation

This section describes the transportation infrastructure and conditions in the region surrounding the proposed Reno Creek ISR Project. As described in SEIS Section 2.1.1.1.7, the applicant has proposed to use trucks to ship equipment, supplies, and produced materials, including wastes, during the lifecycle of the proposed project. The Burlington Northern Santa Fe (BNSF) railroad runs from north to south approximately 20 km [12.5 mi] east of the proposed project area (SEIS Figure 3-5). The BNSF railroad is used primarily to ship coal from mining operations in eastern Wyoming. The applicant does not anticipate using the BNSF railroad as a transportation option for any of the proposed project operations. There are no navigable waterways within close proximity that provide transportation access to the proposed project.

The town of Wright, Wyoming is located approximately 12 km [7.5 mi] northeast of the proposed Reno Creek ISR Project. SEIS Figure 3-5 shows the transportation corridor of the region surrounding the proposed project area, and SEIS Figure 3-1 provides a closer view of the immediate proposed project area and the existing transportation infrastructure. Access to the proposed project area from nearby communities is from State Highway 387, which traverses the

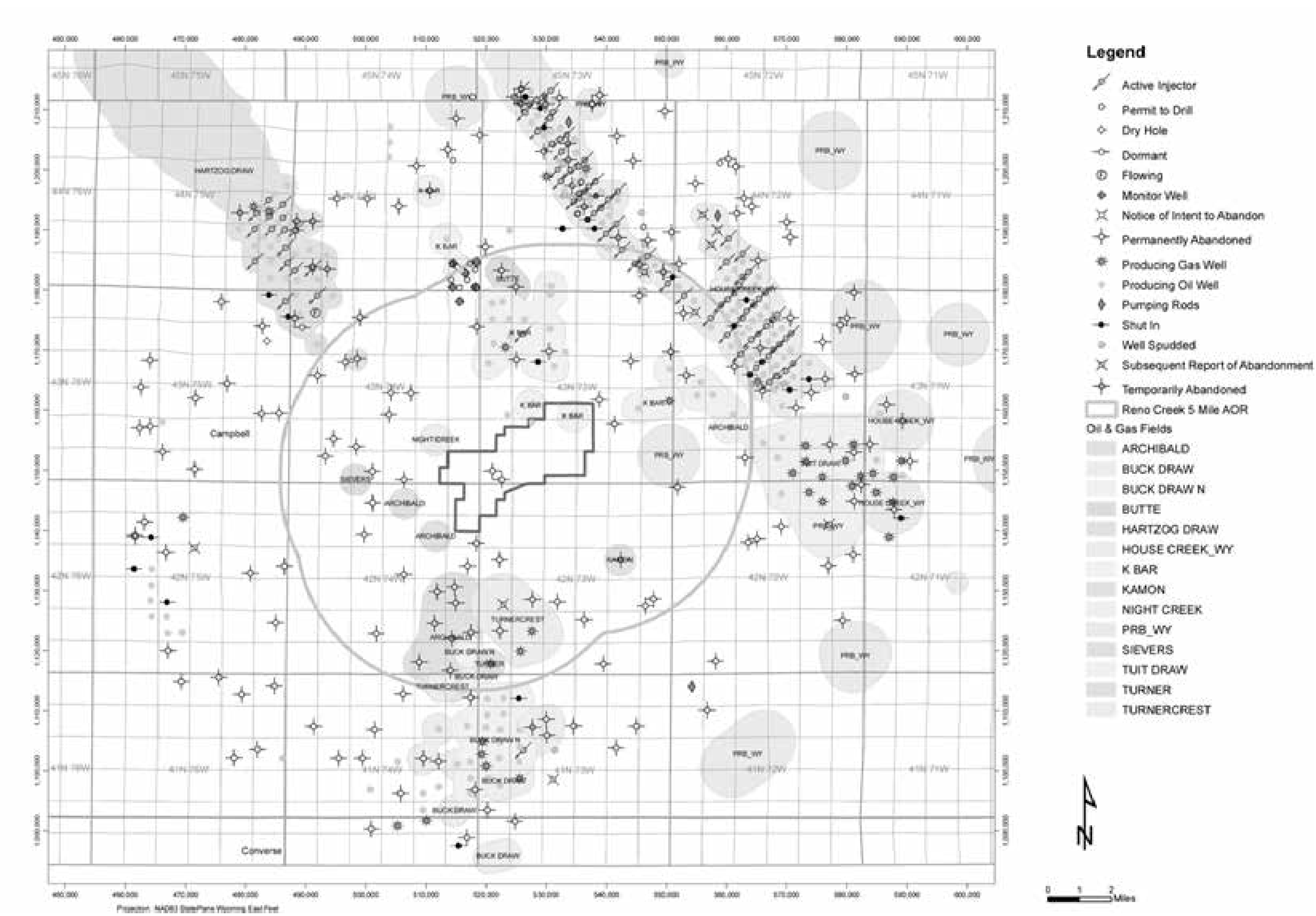

Figure 3-4. Oil and Gas Wells Within 16 km [10 mi] of the Proposed Reno Creek ISR Project Area (AUC, 2014a)

Table 3-5. Producing Oil and Gas Fields Within 8 km [5 mi] of the Proposed Reno Creek ISR Project Area		
Field Name	**Producing Formation(s) (number of wells)**	**Total Well Depth(s) {m [ft]}**
K-Bar	Parkman (7) Parkman and Turner (8) Parkman, Turner, and Niobrara (2) Parkman, Turner, and Sussex (1) Muddy, Parkman, and Turner (1)	2,352–2,896 [7,717–9,500] 3,185–3,624 [10,450–11,891] 3,250–3,261 [10,662–10,700] 3,261 [11,700] 3,619 [11,875]
House Creek	Sussex (10)	2,515–2,583 [8,253–8,475]
Tuit Draw	Parkman and Turner (2) Turner (3)	3,152–3,157 [10,340–10,358] 3,170–3,504 [10,400–11,495]
Buck Draw North	Dakota (3)	3,819–3,836 [12,530–12,585]
Turnercrest	Dakota (2) Frontier (1)	3,818–3,829 [12,525–12,562] 3,848 [12,625]
WC	Parkman (1) Parkman and Turner (2)	3,258 [10,690] 3,287–3,692 [10,786–12,114]
Archibald	Frontier (2)	3,778–3,853 [12,396–12,642]
Night Creek	Turner (1)	3,796 [12,454]
Sievers	Shannon (1)	3,580 [11,745]
Sources: AUC, 2012a; WOGCC, 2014		

proposed project area (see SEIS Figure 3-1). State Highway 387 runs east to west from Wright to the town of Midwest, where it connects with U.S. Interstate Highway (IH) 25. Two transportation routes (State Highways 50 and 59) are available to access the proposed project area from the city of Gillette, located approximately 66 km [41 mi] to the north (SEIS Figure 3-6). State Highway 50 runs south from Gillette and connects with State Highway 387 approximately 7.2 km [4.5 mi] west of the proposed project area. State Highway 59 also runs south from Gillette and connects with State Highway 387 at Wright, located approximately 12 km [7.5 mi] northeast of the proposed project area. State Highways 387, 50, and 59 are two-lane, asphalt-paved highways, which are maintained year round. Lane width on these highways is approximately 3.65 m [12 ft] and, based on varying shoulder width, total width of the paved roadway ranges from 7.9 to 12.1 m [26 to 40 ft] (AUC, 2012a). Routine maintenance on the state highways includes snow and debris removal, grading, and road repairs.

Access from State Highway 387 to the location of the proposed Reno Creek CPP is along Clarkelen Road (County Road 22) (see SEIS Figure 3-1). Clarkelen Road is currently used for agricultural and oil and gas activities in the area. The proposed CPP is approximately 550 m [1,800 ft] north of the intersection of Clarkelen Road and State Highway 387 (AUC, 2012a). Cosner Road (County Road 25) and Turnercrest Rd (County Road 22) are other county roads that traverse the project area (see SEIS Figure 3-1). Clarkelen/Turnercrest Road and Cosner Road are improved, all-weather, unpaved roads. These county roads are maintained and are in fair condition. However, Clarkelen Road may require improvements to accommodate trucks and heavy equipment access during the construction, operations, and decommissioning phases of the proposed project (AUC, 2012a).

SEIS Table 3-6 lists traffic counts recorded in 2014 at three automated traffic counter locations on the state highways in the vicinity of the proposed project. The automated traffic counters are operated by the Wyoming Department of Transportation (WYDOT). The location of the automated traffic counters is shown in SEIS Figure 3-6. Projected traffic volumes for the traffic counter locations in 2015, 2020, and 2030 are also listed in SEIS Table 3-6.

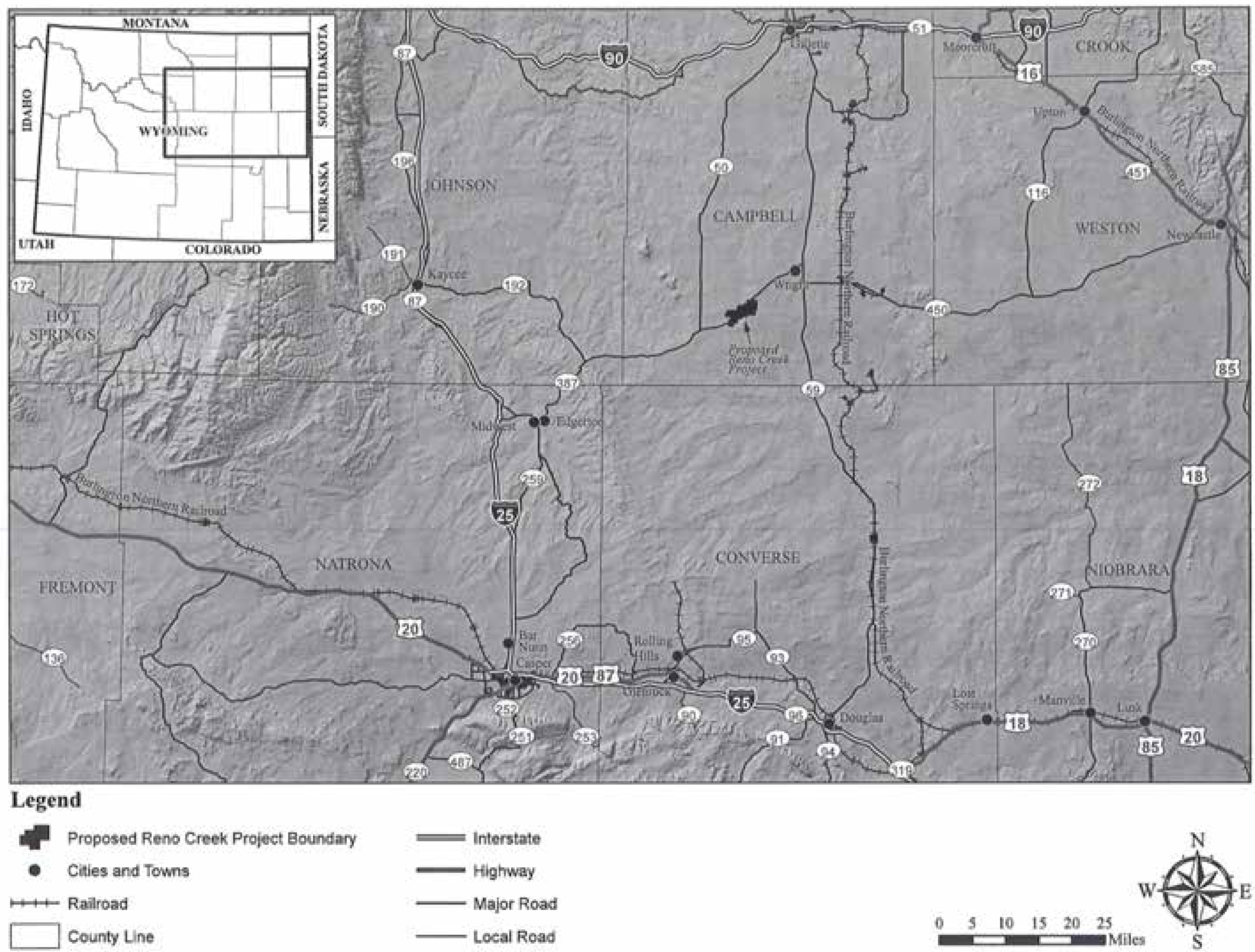

Figure 3-5. Transportation Corridor Surrounding the Proposed Reno Creek ISR Project (AUC, 2014a)

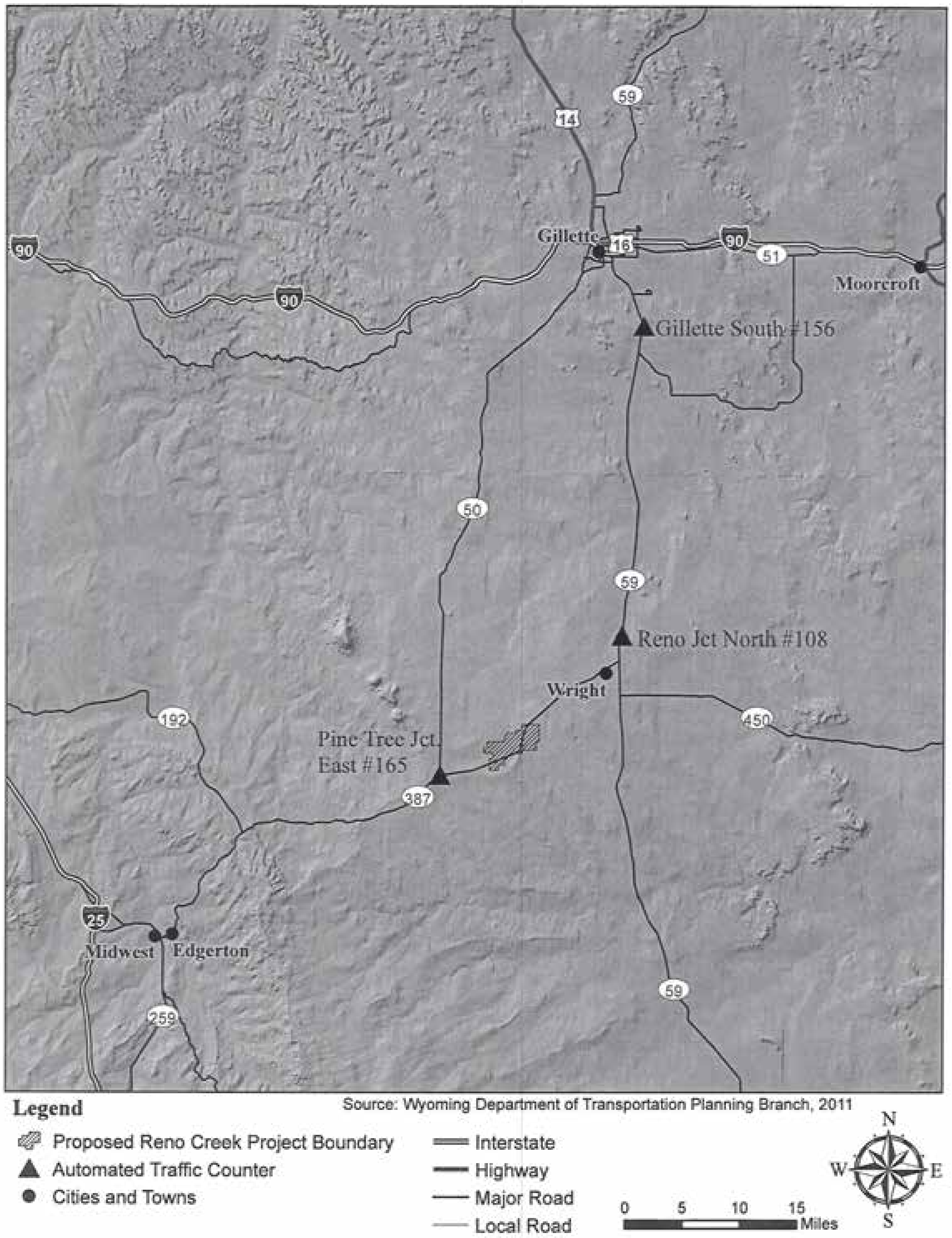

Figure 3-6. Locations of Automated Traffic Counters (AUC, 2014a)

Table 3-6. 2014 and Projected Annual Average Daily Traffic in the Vicinity of the Proposed Reno Creek ISR Project								
	2014*		**2015†**		**2020†**		**2030†**	
Traffic Counter (Location)	**All Vehicles**	**Trucks**	**All Vehicles**	**Trucks**	**All Vehicles**	**Trucks**	**All Vehicles**	**Trucks**
Reno Junction North (State Highway 59 milepost 75.21)	5,163	784	5,240	807	5,645	870	6,551	1,010
Gillette South (State Highway 59 milepost 103.12)	6,656	834	6,756	859	7,278	925	8,447	1,074
Pine Tree Junction (State Highway 387 milepost 136.2)	1,645	437	1,670	450	1,799	485	2,088	563

Sources: WYDOT (2013, 2014)
*Traffic counts are annual average daily traffic for both directions of travel for year 2014 from WYDOT (2013, 2014).
†Projected traffic counts based on 1.5 percent annual increase of year 2014 traffic counts from WYDOT (2013, 2014).

Projected traffic volumes were calculated using a 1.5 percent annual rate of increase, which WYDOT uses when available site-specific data are limited (AUC, 2012a). Traffic volumes on the county roads in the vicinity of the proposed project (e.g., Clarkelen/Turnercrest Road and Cosner Road) are not available. There are few residences along these roads (see SEIS Figure 3-1) and therefore little traffic. Peak traffic on the county roads occurs in the summer and fall when outdoor recreation is greatest (AUC, 2012a).

The Campbell County Coal Belt Transportation Study (Kadrmas, Lee, and Jackson, Inc., 2010) provides insights into the ability of the existing roadway network in Campbell County to accommodate increases in traffic levels due to future growth. The objective of this study was to develop a comprehensive transportation plan that services the primary coal, oil, and gas production areas within Campbell County. Based on WYDOT automated daily traffic count information on state highways in Campbell County, the study estimated a rural 2-lane highway hourly capacity of 1,375 vehicles. This estimate accounted for known roadway conditions such as terrain, grade, truck traffic, and peak-hour volumes. The study concluded that present traffic volumes on roads in Campbell County are low when compared to existing capacity, and that the existing roadway network has sufficient capacity to accommodate projected future increases in traffic levels (Kadrmas, Lee, and Jackson, Inc., 2010).

3.4 Geology and Soils

GEIS Section 3.3.3 provides a description of the geology and soils of the PRB and the Pumpkin Buttes Uranium District (SEIS Figure 3-7). The structural geology, stratigraphy, uranium mineralization, soil characteristics, and seismology of the proposed project area are described in the following sections.

3.4.1 Geology

3.4.1.1 Powder River Basin

The PRB is a large structural and topographic depression parallel to the Rocky Mountain Range. Within the Wyoming East Uranium Milling Region, the PRB encompasses an area of approximately 31,000 km^2 [12,000 mi^2] in Campbell, Johnson, and Converse Counties, Wyoming (NRC, 2009). As described in the GEIS Section 3.3.3, uranium was first discovered in the PRB in 1951 near the Pumpkin Buttes (Davis, 1969). Other uranium deposits were found

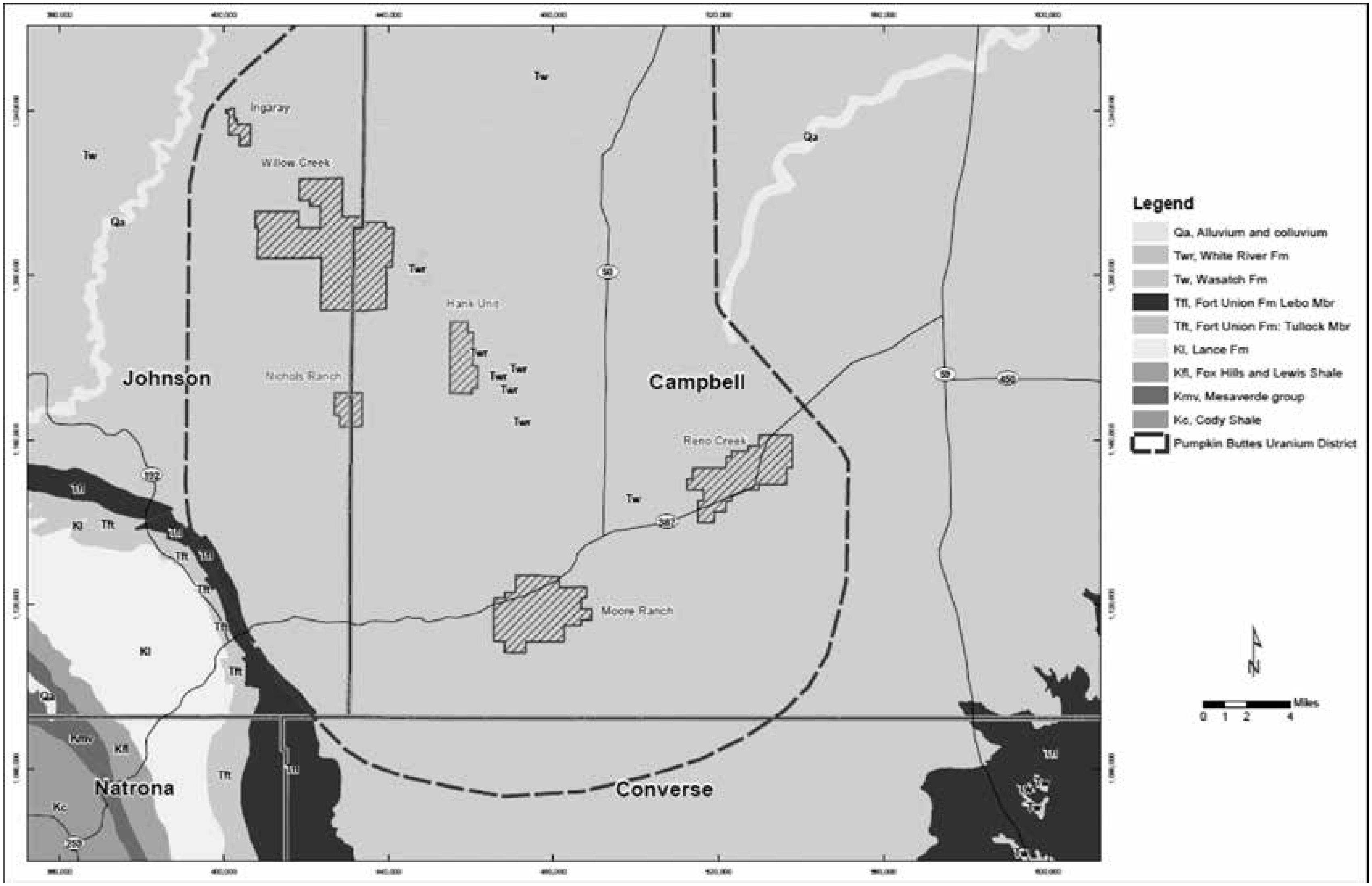

Figure 3-7. Geologic Map of the Pumpkin Buttes Uranium District in the Powder River Basin Showing the Locations of Active ISR Projects (Modified From AUC, 2012b)

along a 97-km [60-mi] northwest-southeast trend in the southwest part of the basin, and production began in 1953. Active ISR projects (i.e., projects that are licensed or undergoing licensing) include Moore Ranch, Willow Creek, and Irigaray (Uranium One Inc.); Nichols Ranch and Hank Unit (Uranerz Energy Corporation); and Reno Creek (AUC) (SEIS Figure 3-7). Some of these projects have also requested license amendments for expansions in the area.

Structural Geology

The PRB is a north-northwest trending synclinal basin extending over northeastern Wyoming and southeastern Montana. The basin is bounded by the Hartville Uplift and the Laramie Range to the south, the Black Hills to the east, and the Big Horn Mountains to the west. The PRB comprises marine and continental strata ranging in age from recent (Holocene) to early Paleozoic (SEIS Figure 3-8). These sediments were deposited on a basement complex of Precambrian igneous and metamorphic rocks. In the deepest parts of the basin, sediments reach a maximum thickness of about 6,100 m [20,000 ft]. Within the proposed Reno Creek ISR Project area, the top of the Precambrian basement is estimated to be about 5,300 m [17,500 ft] below ground surface (SEIS Figure 3-8).

During the Paleozoic, most of northeastern Wyoming was a continental shelf covered by shallow marine seas. Deposition of marine limestone, shale, and sandstone occurred during this time. In the late Paleozoic and early Mesozoic, periods of marine regression and transgression deposited sequences of marine sand and carbonates interbedded with nonmarine clastic sediments. Following an extended period of stability during the Mesozoic, tectonic forces in the Paleocene to early Eocene triggered mountain building events related to the Laramide Orogeny. During this time, the PRB was the site of active subsidence surrounded by uplift of the Big Horn Mountains, Laramie Mountains, and Black Hills. Erosion of these highlands produced clastic sediments, which now constitute the Tertiary-age sedimentary strata in the basin. During the Oligocene, regional volcanism to the west of the basin resulted in deposition of tuffaceous claystone, sandstone, and conglomerate. Sediments deposited in the basin have been undergoing erosion since the Pleistocene. Most recently, Holocene alluvium has filled channels eroded into the older rocks.

Stratigraphy

As described in the GEIS, the upper part of sedimentary sequence present in other portions of central Wyoming has been eroded away in the PRB, leaving only the Tertiary-aged White River, Wasatch, and Fort Union Formations. The White River Formation is of Oligocene age and is the shallowest Tertiary unit in the PRB. Underlying the White River Formation is the Eocene age Wasatch Formation. The Paleocene age Fort Union Formation directly underlies the Wasatch Formation, which directly overlies the Cretaceous Lance Formation.

The White River Formation is the youngest Tertiary unit that exists in the PRB. Remnants of the White River Formation are found on top of the Pumpkin Buttes, located approximately 16 km [10 mi] west-northwest of the proposed Reno Creek ISR Project. A basal conglomerate of the White River Formation forms the resistant cap rock of the Pumpkin Buttes. Elsewhere, the White River Formation consists of thick sequences of buff-colored tuffaceous sedimentary strata mixed with lenses of fine sandstone and siltstone. The White River Formation does not contain significant uranium resources in the Pumpkin Buttes area.

The Wasatch Formation underlies the White River Formation and consists of interbedded mudstones, carbonaceous shales, silty sandstones, and relatively clean sandstones. In the

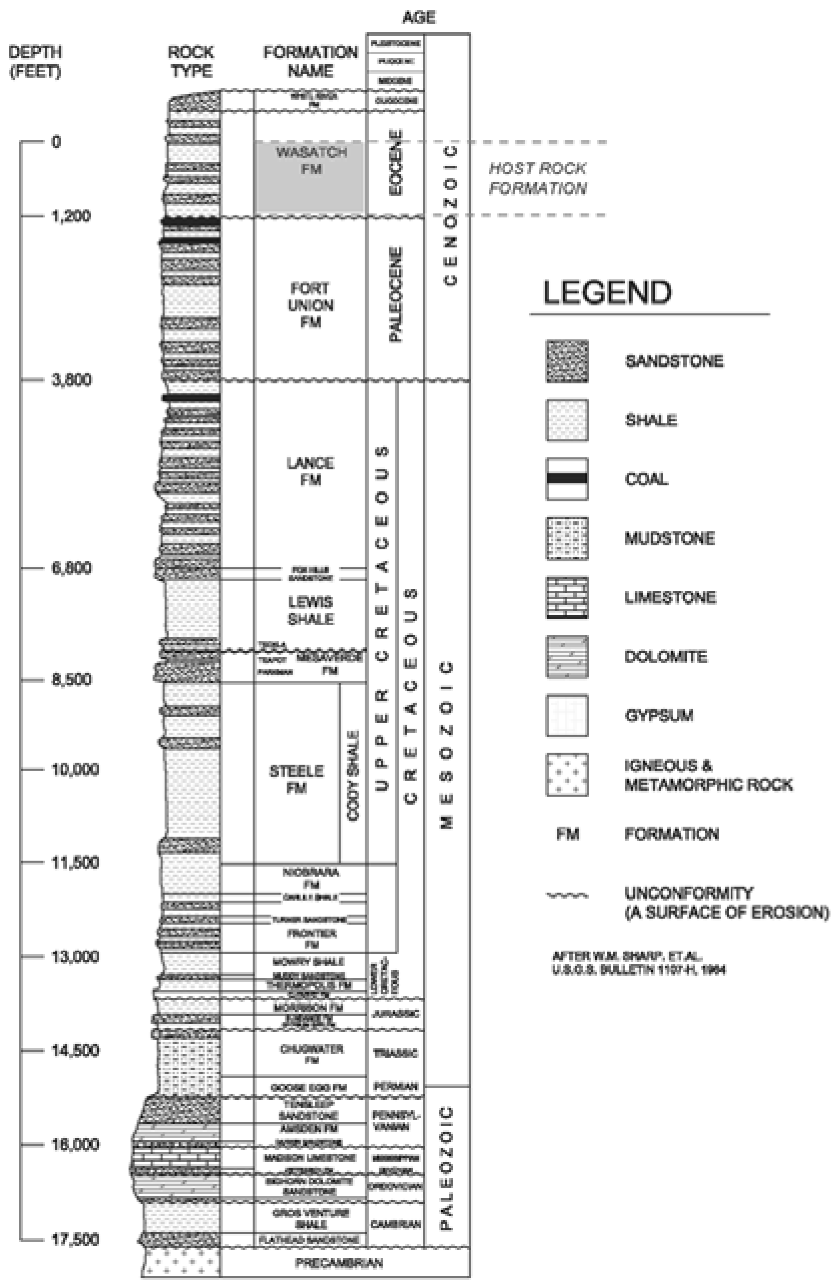

Figure 3-8. Stratigraphic Section for the Powder River Basin (AUC, 2014a)

vicinity of the Pumpkin Buttes, the Wasatch Formation is approximately 480 m [1,575 ft] thick (Sharp and Gibbons, 1964). The interbedded mudstones, siltstones, and relatively clean sandstones in the Wasatch Formation have varying degrees of lithification from uncemented to moderately well cemented sandstones to weakly compacted and cemented mudstones to fissile shales. The Wasatch Formation contains significant uranium resources and hosts the uranium ore bodies at the proposed Reno Creek ISR Project (AUC, 2012a).

The Fort Union Formation is lithologically similar to the Wasatch Formation in the PRB. The Fort Union Formation includes interbedded silty claystones, sandy siltstones, relatively clean sandstones, claystones, and coal. These units display varying degrees of lithification ranging from uncemented sands to moderately well cemented siltstones and sandstones. The total thickness of the Fort Union Formation varies between about 610 and 1,070 m [2,000 and 3,500 ft] (Sharp and Gibbons, 1964). The Fort Union Formation contains significant uranium resources at various locations in the basin and is also the target formation for CBM extraction operations.

The Upper Cretaceous Lance Formation underlies the Fort Union Formation and consists of 305 to 915 m [1,000 to 3,000 ft] of thinly bedded sandstones and shales. The upper part contains minor, dark carbonaceous shales and thin coal seams.

In the central part of the PRB, at least 3,050 m [10,000 ft] of mostly marine shales and mudstones underlie the Upper Cretaceous Lance Formation. Sandstone beds below the Lance Formation are found in the Cretaceous Fox Hills Formation and the Teckla, Teapot, and Parkman members of the Mesa Verde Formation. The Teapot and Parkman Sandstones are currently used in the PRB for disposal of ISR byproduct waste in Class I Underground Injection Control (UIC) disposal wells. These sandstones occur at depths ranging from approximately 2,165 to 2,485 m [7,100 to 8,150 ft]. The Teckla, Teapot, and Parkman Sandstones are also potential oil and gas targets in the PRB. Deeper oil and gas targets include the Cretaceous age Niobrara Shale and Turner Sandstone. These formations are over 610 m [2,000 ft] deeper than the Teckla, Teapot, and Parkman Sandstones (AUC, 2012i).

3.4.1.2 Reno Creek ISR Project Area Geology

As described in the GEIS, the primary hosts for uranium mineralization in the Pumpkin Buttes Uranium District, are sandstones of the lower Wasatch Formation (NRC, 2009). Harshman (1968) described the Wasatch Formation as consisting of interbedded arkosic sandstone, conglomerate, siltstone, mudstone, and carbonaceous shale, all compacted but uncemented to moderately well-cemented.

Structural Geology

The proposed project area lies within a portion of the PRB that dips to the northwest at approximately one degree (Fox and Higley, 1987). Based on structure maps and structural cross sections constructed from historic and recent geophysical and lithologic logs, mineralized sandstones, confining units, and marker beds within the proposed project area dip gently to the northwest and do not indicate the presence of faults (AUC, 2012a,b).

Stratigraphy

The Wasatch Formation outcrops at the surface in the proposed project area, except where it is occasionally covered by recent alluvium deposited in shallow drainages. As described previously, the Wasatch Formation consists of interbedded mudstones, carbonaceous shales, silty sandstones, and relatively clean sandstones. The upper Wasatch Formation has been eroded away in the proposed project area. The lower Wasatch Formation is the host for the uranium deposits at the proposed project. SEIS Figure 3-9 shows a typical geophysical log summarizing the stratigraphic nomenclature used to describe mineralized and confining units within the Wasatch Formation at the proposed project area. SEIS Figure 3-10 displays a cross section constructed from geophysical logs showing the position of mineralized and confining units within the Wasatch Formation.

The host sandstone for uranium mineralization at the proposed Reno Creek ISR Project is termed the Production Zone Aquifer (PZA) (AUC, 2012a). The PZA is laterally continuous across the proposed project area and ranges in thickness from less than 23 m [75 ft] to as much as 67 m [220 ft]. Discontinuous mudstone lenses of varying lateral extent are common within the PZA, and uranium mineralization can be found both above and below the mudstone lenses. At various localities in the proposed project area, all horizons from the base to the top of the PZA contain uranium mineralization (AUC, 2012b). However, the lower half of the PZA typically contains the most economically significant uranium mineralization.

The lowermost unit of the Wasatch Formation in the proposed project area is termed the Underlying Aquitard (UA). The UA lies below the PZA and above the Badger Coal. The top of the Badger Coal is considered the base of the Wasatch Formation in the proposed project area. An isopach map constructed by the applicant indicates that the UA ranges from approximately 46 to 76 m [150 to 250 ft] thick within the proposed project area (AUC, 2012b). The UA consists of laterally continuous silt and clay-rich mudstones. Discontinuous lenticular sandstones of varying thickness and lateral extent are present within the UA. The first significant sandstone underlying the PZA is termed the Underlying Unit (UM Unit) (see SEIS Figure 3-10).

The Overlying Aquitard (OA) occurs above the PZA and consists of a laterally continuous sequence of silt and clay-rich mudstones, thin coal seams, and discontinuous sandstones. The Upper and Lower Felix Coal seams form laterally continuous marker beds within the lower part of the OA. The Upper and Lower Felix Coal seams range from 1.5 to 3 m [5 to 10 ft] in thickness and are separated by approximately 1.5 m [5 ft] of mudstone. The Upper Felix Coal seam is not present in the western portion of the proposed project area. The Felix Coal seams are not targets for CBM production within the proposed project area.

The first significant sandstone above the Felix Coal is termed the Overlying Aquifer (OM Unit). Sandstones comprising the OM Unit are discontinuous, contained within mudstones of the OA, and difficult to correlate over distances exceeding several hundred meters [a few thousand feet]. In the central part of the project area, the OM Unit is well developed and approximately 27.4 m [90 ft] thick. A discontinuous water table zone, termed the Shallow Water Table Unit (SM Unit), has also been identified by drilling within the proposed project area. The shallowest water level in the SM Unit is approximately 10.7 m [35 ft] below ground surface.

Hydrologic characteristics (e.g., permeability and porosity) of the stratigraphic units within the Wasatch Formation (e.g., the PZA, OM Unit, UA, and OA) are described in SEIS Section 3.5 (Water Resources).

The Fort Union Formation, which unconformably underlies the Wasatch Formation, is composed of continental and nonmarine deposits consisting of fine-grained sandstones, interbedded shales, carbonaceous shale, and coal. According to Hodson (1973), the Fort Union Formation

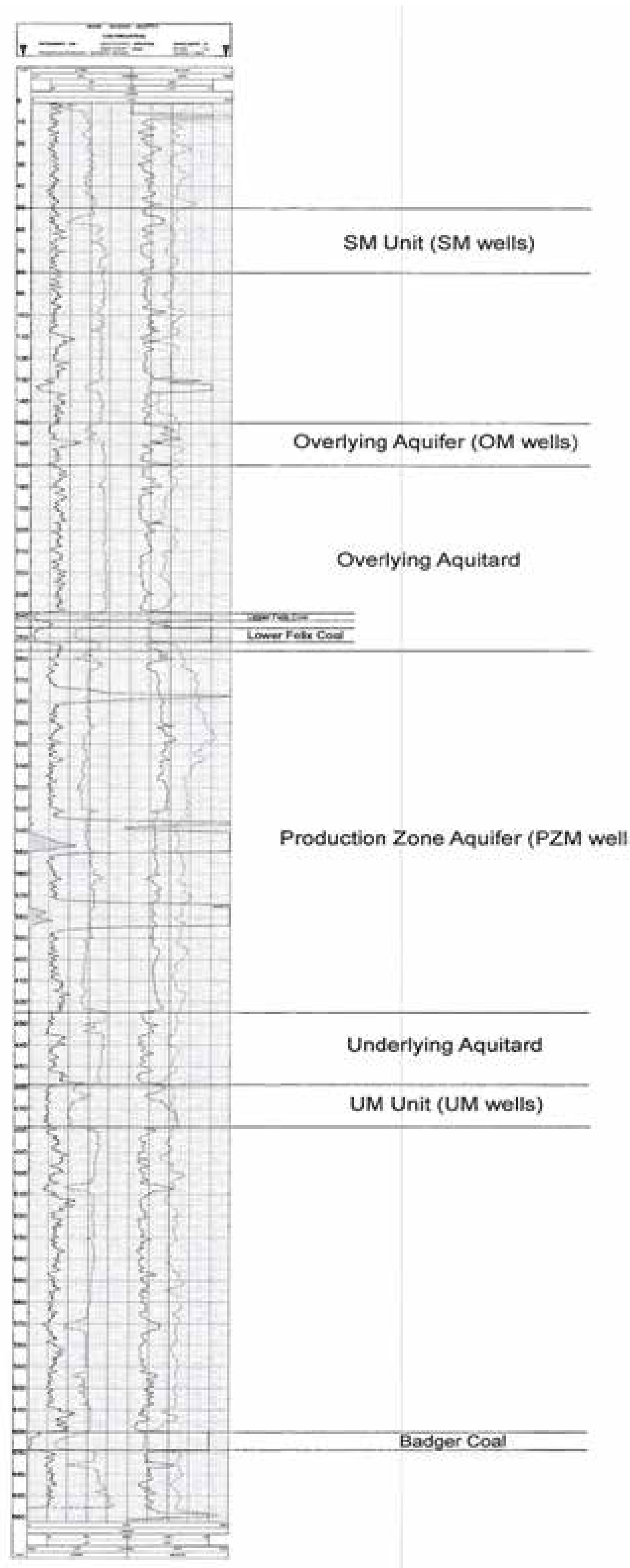

Figure 3-9. Typical Geophysical Log (AUC, 2014a)

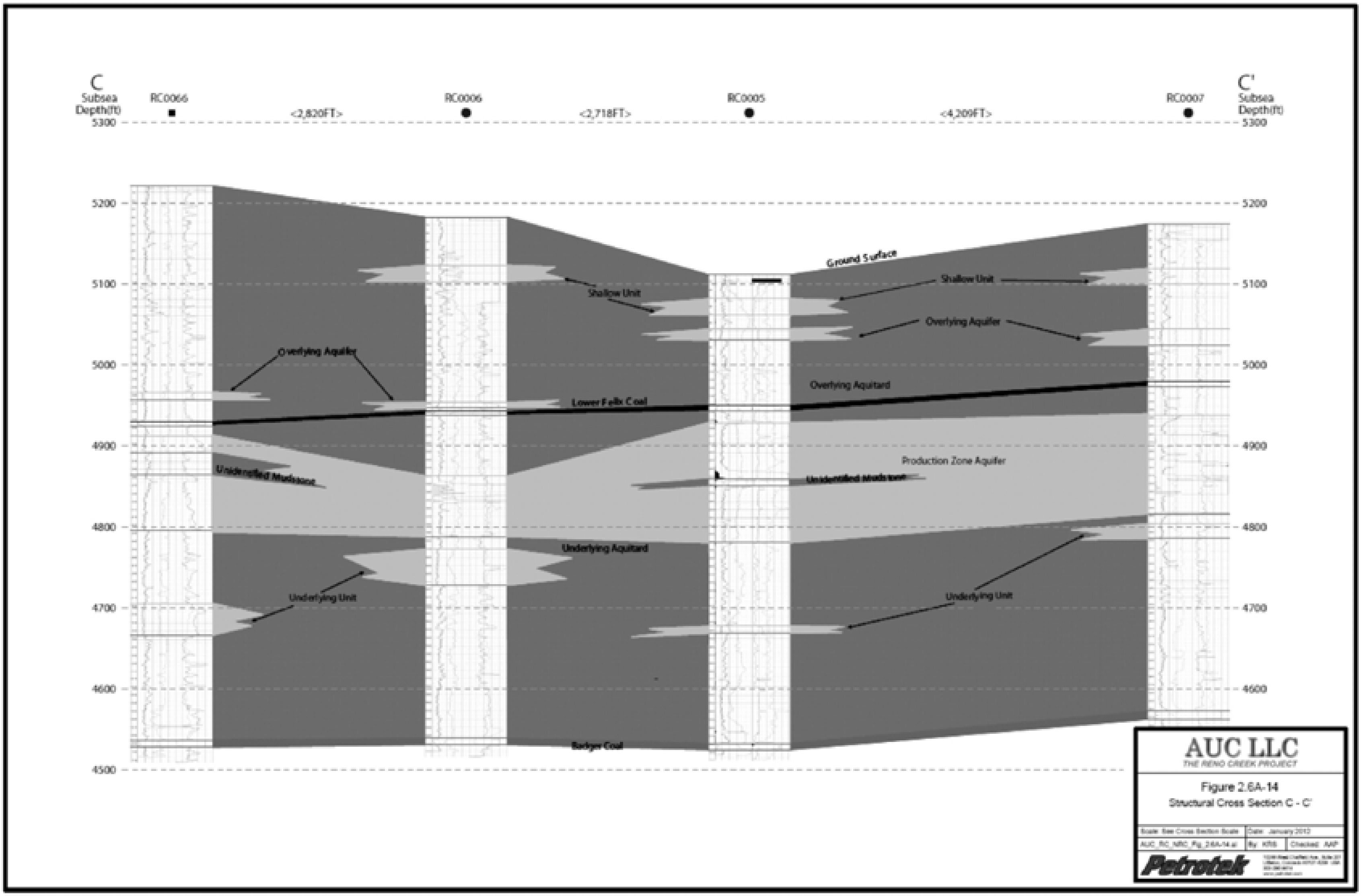

Figure 3-10. Structural Cross Section Trending Northwest-to-Southeast Across the Eastern Part of the Proposed Reno Creek ISR Project Area (AUC, 2012b)

is approximately 884 m [2,900 ft] thick in the southwest PRB where the proposed Reno Creek ISR Project would be located. The Fort Union Formation is a major source of coal in the PRB and hosts significant volumes of exploitable CBM reserves. Coal mines are located approximately 12.9 km [8 mi] east of Wright, Wyoming, along the north-south trending outcrop of the Fort Union Formation. The closest coal mines to the proposed project area are the North Antelope, Rochelle, and Thunder Basin coal mines, approximately 26 km [16 mi] to the east. These coal mines produce from the Anderson/Big George coal seams, which are within the Fort Union Formation. The Anderson/Big George coal seams can reach thicknesses of over 30.5 m [100 ft]. The CBM production that is present within the proposed project area is from the Anderson/Big George Coal. The Anderson/Big George coal seams are approximately 305 to 335 m [1,000 to 1,100 ft] below ground surface in the proposed project area and approximately 183 m [600 ft] below the base of the PZA (the sandstone unit proposed for ISR operations).

The Fort Union Formation is underlain by the Cretaceous Lance Formation, which is in turn underlain by a thick sequence of older sandstones, mudstone, and shales. The Wyoming Department of Environmental Quality (WDEQ) has authorized the applicant to drill, complete, and operate four deep Class I disposal wells and thereby inject radionuclide-bearing liquid waste streams into the Teckla Sandstone member of the Lewis Formation and Teapot Sandstone member of the Cretaceous Mesa Verde Formation (WDEQ, 2015). The Teapot Sandstone member is approximately 2,130 to 2,400 m [7,000 to 7,860 ft] below ground surface in the proposed project area (WDEQ, 2015). The Teapot member is characterized by marine, coarsening-upward sandstone intervals within thick intervals of shale. In the proposed project area, the Teapot Sandstone member is overlain by the Lewis Shale, a low-permeability marine shale with a thickness of approximately 259 m [850 ft] (including the Teckla Sandstone member).

Uranium Mineralization

Uranium deposits within the PZA sandstone of the Wasatch Formation are present as roll-front deposits at the proposed Reno Creek ISR Project area. GEIS Section 3.1.2.1 (NRC, 2009) describes the formation and characteristics of roll-front uranium deposits in the western United States, which includes the Wyoming East Uranium Milling Region. Uranium mineralization at the proposed project area is confined to the host sandstone of the PZA (AUC, 2012a,b). Uranium deposits within the PZA are found within a sand unit ranging from 15.2 to 61 m [50 to 200 ft] thick, and at depths from 52 to 137 m [170 to 450 ft] below ground surface. As described previously, discontinuous mudstone lenses of varying lateral extent are common within the PZA, and uranium mineralization can be found both above and below the mudstone lenses. Uranium intercepts vary in thickness from 0.3 to 12.2 m [1 to 40 ft]. The uranium mineralization typically occurs as coatings on sand grains. As discussed in GEIS Section 3.1.2.1, the principal uranium ore minerals found in roll-front deposits are coffinite and pitchblende (a form of uraninite). The source of uranium in roll-front uranium deposits in the PRB is unknown. Proposed uranium sources include (i) leached uranium from overlying ash-fall tuffs, (ii) leached uranium from igneous and metamorphic rocks in the highlands surrounding the basin, and (iii) leached uranium from the sandstones themselves (Harris and King, 1993). Although the estimate of recoverable uranium resources has not been fully developed, the applicant estimates that at the proposed Reno Creek ISR Project there is approximately 7.1 million kg [15.7 million lb] of uranium at an average grade of approximately 0.065 percent U_3O_8 (yellowcake) (AUC, 2012a).

Artificial Penetrations

The Reno Creek area has been extensively explored for uranium resources since the late 1960s (AUC, 2012a). Within the proposed Reno Creek ISR Project boundary, former operators drilled approximately 2,665 exploration holes. Approximately 100 of the holes were cased wells that were plugged and abandoned. An additional 215 drill holes are within 0.8 km [0.5 mi] of the proposed project boundary. From 2010 through 2012, the applicant drilled 807 exploration holes. Of these holes, 45 were cased and would remain in place as groundwater monitoring wells. The remaining 762 were plugged and abandoned, in accordance with WDEQ rules and regulations (WDEQ, 2013b). Rocky Mountain Energy (formerly operating in the proposed project area) conducted integrity testing during 1982 to determine whether historical exploration holes drilled prior to enactment of drill hole abandonment regulations had naturally sealed themselves. The integrity testing indicated that old drill holes have been sealed by either natural swelling clays or by plug gel, which was used in accordance with regulatory requirements after 1980 (AUC, 2012d). While the integrity testing indicates that replugging old drill holes may not be necessary, the applicant has committed to ensure that unplugged drill holes would not impact human health and the environment during ISR operations (AUC, 2012a). These commitments include pump testing and hydrogeologic characterization to identify and plug old drill holes in proximity to proposed production units in the wellfields.

3.4.2 Soils

The topography of the proposed Reno Creek ISR Project area consists of rolling hills and ridges, as well as drainages. Soils in the proposed project area are typical of semi-arid grasslands and shrublands in the western United States and are classified as Ustic Paleagids, Ustic Haplargids, Ustic Torriorthents, and Ustic Haplocambids. Parent soil material includes colluvium, residuum, and alluvium. To provide site-specific soil characteristics, the applicant had a soil survey conducted over the entire 2,451 ha [6,057 ac] of the proposed project area (AUC, 2012a). All phases of the soil survey (sampling, laboratory analysis, and interpretation of results) were carried out in accordance with WDEQ guidelines (WDEQ, 1994).

Results of the soil survey indicated that soils within the proposed project area are generally fine textured, with patches of sandy textures on upland areas and fine-textured soils occurring near or in drainages. Deep soils are found on lower toe slopes and flat areas near drainages. Shallow and moderately deep soils are located on upland ridges and shoulder slopes. SEIS Table 3-7 summarizes areas, soil salvage depths, and soil erosion properties for each soil unit mapped within the proposed project area. Approximate salvage depths ranged from 0.06 to 1.1 m [0.2 to 3.6 ft] and averaged about 0.4 m [1.31 ft]. The potential for wind and water erosion is mainly a factor of surface soil characteristics, including texture and organic matter content. Based on the survey results, the hazard for wind and water erosion within the proposed project area varies from slight to severe. Surface horizons throughout the proposed project area have a fine-loamy to sandy texture, which makes the soils more susceptible to wind erosion.

3.4.3 Seismology

No faulting has been identified within the entirety of the proposed project area (AUC, 2012a). As mentioned previously, structure maps and structural cross sections constructed from historic and recent geophysical and lithologic logs do not indicate the presence of faults within mineralized sandstones, confining units, and marker beds at the proposed project (AUC, 2012a,b). According to the U.S. Geological Survey (USGS) Quaternary Fault and Fold Database, no capable faults (faults that have discernable surface expression that have

Table 3-7. Soil Mapping Unit Area, Soil Salvage Depth, and Erosion Hazard*					
Map Unit Description	**Area, ha [ac]**	**% Total Area**	**Salvage Depth, m [ft]**	**Water Erosion Hazard**	**Wind Erosion Hazard**
Birdman Loam	57.52 [142.13]	2.35	0.3 [1]	Moderate	Slight
Bowbac Sandy Loam	13.94 [34.44]	0.57	0.06 [0.2]	Slight	Moderate
Cambria Loam	341.61 [844.13]	13.94	0.36 [1.2]	Moderate	Slight
Cushman Loam	90.46 [223.54]	3.69	0.3 [1]	Moderate	Slight
Disturbed	112.98 [279.18]	4.61	0	n/a[†]	n/a
Forkwood Loam	596.70 [1,474.49]	24.34	0.27 [0.9]	Moderate	Slight
Haverdad Loam	60.43 [149.33]	2.47	0.43 [1.4]	Moderate	Moderate
Hiland Sandy Loam	105.62 [260.99]	4.31	0.46 [1.5]	Slight	Moderate
Kishona Loam	201.36 [497.56]	8.21	0.58 [1.9]	Moderate	Moderate
Shingle Loam	283.69 [701.01]	11.57	0.55 [1.8]	Moderate	Moderate
Terro Sandy Loam	66.24 [163.69]	2.7	0.91 [3]	Slight	Moderate
Theedle Loam	412.30 [1,018.81]	16.82	0.46 [1.5]	Moderate	Moderate
Tullock Loamy Sand	6.45 [15.94]	0.26	0.18 [0.6]	Slight	Severe
Ulm Clay Loam	89.28 [220.61]	3.64	0.36 [1.2]	Slight	Moderate
Vonalee Sandy Loam	10.65 [26.33]	0.43	1.1 [3.6]	Slight	Moderate
Water	2.13 [5.26]	0.09	0	n/a	n/a
Total	**2,451.36 [6,057.44]**	**100**			
Average Salvage Depth			**0.4 [1.31]**		

Source: AUC, 2012e
*Based on soil mapping unit descriptions
[†]n/a – not applicable

produced earthquakes in the last 10,000 to 100,000 years) occur within or near the proposed project area, demonstrating a low seismic potential.

The Wyoming State Geological Survey (WSGS) reported that five, magnitude 2.5 or greater, earthquakes have been recorded in Campbell County since 1967 (Case, et al., 2002). Two of these earthquakes occurred within approximately 40 km [25 mi] of the proposed Reno Creek ISR Project area. The first of these earthquakes (recorded on May 11, 1967), had a magnitude of 4.8 and was centered in southwestern Campbell County approximately 11.3 km [7 mi] north-northwest of Pine Tree Junction. The second of these earthquakes (recorded on February 24, 1993) had a magnitude of 3.6 and occurred in southeastern Campbell County approximately 16 km [10 mi] east-southeast of Reno Junction. No damage was reported for these two earthquakes. The other three earthquakes in Campbell County had magnitudes of 2.5 (recorded on October 29, 1984), 4.3 (recorded on February 18, 1972), and 5.0 (recorded on May 28, 1984) and occurred east and west of Gillette (Case et al., 2002). No damage was reported for the magnitude 2.5 and 4.3 events. The magnitude 5.0 earthquake occurred approximately 39 km [24 mi] west-southwest of Gillette and was felt in Gillette, Sheridan, Buffalo, Casper, Douglas, Thermopolis, and Sundance. No damage was reported for the magnitude 5.0 event. Earthquakes have also occurred within approximately 80 km [50 mi] of the proposed Reno Creek ISR Project area in southwestern Johnson County. A magnitude 4.7 earthquake (recorded on June 3, 1965) occurred approximately 19.3 km [12 mi] south of Kaycee, and a magnitude 4.8 earthquake (recorded September 2, 1976) occurred approximately 53 km [33 mi] northeast of Kaycee. No damage was reported from these events.

Because of the lack of known capable faults within the vicinity of the proposed project area, the most significant seismic hazards are from background earthquakes, those that could occur randomly within a defined areal seismic source or tectonic province. The magnitude and frequency of these random earthquakes is determined from statistical analyses of past earthquakes. The USGS has classified Campbell County as a tectonic province with a background earthquake having a maximum magnitude of 6.1 (Algermissen et al., 1982). In contrast, Geomatrix (1988) estimated that the largest background earthquake in Campbell County would have a maximum magnitude of 6.0–6.5, with an average maximum magnitude of 6.25. The WSGS estimated that a magnitude 6.25 floating earthquake placed 15 km [9.3 mi] from any structure in Campbell County would generate horizontal peak ground acceleration of approximately 15%g {i.e., the probability of a ground motion exceeding 15 percent of the acceleration of gravity (g = 9.8 m/s^2 [32.1 ft/s^2]) in 50 years} at the site (Case et al., 2002). Based on the Modified Mercalli Intensity scale, this acceleration could produce damage that falls within an intensity VI, which results in light damage such as fallen plaster and damaged chimneys.

3.5 Water Resources

3.5.1 Surface Water

3.5.1.1 Surface Water Features

The proposed Reno Creek ISR Project area straddles the water divide between the Upper Belle Fourche River and the Antelope Creek drainage basins (SEIS Figure 3-11). Within the proposed project area, the tributaries flow to the northwest toward the Upper Belle Fourche River and to the southeast toward Antelope Creek. As defined in GEIS Section 3.3.4.1, Figure 3-12, the Upper Belle Fourche River and Antelope Creek drainage basins are among 10 primary watersheds covering the Wyoming East Uranium Milling Region. Approximately 80 percent of the proposed project area drains into the Upper Belle Fourche River, and the remaining portion, on the eastern edge, drains into the Antelope Creek basin. All drainage channels within the proposed project area are ephemeral in nature, flowing for short durations in response to snowmelt or local precipitation events. Other surface water features within the proposed project area include manmade reservoirs or stock ponds and permitted discharge sites for CBM dewatering activities.

3.5.1.2 Surface Water Flow

The Upper Belle Fourche River originates approximately 8 km [5 mi] west of the proposed project area boundary, flows eastward through the proposed project area then bends northward, continues as the Belle Fourche River, and turns eastward to join the Cheyenne River in South Dakota. The Cheyenne River ultimately flows into the Missouri River. The proposed project area lies within the uppermost subwatershed of the Upper Belle Fourche River, which is identified by USGS Hydrologic Unit Code 101202010101. This subwatershed covers an area of 185 km^2 [72 mi^2]. The average discharge rate for the Belle Fourche River is 0.12 m^3/s [4.33 ft^3/s], based on measurements at USGS Gaging Station 06425780 located 45 km [28 mi] northeast of the proposed project boundary (AUC, 2012a). Antelope Creek runs south of the proposed project area and flows eastward into the Cheyenne River. The eastern edge of the proposed project area is drained by two ephemeral tributaries of Antelope Creek, namely Spring Creek {HUC 101201010302; 165 km^2 [65 mi^2]} and Porcupine Creek {HUC 101201010303; 165 km^2 [65 mi^2]}. The average discharge rates for Antelope Creek and Porcupine Creek are 0.27 and 0.01 m^3/s [9.37 and 0.29 ft^3/s], respectively (USGS Gaging Stations 06364700 and 06364300; AUC, 2012a).

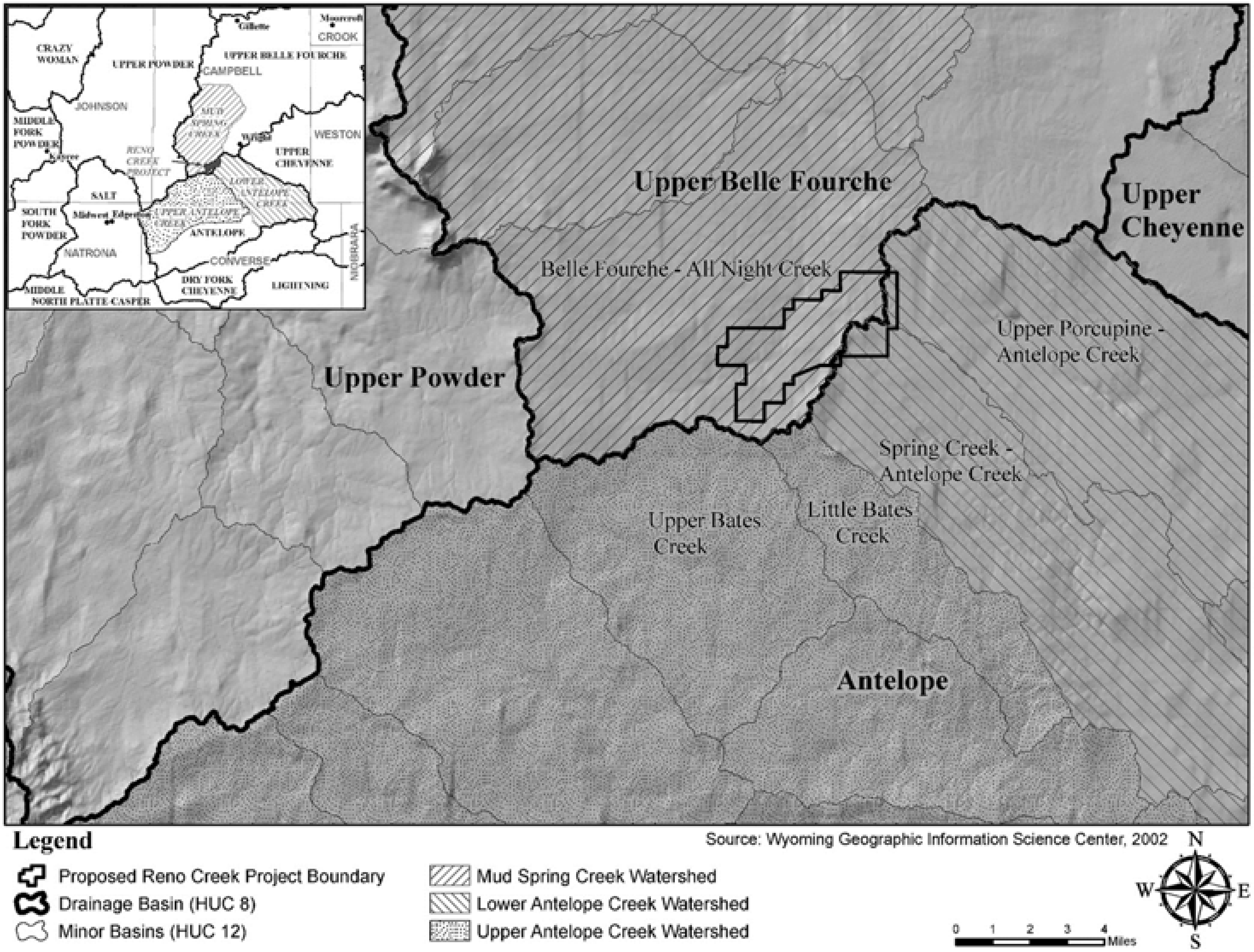

Figure 3-11. Map Showing the Upper Belle Fourche River and Antelope Creek Drainage Basins in Relation to the Proposed Reno Creek ISR Project and Subbasin Characteristics Used for the Watershed Hydrological Simulation (Modified From AUC, 2012b)

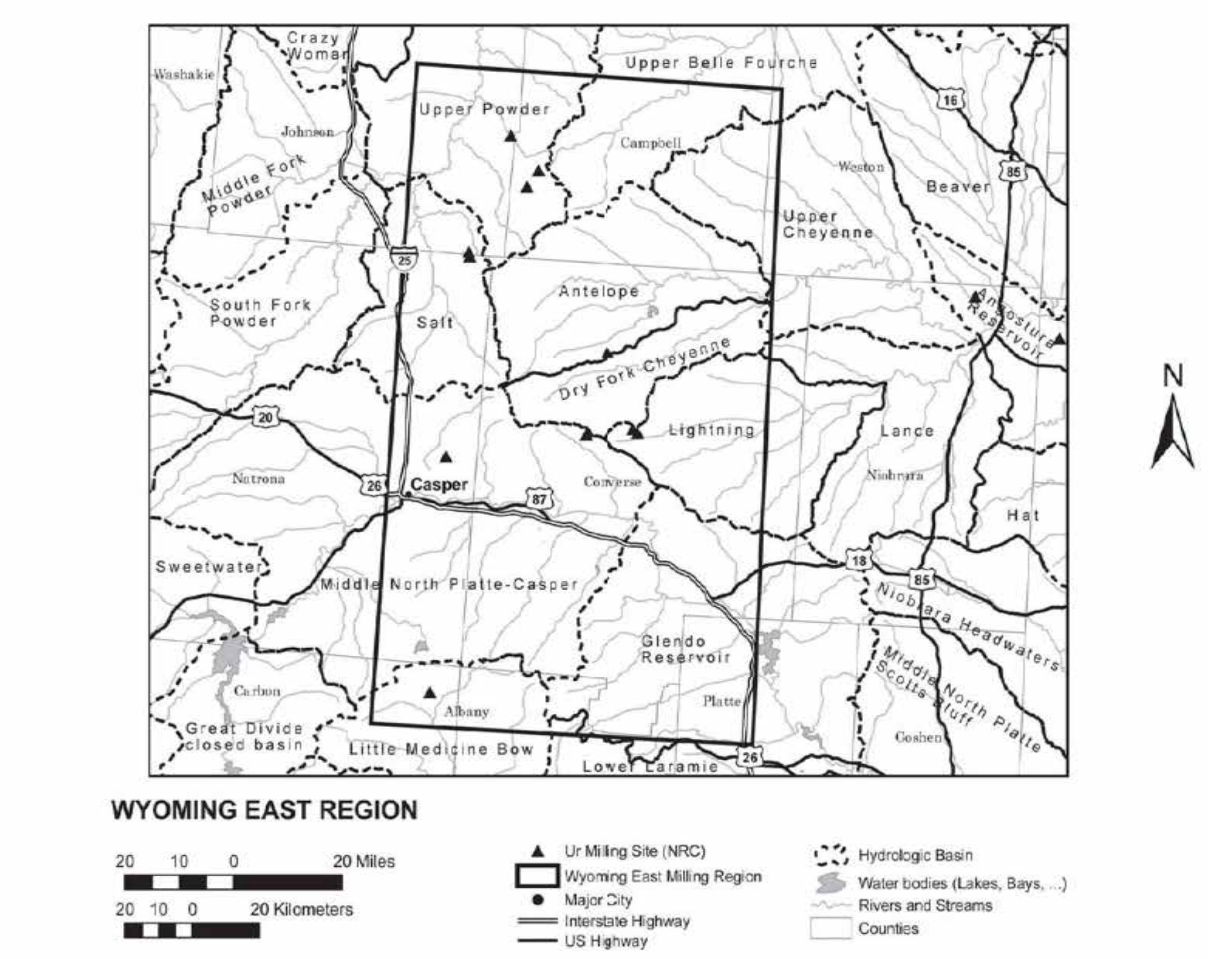

Figure 3-12. Watersheds Within the Wyoming East Uranium Milling Region (NRC, 2009)

The applicant developed floodplain models for the Upper Belle Fourche River channel. The smaller ephemeral tributaries were excluded from the flood inundation analysis due to small watershed area and lack of a floodplain. The floodplain model was limited to the proposed project area to determine the extent of potential inundation of the proposed project from a simulated 100-year flood event (AUC, 2012a). Results of the modeling showing the areal extent of a 100-year flood, with respect to proposed project facilities and wellfields, are provided in SEIS Figure 3-13. The modeling results indicate that, except for small portions of some proposed wellfields, most of the proposed project facilities would be located outside the estimated 100-year flood inundation boundary of the Upper Belle Fourche River. In particular, the CPP, which is proposed to be located on a hill to minimize the risk of inundation, would be approximately 520 m [1,700 ft] from the estimated 100-year flood inundation boundary of the Upper Belle Fourche River.

3.5.1.3 Surface Water Quality

According to the Wyoming state classification of designated uses, water bodies within this region are classified mainly as Class 3B surface waters suitable for recreation, aquatic life other than fish, wildlife, agriculture, industry, and scenic value (WDEQ, 2013a). Within the proposed

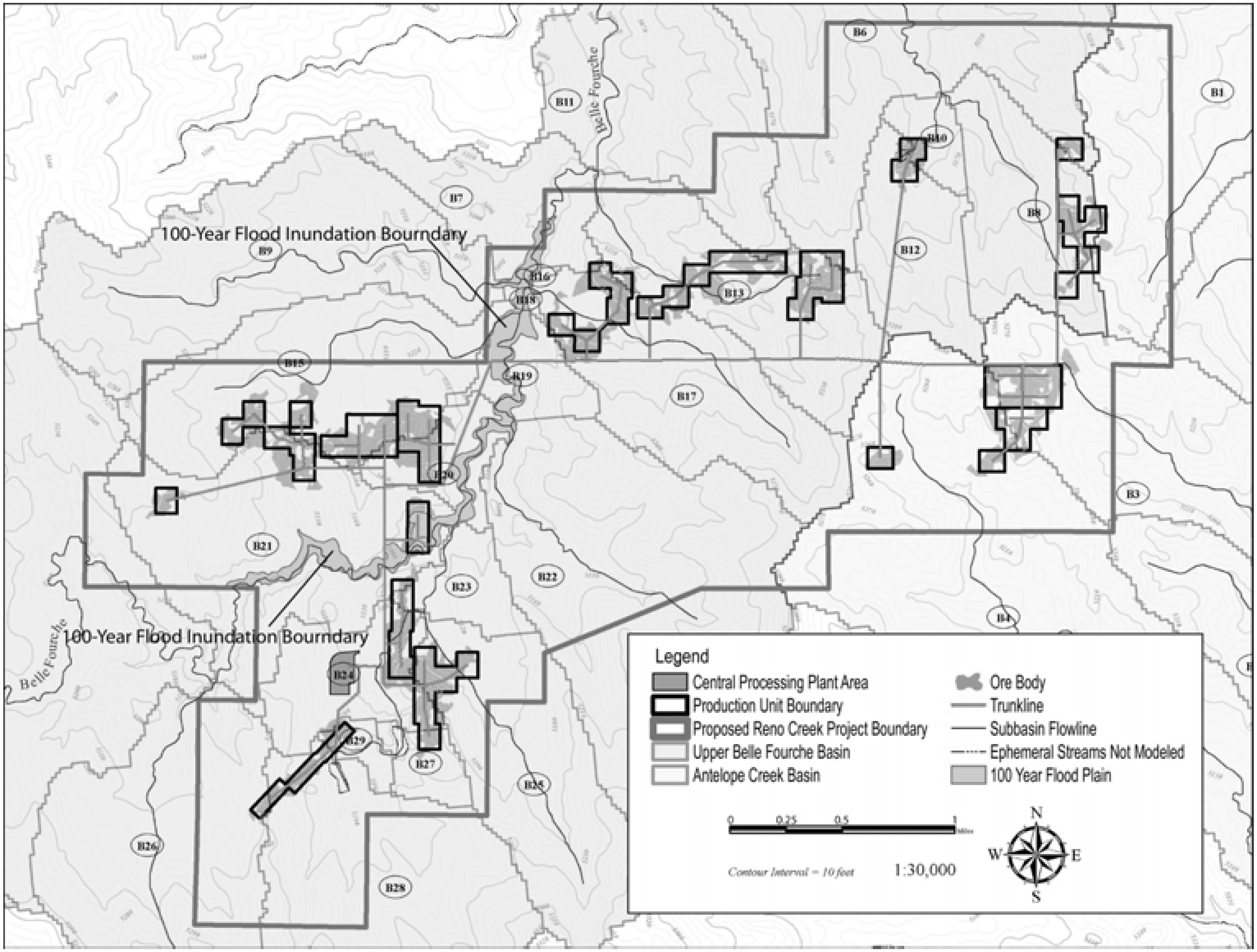

Figure 3-13. Map Showing the Modeled 100-Year Flood Inundation Boundary of the Belle Fourche River Within the Proposed Reno Creek ISR Project Area (Modified From AUC, 2012b)

project area, Porcupine Creek, Spring Creek, and the tributaries of the Upper Belle Fourche River are classified as Class 3B surface waters. The Belle Fourche River itself is classified as Class 2AB, which is suitable for all uses, including drinking and fish consumption.

To provide baseline water quality information for the proposed project, the applicant collected surface water samples quarterly from 21 locations within and surrounding the proposed project area (SEIS Figure 3-14). The sample locations consisted of existing stock ponds or areas in drainages where ponding occurs. Sampling was conducted from September 2010 to January 2012. Several of the sampling locations were dry at the time of sampling because of the ephemeral nature of streams and drainages in the area, which contain water only from storm runoff, snowmelt, and CBM contributions. Because sampling sites were often dry, six sampling locations had just one set of water quality data, eight locations had two samples, and one location had three samples. Only four sites had complete quarterly samples, while no samples were collected from two sites that remained dry during all four quarterly sampling events. Seven of the sites sampled for the baseline studies are located close to Wyoming Pollutant Discharge Elimination System (WYPDES)-permitted CBM outfalls. Of these, three sites had complete quarterly samples, one location had three samples, and three locations had two samples. SEIS Table 3-8 summarizes the sample results for locations with two or more quarterly samples collected. The tabulated value for each water quality parameter and sampling location is the average of the quarterly samples collected.

SEIS Table 3-8 also includes the State of Wyoming surface water quality standards for sample parameters (WDEQ, 2013a). The baseline surface water quality results presented in Table 3-8 indicated exceedances of the state surface water standards for pH, turbidity, and arsenic. Samples from locations SW18 and SW22 indicated pH levels outside the range of values considered suitable for all designated uses. Arsenic values exceeded the state standard at SW3 and SW22. These three sampling sites are located near CBM outfalls regulated under WYPDES permits. Except at three sampling sites (SW13, SW14, and SW19), turbidity values exceeded the state standards. SW13 and SW14 are located within the Antelope Creek basin, while SW19 is within the proposed project area in a tributary of the Belle Fourche River.

3.5.1.4 Wetlands

The applicant performed a wetland delineation survey of the proposed Reno Creek ISR Project area in accordance with the U.S. Army Corps of Engineers (2010) methodology. Potential wetlands were identified by vegetation and hydrology indicators determined from orthophotography maps, soil maps, the U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory mapping application, and pedestrian reconnaissance. Additionally, subsurface soil sampling was conducted to determine the presence of wetland criteria indicators.

The wetland survey identified a total of 17.12 ha [42.23 ac] of wetlands within the proposed project area, consisting of 8 wetland classes, based on Cowardin et al. (1979) and the National Wetland Inventory classification system (SEIS Table 3-9). These wetlands are mostly of the Palustrine Emergent (PEM) designation and were found mainly within the channels of the Belle Fourche River and its tributaries (see Addendum 3.5-F, Figure 1; AUC, 2012f). The PEM wetlands are not continuous and often are isolated by upland swales or manmade berms created within the channel.

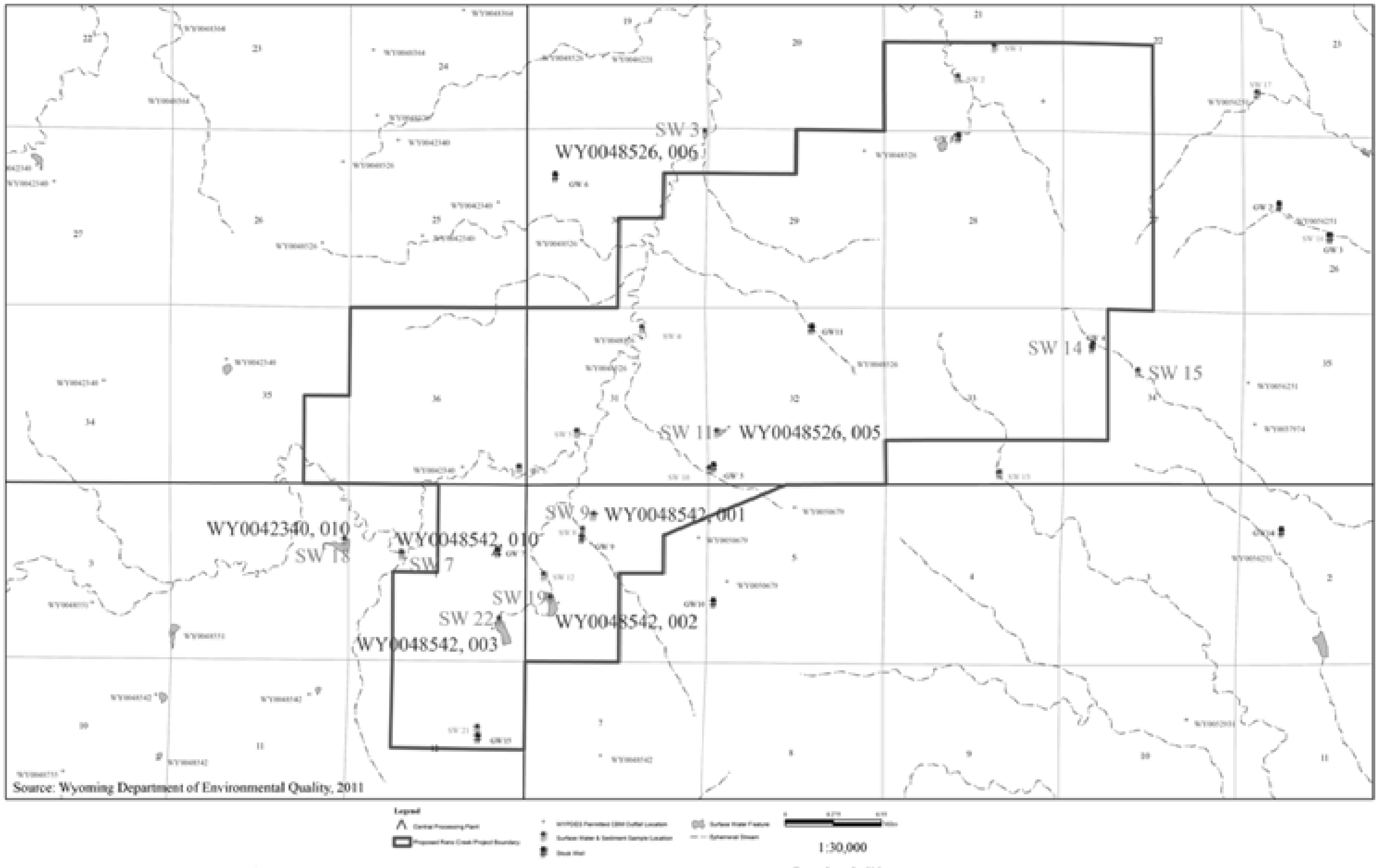

Figure 3-14. Map Showing Surface Water Sampling Locations Within the Proposed Reno Creek ISR Project Area. (Modified From AUC, 2012b)

Table 3-8. Surface Water Quality at the Proposed Reno Creek ISR Project*										
Sample Parameter	Unit	WDEQ Standard	Sampling Locations							
			SW1	SW3	SW7	SW9	SW10	SW11	SW13
Field pH	S.U.	6.5–9.0	7.82	8.58	8.25	8.55	8.12	8.72	7.80
Laboratory pH	S.U.	6.5–9.0	7.95	8.70	7.95	8.35	8.40	8.68	8.00
Dissolved Oxygen	mg/L	4 (minimum)	7.69	8.92	10.05	9.68	9.88	9.42	170.00
Electrical Conductivity	µohms/cm		1,671	1,464	297	172	513	888	195
Total Dissolved Solids	mg/L		1,515	1,245	200	120	310	615	130
Total Suspended Solids	mg/L		33.50	575.00	26.00	10.00	40.00	56.00	10.50
Turbidity	NTU	10	31.45	2515.00	24.00	20.75	81.70	158.28	9.95
Chloride	mg/L		18.00	17.00	2.00	2.00	6.00	7.75	4.00
Sulfate	mg/L		824	6	62	5	10	16	14
Arsenic	mg/L	0.01	0.003	0.012	0.005	0.006	0.008	0.008	0.002
Cadmium	mg/L	0.005	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL
Chromium	mg/L	0.1	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL
Copper	mg/L	1	LLDL	0.02	LLDL	0.23	LLDL	LLDL	LLDL
Lead	mg/L	0.015	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL
Mercury	mg/L	0.00005	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL
Nickel	mg/L	0.61	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL
Selenium	mg/L	0.05	LLDL	0.006	LLDL	LLDL	LLDL	0.005	LLDL
Zinc	mg/L	5	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL	LLDL
Uranium	mg/L	0.03	0.0131	0.0068	0.0028	0.0015	0.0029	0.0045	0.0013
Iron	mg/L		2.03	44.75	0.66	1.30	2.33	4.07	0.38
Manganese	mg/L		0.34	0.82	0.07	0.03	0.12	0.10	0.04
Gross Alpha	pCi/L	15	10.20	6.55	2.60	2.05	3.50	6.23	2.00
Lead 210	pCi/L		1.20	6.80	LLDL	9.50	1.10	2.15	LLDL
Radium 226+228	pCi/L	5	0.30	4.90	LLDL	LLDL	1.90	1.67	LLDL
			SW14	SW16	SW17	SW18	SW19	SW22	
Field pH	S.U.	6.5–9.0	8.02	8.26	7.66	9.15	8.04	9.48	
Laboratory pH	S.U.	6.5–9.0	8.25	7.90	7.70	8.93	8.03	9.53	
Dissolved Oxygen	mg/L	4 (minimum)	10.04	9.72	7.84	9.61	8.53	12.99	
Electrical Conductivity	µohms/cm		1,049	2,203	145	946	2,860	797	
Total Dissolved Solids	mg/L		720	1,180	185	728	2,693	485	
Total Suspended Solids	mg/L		5.50	116.25	26.00	41.25	12.67	11.25	
Turbidity	NTU	10	9.85	71.00	63.95	56.58	8.77	28.30	
Chloride	mg/L		4.00	6.00	3.00	17.50	15.67	8.25	
Sulfate	mg/L		413	1,158	LLDL	167	1,682	28	
Arsenic	mg/L	0.01	0.003	0.002	0.006	0.010	0.003	0.013	

Table 3-8. Surface Water Quality at the Proposed Reno Creek ISR Project* (Continued)								
Sample Parameter	Unit	WDEQ Standard	Sampling Locations					
			SW14	SW16	SW17	SW18	SW19	SW22
Cadmium	mg/L	0.005	0.001	LLDL	LLDL	LLDL	LLDL	LLDL
Chromium	mg/L	0.1	0.01	LLDL	LLDL	LLDL	LLDL	LLDL
Copper	mg/L	1	0.01	LLDL	LLDL	LLDL	LLDL	LLDL
Lead	mg/L	0.015	0.01	LLDL	LLDL	LLDL	LLDL	LLDL
Mercury	mg/L	0.00005	0.001	LLDL	LLDL	LLDL	LLDL	LLDL
Nickel	mg/L	0.61	0.05	LLDL	LLDL	LLDL	LLDL	LLDL
Selenium	mg/L	0.05	0.005	LLDL	LLDL	LLDL	LLDL	LLDL
Zinc	mg/L	5	0.01	LLDL	LLDL	LLDL	LLDL	LLDL
Uranium	mg/L	0.03	0.0041	0.0008	LLDL	0.0101	0.0041	0.0019
Iron	mg/L		0.53	2.20	4.66	1.87	0.61	1.25
Manganese	mg/L		0.10	0.12	0.16	0.07	0.60	0.04
Gross Alpha	pCi/L	15	3.65	3.00	2.00	9.28	4.13	2.78
Lead 210	pCi/L		2.00	2.18	2.60	1.18	2.13	2.15
Radium 226+228	pCi/L	5	1.40	1.47	LLDL	1.75	2.93	1.43

*Source: AUC (2015b). WDEQ Standards obtained from WDEQ (2013a).
LLDL = Less than laboratory detection limit.
All values are in mg/L, which is equivalent to ppm

Table 3-9. Wetland Types Found in the Proposed Reno Creek ISR Project Area	
Wetland Classification	**Area {Ha [Ac]}**
Palustrine Aquatic Bed Semipermanently Flooded Diked (PABFh)	3.15 [7.78]
Palustrine Emergent Temporarily Flooded (PEMA)	6.89 [17.02]
Palustrine Emergent Temporarily Flooded Diked (PEMAh)	4.15 [10.26]
Palustrine Emergent Saturated (PEMB)	0.03 [0.08]
Palustrine Emergent Seasonally Flooded (PEMC)	2.19 [5.42]
Palustrine Emergent Seasonally Flooded Diked (PEMCh)	0.04 [0.11]
Palustrine Unconsolidated Bottom Semipermanently Flooded Excavated (PUBFx)	0.02 [0.04]
Palustrine Unconsolidated Bottom (PUB)	0.15 [0.36]
Other Water of the United States (OWUS)	0.50 [1.24]
Total	**17.12 [42.31]**

Source: AUC (2012f).

3.5.2 Groundwater

3.5.2.1 Regional Groundwater Resources

The proposed project area is located in the southern portion of the PRB, in the Northern Great Plains area in the Wyoming East Uranium Milling Region (NRC, 2009; Whitehead, 1996; AUC, 2012a). The major aquifers in this area, from the shallowest to the deepest, are the Lower Tertiary, Upper Cretaceous, Lower Cretaceous, and Paleozoic aquifers. A regional hydrostratigraphic section for the PRB is shown in SEIS Figure 3-15.

ERA	SYSTEM, SERIES AND OTHER SUBDIVISIONS			STRATIGRAPHIC UNIT
Cenozoic	Quaternary			Alluvium
Cenozoic	Tertiary	Pliocene Miocene	Upper	(Absent in Powder River Basin)
Cenozoic	Tertiary	Oligocene	Lower	White River Formation
Cenozoic	Tertiary	Eocene Paleocene	Lower	Wasatch Formation* Fort Union Formation*
Mesozoic	Cretaceous		Upper	Lance Formation* Fox Hills Sandstone*
Mesozoic	Cretaceous		Upper	Lewis Shale Teckla, Teapot and Parkman Sandstones Steele Shale Sussex Sandstone Shannon Sandstone Niobrara Formation Carlile Shale Turner Sandstone Frontier Formation Mowry Shale
Mesozoic	Cretaceous		Lower	Muddy Sandstone* Thermopolis Shale
Mesozoic	Cretaceous		Lower	Inyan Kara Group: Fall River Formation* Lakota Formation*
Mesozoic	Jurassic			Morrison Formation Sundance Formation* Gypsum Spring Formation
Mesozoic	Triassic			Chugwater Formation
Paleozoic	Permian			Goose Egg Formation
Paleozoic	Pennsylvanian			Tensleep* Sandstone / Minnelusa* Formation
Paleozoic	Pennsylvanian			Amsden Formation
Paleozoic	Mississippian			Madison Formation*
Paleozoic	Cambrian			Gross Venture Shale Flathead Sandstone*
Paleozoic	Precambrian			Granite

* Stratigraphic units that can be underground sources of drinking water (USDWs) in the PRB (NRC, 2009; AECOM, 2014).

Figure 3-15. Regional Hydrostratigraphic Section for the Powder River Basin (Modified From AUC, 2012b).

The Lower Tertiary aquifers consist of semi-consolidated to consolidated sandstone beds of Oligocene to Paleocene age (NRC, 2009). The Wasatch Formation (host formation for uranium mineralization at the proposed project area) and the Fort Union Formation are part of the Lower Tertiary aquifers. Both formations consist of alternating sandstone, siltstone, and claystone beds and contain lignite and subbituminous coal. Most water is stored in and flows through the more permeable sandstone beds. In the Lower Tertiary aquifers, the regional flow direction is northward and northeastward in the Wyoming portion of the PRB (AUC, 2012a). Groundwater in the PRB flows from the upland areas of recharge, along the basin margins, to areas where there is discharge to larger surface streams (groundwater flow changes locally).

In Wyoming, the potentiometric surface of the Lower Tertiary aquifers is higher than the underlying Upper Cretaceous aquifers; consequently, groundwater moves vertically downward from the Lower Tertiary aquifers, to the Upper Cretaceous aquifers, through the confining unit separating the two aquifers (NRC, 2009).

The Upper Cretaceous aquifers, which include the Lance Formation and the Fox Hills Sandstone, consist of consolidated sandstone interbedded with shale, siltstone, and occasional thin, lenticular beds of coal (NRC, 2009; Whitehead, 1996). The Fox Hills Sandstone is one of the most continuous water-yielding formations in the Northern Great Plains aquifer system. Several thick confining units separate the Upper Cretaceous aquifers and the Lower Cretaceous aquifers (NRC, 2009). The Lewis Shale (also regionally known as the Pierre Shale) and Steele Shale are the thickest and most extensive confining units in the region (NRC, 2009). The applicant refers to the confining unit below the Lance Formation and Fox Hills Sandstone at the proposed project area as the Lewis Shale (AUC, 2012a). The hydrostratigraphic units deeper than the Fox Hills Formation near the proposed project area are generally too deep to economically develop as domestic water supplies or for uranium recovery (AUC, 2012a). These hydrostratigraphic units also typically have elevated dissolved solids concentrations, further reducing the likelihood of domestic water use (see SEIS Section 3.5.3.1).

The Lower Cretaceous aquifers are the most widespread aquifers in the Northern Great Plains area and contain several sandstones (Whitehead, 1996). The principal water-yielding units are the Muddy Sandstone and the Inyan Kara Group in the PRB. The Lower Cretaceous aquifers contain little freshwater and the water becomes saline in the deep parts of the PRB.

The Paleozoic aquifers, consisting of mostly limestone and dolomite, are separated into two groups—upper Paleozoic and lower Paleozoic rocks (Whitehead, 1996). The principal water-yielding units are the Madison Limestone and Minnelusa Formation. Confining units that overlie and separate the aquifers consist of shale and siltstone with some beds of anhydrite and halite (rock salt). The aquifers in lower Paleozoic rocks are deeply buried near the proposed project area and, therefore, are not a major source of water.

3.5.2.2 Surrounding Aquifers for Water Supply

As indicated in GEIS Section 3.3.4.3.4, the Wasatch and Fort Union Formations are important aquifers for regional water supply. The Fox Hill Sandstone is one of the most continuous water-yielding formations in the Northern Great Plains area. Except near outcrop areas, the Lower Cretaceous and Paleozoic aquifers are not usually used for water production because they are either deeply buried or contain saline water (NRC, 2009).

The hydrostratigraphic units of importance to water supply in the vicinity of the proposed project area, in order of shallowest to the deepest, are described in detail next.

Wasatch Formation (Host formation)

This Eocene-aged formation is composed of alternating beds of (i) valley and channel-fill fine- to coarse-grained lenticular sandstones and (ii) interbedded shale and coal, with relatively coarser-grained deposits (AUC, 2012a). The Wasatch formation generally dips at approximately one to two degrees to the northwest. The sandstones that contain uranium mineralization are generally coarse, cross-bedded, arkosic sands, with individual channel sand deposits trending generally to the north. The Wasatch is approximately 488 m [1,600 ft] thick in southern Campbell County, although basin erosion since the middle Tertiary period removed approximately half of the original deposited material. The reported groundwater well yields range from 38 to 189 Lpm [10 to 50 gpm] in the northern basin, and 1893 Lpm [500 gpm] or more is possible in the southern portion of the basin. The applicant notes that most of the available hydrologic data are from shallow stock and domestic wells, and as hydraulic heads often vary with depth and between sandstones, hydraulic head data from these wells do not adequately define the potentiometric surface in the Wasatch Formation (AUC, 2012i). Recharge is primarily through infiltration at outcrops, and discharge occurs in topographic alluvial valleys. Shallow groundwater flow is primarily controlled by topography and defined by stratigraphy at greater depths. Groundwater flow is mostly horizontal at greater depths.

Fort Union Formation

The Paleocene-aged Fort Union Formation is a heterogeneous unit of sandstones, interbedded shale, carbonaceous shale, and coal. Its thickness ranges from 701 to 1,067 m [2,300 to 3,500 ft] with the maximum thickness in the southwest portion of the PRB (AUC, 2012a). It is conformably underlain by the Lance Formation and unconformably overlain by the Eocene-age Wasatch Formation. This formation serves as a source of water mostly for stock and domestic purposes and is the municipal water supply source for the cities of Wright and Gillette. Maximum yields of up to 568 Lpm [150 gpm] have been reported (AUC, 2012a).

Lance Formation

The Lance Formation consists of interbedded, light yellow-grey, fine- to medium-grained, cross-bedded, and lenticular sandstones, with grey carbonaceous shale, siltstone, and thin coals (AUC, 2012a). The thickness ranges from 183 to 914 m [600 to 3,000 ft]. The Lance Formation is the uppermost Cretaceous aquifer in the region. The wells in the Lance Formation are for domestic and stock use and are located near outcrops. The well yields are generally less than 76 Lpm [20 gpm]. The Lance Formation is hydrologically connected to the underlying Fox Hills Sandstone.

Fox Hills Sandstone

The Fox Hills Sandstone is the basal aquifer unit in the Lower Tertiary/Upper Cretaceous aquifer system and consists of fine- to medium-grained sandstone beds (AUC, 2012a). The sandstone ranges from thin to massively bedded, weakly cemented, friable, lenticular sandstone and is interbedded with carbonaceous shale and siltstone. The applicant states that the thickness in the southern basin ranges from 122 to 152 m [400 to 500 ft] in Niobrara County to 213 m [700 ft] in Natrona County. In the northern basin, the Fox Hills Sandstone thins out to 45 to 60 m [150 to 200 ft] thick in Crook County. Other sources, such as U.S. Bureau of Land Management (BLM, 2009), note that the thickness of the Fox Hills Sandstone in the northern portion of the PRB is approximately 30.5 m [100 ft], and thickens to approximately 91 m [300 ft] in the southern portion of the PRB.

The industrial groundwater supply locations at Rozet (east of Gillette) and Hilight Field (southeastern Campbell County) utilize wells completed across the Lance and Fox Hills sequence. The hydrologically connected Lance and Fox Hills Formations are also a source for domestic and stock wells in the outcrop areas along the margins of the PRB. These formations are the source for municipal water supply for the cities of Gillette, Glenrock, and Moorcroft. Well yields as high as 757 Lpm [200 gpm] were reported in the eastern part of the basin, and yields less than 379 Lpm [100 gpm] were reported in the western basin. A maximum well yield of 1,438 Lpm [380 gpm] in the deep industrial wells was also reported (AUC, 2012a). The values of specific capacity range from 0.02 to 0.4 Lps per meter (Lps/m) of drawdown [0.1–2 gpm per foot of drawdown (gpm/ft)]. An average yield of 1,223 Lpm [323 gpm] and average specific capacity of 0.06 Lps/m [0.3 gpm/ft] was reported for wells in southeastern Campbell County. The reported transmissivity for the Lance/Fox Hills Formation ranged from 1.2 to 25 m^2/day [13 to 270 ft^2/day]. For the entire aquifer system in southeastern Campbell County, a minimum transmissivity of 3.1 m^2/day [33 ft^2/day] was reported.

Based on potentiometric maps, the applicant observed a general northward regional groundwater flow in the Lance and Fox Hills aquifer system with a groundwater divide in southeastern Campbell County and subsequent groundwater flow toward the northeast (AUC, 2012a). Local recharge is observed in eastern outcrop areas. Though a potential for vertical leakage from the overlying Wasatch and Fort Union Formations exists, the applicant cites the low vertical hydraulic conductivities {~10^{-8} cm/s [3.9×10^{-9} in/s]} of the fine-grained shale and mudstone intervals within the formations as a reason to expect minimal vertical leakage (AUC, 2012a).

Lewis Shale

The Lewis Shale primarily consists of a sequence of marine shales and sandstones with an approximate thickness of 274 m [900 ft] near the proposed project area. It is the regional confining aquitard between the overlying Wasatch through Fox Hills Formations and underlying aquifers. Most of the formation does not yield water, but some sandy zones may yield as much as 38 Lpm [10 gpm] (AUC, 2012a).

Muddy Sandstone and the Inyan Kara Group

The Muddy (or Newcastle) Sandstone and Inyan Kara Group (Lakota and Fall River Formations) comprise the Lower Cretaceous Dakota Aquifer System (AECOM, 2014). The Lakota Formation ranges in thickness from 14 to 61 m [45 to 200 ft] and is mainly sandstone with interbedded conglomerates and shales. The Fall River Formation is also sandstone with interbedded shale and siltstone and ranges in thickness from 11 to 46 m [35 to 150 ft]. Wells in the Lakota and Fall River yield 3.8 to 38 Lpm [1 to 10 gpm] and are generally not used for water supply. The Muddy Sandstone is a major aquifer in the eastern Wyoming PRB and ranges in thickness up to 30 m [100 ft]. Because of low transmissivity (up to 1.7 m^2/day [up to 18 ft^2/day]) and poor water quality, the Muddy Sandstone is used for water supply only near its outcrop area along the eastern rim of the PRB.

Madison Limestone and Minnelusa Formation

The Madison Limestone and Minnelusa Formation are units within the Paleozoic Madison Aquifer System that yield water of good quality for public water supply (AECOM, 2014). The Madison Limestone is a 61 to 305 m [200 to 1,000 ft] thick massive limestone and has wells with yields of up to 3,785 Lpm [1,000 gpm]. The Madison Limestone is a source of water for municipal water supply as well as industrial, irrigation, and stock water use in the easternmost Wyoming PRB. The City of Gillette uses the aquifer for its water supply. The Minnelusa Formation is also a major aquifer in the easternmost Wyoming PRB. The Minnelusa is 183 to 244 m [600 to 800 ft] thick and consists of sandstone interbedded with limestone, dolomite, and shale. The upper part of the Minnelusa yields 757 Lpm [200 gpm] to wells. Historical use of water from the Minnelusa has been for public water supply and domestic and stock use.

3.5.2.3 Local Groundwater Resources

Several hydrogeologic investigations were performed within the proposed project area from 1978 to 2011 (AUC, 2012a). The applicant collected lithologic, water level, water quality, and pump test data as part of its ongoing evaluations of hydrologic conditions at the proposed project area during 2010 and 2011. Recent hydrologic testing, described in the environmental report (ER) (AUC, 2012a), includes multi- and single-well pump testing at four clusters within the proposed project area: PZM1, PZM3, PZM4, and PZM5 (AUC, 2012i). Well clusters PZM6 and PZM7 in the western and southwestern part of the proposed project area were installed for baseline groundwater monitoring.

The applicant has identified the following hydrostratigraphic layers within the Wasatch Formation at the proposed project area (AUC, 2012a). SEIS Figures 3-16 through 3-22 display cross-sections constructed from geophysical logs showing the position of aquifers and confining units within the Wasatch Formation at the proposed project area.

Shallow Water Table Unit (SM Unit)

The applicant describes this sand unit as a perched shallow water table unit that is partially saturated (AUC, 2012i) and is not continuous across the proposed project area. The thickness ranges from 3 to 6 m [10 to 20 ft] and occurs 12 to 24 m [40 to 80 ft] below ground surface. The applicant stated that the SM Unit wells installed at clusters PZM1, PZM3, and PZM4 were observed to be dry. Hydrologic testing indicated that the specific capacity and transmissivity of the SM Unit is very low, ranging from 0.01 to 0.03 Lps/m [0.07 to 0.13 gpm/ft] and 0.001 to 0.02 m^2/day [0.014 to 0.3 ft^2/day], respectively (AUC, 2012a). Calculated permeability ranged between 0.0003 and 0.006 m/day [0.001 and 0.02 ft/day]. The applicant states that though data do not support interpretation of the SM Unit as a regional aquifer, this unit may be characterized as exhibiting some aquifer characteristics locally (AUC, 2015a). The SM Unit can be considered the uppermost aquifer, if at any specific location, the SM Unit or similar shallow sandstone unit, contains sufficient groundwater.

Overlying Aquifer (OM Unit)

The OM Unit is described as a water-bearing unit exhibiting aquifer characteristics based on geologic and potentiometric data (AUC, 2012a). The OM Unit is the uppermost aquifer if the OM Unit is the shallowest sandstone containing groundwater (AUC, 2015a). The applicant states that though the OM Unit appears continuous on a local scale (within the PZM well clusters), it does not correlate over greater distances across the proposed project area (AUC, 2012a). The thickness of the OM Unit ranges from 3.7 m [12 ft] at the PZM5 (western) cluster to a maximum thickness of approximately 18 m [60 ft] at the PZM4 (central) cluster. The OM Unit occurs at various depths: (i) 47 to 66 m [155 to 215 ft] below ground surface at the PZM1 and PZM3 clusters (northeastern portion); (ii) 38 to 56 m [125 to 185 ft] below ground

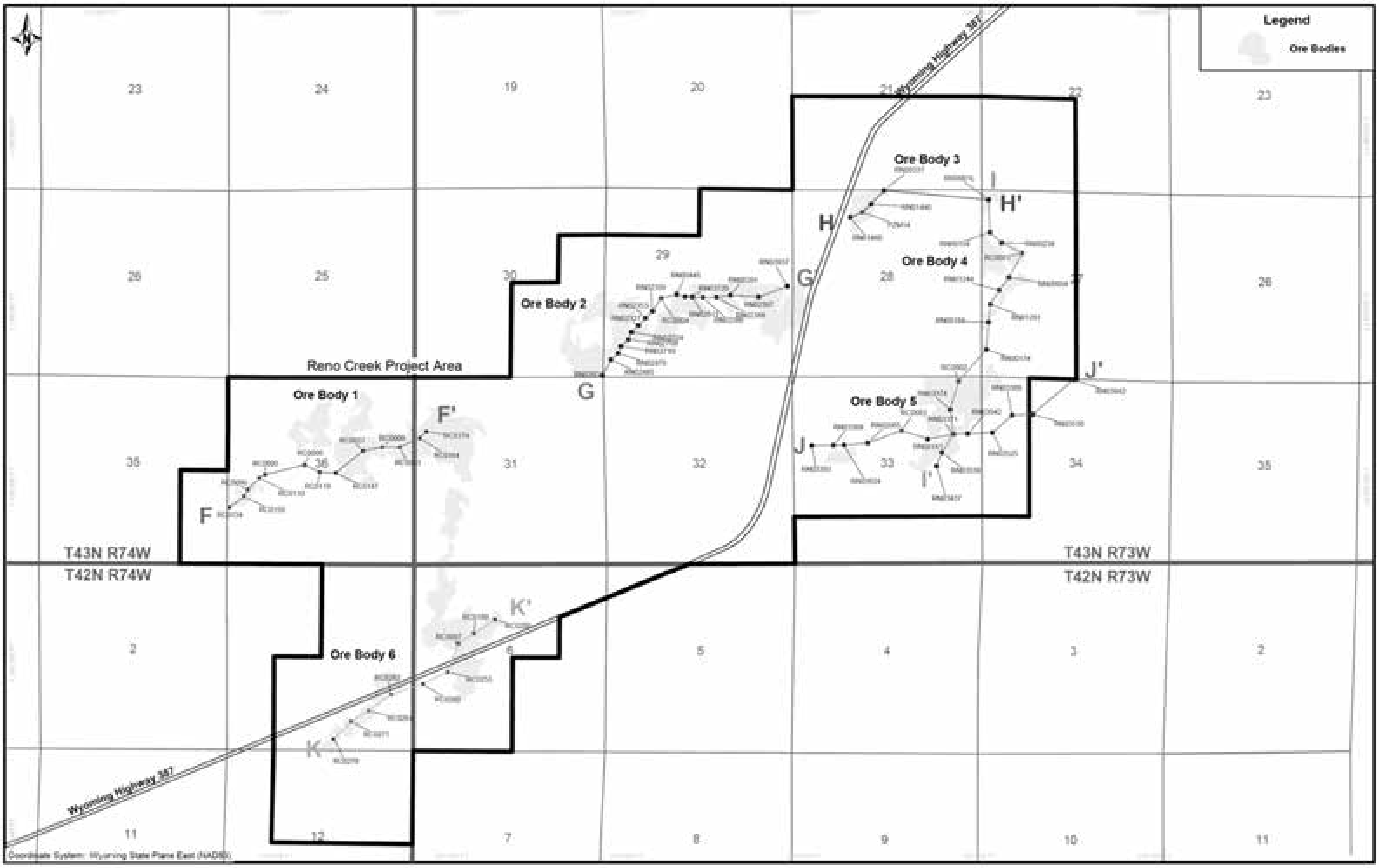

Figure 3-16. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section Locations (AUC, 2014a)

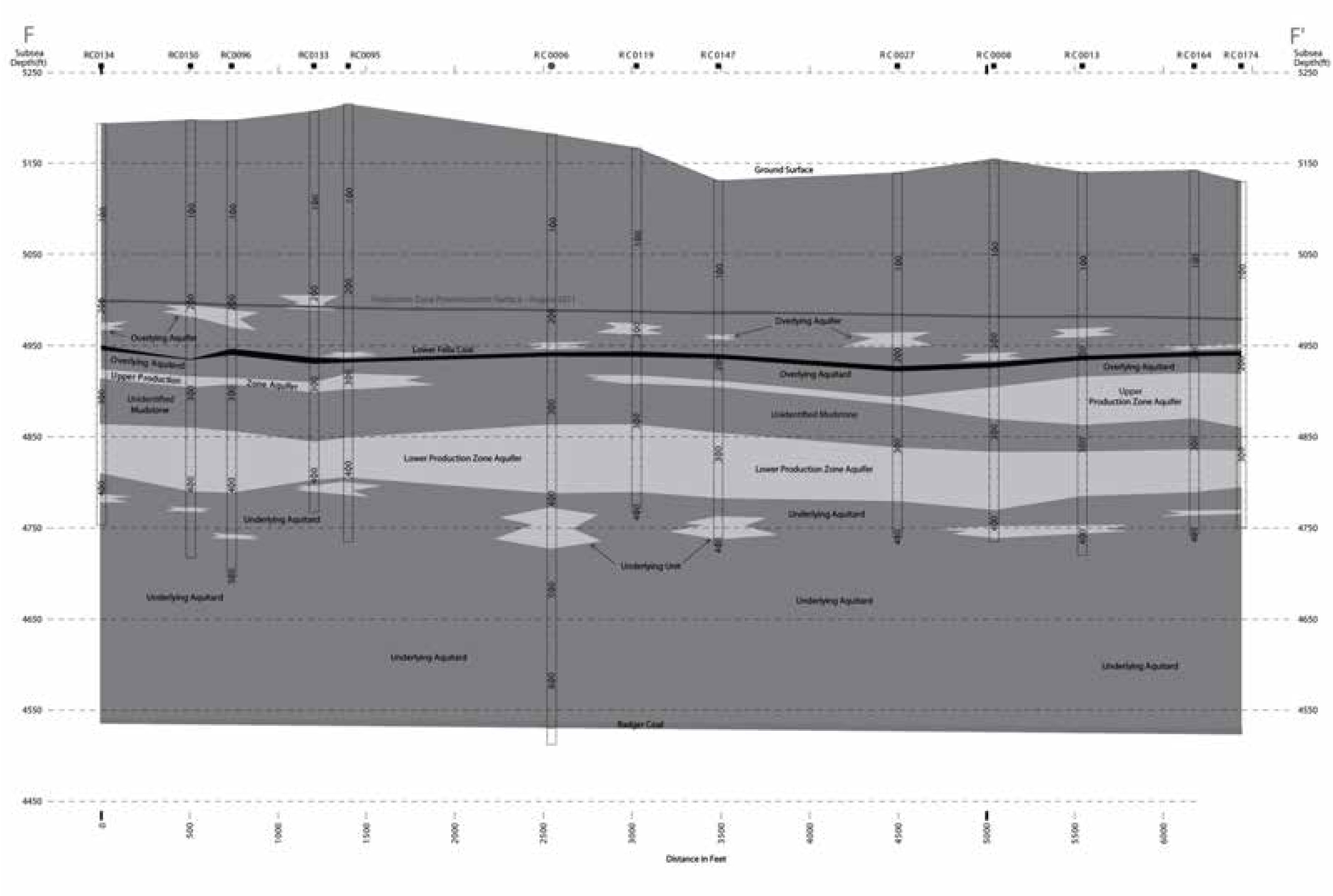

Figure 3-17. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section, F-F' (AUC, 2014a)

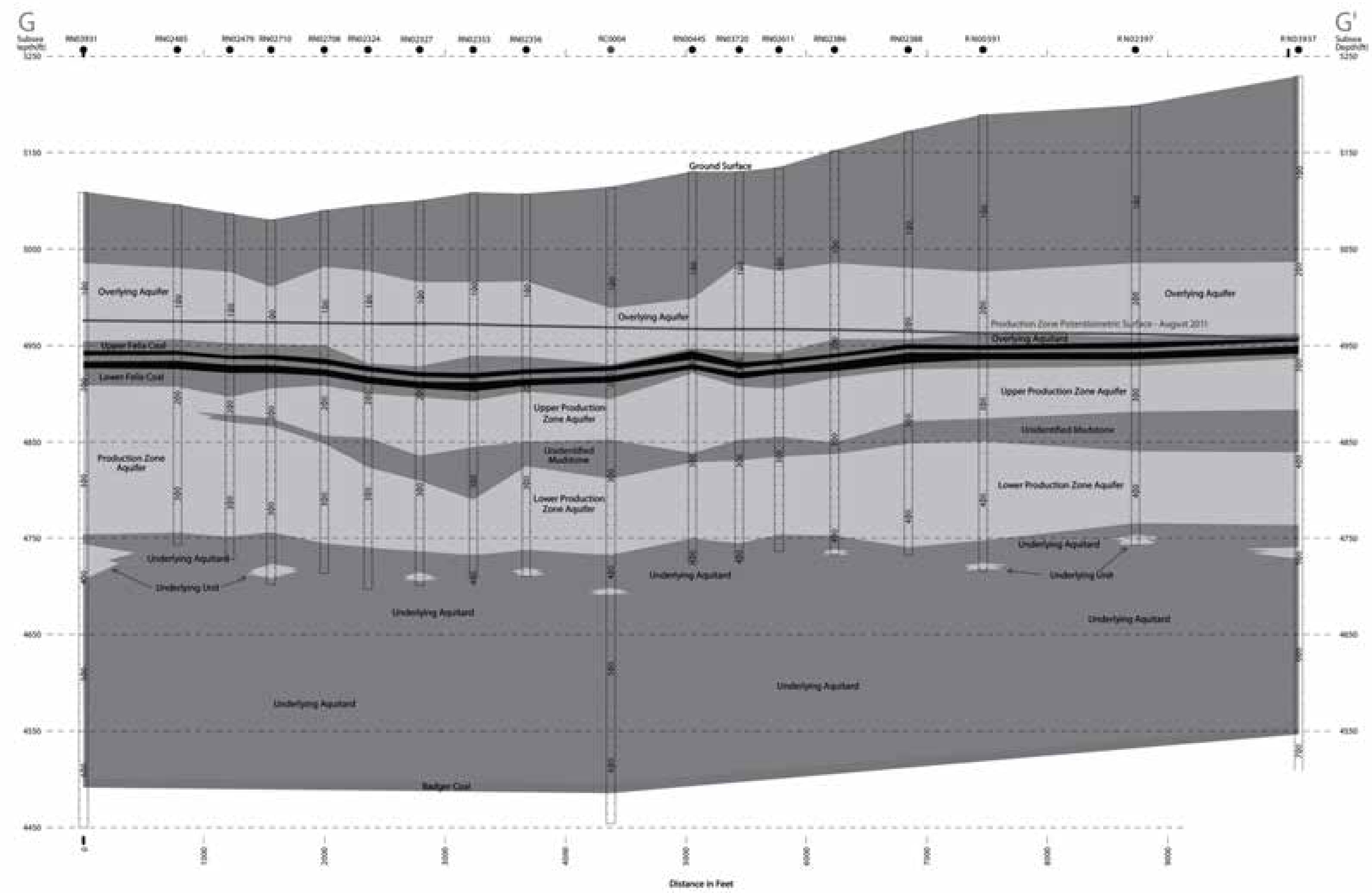

Figure 3-18. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section, G-G' (AUC, 2014a)

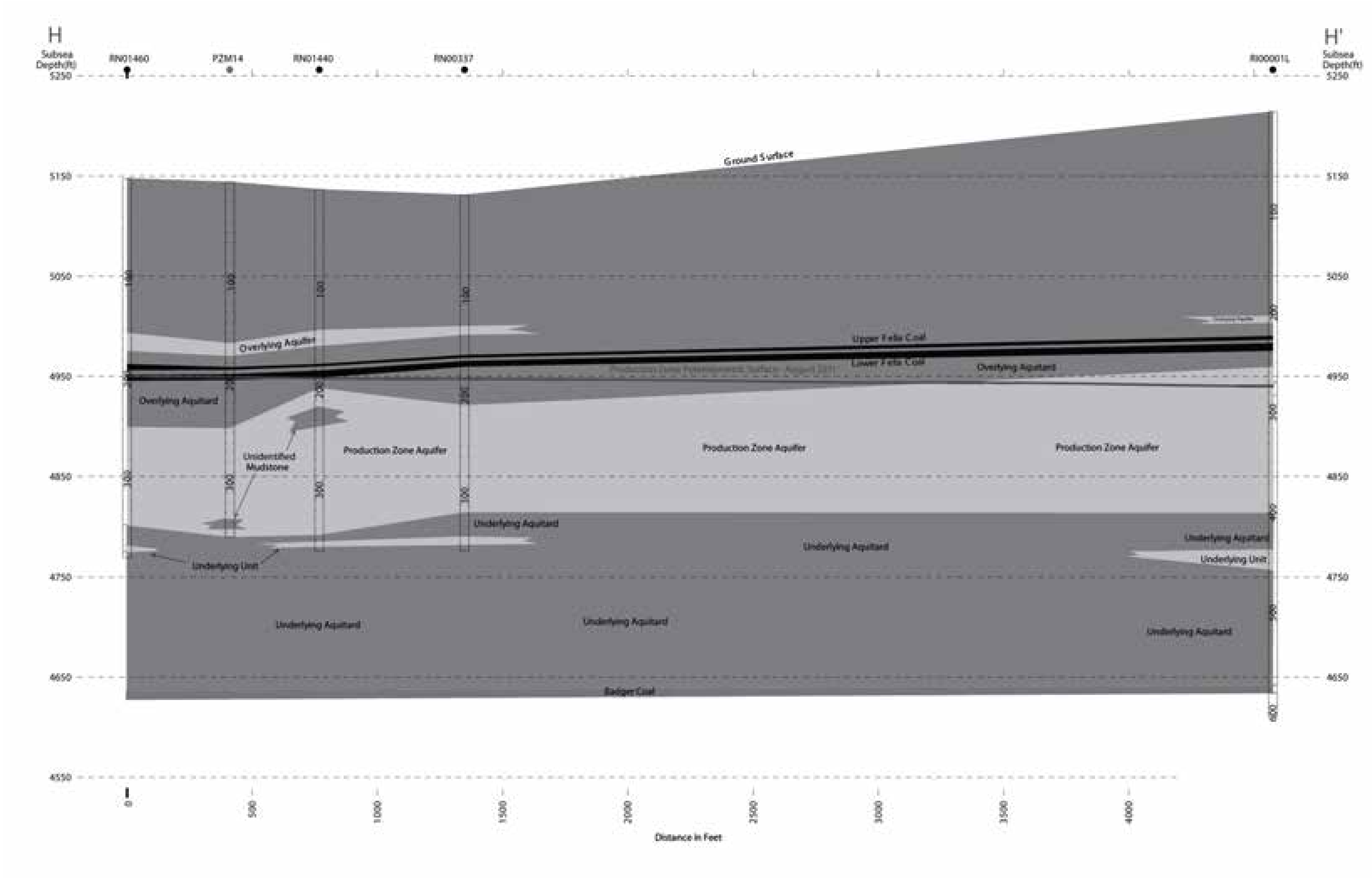

Figure 3-19. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section, H-H' (AUC, 2014a)

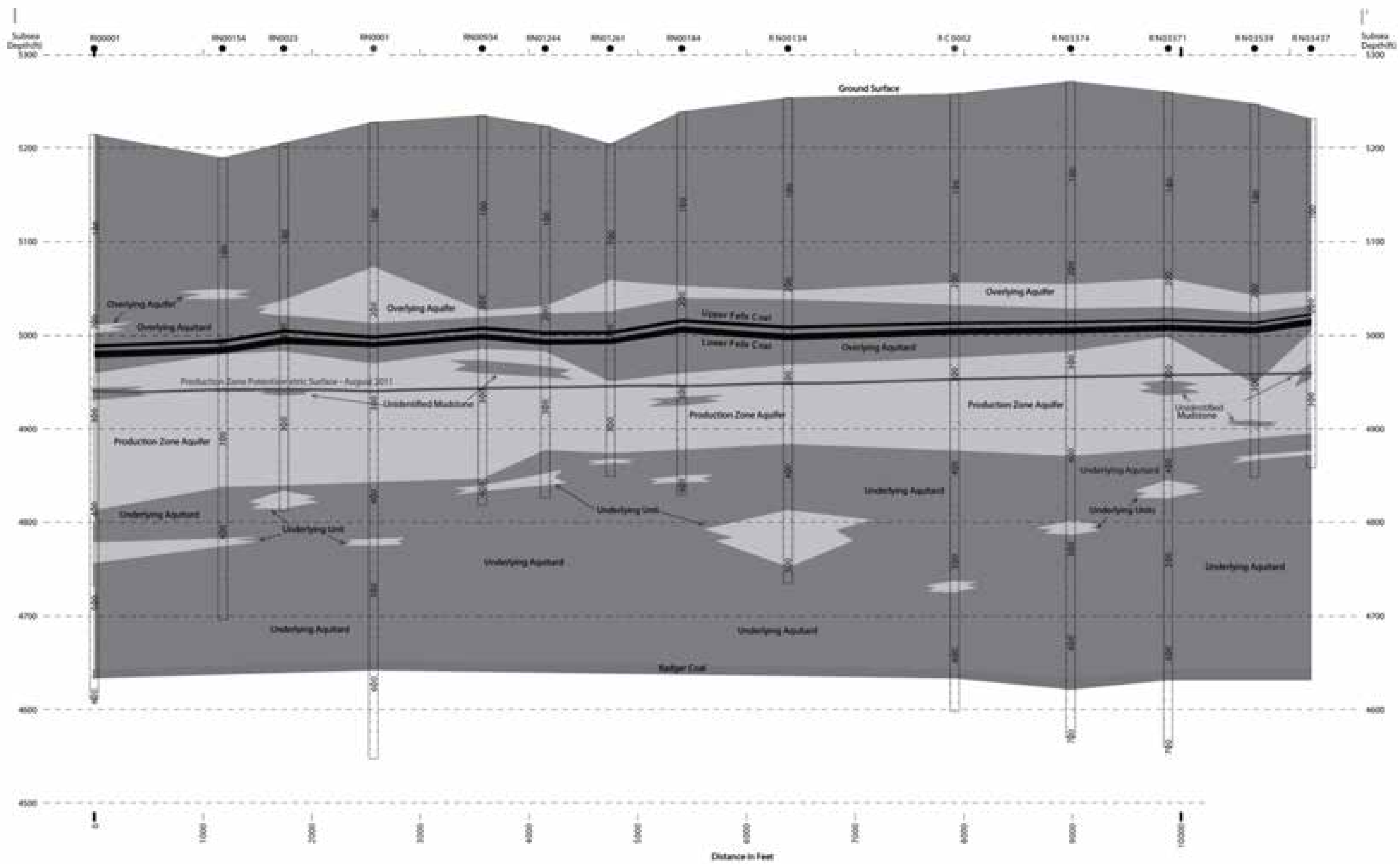

Figure 3-20. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section, I-I’ (AUC, 2014a)

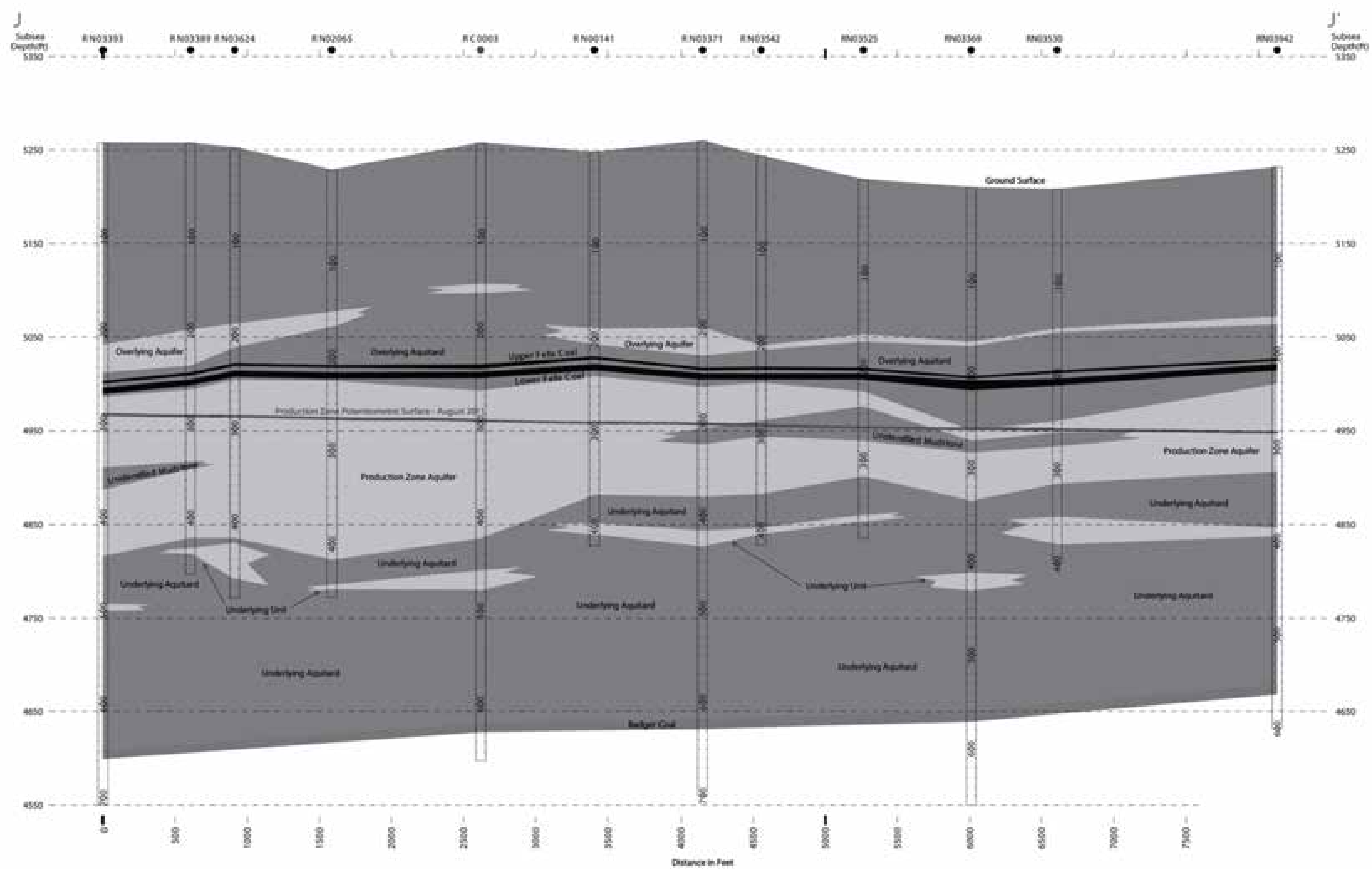

Figure 3-21. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section, J-J' (AUC, 2014a)

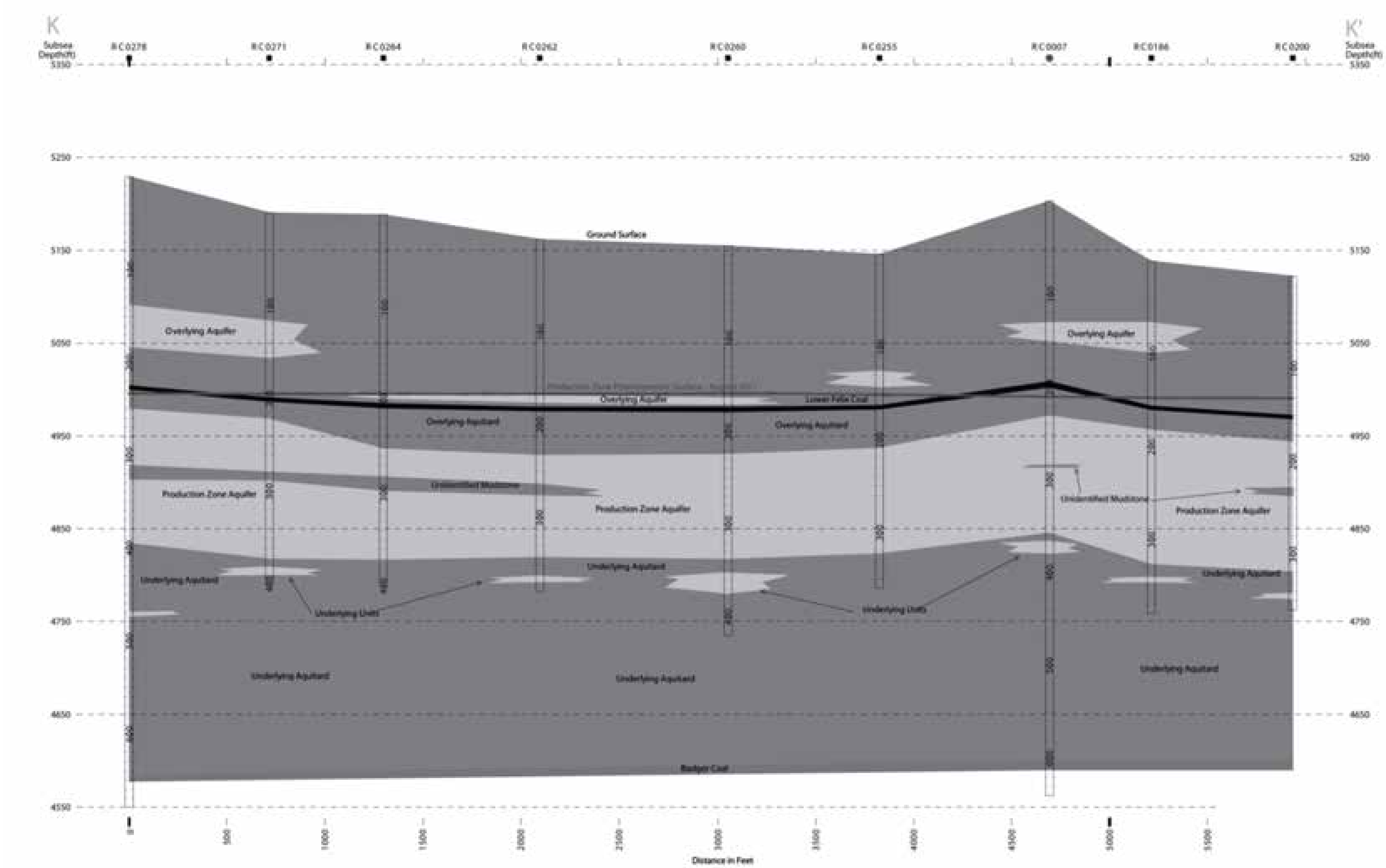

Figure 3-22. Proposed Reno Creek ISR Project Hydrostratigraphy—Cross Section, K-K' (AUC, 2014a)

surface at the PZM4 cluster (central portion); and (iii) 21 to 25 m [70 to 82 ft] below ground surface at the PZM5 cluster (western portion). Calculated hydraulic conductivities in the OM Unit at the PZM1, PZM4, and PZM5 clusters ranged from 0.26 to 1 m/day [0.84 to 3.3 ft/day] (AUC, 2012a).

However, the calculated hydraulic conductivity at the PZM3 cluster was much lower, on the order of 0.009 to 0.02 m/day [0.03 to 0.05 ft/day]. The applicant concluded that the OM Unit is isolated from surface water infiltration at the proposed project area based on (i) the lack of a perennial wetting front from the ephemeral surface drainages and (ii) the thick sequence of shale and finer-grained sediments {21 to 66 m [70 to 215 ft]} between the ground surface and the top of the OM Unit (AUC, 2012a).

Overlying Aquitard (OA)

The OA, consisting of a laterally continuous sequence of clays and silt, provides confinement between the production zone and the Overlying Aquifer (OM Unit) (AUC, 2012a). The thickness ranges from 7.6 to 30.5 m [25 to 100 ft] (AUC, 2012h). The applicant reported a single-point, vertical permeability analysis (to brine) of 8.2×10^{-10} cm/sec [2.34×10^{-6} ft/day] for the OA. The Felix Coal is found in the lower portion of the OA with a thickness that ranges from 1.5 to 3 m [5 to 10 ft]. A continuous mudstone with a minimum thickness of 1.5 m [5 ft] separates the Felix Coal into the Upper and Lower Felix Coal seams in the eastern portion of the proposed project area (see SEIS Figures 3-18 through 3-21). The Upper Felix Coal seam gradually pinches out in the western portion of the proposed project area, where only the Lower Felix Coal seam is present (see SEIS Figures 3-17 and 3-22). Piezometric data indicated that these coal seams are not aquifers.

Production Zone Aquifer (PZA)

The PZA is described as a “discrete and continuous aquifer” across the proposed project area with an approximate thickness range of 23 to 61 m [75 to 200 ft] (AUC, 2012h). The applicant describes the sand that hosts the uranium mineralization as commonly cross-bedded, graded sequences from very coarse at the base to fine grained at the top. The applicant states that there is geologic confinement of the PZA by the Overlying Aquitard (OA) and Underlying Aquitard (UA) (see below) over the entire proposed project area. The aquifer conditions change from saturated conditions in the western portion of the proposed project area to partially saturated conditions in the eastern portion (~30 percent in area) of the proposed project area (AUC, 2012i). At well cluster PZM1 (see SEIS Figure 3-23), the saturated thickness of the PZA is approximately 29 m [94 ft], and the total sand thickness is approximately 38 m [125 ft] (i.e., 75 percent of the PZA is under saturated conditions). At well cluster PZM3, 33 m [109 ft] out of a total thickness of 50 m [165 ft] is saturated. The PZA occurs at various depths: (i) 79–116 m [260 to 380 ft] below ground surface at the PZM1 cluster; (ii) 82 to 128 m [270 to 420 ft] below ground surface at the PZM3 cluster; (iii) 67 to 115 [220 to 380 ft] below ground surface at the PZM4 cluster; and (iv) 55 to 100 m [180 to 330 ft] below ground surface at the PZM5 cluster (western portion). Groundwater in the PZA flows toward the northeast. The horizontal hydraulic gradient estimated in recent hydrologic investigations varied across the proposed project area from 0.0032 to 0.0035 in the southwestern and northeastern portions to 0.0017 in the central portion (AUC, 2012a). The lower gradients in the central portion were attributed to the presence of thicker and more transmissive sands (AUC, 2012a). The applicant notes that an unidentified mudstone unit is present in some portions that divides the PZA into upper and lower sand units (AUC, 2012a). The applicant states that wellfield-scale hydrologic testing at a later date would address the effects of this mudstone unit. However, this

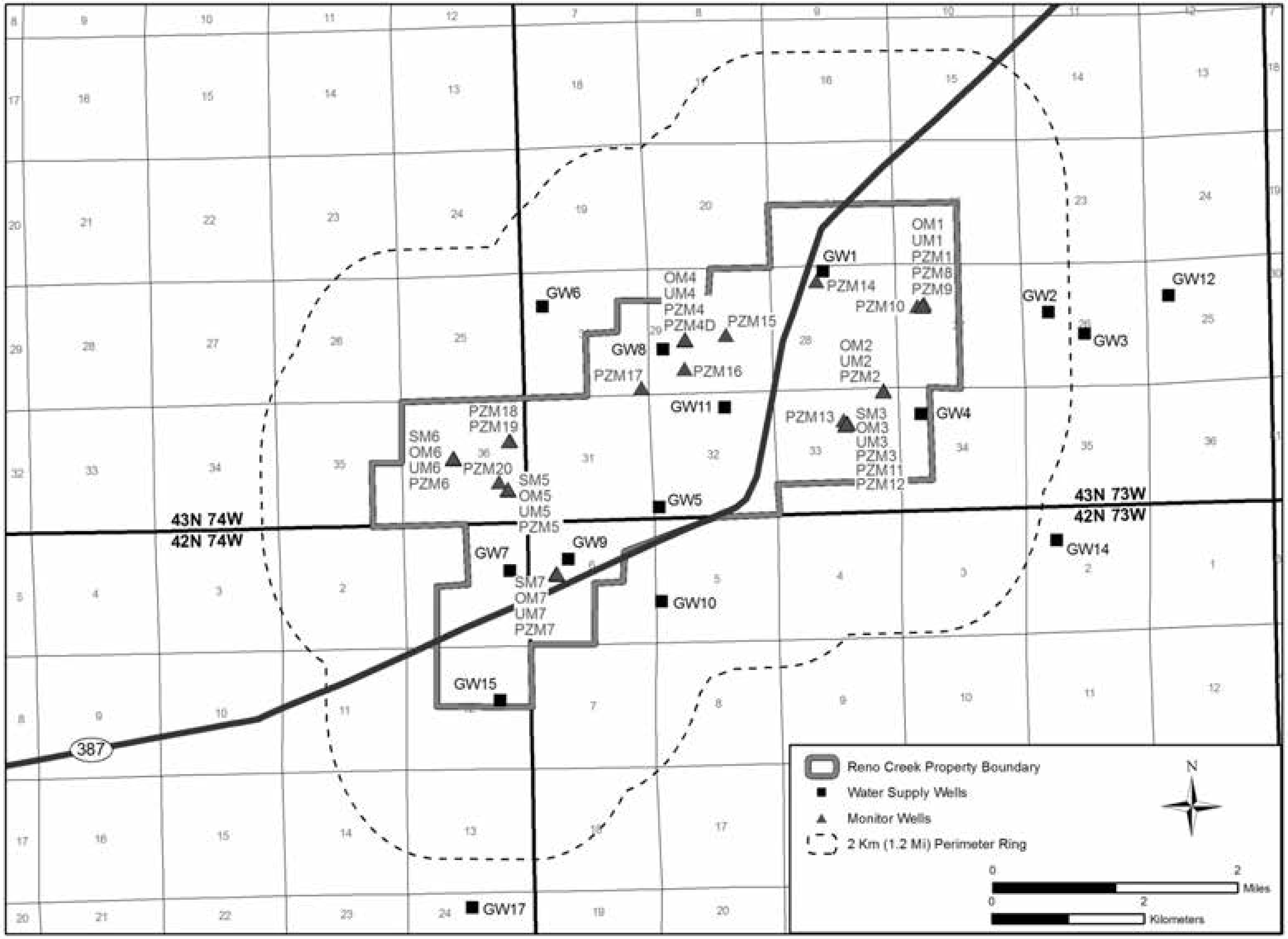

Figure 3-23. Monitoring Wells and Existing Domestic and Stock Wells Used to Characterize Groundwater Quality Conditions and Establish Preoperational Baseline Groundwater Quality

information is not needed to determine the confinement of the PZA in the proposed project area as a whole because any effects of the division into upper and lower sand units would still be localized to the PZA layer itself and would not affect other hydrostratigraphic layers. The calculated transmissivity and hydraulic conductivity of the PZA ranged from 1.9 to 132.7 m^2/day [20 to 1,428 ft^2/day] and 0.09 to 3.7 m/day [0.3 to 12 ft/day], respectively (AUC, 2012a).

Underlying Aquitard (UA)

The UA is a laterally continuous sequence of undifferentiated mudstones and clays, with discontinuous and often lenticular sandstones, and provides confinement between the PZA and underlying aquifers (AUC, 2012a). An isopach map constructed by the applicant indicates that the UA ranges from approximately 46 to 76 m [150 to 250 ft] within the proposed project area (AUC, 2012a, Figure 2.6-A-24 in TR Addendum 2.6). The UA extends to the Badger Coal (see SEIS Figures 3-17 to 3-22). The top of the Badger Coal is considered the base of the Wasatch Formation in the proposed project area. The applicant reported Klinkenberg vertical air permeability results ranging from 4.55×10^{-6} to 9.1×10^{-6} cm/sec [0.013 to 0.026 ft/day] and a brine permeability of 5.46×10^{-10} cm/sec [1.5×10^{-6} ft/day].

Underlying Unit (UM Unit)

This discontinuous sand unit, consisting of relatively thin and lenticular sandstones, lies within the UA. Geologic and potentiometric data indicate that the UM Unit is not hydrologically connected across the proposed project area. The thickness of the UM Unit observed at the well clusters ranged from 10.1 to 32 m [35 to 105 ft] (AUC, 2012a). The minimum distance from the PZA to the UM Unit is 3 m [10 ft]. Hydraulic conductivity estimates ranged from 0.001 to 0.006 m/day [0.005 to 0.02 ft/day], which is significantly less than the PZA. The applicant concludes that the UM Unit does not meet the definition for an aquifer, based on the observed well yields and hydraulic conductivity estimates.

3.5.2.4 Groundwater Use

The applicant provided information regarding groundwater use within a 3.2-km [2-mi] radius of the proposed project area boundary (i.e., outside of the proposed project boundary), based on information available from the Wyoming State Engineer's Office (AUC, 2012a). The applicant identified 49 wells used for stock, domestic, miscellaneous, and industrial purposes (AUC, 2012i, 2014b). The well permits for the 49 wells can be found in Table 2.7B-18 of Addendum 2.7B in the applicant's technical report (TR) (AUC, 2012g). The NRC staff have proposed and the applicant has agreed to a preoperational license condition that would require the applicant to sample all wells within 2 km [1.2 mi] of the project area and provide the NRC with a report that lists all known wells (functional and non-functional) and their intended use, if known (AUC, 2015a). In addition, the NRC staff proposed and the applicant has agreed to a license condition that would require the applicant to perform an annual survey of water supply wells within 2 km [1.2 mi] of the project boundary (AUC, 2015a). Of the 49 wells identified by applicant, 15 are located within the proposed project area, including (i) one well (Taffner #1 well) formerly used for domestic water supply at the now vacated Taffner property, (ii) eight wells for stock watering usage, and (iii) six wells with water rights that have been cancelled. The applicant has acquired the Taffner property (First American Title, 2015) and has plugged the Taffner #1 well located on the property. The eight stock wells with existing water rights include (i) four completed in the OM Unit, (ii) three completed in the PZA, and (iii) one completed in the sandstone interval below the Badger Coal.

The applicant also provides information for wells used for CBM (AUC, 2012j). The applicant states that 324 wells are identified as being used for CBM or CBM and stock within 3.2 km [2 mi] of the proposed project area. The target coal seam for CBM is the Big George Coal within the Fort Union Formation with reported total depths ranging between 192 and 434 m [631 and 1,424 ft] and averaging approximately 305 m [1,000 ft] (AUC, 2012b).

3.5.3 Groundwater Quality

Regional and site-specific groundwater quality conditions in the production zone and surrounding aquifers are discussed in this section in the context of federal and state groundwater standards. Maximum contaminant levels (MCLs) for primary drinking water contaminants are provided in U.S. Environmental Protection Agency (EPA) regulations in 40 CFR Part 141. Secondary maximum contaminant levels (SMCLs) are EPA-established nonmandatory water quality standards for parameters that affect the taste, color, and odor of groundwater. SMCLs are not considered to present a risk to human health and include parameters such as pH, total dissolved solids (TDS), and sulfate. State of Wyoming groundwater is classified by use in order to apply standards to protect water quality. State groundwater quality standards have been established for domestic use (Class I standards), agricultural use (Class II standards), livestock use (Class III standards), and industrial use (Class IV standards) (WDEQ, 2005). The applicant implemented a preoperational or baseline groundwater monitoring program to collect site-specific groundwater quality information.

3.5.3.1 Regional Groundwater Quality

The *Task 1B Report for the Powder River Basin Coal Review Current Water Resources Conditions* (AECOM, 2014) summarizes information on regional groundwater quality in Paleozoic and Lower Cretaceous aquifer systems in the PRB. The Madison Formation (or Madison Limestone) is the principal unit of the Paleozoic Madison Aquifer System, which is the deepest aquifer system in the PRB. Water quality at the outcrop of the Madison Limestone along the eastern flank of the PRB is calcium-magnesium bicarbonate water with a TDS concentration of less than 600 mg/L [600 ppm] (AECOM, 2014). The TDS increases basinward to greater than 3,000 mg/L [3,000 ppm], and the water becomes dominated by sodium sulfate and sodium chloride with locally high concentrations of fluoride and radionuclides. The Minnelusa Formation, which is also a unit of the Madison Aquifer System, is a major aquifer in the eastern Wyoming PRB. Water quality is good near the outcrop of the Minnelusa Formation with TDS concentrations below 600 mg/L [600 ppm] (AECOM, 2014). TDS concentrations increase basinward to around 2,400 mg/L [2,400 ppm] (AECOM, 2014). In the deeper portions of the Powder River Basin in Campbell County, TDS concentrations in the Minnelusa exceed 10,000 mg/L [10,000 ppm], and often exceed 100,000 mg/L [100,000 ppm] (Wells et al., 1979). The water quality changes from calcium bicarbonate water near the outcrop to water dominated by calcium sulfate and sodium chloride in deeper parts of the PRB. Fluoride enrichment and locally high values of radionuclides in water from the Minnelusa Formation are a problem for municipal water use (AECOM, 2014).

The Lower Cretaceous Dakota Aquifer System in the PRB is comprised of three water-bearing units: Lakota Formation, Fall River Formation, and Muddy (Newcastle) Sandstone. Water in the Dakota Aquifer System is of poor quality in the PRB and is used only for water supply near its exposures along the eastern flank of the PRB. The TDS of the water can range up to 3,200 mg/L [3,200 ppm] in the basin with the water dominated by calcium and sodium sulfate (AECOM, 2014). High concentrations of selenium and radionuclides in some parts of the aquifer make the water unsuitable for public use (AECOM, 2014).

Lowry et al. (1986), Feathers (1981), and Rankl and Lowry (1990) provide information on regional groundwater quality in Upper Cretaceous to Lower Tertiary aquifer systems in the PRB. SEIS Table 3-10 summarizes TDS concentrations in Upper Cretaceous and Lower Tertiary aquifers in the PRB that Lowry et al. (1986) reported. The Upper Cretaceous aquifer system consists of the Fox Hills Sandstone and Lance Formation, and the Lower Tertiary aquifer system consists of the Wasatch and the Fort Union Formations. In general, the water in each aquifer has a considerable range of TDS concentrations. For example, samples from the Lance Formation contained from 251 to 2,850 mg/L [251 to 2,850 ppm] TDS, whereas those from the Wasatch Formation contained from 227 to 8,200 mg/L [227 to 8,200 ppm] TDS. Wells close to recharge areas generally had the lowest TDS concentrations, whereas wells remote from the recharge areas have high TDS concentrations (Lowry et al., 1986). Lowry et al. (1986) concluded that the length of flow time or the length of flow path from recharge to discharge or withdrawal is probably the dominant factor affecting the TDS concentration in the aquifers. Rankl and Lowry (1990) reported that water from shallow wells {e.g., less than about 150 m [500 ft] deep} is calcium sulfate or calcium sodium sulfate in composition, while water from deeper wells is generally sodium bicarbonate in composition.

Chemical data for Fox Hills and Lance aquifer system waters are sparse and largely limited to outcrop areas. Feathers (1981) reported that Fox Hills and Lance waters from outcrop areas in the eastern half of the PRB have a TDS content ranging from 600 to 3,300 mg/L [600 to 3,300 ppm] and are primarily sodium bicarbonate-sulfate in composition. In the western half of the PRB, Fox Hills and Lance waters from outcrop wells have TDS contents ranging from 450 to 4,060 mg/L [450 to 4,060 ppm] and vary from calcium bicarbonate to calcium sulfate to sodium sulfate to sodium bicarbonate in composition (Feathers, 1981). Feathers (1981) concluded that local lithologic variation likely controls anion composition in the Fox Hills and Lance waters through dissolution of carbonate, gypsum, and pyrite, while exchange reactions (e.g., sodium replacement of calcium) control cation composition.

Extensive chemical data exist on the Wasatch and Fort Union aquifer system waters in the central portion of the PRB. The discontinuous, lenticular nature of the sandstones comprising the system results in significant water quality differences over short geographic distances (Feathers, 1981). Feathers (1981) reported that the Wasatch and Fort Union waters have TDS contents ranging from less than 250 mg/L [250 ppm] to over 6,500 mg/L [6,500 ppm] and that there is little correlation between TDS and well depth. Wasatch and Fort Union waters from relatively shallow wells exhibit wide variations in major ion composition with most analyses showing a mixed cation content or sodium enrichment (Feathers, 1981). Waters in shallow wells containing less than 500 mg/L [500 ppm] TDS are enriched in bicarbonate, while more saline waters are generally high in dissolved sulfate. In deeper wells, dissolved sodium and bicarbonate increase, with the increase in sodium being attributed to cation exchange with calcium and magnesium (Feathers, 1981).

Lowry et al. (1986) reported trace metal concentrations in PRB groundwater. The EPA MCL for selenium of 0.05 mg/L [0.05 ppm] was exceeded in 4 of 159 groundwater samples analyzed, and the MCL for lead of 0.05 mg/L [0.05 ppm] was exceeded in 6 of 165 samples analyzed. The MCL for arsenic of 0.05 mg/L [0.05 ppm] was exceeded in 1 of 154 samples analyzed, and the MCL for cadmium of 0.01 mg/L [0.01 ppm] was exceeded in 1 of 165 samples analyzed. Concentrations of manganese and iron commonly exceeded EPA SMCLs. For example, 100 of 257 samples exceeded the SMCL of 0.05 mg/L [0.05 ppm] for manganese and 56 of 366 samples exceeded the SMCL of 0.03 mg/L [0.03 ppm] for iron.

Table 3-10. TDS Concentrations in Upper Cretaceous and Lower Tertiary Aquifers in the Powder River Basin*

Aquifer	Median	Average	Minimum	Maximum	No. of Samples
Wasatch Formation	1,010	1,298	227	8,200	191
Fort Union Formation	1,260	1,464	209	5,620	257
Fox Hills Sandstone	943	1,494	451	5,450	26
Lance Formation	977	1,218	251	2,850	31

*All values are in mg/L, which is equivalent to ppm.
Source: Lowry, et al. (1986).

Numerous radionuclide analyses of Wasatch and Fort Union waters exist due to the presence of economic uranium deposits in these formations. Available data show a wide range in radionuclide concentrations. For example, radium-226 ranges from less than 3.7 Bq/m^3 [0.1 Ci/L] to over 35,150 Bq/m^3 [950 pCi/L]; gross alpha radiation varies from 0.0 pCi/L to 4,691 pCi/L; and dissolved uranium concentrations of over 10 mg/L [10 ppm] have been reported (Feathers, 1981). High concentrations are restricted to areas adjacent to uranium ore zones. Analyses of waters from non-mining areas show no exceedances of radium-226 or gross alpha primary drinking water standards 185 Bq/m^3 and 555 Bq/m^3 [5 pCi/L and 15 pCi/L], respectively and contain less than 0.001 mg/L [0.001 ppm] dissolved uranium (Feathers, 1981).

Water in Upper Cretaceous formations deeper than the Fox Hills Sandstone near the proposed project area are typically saline (i.e., they have elevated dissolved solids concentrations), which prohibits their use for domestic or municipal water supply. As discussed in SEIS Section 3.4.1.1, the Upper Cretaceous Teapot and Parkman sandstones below the Fox Hills Sandstone are currently used in the PRB for disposal of ISR liquid byproduct waste in Class I deep disposal wells. As further discussed in SEIS Section 3.2.3, there is extensive oil and gas production from Cretaceous formations below the Fox Hills Sandstone. Within an 8-km [5-mi] radius from the proposed project boundary, oil and gas is produced from the Parkman Sandstone, Turner Sandstone, Niobrara Formation, Sussex Sandstone, Muddy Sandstone, Frontier Formation, and Shannon Sandstone (see SEIS Table 3-5). Because of their chemical characteristics (i.e., saline and hydrocarbon-bearing), Upper Cretaceous formations below the Fox Hills Sandstone near the proposed project area typically do not meet EPA requirements for designation as “underground sources of drinking water” (USDWs) as defined in 40 CFR 144.3.

3.5.3.2 Reno Creek ISR Project Area Groundwater Quality

The applicant followed guidance in NUREG–1569 (NRC, 2003) and WDEQ (2013b) to characterize preoperational or baseline groundwater quality conditions at the proposed project area (AUC, 2012a). The applicant installed 39 monitoring wells in 4 aquifers: 21 wells in the PZA (designated PZM); 7 wells in the Overlying Aquifer (OM Unit) (designated OM); 7 wells in the Underlying Unit (UM Unit) (designated UM); and 4 wells in the Shallow Water Table Unit (SM Unit) (designated SM; monitoring wells were installed but dry at 3 additional locations in the SM Unit). The locations of groundwater monitoring wells are shown in SEIS Figure 3-23. To establish preoperational baseline groundwater quality, 28 of the monitoring wells (10 of the 21 PZM wells and all OM, UM, and SM wells) were sampled quarterly over a 1-year period, starting in 2010 or 2011 and ending in either 2011 or 2012. These wells are listed in SEIS Table 3-11. The remaining 11 PZM wells were installed to act as either pumping or observation wells for the applicant-conducted pumping tests (AUC, 2014a). However, groundwater was sampled and analyzed in 8 of these 11 PZM wells during 2010 or 2011 (PZM1, PZM3, PZM4, PZM5, PZM9, PZM13, PZM19, and PZM20), and the chemical analyses

Table 3-11. Parameters Exceeding EPA MCLs, EPA SMCLs, and WDEQ Class of Use Standards* in Wells Used to Establish Preoperational Groundwater Quality

Well ID	Parameters Exceeding EPA MCLs	Parameters Exceeding EPA SMCLs	Parameters Exceeding WDEQ Class I Standards	Parameters Exceeding WDEQ Class II Standards	Parameters Exceeding WDEQ Class III Standards	Probable WDEQ Class of Use
Production Zone Aquifer (PZA)						
PZM2	Uranium, Arsenic, Gross alpha[†], Combined Ra-226/228, Rn-222[‡]	pH, Sulfate, TDS	Gross alpha, Sulfate, TDS, pH, Combined Ra-226/228	Gross alpha, Selenium, Vanadium, pH, Combined Ra-226/228	Gross alpha, pH, Vanadium, Combined Ra-226/228	IV
PZM6	Gross alpha, Combined Ra-226/228, Rn-222	pH, Sulfate, TDS, Manganese	Gross alpha, Manganese, Sulfate, TDS, pH, Combined Ra-226/228	Gross alpha, Manganese, Sulfate, Combined Ra-226/228	Gross alpha, pH, Combined Ra-226/228	IV
PZM7	Uranium, Arsenic, Gross alpha, Combined Ra-226/228, Rn-222	pH, Sulfate, TDS	Gross alpha, Sulfate, TDS, pH, Combined Ra-226/228	Gross alpha, Sulfate, pH, Combined Ra-226/228	Gross alpha, pH, Combined Ra-226/228	IV
PZM8	Gross alpha, Combined Ra-226/228, Rn-222	Sulfate, TDS, Manganese	Gross alpha, Manganese, Sulfate, TDS, Combined Ra-226/228	Gross alpha, Sulfate, Combined Ra-226/228	Gross alpha, Combined Ra-226/228	IV
PZM10	Uranium, Arsenic, Cadmium, Lead, Gross alpha, Combined Ra-226/228, Rn-222	Sulfate, TDS	Gross alpha, Cadmium, Lead, Sulfate, TDS, Combined Ra-226/228	Gross alpha, Cadmium, Combined Ra-226/228	Gross alpha, Combined Ra-226/228	IV
PZM14	Gross alpha, Rn-222	Sulfate, TDS, Manganese, Iron	Gross alpha, Manganese, Sulfate, Iron, TDS	Gross alpha	Gross alpha	IV
PZM15	Uranium, Gross alpha, Combined Ra-226/228, Rn-222	Sulfate, TDS	Gross alpha, Manganese, Sulfate, TDS, Combined Ra-226/228	Gross alpha, Sulfate, Combined Ra-226/228	Gross alpha, Combined Ra-226/228	IV
PZM16	Uranium, Gross alpha, Combined Ra-226/228, Rn-222	Sulfate, TDS, Manganese	Gross alpha, Manganese, Sulfate, TDS, Combined Ra-226/228	Gross alpha, Sulfate, Combined Ra-226/228	Gross alpha, Combined Ra-226/228	IV
PZM17	Uranium, Gross alpha, Combined Ra-226/228, Rn-222	Sulfate, TDS, Manganese	Gross alpha, Manganese, Sulfate, TDS, Combined Ra-226/228	Gross alpha, Sulfate, Combined Ra-226/228	Gross alpha, Combined Ra-226/228	IV
PZM18	Gross alpha, Combined Ra-226/228, Rn-222	pH, Sulfate, TDS	Gross alpha, Sulfate, TDS, pH, Combined Ra-226/228	Gross alpha, Sulfate, pH, Combined Ra-226/228	Gross alpha, pH, Combined Ra-226/228	IV

Table 3-11. Parameters Exceeding EPA MCLs, EPA SMCLs, and WDEQ Class of Use Standards* in Wells Used to Establish Preoperational Groundwater Quality (Continued)

Well ID	Parameters Exceeding EPA MCLs	Parameters Exceeding EPA SMCLs	Parameters Exceeding WDEQ Class I Standards	Parameters Exceeding WDEQ Class II Standards	Parameters Exceeding WDEQ Class III Standards	Probable WDEQ Class of Use
GW5	Rn-222	Sulfate, TDS, Manganese, Iron	Sulfate, TDS, Manganese, Iron	Sulfate		III or IV
GW7	Gross alpha, Uranium, Rn-222	Manganese, Sulfate, TDS	Gross alpha, Manganese, Sulfate, TDS	Gross alpha, Sulfate	Gross alpha	IV
GW9	Gross alpha, Rn-222, Ra-226/228	Manganese, Sulfate, TDS, Iron	Manganese, Sulfate, TDS, Ra-226/228, Iron	Manganese, Sulfate, Ra-226/228	Ra-226/228	IV
GW10	Gross alpha, Uranium, Rn-222	Sulfate, TDS	Gross alpha, Sulfate, TDS	Gross alpha, Sulfate	Gross alpha	IV
Overlying Aquifer (OM Unit)						
OM1		Sulfate, TDS, Manganese, Iron	Sulfate, TDS, Iron	Sulfate, Manganese		III or IV
OM2	Rn-222	pH	pH	pH	pH	IV
OM3	Arsenic, Rn-222	pH, Iron	pH, Iron	pH	pH	IV
OM4		Sulfate, TDS, Manganese	Sulfate, TDS, Manganese	Sulfate, Manganese		III or IV
OM5		Sulfate, TDS, Manganese, Iron	Sulfate, TDS, Manganese, Iron	Sulfate, Manganese		III or IV
OM6		Sulfate, TDS, Manganese, Iron	Sulfate, Manganese, Iron	Sulfate, Manganese		III or IV
OM7	Arsenic, Rn-222	Sulfate, TDS, pH	Sulfate, TDS, pH, Nitrogen, Ammonia (as N)	Sulfate, pH	pH	IV
GW2	Rn-222	Manganese, Sulfate, TDS	Manganese, Sulfate, TDS	Manganese, Sulfate, TDS		III or IV
GW11	Rn-222, Ra-226/228	Manganese, Sulfate, TDS, Iron	Manganese, Sulfate, TDS, Iron, Ra-226/228	Manganese, Sulfate, TDS, Ra-226/228	Ra-226/228	IV
Underlying Unit (UM Unit)						
UM1	Gross alpha, Rn-222	pH, Iron	Gross alpha, pH, Iron	Gross alpha	Gross alpha, pH	IV
UM2	Arsenic, Rn-222	pH, Sulfate, TDS	pH, Sulfate, TDS	pH, Sulfate	pH	IV
UM3R	Arsenic	Sulfate, TDS	Sulfate, TDS	Sulfate		III or IV
UM4	Arsenic	Sulfate, TDS , Manganese, Iron	Sulfate, TDS, Manganese, Iron	Sulfate, Manganese		III or IV
UM5		pH, Manganese	pH		pH	II or IV
UM6		pH, Iron	pH, Iron	pH, Sulfate	pH	IV
UM7	Gross alpha, Combined Ra-226/228, Rn-222	pH, Iron	Gross alpha, pH, Iron, Combined Ra-226/228	Gross alpha, pH, Combined Ra-226/228	Gross alpha, pH, Combined Ra-226/228	IV

Table 3-11. Parameters Exceeding EPA MCLs, EPA SMCLs, and WDEQ Class of Use Standards* in Wells Used to Establish Preoperational Groundwater Quality (Continued)						
Well ID	**Parameters Exceeding EPA MCLs**	**Parameters Exceeding EPA SMCLs**	**Parameters Exceeding WDEQ Class I Standards**	**Parameters Exceeding WDEQ Class II Standards**	**Parameters Exceeding WDEQ Class III Standards**	**Probable WDEQ Class of Use**
GW6		Manganese, Sulfate, TDS	Manganese, Sulfate, TDS	Sulfate		III or IV
GW8	Gross alpha		Gross alpha	Gross alpha	Gross alpha	IV
Shallow Water Table Unit (SM Unit)						
SM3	Rn-222	Sulfate, TDS, Manganese, Iron	Sulfate, TDS, Manganese, Iron	Sulfate, TDS, Manganese		III or IV
SM5	Rn-222	Sulfate, TDS, Manganese, Iron	Sulfate, TDS, Manganese, Iron, Nitrogen, Ammonia (as N)	Sulfate, TDS, Manganese, Iron		III or IV
SM6	Gross alpha, Rn-222	Sulfate, TDS, Manganese, Iron	Gross alpha, Sulfate, TDS, Manganese, Iron	Gross alpha, Sulfate, Manganese, Iron	Gross alpha	IV
SM7	Gross alpha, Uranium	Sulfate, TDS, Manganese, Iron	Gross alpha, Sulfate, TDS, Manganese, Iron, Nitrogen, Ammonia (as N)	Gross alpha, Sulfate, TDS, Manganese, Iron	Gross alpha	IV
GW1	Rn-222	Manganese, Sulfate, TDS	Manganese, Sulfate, TDS	Manganese, Sulfate		III or IV
Unknown Aquifers§						
GW3	Rn-222	Manganese, Sulfate, TDS	Manganese, Sulfate, TDS	Manganese, Sulfate		III or IV
GW4	Gross alpha, Rn-222	Manganese, Sulfate, TDS	Gross alpha, Manganese, Sulfate, TDS	Gross alpha, Sulfate	Gross alpha	IV
GW12		Manganese, Sulfate, TDS	Manganese, Sulfate, TDS, Ammonia	Manganese, Sulfate, TDS		III or IV
GW14	Rn-222	pH	pH		pH	II or IV
GW15		pH	pH		pH	IV
GW17		Manganese, Sulfate, TDS	Manganese, Sulfate, TDS	Manganese, Sulfate		III or IV

Source: AUC, 2012i, 2014b.
*State of Wyoming groundwater is classified by use in order to apply standards to protect water quality. WDEQ has established groundwater quality standards for domestic use (Class I standards), agricultural use (Class II standards), livestock use (Class III standards), and industrial use (Class IV standards) (WDEQ, 2005).
†A gross alpha standard for all alphas of 15 pCi/L (not including radon and uranium).
‡The MCL for radon (Rn) is a proposed standard, not an approved standard. The proposed EPA MCL for Rn-222 is 11,100 Bq/m^3 [300 pCi/L] (56 FR 33050).
§Waters sampled for baseline quality from existing domestic and stock wells where the aquifer is unknown.

were used to develop Piper Diagrams to characterize baseline groundwater quality based on anion and cation distributions (AUC, 2012a, 2014a).

Using chemical data from the groundwater monitoring wells, the applicant also developed Piper Diagrams to illustrate the relative concentration of major ions in each aquifer (AUC, 2012g, Figures 2.7B-60, 2.7B-61, and 2.7B-62). Waters from the PZM wells display a consistent composition with sodium, potassium, and sulfate as the dominant ions. The consistent composition of the PZM well waters is related to the geochemical reactions responsible for formation of the ore bodies. For example, oxidation of pyrite produces sulfate that is dominant in these waters. In contrast to waters in PZM wells, UM well waters generally have greater amounts of sodium and vary in sulfate and bicarbonate/carbonate concentration. Waters from the OM Unit and SM Unit wells often have more calcium than water from the PZM wells. Chemically, waters from the OM and SM wells are the most variable in composition, which is related to the discontinuous nature of the shallow aquifers at the proposed project area and the abundance of low-permeability mudstones (AUC, 2012a).

In addition to the groundwater monitoring wells, 15 existing domestic and stock wells (designated GW) within 2 km [1.2 mi] of the project boundary were also sampled quarterly over a 1-year period (starting in 2010 or 2011 and ending in 2011 or 2012) for preoperational baseline groundwater quality. These wells are listed in SEIS Table 3-11 and their locations are shown in SEIS Figure 3-23. Based on a comparison of available hydrogeologic information within the proposed project area, such as aquifer depths and structural configurations, with available information on well completion intervals from the Wyoming State Engineer's Office (WSEO), the applicant determined the aquifer completion zone for the GW wells (AUC, 2012a, 2014b). One well (GW1) was completed in the SM Unit, two wells (GW2 and GW11) were completed in the OM Unit, four wells (GW5, GW7, GW9, and GW10) were completed in the PZA, and two wells (GW6 and GW8) were completed in the UM Unit (AUC, 2014b). For the remaining six GW wells (GW3, GW4, GW12, GW14, GW15, and GW17), the available hydrogeologic information within the proposed project area and well completion intervals from the WSEO was inadequate for determining the aquifer completion zone (AUC, 2014b). For these six wells, the aquifer from which groundwater was collected is listed as "unknown" in SEIS Table 3-11.

Groundwater quality parameters that exceeded EPA MCLs, EPA SMCLs, and WDEQ water quality standards in the 28 monitoring wells and 15 existing domestic and stock wells used to establish preoperational baseline groundwater quality are summarized in SEIS Table 3-11. Baseline groundwater quality results for the PZA, OM Unit, UM Unit, and SM Unit are discussed next.

Production Zone Aquifer (PZA)

Baseline groundwater quality samples collected from the PZA exceeded EPA MCLs for one or more of the following contaminants: uranium, arsenic, cadmium, lead, gross alpha, combined radium-226/228, and radon-222 (see SEIS Table 3-11; as described in the SEIS Table 3-11 footnotes, the EPA MCL for radon-222 is a proposed standard). Uranium concentrations ranged from <0.0003 to 0.661 mg/L [<0.0003 to 0.661 ppm] (AUC, 2015b). The MCL for uranium {0.03 mg/L [0.03 ppm]} was exceeded in 10 wells (PZM2, PZM7, PZM8, PZM10, PZM15, PZM16, PZM17, GW7, GW9, and GW10). Arsenic concentrations ranged from <0.001 to 0.045 mg/L [<0.001 to 0.045 ppm] (AUC, 2015b). Samples collected from three wells (PZM2, PZM7, and PZM10) exceeded the MCL for arsenic {0.01 mg/L [0.01 ppm]}. In addition, one quarterly cadmium and lead concentration in well PZM10 {0.026 mg/L [0.026 ppm] and 0.02 mg/L [0.02 ppm], respectively} exceeded the MCL for cadmium {0.005 mg/L [0.005 ppm]} and lead {0.015 mg/L [0.015 ppm]}. The MCL for other metals, such as selenium {0.05 mg/L [0.05 ppm]}, was not exceeded in any of the groundwater samples.

With the exception of well GW5, samples collected from PZA wells exceeded the MCL for gross alpha {555 Bq/m^3 [15 pCi/L]}. Gross alpha concentrations ranged from 74 to 102,120 Bq/m^3 [2.0 to 2,760 pCi/L] (AUC, 2015b). With the exception of monitoring well PZM14, samples collected from PZA monitoring wells exceeded the MCL for combined radium-226/228 {185 Bq/m^3 [5 pCi/L]}. Radium-226 concentrations in the monitoring wells (i.e., PZM wells) ranged from 114.7 to 25,900 Bq/m^3 [3.1 to 700 pCi/L] and radium-228 concentrations ranged from 37 to 70.3 Bq/m^3 [<1.0 to 1.9 pCi/L] (AUC, 2015b). None of the samples collected from domestic and stock wells completed in the PZA exceeded the MCL for combined radium-226/228 {185 Bq/m^3 [5 pCi/L]}. Radium-226 concentrations in domestic and stock wells (i.e., GW wells) ranged from 7.4 to 111 Bq/m^3 [0.2 to 3.0 pCi/L] and radium-228 concentrations ranged from <37 to 137 Bq/m^3 [<1.0 to 3.7 pCi/L]. A majority of samples collected from PZA wells exceeded the proposed EPA MCL for radon-222 {11,100 Bq/m^3 [300 pCi/L]} (56 FR 33050). Radon-222) concentrations ranged from 3,404 to 1.05×10^8 Bq/m^3 [92 to 2,830,000 pCi/L] (AUC, 2015b).

Baseline groundwater quality samples from PZA wells also exceeded the SMCLs for bulk water quality properties, including pH, TDS, and other major constituents such as manganese, iron, and sulfate (SEIS Table 3-11). Samples from all the PZA wells exceeded the SMCL for TDS {500 mg/L [500 ppm]} and sulfate {250 mg/L [250 ppm]}. TDS concentrations ranged from 530 to 2,170 mg/L [530 to 2,170 ppm] and sulfate concentrations ranged from 231 to 1,180 mg/L [231 to 1,180 ppm] (AUC, 2015b). The pH of PZA wells ranged from 7.64 to 12.6 (AUC, 2015b). The SMCL for pH (6.5 to 8.5) was exceeded in four monitoring wells (PZM2, PZM6, PZM7, and PZM18). The manganese concentration in PZM wells ranged from <0.01 to 0.52 mg/L [<0.01 to 0.52 ppm] (AUC, 2015b). The SMCL for manganese {0.05 mg/L [0.05 ppm]} was exceeded in eight wells (PZM6, PZM8, PZM14, PZM16, PZM17, GW5, GW7, and GW9). Samples from three wells (PZM14, GW5, and GW9) exceeded the SMCL for iron {0.3 mg/L [0.3 ppm]}.

As shown in SEIS Table 3-11, all the PZA wells contained one or more parameters that exceeded State of Wyoming standards for Classes I, II, and III groundwater use. Parameters exceeding Class I standards included gross alpha, sulfate, manganese, iron, cadmium, lead, TDS, pH, and combined radium-226/228. Parameters exceeding Class II standards included gross alpha, sulfate, manganese, selenium, vanadium, pH, and combined radium-226/228. Parameters exceeding Class III standards included gross alpha, vanadium, pH, and combined radium-226/228.

Overlying Aquifer (OM Unit)

Baseline groundwater quality samples collected from five OM Unit wells (OM2, OM3, OM7, GW2, and GW11) exceeded EPA MCLs for the following contaminants: arsenic, radon-222, and combined radium-226/228 (SEIS Table 3-11). Arsenic concentrations ranged from <0.001 to 0.033 mg/L [<0.001 to 0.033 ppm] (AUC, 2015b). The MCL for arsenic {0.01 mg/L [0.01 ppm]} was exceeded in two wells (OM3 and OM7). The MCL for other metals, such as uranium {0.03 mg/L [0.03 ppm]} and selenium {0.05 mg/L [0.05 ppm]} was not exceeded in any of the OM Unit groundwater well samples. Radon-222 concentrations in the OM Unit wells ranged from <1,850 to 55,500 Bq/m^3 [<50 to 1,500 pCi/L] (AUC, 2015b). The proposed EPA MCL for radon-222 {11,100 Bq/m^3 [300 pCi/L]; 56 FR 33050} was exceeded in five wells (OM2, OM3, OM7, GW2, and GW11). The MCL for combined radium-226/228 {185 Bq/m^3 [5 pCi/L]} was exceeded in one well (GW11). Radium-226 concentrations in well GW11 ranged from 48.1 to 55.5 Bq/m^3 [1.3 to 1.5 pCi/L] and radium-228 concentrations ranged from 55.5 to 181 Bq/m^3 [1.5 to 4.9 pCi/L] (AUC, 2015b).

Baseline groundwater quality samples from wells in the OM Unit exceeded the SMCLs for bulk water quality properties, including pH, TDS, and other constituents such as manganese, iron, and sulfate (SEIS Table 3-11). Samples from seven wells (OM1, OM4, OM5, OM6, OM7, GW2, and GW11) exceeded the SMCL for TDS {500 mg/L [500 ppm]} and sulfate {250 mg/L [250 ppm]}. TDS concentrations in OM Unit wells ranged from 250 to 2,400 mg/L [250 to 2,400 ppm] and sulfate concentrations ranged from 17 to 1,560 mg/L [17 to 1,560 ppm] (AUC, 2015b). The pH of wells ranged from 6.26 to 11.87 (AUC, 2015b). The SMCL for pH (6.5 to 8.5) was exceeded in four wells (OM2, OM3, OM7, and GW11). The manganese concentration in OM Unit wells ranged from <0.01 to 1.16 mg/L [<0.01 to 1.16 ppm] (AUC, 2015b). The SMCL for manganese {0.05 mg/L [0.05 ppm]} was exceeded in six wells (OM1, OM4, OM5, OM6, GW2, and GW11). The iron concentration ranged from <0.05 to 0.76 mg/L [<0.05 to 0.76 ppm] (AUC, 2015b). The SMCL for iron {0.3 mg/L [0.3 ppm]} was exceeded in five wells (OM1, OM3, OM5, OM6, and GW11).

All the OM Unit wells contained parameters that exceeded State of Wyoming standards for Classes I and II groundwater use (see SEIS Table 3-11). Parameters exceeding Class I standards included sulfate, manganese, iron, TDS, pH, nitrogen, ammonia, and radium-226/228. Parameters exceeding Class II standards included sulfate, manganese, iron, pH, and radium-226/228. In addition, three wells (OM2, OM3, and OM7) exceeded the State of Wyoming Class III standard for pH, and one well (GW11) exceeded the Class III standard for radium-226/228.

Underlying Unit (UM Unit)

Baseline groundwater quality samples collected from six UM unit wells (UM1, UM2, UM3R, UM4, UM7, and GW8) exceeded EPA MCLs for the following contaminants: arsenic, gross alpha, combined radium-226/228, and radon-222 (SEIS Table 3-11). Arsenic concentrations ranged from <0.001 to 0.022 mg/L [<0.001 to 0.022 ppm] (AUC, 2015b). The MCL for arsenic {0.01 mg/L [0.01 ppm]} was exceeded in three UM unit wells (UM2, UM3R, and UM4). The MCL for other metals, such as uranium {0.03 mg/L [0.03 ppm]} and selenium {0.05 mg/L [0.05 ppm]}, was not exceeded in any of the UM unit groundwater samples.

Gross alpha concentrations in the UM unit wells ranged from 74 to 9,102 Bq/m^3 [2.0 to 24.6 pCi/L] (AUC, 2015b). The MCL for gross alpha {555 Bq/m^3 [15 pCi/L]} was exceeded in three wells (UM1, UM7, and GW8). In addition, one quarterly combined radium-226/228 concentration in well UM7 {233 Bq/m^3 [6.3 pCi/L]} exceeded the MCL for combined radium-226/228 {185 Bq/m^3 [5 pCi/L]}. Radon-222 concentrations in the wells ranged from <1,850 to 171,680 Bq/m^3 [<50 to 4,640 pCi/L] (AUC, 2015b). The proposed EPA MCL for radon-222 {11,100 Bq/m^3 [300 pCi/L]; 56 FR 33050} was exceeded in three wells (UM1, UM2, and UM7).

Baseline groundwater quality samples from UM unit wells exceeded the SMCLs for bulk water quality properties, including pH, TDS, and other constituents such as manganese, iron, and sulfate (SEIS Table 3-11). Samples from four wells (UM2, UM3R, UM4, and GW6) exceeded the SMCL for TDS {500 mg/L [500 ppm]} and sulfate {250 mg/L [250 ppm]}. TDS concentrations in UM unit wells ranged from 250 to 1,620 mg/L [250 to 1,620 ppm] and sulfate concentrations ranged from <1 to 852 mg/L [<1 to 852 ppm] (AUC, 2015b). The pH of wells ranged from 7.5 to 11.57 (AUC, 2015b). The SMCL for pH (6.5 to 8.5) was exceeded in five wells (UM1, UM2, UM5, UM6, and UM7). The manganese concentration in wells ranged from <0.01 to 0.72 mg/L [<0.01 to 0.72 ppm] (AUC, 2015b). The SMCL for manganese {0.05 mg/L [0.05 ppm]} was exceeded in three wells (UM4, UM5, and GW6). The iron concentration in wells ranged from <0.05 to 1.16 mg/L [<0.05 to 1.16 ppm] (AUC, 2015b). The SMCL for iron {0.3 mg/L [0.3 ppm]} was exceeded in three wells (OM1, OM6, and OM7).

All the UM unit wells contained parameters that exceeded State of Wyoming standards for Class I groundwater use (see SEIS Table 3-11). Parameters exceeding Class I standards included gross alpha, sulfate, manganese, iron, TDS, pH, and combined radium-226/228. With the exception of well UM5, all UM unit wells contained parameters that exceeded State of Wyoming standards for Class II groundwater use. Parameters exceeding Class II standards included gross alpha, sulfate, manganese, iron, pH, and combined radium-226/228. In addition, six wells (UM1, UM2, UM5, UM6, UM7, and GW8) exceeded the State of Wyoming Class III standards for one or more of the following parameters: pH, gross alpha, and combined radium-226/228.

Shallow Water Table Unit (SM Unit)

Baseline groundwater quality samples collected from SM Unit wells exceeded EPA MCLs for one or more of the following contaminants: uranium, gross alpha, and radon-222 (SEIS Table 3-11). Uranium concentrations in wells ranged from 0.0005 to 0.0304 mg/L [0.0005 to 0.0304 ppm] (AUC, 2015b). The MCL for uranium {0.03 mg/L [0.03 ppm]} was exceeded in one well (SM7). The MCL for other metals, such as arsenic {0.01 mg/L [0.01 ppm]} and selenium {0.05 mg/L [0.05 ppm]} was not exceeded in any of the SM Unit groundwater well samples.

Gross alpha concentrations in SM Unit wells ranged from 74 to 1,136 Bq/m^3 [2.0 to 30.7 pCi/L] (AUC, 2015b). Gross alpha concentrations in two wells (SM6 and SM7) exceeded the MCL for gross alpha {555 Bq/m^3 [15 pCi/L]}. Radon-222 concentrations in wells ranged from <1,850 to 26,714 Bq/m^3 [<50 to 722 pCi/L] (AUC, 2015b). With the exception of well SM7, samples collected from the SM Unit wells exceeded the proposed EPA MCL for radon-222 {11,100 Bq/m^3 [300 pCi/L]} (56 FR 33050).

Baseline groundwater quality samples from the SM Unit wells also exceeded the SMCLs for TDS {500 mg/L [500 ppm]}, sulfate {250 mg/L [250 ppm]}, manganese {0.05 mg/L [0.05 ppm]}, and iron {0.3 mg/L [0.3 ppm]} (SEIS Table 3-11). TDS concentrations ranged from 430 to 3,060 mg/L [430 to 3,060 ppm], sulfate concentrations ranged from 68 to 1,730 mg/L [68 to 1,370 ppm], manganese concentrations ranged from 0.08 to 0.99 mg/L [0.08 to 0.99 ppm], and iron concentrations ranged from <0.05 to 11.9 mg/L [<0.05 to 11.9 ppm] (AUC, 2015b).

All the SM Unit wells contained parameters that exceeded State of Wyoming standards for Classes I and II groundwater use (see SEIS Table 3-11). Parameters exceeding Class I standards included gross alpha, sulfate, manganese, iron, TDS, nitrogen, and ammonia. Parameters exceeding Class II standards included gross alpha, sulfate, manganese, iron, and TDS. In addition, two wells (SM6 and SM7) exceeded the State of Wyoming Class III standard for gross alpha.

Unknown Aquifer

As described previously, six domestic and stock wells (GW3, GW4, GW12, GW14, GW15, and GW17) were sampled for baseline groundwater quality where the aquifer from which the water was collected could not be determined based on a comparison of available hydrogeologic information within the proposed project area with available information on well completion intervals from the WSEO (AUC, 2012a, 2014b). For these six wells, the aquifer from which groundwater was collected is listed as "unknown" in SEIS Table 3-11. Baseline groundwater quality samples collected from four of these wells (GW3, GW4, GW14, and GW15) exceeded EPA MCLs for the following contaminants: gross alpha and radon-222 (SEIS Table 3-11). The MCL for gross alpha {555 Bq/m^3 [15 pCi/L]} was exceeded in one well (GW4). Gross alpha concentrations in well GW4 ranged from 455 to 692 Bq/m^3 [12.3 to 18.7 pCi/L] (AUC, 2015b). Radon-222 concentrations in the samples collected from wells completed in unknown aquifers ranged from <1,850 to 208,680 Bq/m^3 [<50 to 5,640 pCi/L] (AUC, 2015b). The proposed EPA MCL for radon-222 {11,100 Bq/m^3 [300 pCi/L]; 56 FR 33050} was exceeded in three wells (GW3, GW4, and GW14).

Baseline groundwater quality samples from unknown aquifer wells exceeded the SMCLs for bulk water quality properties, including pH, TDS, and other constituents such as manganese, iron, and sulfate (SEIS Table 3-11). Samples from four wells (GW3, GW4, GW12, and GW17) exceeded the SMCL for TDS {500 mg/L [500 ppm]} and sulfate {250 mg/L [250 ppm]}. TDS concentrations ranged from 280 to 2,360 mg/L [280 to 2,360 ppm] and sulfate concentrations ranged from 56 to 1,520 mg/L [56 to 1,520 ppm] (AUC, 2015b). The pH of wells ranged from 7.02 to 9.80 (AUC, 2015b). The SMCL for pH (6.5 to 8.5) was exceeded in two wells (GW14and GW15). The manganese concentration ranged from <0.01 to 0.71 mg/L [<0.01 to 0.71 ppm] (AUC, 2015b). The SMCL for manganese {0.05 mg/L [0.05 ppm]} was exceeded in four wells (GW3, GW4, GW12, and GW17).

All samples from wells in unknown aquifers contained parameters that exceeded State of Wyoming standards for Class I groundwater use (see SEIS Table 3-11). Parameters exceeding Class I standards included sulfate, manganese, TDS, pH, ammonia, and gross alpha. Four wells (GW3, GW4, GW12, and GW17) had parameters exceeding Class II standards, including sulfate, manganese, TDS, and gross alpha. In addition, two wells (GW14 and GW15) exceeded the State of Wyoming Class III standard for pH and one well (GW4) exceeded the Class III standard for gross alpha.

Summary

The baseline groundwater sampling results found that samples from 33 of the 43 wells listed in SEIS Table 3-11 contained parameters that exceeded the MCLs for primary drinking water standards, as provided by EPA regulations in 40 CFR Part 141. In addition, all of the wells contained parameters that exceeded State of Wyoming Class I standards for domestic use. All groundwater samples from the PZA exceeded the MCLs for primary drinking water, as provided by EPA regulations in 40 CFR Part 141 and State of Wyoming Class I standards for domestic use. Therefore, groundwater from the proposed PZA within the permit boundaries would not be used in public water systems and is unsuitable for private domestic use without treatment.

3.6 Ecology

The Wyoming East Uranium Milling Region, as described in the GEIS, encompasses the Wyoming Basin, Northern Great Plains, Southern Rockies, and Western High Plains ecoregions. The proposed Reno Creek ISR Project area is located in the Northwestern Great Plains ecoregion (SEIS Figure 3-24). GEIS Section 3.3.5.1 describes the PRB as rolling prairie and dissected river breaks surrounding the Powder, Cheyenne, and Upper North Platte Rivers. The PRB has less precipitation and less available water than neighboring regions (NRC, 2009). Vegetation within this region is composed of sagebrush and mixed-grass prairie dominated by blue grama (*Bouteloua gracilis*); western wheatgrass (*Elymus smithii* syn. *Pascopyrum smithii*);

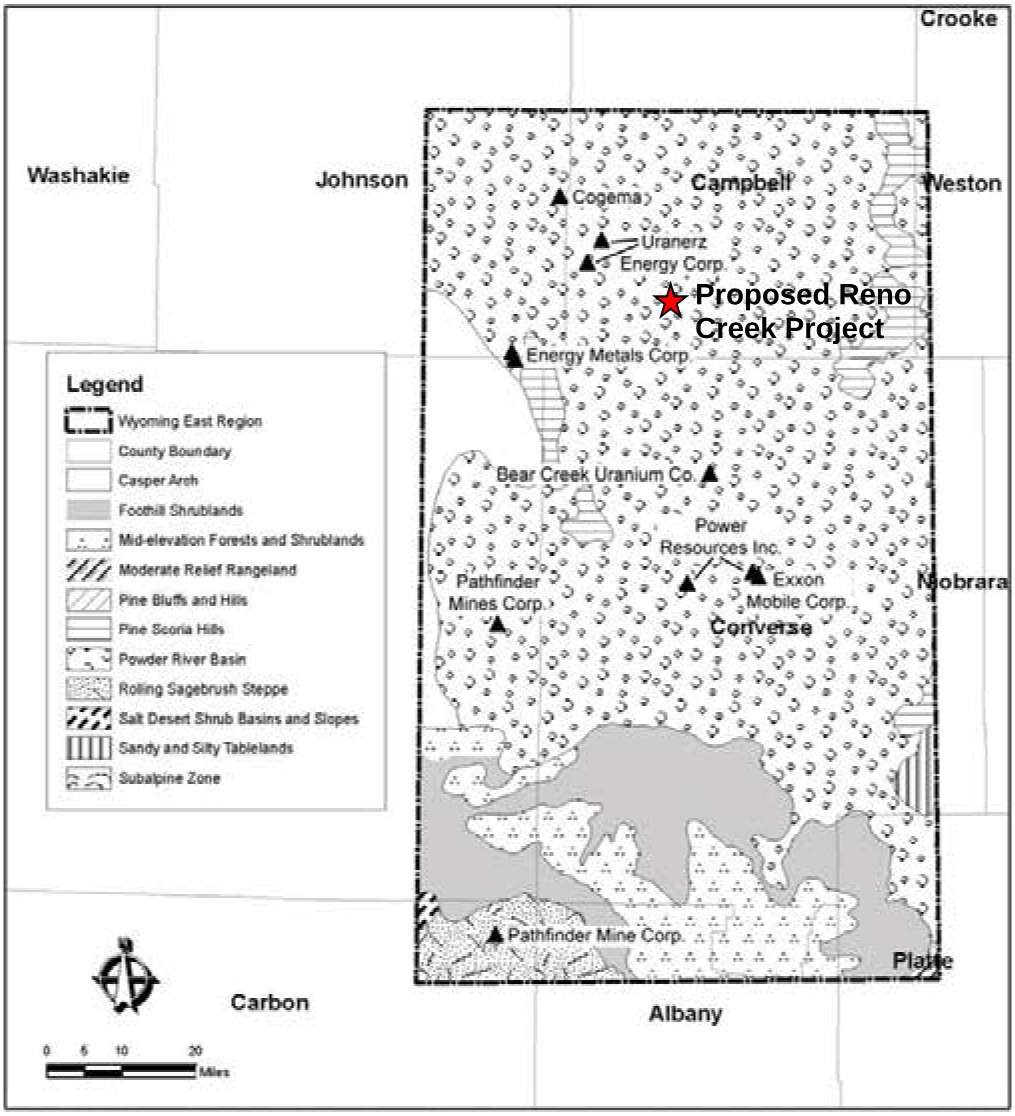

Figure 3-24. Ecoregions of the Wyoming East Uranium Milling Region (NRC, 2009)

prairie junegrass (*Koeleria macrantha*); Sandberg Bluegrass (*Poa secunda*); needle-and-thread grass (*Stipa comata*); rabbitbrush (*Chrysothamnus nauseosus*);

fringed sage (*Artemisia frigida*); and other forbs, shrubs, and grasses (Chapman et al., 2004). The region includes native grasslands and some woodlands, especially in areas of steep or broken topography (Chapman et al., 2004). Topography in the proposed project area is relatively flat, with gently rolling hills, ridges, and ephemeral surface water drainages. The proposed project area elevation ranges from 1,536 to 1,614 m [5,041 to 5,296 ft] above mean sea level with the highest elevation in the eastern portion (AUC, 2012a).

The applicant conducted a number of ecological studies of the proposed Reno Creek ISR Project area (AUC, 2012a) to address the guidelines in NUREG–1569 (NRC, 2003), including the identification of important species and their relative abundances and to meet the applicable Wyoming requirements. In fall 2010 and summer 2011, baseline vegetation and wetland surveys were conducted for the proposed project area and a 0.8-km [0.5-mi] buffer around the proposed project area. Additionally, in spring 2008 and 2010, and in spring and summer 2011, baseline wildlife surveys were conducted for the proposed project area and a 1.6-km [1-mi] buffer around the proposed project area (AUC, 2012a). In addition, the applicant searched for Greater sage-grouse (*Centrocercus urophasianus*) leks within a 6.4 km [4 mi] around the proposed project area to address Wyoming assessment procedures (Mead, 2015). No surveys were conducted for aquatic species due to the lack of sufficiently deep-water habitat or extensive water sources that would support the presence of fish and other aquatic species (AUC, 2012a).

3.6.1 Terrestrial Species

3.6.1.1 Vegetation

Using 2009 National Agricultural Imagery Program (NAIP) true color ortho-aerial imagery, the applicant mapped the plant communities within the proposed project area and a 0.8-km [0.5-mi] buffer around the proposed project area (AUC, 2012a). Following WDEQ guidelines to verify the aerial imagery results, the applicant conducted quantitative (field samples) vegetation sampling only within the proposed project area during the summer of 2011 (AUC, 2012a). In addition, wetland surveys were conducted within the proposed project area in fall 2010 and summer 2011 following the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0) (USACE, 2010). The wetland surveys identified a total of 17.12 ha [42.23 ac] of wetlands within the proposed project area. Wetlands are further described in SEIS Section 3.5.1.4. State and county noxious weeds and FWS threatened, endangered, and candidate plant species were inventoried during the baseline vegetation surveys (AUC, 2012a).

Four plant communities were mapped within the proposed project area and the 0.8-km [0.5-mi] buffer around the project area and include big sagebrush shrubland, meadow grassland, upland grassland, and breaks grassland (AUC, 2012a). The big sagebrush shrubland community covers approximately 78 percent of the proposed project area and 0.8-km [0.5-mi] buffer, and is denser in the eastern portion of the proposed project area and 0.8-km [0.5-mi] buffer. Combined, the three aforementioned grassland plant communities cover approximately 17 to 18 percent of the proposed project area and 0.8-km [0.5-mi] buffer. Upland grassland is found scattered throughout the proposed project area and 0.8-km [0.5-mi] buffer, covering a relatively large area within higher elevations adjacent to Highway 387. Meadow grassland and breaks grassland are interspersed along lower elevation creeks and drainages throughout the proposed project area and 0.8-km [0.5-mi] buffer. The acreage of each plant community, disturbed ground, and open water at the proposed project area and surrounding buffer area are summarized in Table 3-12.

The four plant communities in the proposed project area are composed of 93 individual plant species. Field samples of vegetation were collected and specific species were counted only within the proposed project area. Between 36 and 61 plant species were found in each plant community. Table 3-13 summarizes the species diversity by vegetation type within each plant community. The most common perennial grasses included Western wheatgrass, green needlegrass (*Nassella viridula*), crested wheatgrass (*Agropyron cristatum*), and blue grama

Table 3-12. Plant Communities at the Proposed Reno Creek ISR Project Area and 0.8 km [0.5 mi] Buffer During 2010 and 2011 Baseline Vegetation Surveys				
Plant Community, Disturbed Ground, or Water	**Proposed Reno Creek Project Area**		**0.8 km [0.5 mi] Buffer Area (not field verified)**	
	Hectares [Acres]	**Percent of Proposed Project Area**	**Hectares [Acres]**	**Percent of Buffer Area**
Big Sagebrush Shrubland	1,913.87 [4,729.27]	78.08	1859.77 [4,595.60]	78.59
Meadow Grassland	195.89 [484.06]	7.99	200.46 [495.34]	8.47
Upland Grassland	194.34 [480.23]	7.93	164.73 [407.06]	6.96
Breaks Grassland	32.54 [80.41]	1.33	57.79 [142.80]	2.44
Disturbed Ground	112.96 [279.14]	4.61	82.54 [203.97]	3.49
Water	1.74 [4.31]	0.07	1.26 [3.11]	0.05
Total	2,451.35 [6,057.42]	**100.00**	2,366.55 [5,847.88]	**100.00**
Source: (AUC, 2012a)				

Table 3-13. Species Diversity by Vegetation Type Within the Proposed Reno Creek ISR Project Area During Baseline Vegetation Surveys				
Vegetation Type	**Number of Individual Plant Species Recorded in Each Plant Community**			
	Big Sagebrush Shrubland	**Upland Grassland**	**Meadow Grassland**	**Breaks Grassland**
Perennials				
Native Cool Season Perennial Grasses	7	5	5	10
Native Warm Season Perennial Grasses	1	2	2	1
Introduced Perennial Grasses	3	2	3	3
Native Grass-like Species	2	2	4	1
Native Perennial Forbs	25	20	19	21
Introduced Perennial Forbs	3	4	2	1
Native Full Shrubs	3	1	2	3
Native Half & Sub-Shrubs	3	4	3	6
Native Succulent	1	1	0	1
Subtotal	48	41	42	47
Annuals				
Native Annual Grasses	1	1	1	0
Introduced Annual Grasses	3	2	3	3
Native Annual Forbs	3	1	3	1
Introduced Annual Forbs	4	3	8	3

Table 3-13. Species Diversity by Vegetation Type Within the Proposed Reno Creek ISR Project Area During Baseline Vegetation Surveys (Continued)				
Vegetation Type	**Number of Individual Plant Species Recorded in Each Plant Community**			
	Big Sagebrush Shrubland	**Upland Grassland**	**Meadow Grassland**	**Breaks Grassland**
Introduced Biennial Forbs	2	1	2	2
Subtotal	13	8	17	9
Unknown				
Forb species	0	0	2	1
Subtotal	0	0	2	1
TOTAL SPECIES	61	49	61	57
Source: (AUC, 2012a; AUC, 2014a)				

(*Bouteloua gracilis*), which all occurred in each of the four plant communities. Dominant perennial forbs included American vetch (*Vicia americana*), Hoods phlox (*Phlox hoodii*), and spoonleaf milkvetch (*Astragalus spatulatus*). Dominant perennial shrub species included big sagebrush (*Artemisia tridentata*), fringed sagewort (*Artemisia frigida*), and birdfoot sagebrush (*Artemisia pedatifida*). Threadleaf sedge (*Carex filifolia*) was the dominant grass-like vegetation type. Japanese brome (*Bromus japonicus*) and cheatgrass (*Bromus tectorum*), introduced and invasive annual grasses, were prevalent in each plant community. Desert alyssum (*Alyssum desertorum*) was the dominant annual forb. Lichens and plains prickly pear (*Opuntia polyacantha*), a succulent, were also present. Russian olive (*Elaeagnus angustifolia*), a state designated noxious weed, and plains cottonwood (*Populus deltoides)*, the Wyoming state tree, are the only trees present in the proposed project area. A stand of these two trees is present north of Hwy 387 within the proposed project area (AUC, 2012a).

State designated noxious weed species Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvensis*), and the Russian olive tree were recorded and mapped when encountered during the baseline vegetation surveys (AUC, 2012a; Wyoming Weed and Pest Control Council, 2014). Canada thistle occurred at eight survey locations within the project area, and field bindweed and Russian olive occurred at one survey location within the project area (AUC, 2012a). No federal or state threatened or endangered plant species were documented during surveys at the proposed Reno Creek ISR Project area. The vegetation types sampled or observed in each vegetative community within the proposed Reno Creek project area and 0.8-km [0.5-mi] buffer are shown in SEIS Figure 3-25.

The WDEQ describes selenium indicator plant species as plant species that may selectively concentrate selenium in their tissue, be tolerant of high selenium concentrations in the soil, or both. These species, when grazed by livestock, may produce toxic reactions known as selenium poisoning (WDEQ, 2014a; USDA, 2006). Twogrooved milkvetch (*Astragalus bisulcatus)*, which is identified as a primary selenium indicator plant species (WDEQ, 2014a), was observed during baseline vegetation surveys in the big sagebrush shrubland and breaks grassland plant communities, but it was not sampled to obtain relative cover. Western wheatgrass, a secondary selenium indicator plant (USDA, 2006), was observed in all of the plant communities within the proposed project area. For more information on livestock grazing within the proposed project area, see SEIS Section 3.2.

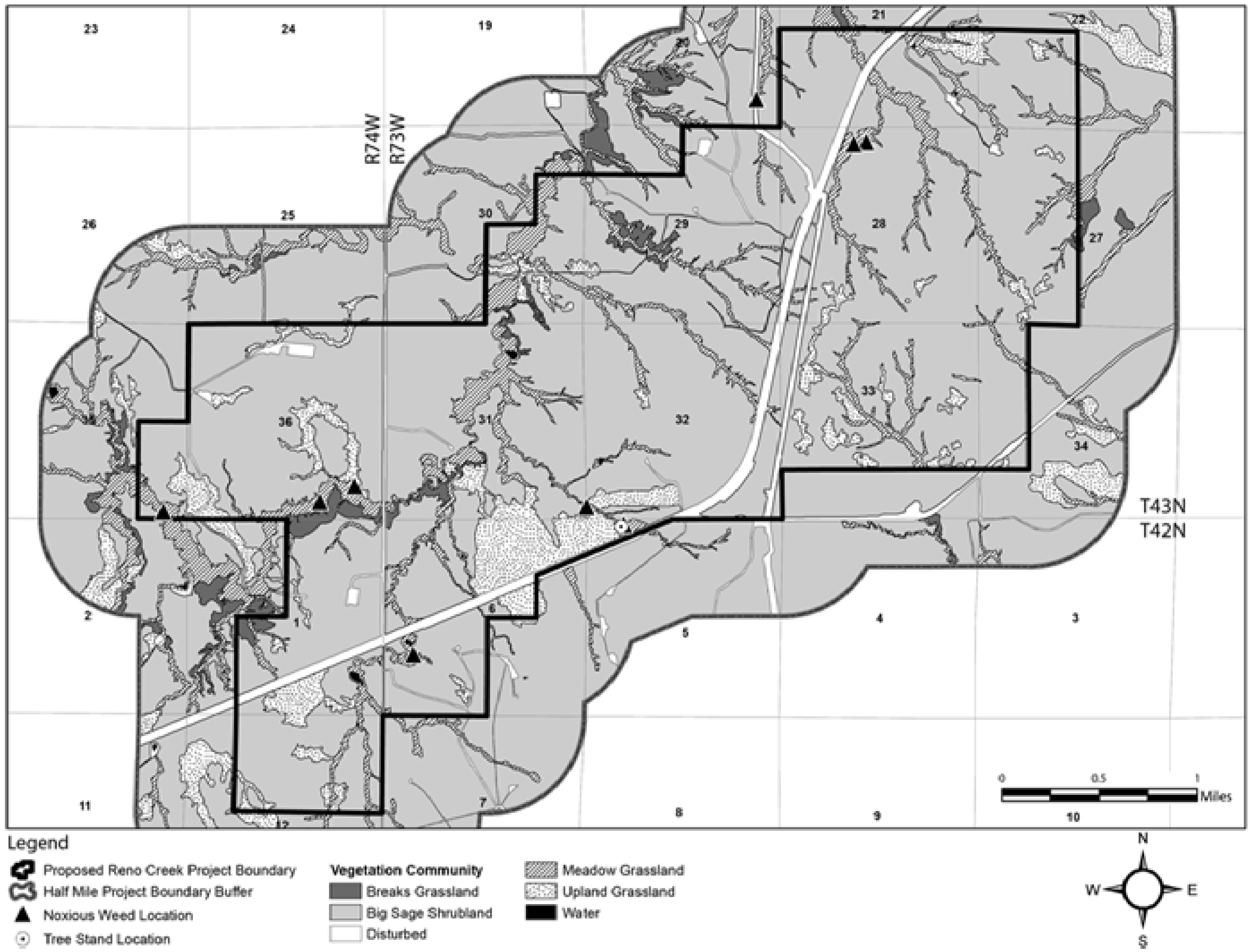

Figure 3-25. Baseline Vegetation Within the Proposed Reno Creek ISR Project Area and 0.8-km [0.5-mi] Buffer (AUC, 2014a).

3.6.1.2 Wildlife

General ranges for terrestrial vertebrate wildlife species in the Wyoming East Uranium Milling Region are presented in the GEIS (NRC, 2009). The applicant collected background information for the proposed Reno Creek ISR Project area from several sources, including records from the WGFD, BLM, and FWS (AUC, 2012a), as well as from the GEIS (NRC, 2009). Wildlife baseline surveys were conducted in 2008, 2010, and 2011 after consultation with the WGFD and review of the FWS website (AUC, 2012a). WGFD letters to the applicant in 2008 and 2010 stated that the applicant should conduct raptor nest surveys and Greater sage-grouse lek surveys within the proposed project area and a 1.6-km [1-mi] buffer around the proposed project area as part of the applicant's baseline wildlife survey activities. WGFD staff also recommended in 2010 that the applicant conduct surveys for swift fox (*Vulpes velox)* and delineate prairie dog colonies, if found, within the proposed project area. The applicant conducted baseline wildlife surveys following these WGFD recommendations as well as applicable sections of WDEQ rules and regulations (WDEQ, 1994b; 2000) and WDEQ guidelines (WDEQ, 2007; 2013b) (AUC, 2012a).

The applicant conducted baseline wildlife surveys in 2008, 2010, and 2011. The applicant conducted surveys to look for raptor nests on July 1, 2008; June 4 and 16, 2010; and April 11, May 2 and 16, June 3, and July 11, 2011. The applicant followed the guidelines recommended by Grier and Fyfe (1987) during these raptor nest surveys to prevent adverse disturbances. Consistent with FWS and WGFD recommendations (BLM, 2015; WGFD, 2014a), upland gamebird surveys were conducted on April 12 and 28, 2008; April 12, 19, and 29, 2010; and April 1, 12, and 28, 2011 (AUC, 2012a).

The applicant recorded threatened and endangered species and habitats and other sensitive species, Wyoming species of greatest conservation need (SGCN), and FWS Migratory Bird Species of Management Concern when observed (AUC, 2012a). In addition to those species that were targeted on specific dates, each vertebrate species that was observed during baseline wildlife surveys was recorded (AUC, 2012a). No quantitative surveys were conducted at the proposed Reno Creek project area for big game, lagomorphs [e.g., jackrabbits (Lepus spp.) and cottontails (Sylvilagus spp.)], breeding birds, waterfowl, small mammals, mammalian predators, furbearers, reptiles, amphibians, or fish (AUC, 2012a).

3.6.1.2.1 Habitat Description

Big sagebrush shrubland previously described in SEIS Section 3.6.1.1 is an important habitat for pronghorn (*Antilocapra americana*); mule deer (*Odocoileus hemionus*); Greater sage-grouse; small- and medium-sized mammals such as badgers, mice, and voles; and several sagebrush obligate avian species, such as the sage thrasher (*Oreoscoptes montanus*), sage-grouse, and Brewer's sparrow (*Spizella breweri*) (AUC, 2012a). This habitat type provides important food and cover for resident and migratory birds and small mammals, nesting sites for raptors, and critical forage for ungulates (e.g., pronghorn and mule deer) and Greater sage-grouse during winters (WGFD, 2010a).

Grasslands in the proposed Reno Creek ISR Project area support nesting, foraging, and refuge for mammals, reptiles, and avian species, including raptors such as Northern harriers (*Circus cyaneus),* Swainson's hawks (*Buteo swainsoni*), ferruginous hawks (*Buteo regalis)* and golden eagles (*Aquila chrysaetos)*, migratory birds, and song birds (AUC, 2012a). Mixed grasslands, such as those found at the proposed Reno Creek ISR Project area, offer a variety of habitat needs for birds that require short vegetation and open ground, such as the McCown's longspur (*Calcarius mccownii)*, and birds that prefer taller grasses, such as the grasshopper sparrows (*Ammodramus savannarum*) (WGFD, 2010a). Table 3-14 lists the 37 different species observed during the baseline wildlife surveys conducted in spring and summer 2008, spring 2010, and spring and summer 2011 (see SEIS Section 3.6.1.2). SEIS Figure 3-26 shows raptor nest locations within the proposed project area and a 1.6-km [1-mi] buffer around the proposed project area. Greater sage-grouse lek locations within 6.4 km [4 mi] of the proposed project area are also shown on SEIS Figure 3-26; the 6.4 km [4 mi] distance is based on State of Wyoming recommendations for Greater sage-grouse (Mead, 2015).

The proposed project area and 1.6 km [1 mi] buffer lies within habitat WGFD designates as winter/yearlong and yearlong range for pronghorn antelope and yearlong range for mule deer (AUC, 2012a). Winter/yearlong habitat use is when a population or a portion of a population of animals makes general use of the range on a year-round basis. During the winter months, there is typically an influx of additional animals into the area from other seasonal ranges. No WGFD crucial big game habitats or migration corridors are located within 30.6 km [19 mi] of the proposed Reno Creek ISR Project area (NRC, 2009; BLM, 2015). Big game species are discussed further in SEIS Section 3.6.1.2.2.

The eastern portion of the proposed project area and 1.6 km [1 mi] buffer is characterized by taller and denser sagebrush plants than other parts of the proposed project area and is identified as a WGFD Crucial Habitat Priority Area and an Enhancement Habitat Priority Area for the sagebrush/mixed grassland habitat within Greater sage-grouse complexes (SEIS Figure 3-26). Crucial Habitat Priority Areas are identified by WGFD based on significant biological or ecological values in areas that need to be protected or managed to maintain viable healthy populations of wildlife species, while enhancement Habitat Priority Areas represent those habitat areas that can realistically be improved, enhanced, or restored (WGFD, 2010a). Wyoming big sagebrush provides crucial food for Greater sage-grouse, and mature sagebrush cover is important for Greater sage-grouse broods (WGFD, 2010a). Although available Greater sage-grouse nesting and winter habitat are located within the proposed project area (BLM, 2015), the proposed project area and 1.6 km [1 mi] buffer are not located in a Greater sage-grouse core population area or connectivity corridor, as designated by the State of Wyoming. Greater sage-grouse core population areas or connectivity corridors are areas the State of Wyoming has identified as high-quality habitat for Greater sage-grouse nesting and brood-rearing and are necessary to maintain Greater sage-grouse populations (WGFD, 2010a,b). The BLM identifies core population areas or connectivity corridors as priority habitat management areas (PHMAs). Greater sage-grouse located within 6 km [4 mi] of the proposed project area are discussed further in SEIS Section 3.6.1.2.3.

As previously stated in SEIS Section 3.6.1.2, WGFD recommended the applicant conduct surveys for the swift fox as part of their baseline wildlife surveys. However, the applicant's swift fox surveys did not find large burrows, tracks, scat, or prey remains indicative of swift fox presence, and no swift foxes were observed. The applicant also surveyed for the presence of black-tailed prairie dog (*Cynomys ludovicianus*) colonies as part of the baseline wildlife surveys. No active prairie dog colonies were observed within the proposed project area (AUC, 2012a). The applicant stated that WGFD database reviews indicated black-tailed prairie dog colonies were present within 1.6 km [1 mi] north and south of the proposed project area but were inactive during the applicant's baseline wildlife surveys. BLM records indicate that prairie dog colonies

Table 3-14. Wildlife Species Observed During Baseline Wildlife Surveys for the Proposed Reno Creek ISR Project Area and 1.6-km [1-mi] Buffer		
Scientific Name	**Common Name**	**Primary Habitat Type**
Mammals		
Antilocapra americana	Pronghorn	sagebrush/desert shrublands
Lepus townsendii	White-tailed jackrabbit	desert shrubland
Odocoileus hemionus	Mule deer	sagebrush/desert/foothill shrublands
Ondatra zibethicus	Muskrat	wetlands, riparian
Sylvilagus spp.	Cottontail species	grasslands, shrublands
Taxidea taxus	Badger	desert shrubland
Birds		
Agelaius phoeniceus	Red-winged blackbird	wetlands, meadows
_Ammodramus savannarum_*[†]	Grasshopper Sparrow	shortgrass prairie, shrub-steppe
Anas platyrhynchos[‡]	Mallard	wetlands
_Anas acuta_*[‡]	Northern pintail	wetlands
Anas crecca[‡]	Green-winged teal	wetlands
Anas americana[‡]	American wigeon	wetlands
Anas clypeata[‡]	Northern shoveler	wetlands, meadows
Aquila chrysaetos[‡†]	Golden eagle	cliffs
Buteo jamaicensis	Red-tailed hawk	desert shrubland
_Buteo swainsoni_*[‡§]	Swainson's hawk	sagebrush shrubland, plains/basin riparian, grasslands
_Buteo regalis_*[†‡§]	Ferruginous hawk	shrub-steppe, shortgrass prairie
_Calcarius mccownii_*[†‡‖]	McCown’s Longspur	shortgrass prairie, shrub-steppe
_Calamospiza melanocorys_*	Lark bunting	shortgrass prairie, shrub-steppe
Circus cyaneus	Northern harrier	shortgrass prairie, meadows
_Centrocercus urophasianus_*[†§]	Greater sage-grouse	shrub-steppe, grasslands
Charadrius vociferus	Killdeer	shortgrass prairie
Chondestes grammacus	Lark sparrow	shrub-steppe
Eremophila alpestris	Horned lark	shortgrass prairie
_Lanius ludovicianus_*[†‡§]	Loggerhead shrike	shrub-steppe
Molothrus ater	Brown-headed cowbird	foothill shrubland
_Oreoscoptes montanus_*[†‡§]	Sage thrasher	shrub-steppe, sagebrush/foothill shrublands
Podiceps nigricollis	Eared grebe	wetlands
Pooecetes gramineus	Vesper sparrow	shrub-steppe, shortgrass prairie
Riparia riparia	Bank swallow	riparian
_Spizella reweri_*[†‡§]	Brewer's sparrow	sagebrush/mountain-foothills shrub
Steganopus tricolor	Wilson's phalarope	wetlands
Sturnella neglecta	Western meadowlark	shortgrass prairie
Tyrannus tyrannus	Eastern kingbird	shortgrass prairie
Zenaida macroura[‡]	Mourning dove	desert shrubland

Table 3-14. Wildlife Species Observed During Baseline Wildlife Surveys for the Proposed Reno Creek ISR Project Area and 1.6-km [1-mi] Buffer (Continued)		
Amphibians and Reptiles		
*Pseudacris maculata**	Boreal Chorus frog	wetlands
Phrynsoma douglassi	Short-horned lizard	desert shrublands
Source: AUC, 2012a; WGFD, 2010a, FWS, 2011; FWS, 2015a, BLM, 2010 *WGFD Species of Greatest Conservation Need (WGFD, 2010a) †FWS Birds of Conservation Concern in Bird Conservation Region 17 (FWS, 2008a) and Birds of Conservation Concern That Occur in Wyoming (FWS, 2015a) ‡FWS Birds of Management Concern (FWS, 2011) §BLM Sensitive Species (BLM, 2010) ‖Includes *Rhyncophanes mccownii*		

greater than 1.6 km [1 mi] but less than 4.8 km [3 mi] from the proposed project area (BLM, 2015). No critical habitat for federally-listed threatened or endangered species was identified in the proposed Reno Creek ISR Project area during baseline wildlife surveys (AUC, 2012a).

3.6.1.2.2 Mammals

Pronghorn and mule deer (pronghorn being the more prevalent of the two) were the only big game species observed during the baseline wildlife surveys. As stated in SEIS Section 3.6.1.2.1, pronghorn and mule deer are present throughout the year in the proposed project area and 1.6 km [1 mi] buffer. The proposed Reno Creek ISR Project area and 1.6 km [1 mi] buffer are located within the WGFD pronghorn and mule deer Pumpkin Buttes and North Converse Herd Units (AUC, 2012a). The WGFD reported the 2014 pronghorn populations in those two herd units to be approximately 21,928 and 18,945 individuals, respectively. The Pumpkin Buttes Herd Unit considerably exceeded the WGFD pronghorn population objective of 18,000, and the North Converse Herd Unit was less than the objective of 28,000 pronghorn (WGFD, 2014b,c). The WGFD reported the 2015 mule deer populations in the Pumpkin Buttes Herd Area to be approximately 12,364 and 7,785 individuals, respectively; both were less than their WGFD objectives of 13,000 for Pumpkin Buttes and 9,100 for North Converse (WGFD, 2014b,c).

Although white-tailed deer (*Odocoileus virginianus)* and elk (*Cervus elaphusi)* could be present in the proposed Reno Creek ISR Project area and 1.6 km [1 mi] buffer, WGFD considers the proposed project area and 1.6 km [1 mi] buffer to be outside of the normal range for these species (WGFD, 2014b,c). White-tailed deer in Wyoming are concentrated in areas with rivers and streams such as the foothills of the Big Horn Mountains, and are not usually found in the grasslands and shrubland habitat that cover the proposed project area (BLM, 2015). Elk in northeast Wyoming are also concentrated in the foothills of the Big Horn Mountains and other locations west of Gillette and southeast Campbell County.

A variety of small- and medium-sized mammals could potentially be present in the proposed project area. These mammals include various rodents, predators, and furbearers such as jackrabbits (*Lepus* sp.) and cottontails (*Sylvilagus* sp.), a variety of mice and rats, gophers (*Thomonys* sp.), muskrats (*Ondatra zibethicus*), shrews (*Sorex* sp.), voles (*Microtus* sp.), coyotes (*Canis latrans*), swift foxes (Vulpes velox), raccoons (*Procyon lotor*), bobcats (*Lynx rufus*), badgers (*Taxidea taxus*), beavers (*Castor canadensis*), and porcupines (*Erethizon dorsatum*) (NRC, 2009; AUC, 2012a). The six species of mammals that were

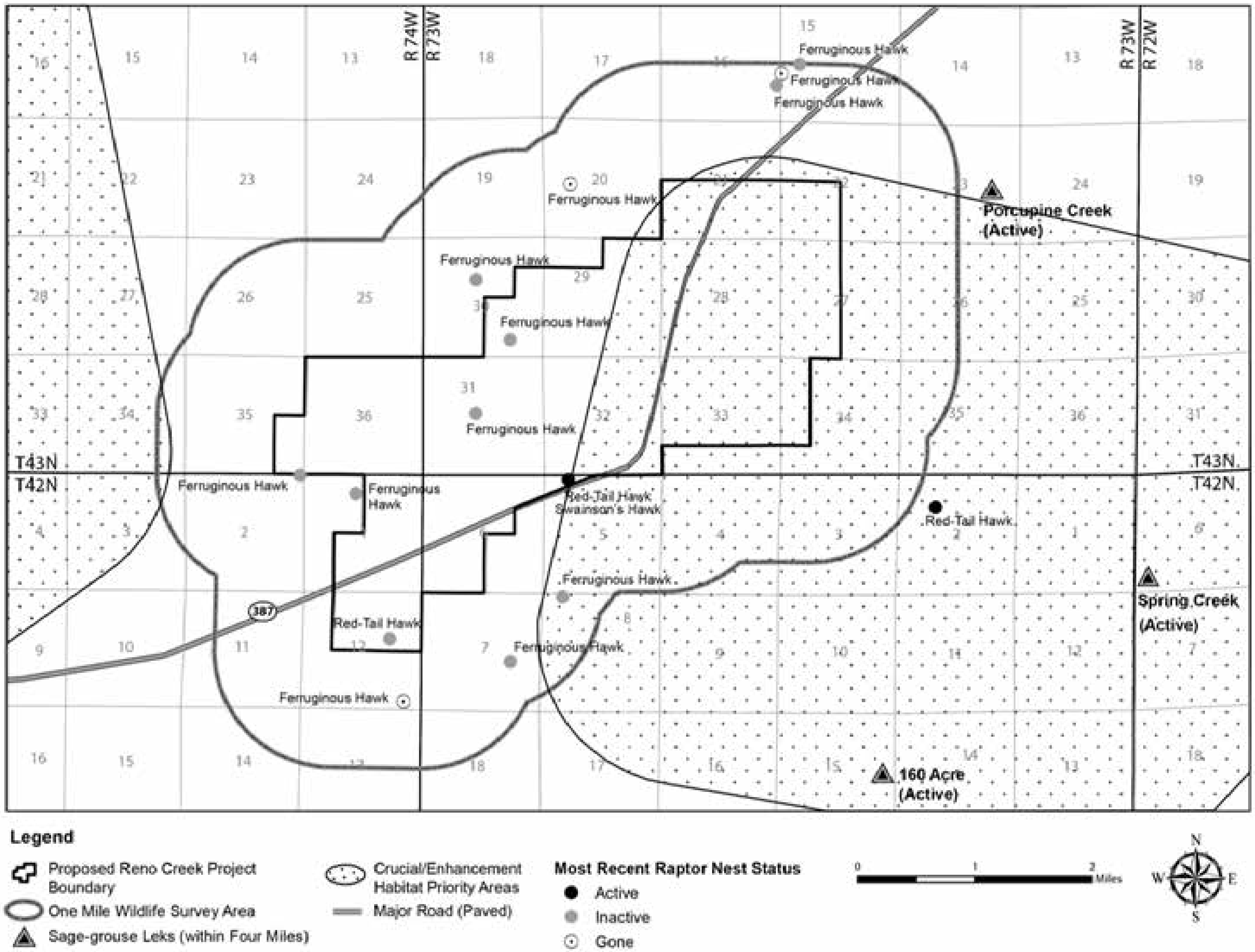

Figure 3-26. Wildlife Habitat at the Proposed Reno Creek ISR Project Area (AUC, 2014a; BLM, 2014; WGFD, 2015)

encountered within the proposed project area or the 1.6-km [1-mi] buffer around the proposed project area are listed in SEIS Table 3-14. Although bat surveys were not conducted as part of the applicant's baseline wildlife surveys, riparian areas, grasslands, and shrub-steppe habitats that are present within eastern Wyoming do serve as important foraging and roosting resources for bats (WGFD, 2005a).

3.6.1.2.3 Birds

Birds account for the largest diversity of animals in eastern Wyoming (NRC, 2009) and for the animals found at the proposed Reno Creek ISR Project area and 1.6-km [1-mi] buffer (SEIS Table 3-14). This section provides a broad description of avian species that could potentially occur at the proposed project, and provides results of baseline wildlife surveys. As previously described in SEIS Section 3.6.1.2, the applicant specifically looked for raptor nests are present east (T43N R73W S24 and S25) and southeast (T42N R73W S2) at distances and Greater sage-grouse leks as part of the baseline wildlife surveys. The applicant also reviewed BLM raptor nest data for the preparation of the application. After the NRC staff received the application, the NRC staff reviewed the most recent BLM raptor nest data available for the development of this SEIS (BLM, 2014).

It is industry standard protocol to document the status and condition of raptor nests when conducting nest surveys (BLM, 2005). "Active" nests are those where reproductive activities such as breeding, brooding, and nest attendance are observed. "Inactive" nests show no signs of physical bird presence or recent use. Nests are identified as "unknown" if there is not enough information to conclusively determine if a nest is active or inactive. The condition of bird nests are also reported during nest surveys and can range from "remnants" (scant material remaining and not usable unless fully rebuilt) to "excellent" (nest is able to be used with little or no maintenance) (BLM, 2005). A nest is considered "gone" if that nest was located during a previous survey but evidence of a nest is no longer there. For Greater sage-grouse leks, "occupied" leks are those that have been active during the breeding season within the last 10 years (BLM, 2005). "Unoccupied" leks are those that have not been active during a consecutive 10-year period.

Raptors

Several raptor species were observed during the baseline wildlife surveys, including golden eagles, ferrugious hawks, red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks, and northern harriers. Golden eagles are cliff-dwellers that use grassland and sagebrush shrubland communities similar to those found within the proposed project area for foraging (BLM, 2015). The ferruginous hawk and Swainson's hawk are Wyoming species of SGCN, and BLM-sensitive species that prefer to inhabit mixed-grass prairies. Red-tailed hawks are a common bird in Wyoming that consumes mostly small mammals and occupies a variety of habitats. Northern harriers nest in a variety of habitats found within the proposed project area, including grasslands, agricultural lands, wetland and riparian areas, and sagebrush.

During the baseline wildlife surveys conducted between 2008 and 2011, 14 raptor nest locations [12 ferruginous hawk, one red-tailed hawk , and one red-tailed hawk/Swainson's hawk] were identified within the proposed project area and the 1.6 km [1 mi] buffer around the proposed project area (AUC, 2012a). Four of the 14 nests (two inactive ferruginous hawk nests and one active red-tailed hawk nest and one inactive red-tailed hawk/Swainson's hawk nest) were located within the proposed project area. The remaining 10 nests were located within the 1.6-km [1-mi] buffer around the proposed project area and were identified either as inactive ferruginous hawk nests or as historical ferruginous hawk nest locations that are no longer there (i.e., gone) (AUC, 2012a). BLM reported the condition of these 10 nests as follows: good (1), fair (3), poor (2), remnants (2), gone (2) (BLM, 2014). The active red-tailed hawk nest, located in a cottonwood tree adjacent to Highway 387, produced two fledglings in 2008, had an unknown status in 2009, was gone in 2010, and was active (rebuilt) in 2011 with no young hatched or fledged (AUC, 2012a). The NRC staff's review of the most recently available BLM data indicates that this same nest was active in 2012 and 2013 and was occupied by a Swainson's hawk in 2013 (SEIS Figure 3-25).

The locations of raptor nest sites within the proposed project area and the 1.6-km [1-mi] buffer around the proposed Reno Creek ISR Project area are shown in SEIS Figure 3-26. Raptor SGCN that are known to occur within Campbell County are listed in SEIS Table 3-15.

Upland Game Birds

Gray partridge (*Perdix perdix*), Greater sage-grouse, and mourning dove (*Zenaida macroura*) are upland game birds that occur at the proposed project area and 1.6-km [1-mi] buffer (NRC, 2009; USGS, 2015). Both mourning dove and Greater sage-grouse were observed during baseline surveys. Within the proposed project area and 1.6-km [1-mi] buffer, the grey partridge would most likely inhabit open grasslands (BLM, 2013). Three occupied Greater sage-grouse leks (160 Acre, Porcupine Creek, and Spring Creek) are located between the 1.6-km [1-mi] buffer area and 6.4 km [4 mi] east and southeast of the proposed project area (AUC, 2012a; BLM, 2013)(SEIS Figure 3-26). One female Greater sage-grouse was observed within the 1.6-km [1-mi] buffer around of the proposed project area during the applicant's wildlife surveys (AUC, 2012a). The NRC staff requested the most recent available WGFD and BLM Greater sage-grouse survey data in and within 6.4 km [4 mi] of the proposed project area (WGFD, 2015, BLM, 2014). Males and females were observed during the spring at the Porcupine Creek lek between 2011 and 2015 (WGFD, 2015; BLM, 2014). No Greater sage-grouse were observed during the spring at the 160 Acre lek in 2010, 2011, 2013, or 2014; however, males were observed in April 2015 (WGFD, 2015; BLM, 2014). No Greater sage-grouse were observed at the Spring Creek lek in 2010, 2011, or 2013, but males and females were observed at the lek in April 2014 and 2015 (WGFD, 2015; BLM, 2014). All three leks are considered occupied because a male has been observed at each of the three leks at least once in the last 10 years (BLM, 2005, 2014). As stated in SEIS Section 3.6.1.2.1, the proposed project area and 1.6-km [1-mi] buffer contains Greater sage-grouse nesting and winter habitat, but the proposed project area is not located in a sage-grouse core population area or connectivity corridor, or PHMA. The Greater sage-grouse leks located between the 1.6-km [1-mi] buffer area and a distance of 6.4 km [4 mi] from the proposed project area are shown in SEIS Figure 3-26. Greater sage-grouse are further discussed in SEIS Section 3.6.3.

Waterfowl and Shorebirds

The proposed project area lies within the Central flyway, which is one of several major migratory bird flyways in North America, and a major migration route for waterfowl. Nine avian species associated with wetlands or riparian habitat areas were observed within 1.6 km [1 mi] of the proposed project area, primarily within ponds and reservoirs along the Belle Fourche River and Spring Creek (AUC, 2012a).

Table 3-15. Wildlife Species of Concern in Campbell County and Within the Proposed Reno Creek ISR Project Area				
Common Name ***Scientific Name***	**FWS Birds of Conservation Concern Priority Level* and Birds of Management Concern (MC)**	**BLM Sensitive Species**	**2010 Wyoming Species of Greatest Conservation Need†**	**Observed Within the Proposed Reno Creek ISR Project Area**
Plants				
Ute ladies'-tresses orchid ***Spiranthes diluvialis***		X		
Mammals				
black-tailed prairie dog ***Cynomys ludovicianus***		X	Not listed	
big brown bat *Eptesicus fuscus*			NSS4 (Cb) II	
Eastern red bat *Lasiurus borealis*			NSSU (U) II	
hispid pocket mouse *Chaetodipus hispidus*			NSS3 (Bb) II	
little brown myotis *Myotis lucifugus*			NSS4 (Cb) II	
Northern long-eared bat ***Myotis septentrionalis***		X	NSS3 (Bb) II	
olive-backed pocket mouse *Perognathus fasciatus*			NSS4 (Cb) II	
plains harvest mouse *Reithrodontomys montanus*			NSS3 (Bb) II	
plains pocket gopher *Geomys bursarius*			NSS3 (Bb) II	
dwarf shrew *Sorex nanus*			NSS3 (Bb) II	
Hispid pocket mouse *Chaetodipus hispidus*			NSS3 (Bb) II	
Long-eared myotis *Myotis evotis*			NSS3 (Bb) II	
Long-legged myotis *Myotis volans*			NSS3 (Bb) II	
Northern river otter *Lontra canadensis*			NSSU (U) II	
plains pocket mouse *Perognathus flavescens*			NSS3 (Bb) III	
Plains pocket gopher *Geomys bursarius*			NSS3 (Bb) II	
silky pocket mouse *Perognathus flavus*			NSS3 (Bb) II	
swift fox *Vulpes velox*		X	NSS4 (Cb) II	

Table 3-15. Wildlife Species of Concern in Campbell County and Within the Proposed Reno Creek ISR Project Area (Continued)				
Common Name ***Scientific Name***	**FWS Birds of Conservation Concern Priority Level* and Birds of Management Concern (MC)**	**BLM Sensitive Species**	**2010 Wyoming Species of Greatest Conservation Need[†]**	**Observed Within the Proposed Reno Creek ISR Project Area**
Townsend's big-eared bat *Corynorhinus townsendii*			NSS2 (Ba) I	
Vagrant Shrew *Sorex vagrans*			NSS4 (Cb) III	
Western small-footed myotis *Myotis ciliolabrum*			NSS4 (Cb) II	
Birds				
Waterfowl and Shorebirds				
American Bittern *Botaurus lentiginosus*	Level I; MC		NSS3 (Bb) II	
Barrow's goldeneye *Bucephala islandica*			NSS3 (Bb) II	
Black Tern *Chlidonias niger*			NSS3 (Bb) II	
Canvasback *Aythya valisineria*	MC		NSS3 (Bb) II	
Clark's Grebe *Aechmophorus clarkii*			NSSU (U) II	
Common Loon *Gavia immer*			NSS1 (Aa) I	
Forster's Tern *Sterna forster*			NSS3 (Bb) II	
Franklin's Gull *Larus pipixcan*			NSS3 (Bb) II	
Lesser Scaup *Aythya affinis*	MC		NSS3 (Bb) II	
long-billed curlew *Numenius americanus*	Level I; MC	X	NSS3 (Bb) II	
Northern pintail *Anas acuta*	MC		NSS3 (Bb) II	X
Redhead *Aythya americana*	MC		NSS3 (Bb) II	
Greater sandhill crane *Grus canadensis tabida*	MC		NSS4 (Bc) III	
Virginia rail *Rallus limicola*	MC		NSS3 (Bb) II	
willow flycatcher *Empidonax traillii*	MC		NSS4 (Cb) III	
White-faced Ibis *Plegadis chihi*			NSS3 (Bb) II	

Table 3-15. Wildlife Species of Concern in Campbell County and Within the Proposed Reno Creek ISR Project Area (Continued)

Common Name ***Scientific Name***	**FWS Birds of Conservation Concern Priority Level* and Birds of Management Concern (MC)**	**BLM Sensitive Species**	**2010 Wyoming Species of Greatest Conservation Need**[†]	**Observed Within the Proposed Reno Creek ISR Project Area**
Raptors				
burrowing owl *Athene cunicularia*	Level I; MC	X	NSSU (U) I	
ferruginous hawk *Buteo regalis*	Level I; MC	X	NSSU (U) I	X
Merlin *Falco columbarius*	Level I		NSSU (U) III	
Peregrine Falcon *Falco peregrinus*	Level I; MC	X	NSS3 (Bb) II	
Bald Eagle ***Haliaeetus leucocephalus***	Level I; MC	X	NSS2 (Ba) I	
short-eared owl *Asio flammeus*	Level I; MC		NSS4 (Bc) II	
Swainson's hawk *Buteo swainsoni*	Level I; MC	X	NSSU (U) II	X
Upland Game Birds				
Greater sage-grouse *Centrocercus urophasianus*		X	NSS2 (Ba) I	
Nongame and Migratory Birds				
bobolink *Dolichonyx oryzivorus*			NSS4 (Bc) II	
Brewer's sparrow *Spizella breweri*	Level I; MC	X	NSS4 (Bc) II	X
Black Rosy-Finch *Leucosticte atrata*	Level III; MC		NSSU (U) II	
mountain plover ***Charadrius montanus***	Level I; MC	X	NSSU (U) I	
chestnut-collared longspur *Calcarius ornatus*	Level II; MC		NSS4 (Bc) II	
dickcissel *Spiza americana*	Level II; MC		NSS4 (Bc) II	
grasshopper sparrow *Ammodramus savannarum*	Level II; MC		NSS4 (Bc) II	
Lewis's woodpecker *Melanerpes lewis*	Level II; MC		NSSU (U) II	
McCown's longspur *Calcarius mccownii*	Level I; MC		NSS4 (Bc) II	X
Northern Goshawk *Accipiter gentilis*			NSSU (U) I	
Pygmy Nuthatch *Sitta pygmaea*			NSSU (U) II	

Table 3-15. Wildlife Species of Concern in Campbell County and Within the Proposed Reno Creek ISR Project Area (Continued)				
Common Name ***Scientific Name***	**FWS Birds of Conservation Concern Priority Level* and Birds of Management Concern (MC)**	**BLM Sensitive Species**	**2010 Wyoming Species of Greatest Conservation Need†**	**Observed Within the Proposed Reno Creek ISR Project Area**
sage sparrow *Amphispiza belli*	Level I; MC	X	NSS4 (Bc) II	
sage thrasher *Oreoscoptes montanus*	Level II; MC	X	NSS4 (Bc) II	X
upland sandpiper *Bartramia longicauda*	Level I; MC		NSSU (U) II	
Amphibians and Reptiles				
Great Plains toad *Anaxyrus cognatus*			NSSU (U) III	
Northern leopard frog *Lithobates pipiens*		X	NSSU (U) III	
plains spadefoot *Spea bombifrons*			NSSU (U) III	
Greater short-horned lizard *Phrynosoma hernandesi*			NSS4 (Bc) III	
pale milk snake *Lampropeltis triangulum multistriata*			NSS3 (Bb) II	
red-sided garter snake *Thamnophis sirtalis parietalis*			NSSU (U) II	
plains garter snake *Thamnophis radix*			NSSU (U) II	
plains hog-nosed snake *Heterodon nasicus*			NSSU (U) II	
Western painted turtle *Chrysemys picta bellii*			NSS4 (Bc) III	
Western spiny softshell *Apalone spinifera hartwegi*			NSS4 (Bc) III	

Table 3-15. Wildlife Species of Concern in Campbell County and Within the Proposed Reno Creek ISR Project Area (Continued)				
Common Name *Scientific Name*	**FWS Birds of Conservation Concern Priority Level* and Birds of Management Concern (MC)**	**BLM Sensitive Species**	**2010 Wyoming Species of Greatest Conservation Need†**	**Observed Within the Proposed Reno Creek ISR Project Area**

Bold names are FWS candidate, proposed, or listed species or FWS Species of Concern
Sources: WGFD, 2010a; BLM, 2010; FWS, 2008a, 2011
* FWS Conservation Priority Levels
Level I **(Conservation Action):** species clearly needs conservation action.
Level II **(Monitoring):** The action and focus for the species is monitoring. Declining population trend and habitat loss are not significant at this point.
†WGFD Status

NSS=Native species status

NSS1=Aa
NSS2=Ab, Ba,
NSS3= Bb
NSS4=Bc, Cb
NSSU=Unknown: necessary information for classification is lacking
A=Population size or distribution is restricted or declining, and extirpation is possible
a=Limiting factors are severe and continue to increase in severity
B=Population size or distribution is restricted or declining but extirpation is not imminent
b=Limiting factors are severe and not increasing significantly
C=Population size and distribution is stable, and the species is widely distributed
c=Limiting factors are moderate and appear likely to increase in severity
U=Unknown
I=Highest priority
II=Moderate priority
III=Lowest priority

Because all of the streams within the proposed project area are ephemeral, limited habitat (i.e., waterbodies, wetland, streams) exists within the proposed project area for waterfowl and shorebirds. Therefore, year-round residence is rare for species present during the spring migration period. Based on the wetland survey results presented in SEIS Section 3.5.1.4, the proposed project activities may affect a total of 1.6 ha [3.94 ac] of wetland channels, isolated ponds, isolated depressions, and open water within the proposed project area (AUC, 2014). The Northern pintail was observed during the applicant's baseline wildlife surveys and is a Wyoming SGCN (see SEIS Tables 3-14 and 3-15) that prefers to breed in shallow ephemeral to semi-permanent wetlands with emergent vegetation and into uplands with low cover interspersed throughout prairie grasslands (WGFD, 2010a). Pintails often nest during the spring in crop stubble left from the prior fall harvest (WGFD, 2010a). Waterfowl and shorebirds SGCN that occur within Campbell County are listed in SEIS Table 3-15.

Nongame and Migratory Birds

Thirteen avian species associated with grasslands and shrub-steppe habitats were also observed within the proposed project area and 1.6-km [1-mi] buffer (AUC, 2012a) (SEIS Table 3-14). Surveys specifically to search for breeding birds were not conducted for the proposed Reno Creek ISR Project, but during baseline wildlife surveys, any observations of breeding birds were recorded. Brewer's sparrow (*Spizella breweri*), lark bunting (*Calamospiza melanocorys*), and vesper sparrow (*Pooecetes gramineus*) were observed during baseline wildlife surveys and assumed to be breeding within the proposed project area (AUC, 2012a). Nongame and migratory birds SGCN that occur within Campbell County are listed in SEIS Table 3-15.

3.6.1.2.4 Reptiles and Amphibians

Milk snake (*Lampropeltis triangulum),* prairie rattlesnake (*Crotalus viridis viridis*), plains hog-nosed snake (*Heterodon nasicus),* common sagebrush lizard (*Sceloporus graciosas),* Greater short-horned lizard (*Phrynosoma douglassi*), painted turtle (*Chrysemys picta*), snapping turtle (*Chelydra serpentina*), western toad (*Anaxyrus boreas)*, chorus frogs (*Pseudacris triseriata* and *Pseudacris maculata),* plains spadefoot (*Scaphiopus bombifrons),* and western spiny softshell turtle (*Trionyx spiniferus)* are some of the reptiles and amphibians that could potentially be present in the proposed project area (AUC, 2012a; USGS, 2015; WGFD, 2010a). A single short-horned lizard was the only reptile observed during the applicant's baseline wildlife surveys. The boreal chorus frog, a semiaquatic amphibian species, was the only amphibian reported—it was heard calling in several of the reservoirs throughout the proposed project area and was observed in sagebrush-grassland uplands (AUC, 2012a). Although surveys targeting reptiles and amphibians were not conducted, there is suitable habitat at the proposed Reno Creek ISR Project area to support a variety of reptiles and amphibians, including CBM discharge reservoirs, scattered stock ponds, riparian areas, wetlands, and rocky outcrops. Reptile and amphibian SGCN that occur within Campbell County are listed in SEIS Table 3-15.

3.6.2 Aquatic Species

Water is a limiting factor for wildlife in the proposed Reno Creek ISR Project area due to the ephemeral nature of the surface waters within the proposed project area. GEIS Table 3.4-4 lists the state-designated uses of the Upper Belle Fourche River and tributaries as fisheries, fish and wildlife propagation, recreation, agriculture, and aesthetics, indicating that the water is acceptable for fishing, boating, swimming, agricultural irrigation, and growth of aquatic life. As stated in SEIS Section 3.5.1.1, all drainage channels within the proposed project area are ephemeral in nature, flowing for short durations in response to snowmelt or precipitation events. The lack of sufficient deep-water habitat and perennial water sources decreases the potential for many aquatic species to exist. CBM discharge reservoirs and scattered stock ponds in the area do not provide adequate deep water habitat for fish. In addition, wetlands and ponds found in the proposed project area are seasonal in nature and do not provided a year-round source of surface water sufficient to maintain a population of aquatic species. Wetlands are further discussed in SEIS Section 3.5.1.4.

3.6.3 Protected Species and Species of Concern

Federal agencies have an obligation under Section 7 of the Endangered Species Act (ESA) to determine whether a proposed project may affect federally-listed species. For completeness, this section provides detailed descriptions of federally listed or candidate species under the ESA as well as FWS species of concern that may occur within the proposed project area and in Campbell County (FWS, 2015a,b, 2016a). Six such species were identified, which are discussed next. The FWS identified no other federally threatened or endangered species, candidate species, or proposed species that are known to potentially occur in Campbell County or may be affected by the proposed project (2015b, 2016a). Although the Greater sage-grouse (*Centrocerus Urophasianus)* is not a federally listed or candidate species under the ESA or a

FWS species of concern, this species is included in this section because of a recent FWS to remove the species as a candidate species list and the multi-state efforts to conserve this species in the Western United States.

SEIS Table 3-15 presents federally listed species under the ESA that occur in Campbell County and state SGCN that occur in Campbell County, as provided in the 2010 Wyoming State Wildlife Action Plan (WGFD, 2010a). Table 3-15 also identifies BLM sensitive species, FWS birds of conservation concern, and FWS migratory birds of management concern. Not all species of concern or federal candidate species are afforded the same protections as those species federally listed under the ESA. Candidate species are plants and animals that are proposed for listing under the ESA Section 4. All migratory birds, their feathers and body parts, nests, eggs, and nestling birds are protected by the federal Migratory Bird Treaty Act (MBTA). With a few exceptions, all bird species that are native to the United States are protected by the MBTA. Eagles are additionally protected by the Bald and Golden Eagle Protection Act (BGEPA) (FWS, 2015b).

Ute Ladies'-Tresses

The FWS identified one federally threatened plant species or its designated habitat, Ute ladies'-tresses (*Spiranthes diluvialis*) that may occur in the proposed project area (FWS, 2015b, 2016a). However, this species has not been reported within the proposed project area (Heidel, 2012). The Ute ladies'-tresses orchid is federally listed as threatened (57 FR 2048). The species is a perennial, terrestrial orchid that occurs in Nebraska, Wyoming, Colorado, Utah, Idaho, Montana, and Washington. Within Wyoming, it inhabits early stages of riparian habitats along moist stream beds, edges of stream channels, and meadows with moderately dense but short vegetative cover. The species is found at elevations of 1,280 to 2,130 m [4,200 to 7,000 ft], though no known populations occur in Wyoming above 1,680 m [5,500 ft] (FWS, 2008b). Generally, this orchid is found in low densities of four to eight flowering plants per square meter (Fertig, 2000). The species is likely to inhabit silt, sand, or gravely soils in areas with ample sunlight (FWS, 2008b). It is characterized by 12- to 50-cm [4.7- to 20-in] stems with linear basal leaves up to 28 cm [11 in] long and spikes of small white to ivory flowers that bloom between early August and early September (Fertig, 2000). Urbanization, livestock grazing, pesticide use, competition with noxious weeds, and loss of pollinators threaten this species' survival (Fertig, 2000). Although undocumented populations are predicted to be present in southern Campbell County (BLM, 2015), this species has not been observed in Campbell County (BLM, 2007; Heidel, 2012), and was not observed during baseline vegetation surveys in the proposed project area (AUC, 2012a).

Northern Long-eared Bat (NLEB)

The FWS identified one federally threatened mammal species, the northern long-eared bat (NLEB) (*Myotis septentrionalis*), that may occur in the proposed project area (FWS, 2015b, 2016b,c). However, this species is not known to occur within the proposed project area (WGFD, 2010a). The NLEB is federally listed as threatened (80 FR 17974). The FWS has not designated or proposed critical habitat for the NLEB (FWS, 2016b). This species is also a Wyoming SGCN (WGFD, 2010a). This medium-sized bat is found throughout eastern and central North America, and its range extends into the eastern-most counties of Wyoming (Campbell, Crook, Weston, Niobrara, and Goshen Counties) where it has been more rarely encountered (FWS, 2016c, 2015d; BLM, 2015); however, the area of influence where projects may cause direct and indirect effects to the species extends into Campbell County (FWS, 2016d). The greatest threat to NLEB is white-nose syndrome, a disease caused by a fungus that has and will continue to affect the species population where the disease is present (FWS, 2016b). However, the State of Wyoming and the proposed project area are located outside of the zone where white-nose syndrome occurs (FWS, 2016b). NLEBs emerge at dusk to fly through the understory of forested hillsides and ridges, feeding on flying insects they catch either while in flight or by picking them off of plants and water surfaces (FWS, 2016b). NLEBs have been documented using entrances or internal passages of caves, mines, railroad tunnels, or other entrances to underground voids as winter hibernation habitat. During summer (mid-May through mid-August), NLEBs roost singly or in colonies in cavities, underneath bark, in crevices, or in hollows of both live and dead trees and/or snags (FWS, 2016b). A wide variety of forested/wooded area provides habitats where they roost, forage, and travel. NLEB habitat may also include some adjacent and interspersed non-forested habitats, such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures, as well as linear features such as fencerows, riparian forests, and other wooded corridors. Breeding occurs in late summer and fall (August to November) when bats swarm at entrances of winter hibernation areas, which also are typically located in large underground openings where they spend the rest of the winter (FWS, 2016b). As explained in SEIS Section 3.6.1.1, Russian olive and plains cottonwood trees are present in the proposed Reno Creek ISR Project area just north of Highway 387 near the southeastern project boundary (SEIS Figure 3-25) and could also serve as potential habitat for the NLEB.

Sprague's Pipit

The FWS (2015b) indicated that Sprague's pipit (*Anthus spragueii)*, a federal candidate species, may be affected by the proposed project due to the species' historical breeding range in extreme north central and northwest Wyoming (FWS, 2014). The Sprague's pipit is a small bird that nests, breeds, and spends the winter in open grasslands of the United States (FWS, 2014). The birds breed in northern states and Canada and spends the winter in the southern states and Mexico (FWS, 2014). Sprague's pipit primarily eats insects, spiders, and some seeds (FWS, 2014). Because of its preference to breed in continuous, open grassland ranging from 69 to 314 ha [170 to 776 ac] or more in size that has not been cultivated, habitat loss, conversion, and fragmentation threaten the continued existence of this species (FWS, 2014). Sprague's pipits' historical breeding range is reported to include some small areas in extreme north central and northwest Wyoming (FWS, 2014). However, this species was not observed during baseline wildlife surveys conducted in 2008, 2010, and 2011 (see Section 3.6.1.2) (AUC, 2012a), and is considered a 'rare migrant' in Wyoming (FWS, 2010).

Greater Sage-Grouse

Greater sage-grouse reside in sagebrush shrubland habitats; sagebrush is essential in every phase of the life cycle of this species. Breeding habitat, referred to as leks, and stands of sagebrush surrounding leks are used in early spring; they are particularly important habitat because nesting birds often return to the same leks and nesting areas each year. Leks are common in more sparsely vegetated areas, such as ridgelines and disturbed areas adjacent to stands of sagebrush. Threats to the survival of this species include loss of habitat, agricultural practices, livestock grazing, hunting, and land disturbances related to energy/mineral development and the oil and gas industry (Sage-Grouse Working Group, 2006). Three occupied Greater sage-grouse leks are located between the 1.6-km [1-mi] buffer around the proposed project area and 6.4 km [4 mi] east and southeast of the proposed project area (SEIS Figure 3-26).

The species was put on the federal list of candidate species in 2010 (75 FR 13909), and was removed as a candidate species in 2015 (80 FR 59858). The FWS decision was due, in part, to the conservation efforts implemented by federal, state, and private landowners (80 FR 59858). The State of Wyoming Governor has established impact thresholds and has issued guidance and recommendations in an executive order for Greater sage-grouse management on private and public lands to limit project impacts (Mead, 2015). The governor's executive order establishes core population areas, where 83-percent of the Greater sage-grouse population is concentrated, and connectivity corridors, where Greater sage-grouse travel between population areas. Projects located within core population areas and connectivity corridors, or PHMAs, and project activities located within 3.2 km [2 mi] of an occupied lek outside core population areas, are expected to follow the executive order recommendations for avoiding and minimizing impacts. As previously stated in SEIS Section 3.6.1.2.1, the proposed project area is not located in a Greater sage-grouse core population area or connectivity corridor, or PHMA; however, proposed Reno Creek ISR Project activities are within 3.2 km [2 mi] of an occupied lek (Porcupine Creek lek) and are therefore subject to recommendations in the executive order.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was delisted from the federal list of Endangered and Threatened Wildlife in July 2007 (72 FR 37346) but remains an FWS species of concern (FWS, 2015a). No bald eagles or nests were observed during the baseline wildlife surveys conducted in 2008, 2010, and 2011 (AUC, 2012a) as described in SEIS Section 3.6.1.2. BLM's approved Resource Management Plan identifies the nearest bald eagle nest at more than 14.5 km [9 mi] from the proposed project area east of Highway 59 (BLM, 2015). The nearest bald eagle roost is located more than 14.5 km [9 mi] northwest from the proposed Reno Creek ISR Project area (BLM, 2015).

The species continues to be protected federally by the BGEPA as well as the MBTA, and at the state level as a species of concern. FWS published its National Bald Eagle Management Guidelines in FWS (2007) to ensure the continued protection of the species. The bald eagle is a large raptor species with a white head and tail and brown body feathers and is generally associated with lakes and other large, open bodies of water. Bald eagles prey on fish, small mammals, birds, and occasionally carcasses of dead animals.

Black-Tailed Prairie Dog

The black-tailed prairie dog (*Cynomys ludovicianus*) is an FWS species of concern (73 FR 73211). The species is a small, diurnal (active during the day) ground squirrel that is endemic to North America and occurs throughout the Great Plains region. In Wyoming, the black-tailed prairie dog inhabits dry, flat, open, short, and mixed-grass prairie within the eastern third of the state (WGFD, 2005b). Adults weigh 0.5 to 1.4 kg [1 to 3 lb] and are 36 to 43 cm [14 to 17 in] long. Coloring can vary from a mixture of brown, black, grey, and white, though the black-tipped tail is characteristic of the species. Black-tailed prairie dogs live in family groups within large colonies (FWS, 2000). The black-tailed prairie dog provides habitat for several burrowing animals, including the black-footed ferret, swift fox, burrowing owl (*Athene cunicularia*), and mountain plover (*Charadrius montanus*). Prairie dogs are also a food source for carnivores, including black-footed ferrets, ferruginous hawks, and golden eagles (WGFD, 2010a).

As stated in SEIS Section 3.6.1.2.1, prairie dog colonies are located between 0.8 and 4.8 km [1 and 3 mi] away from the proposed project area (BLM, 2015), but were not observed within the proposed Reno Creek ISR Project area (AUC, 2012a). Although the black-tailed prairie dog provides habitat for the federal listed species such as the black-tailed ferret, no critical habitat for threatened or endangered species was encountered in the proposed Reno Creek ISR Project area during baseline wildlife surveys (AUC, 2012a). Within the State of Wyoming, the major threat to this species is habitat degradation, habitat loss, and the use of pesticides (WGFD, 2005b).

Mountain Plover

The mountain plover is a FWS species of concern (76 FR 27756) and a Wyoming SGCN (WGFD, 2010a). This bird is a native of the short-grass prairie and is found in open, dry shrublands or agricultural fields with short vegetation and bare ground. Mountain plover breeding habitat includes the western Great Plains and Rocky Mountain states extending from the Canadian border to northern Mexico (76 FR 27756). The prime breeding and nesting period for the mountain plover is from April 10th through July 10th (BLM, 2007). In Wyoming, the greatest concentration of mountain plovers is found in the south central part of the state, but they can be found in every county (WGFD, 2010a). Prairie dog burrows and those of other burrowing animals provide highly suitable habitat for the mountain plover. The mountain plover is often found in areas with heavy grazing and flat landscapes with excessive surface disturbance (WGFD, 2010a). This species is a small bird about 21 cm [8 in] in height with light brown and white coloring (76 FR 27756). This species was not observed during the proposed Reno Creek ISR Project area baseline wildlife surveys, which were conducted on June 4 and 16, 2010, and May 2 and 16, and June 3, 2011 (AUC, 2012a). BLM's proposed Resource Management Plan indicates that the closest mountain plover nest is located approximately 4 km [2.5 mi] east of the proposed project area (BLM, 2015).

3.7 <u>Meteorology, Climatology, and Air Quality</u>

3.7.1 Meteorology and Climatology

The proposed project area is located in the Wyoming East Uranium Milling Region, as defined in the GEIS (NRC, 2009). As discussed in GEIS Section 3.3.6.1, Wyoming's elevation results in relatively cool temperatures. Much of the temperature variation within the state can be attributed to elevation differences, with average values dropping 1 to 2 °C [1.8 to 3.6 °F] per 300 m [1,000 ft] (NRC, 2009). The region's semiarid or steppe climate is characterized seasonally by cold harsh winters, hot dry summers, relatively warm moist springs, and cool autumns. Summer nights are normally cool, although daytime temperatures may be quite high. The fall, winter, and spring can experience rapid changes with frequent variations from cold to mild periods. Freezes in early and late spring are typical and result in long winters and short growing seasons. In addition, mountains and high valleys can freeze during the summertime. During warm winter spells, nighttime temperatures can remain above freezing. Valleys protected from the wind by mountain ranges can provide pockets for cold air to settle. As a result, temperatures in the valley can be considerably lower than temperatures on the nearby mountainsides. Mountain ranges are generally oriented in a north-south direction, which is perpendicular to the prevailing westerlies. Therefore, the mountains often act as a moisture barrier. Air currents from the Pacific Ocean rise and drop much of their moisture along the western slopes of these mountains (known as the rain shadow effect).

The applicant established a weather station near the northeast corner of the proposed project area in October 2010. Information collected at the proposed Reno Creek ISR Project meteorological station includes ambient temperature, wind speed, wind direction, precipitation, and pan evaporation. Although this meteorological station continues to collect hourly data, the baseline annual monitoring period (i.e., the baseline year) ran from October 6, 2010, to October 3, 2011. Onsite data were supplemented with data from a meteorological station at the Antelope Coal Mine because data have been collected at the offsite station over a longer period of time. The representativeness of the long-term data collected at the Reno Creek meteorological station is addressed in the safety analysis rather than the environmental analysis in this SEIS. The Antelope Mine station, located about 32.2 km [20 mi] southeast of the proposed Reno Creek ISR Project area and operated by Inter-Mountain Laboratories, started collecting hourly meteorological data in 1986.

Although not a National Weather Service meteorological station, the Antelope Mine station operates in compliance with WDEQ regulations for air quality monitoring. Data collection at this station also complies with EPA's OnSite Meteorological Program Guidance for Regulatory Modeling Applications. As seen in SEIS Figure 3-26, the Antelope Mine is the closest active station to the proposed project area since the Reno National Weather Station stopped collecting data in 1983. In addition to proximity, the Antelope Mine site topography and elevation are similar to the proposed Reno Creek ISR Project area. As seen in SEIS Figure 3-26, the closest active National Weather Station is Dull Center, which is located about 64.4 km [40 mi] southeast of the proposed project area. However, this station does not collect wind speed or direction data. The nearest National Weather Station that collects wind direction and speed data is Gillette AP, located about 64.4 km [40 mi] north of the proposed project area. Other stations near the proposed project area that collect wind speed and direction data include the Casper AP National Weather Station located about 96.6 km [60 mi] to the southwest and the Glenrock Coal Company station located about 64.4 km [40 mi] to the south.

3.7.1.1 Temperature

As discussed in GEIS Section 3.3.6.1, temperatures fluctuate greatly throughout the year in this region. SEIS Table 3-16 contains both the onsite data and the Antelope Mine station data. The annual mean temperature from the data collected at the onsite station for the baseline year is 6.78 °C [44.2 °F] (AUC, 2012a). July recorded the highest average mean daily temperature at 22.3 °C [72.2 °F], and February recorded the lowest average mean daily temperature at −6.61 °C [20.1 °F] (AUC, 2012a). Generally, the data in SEIS Table 3-16 show that the proposed project area experiences lower mean daily temperatures, relative to the Antelope Mine data, over the 25-year period from 1986 to 2011. However, the onsite data compare favorably and fall within the historical range of the Antelope Mine station data. The region's altitude and low humidity contribute to the large diurnal temperature variations, which typically range from about an 8.3 °C [15 °F] difference during the cooler portions of the year to about a 13.9 °C [25 °F] difference during the summer (AUC, 2012a). Data from the proposed project area show similar diurnal temperature variations. Diurnal variations during the winter are approximately 6.1 °C [11 ° F] and summertime differences are approximately 15 °C [27 °F] (AUC, 2012a).

3.7.1.2 Wind

As discussed in GEIS Section 3.3.6.1, windy conditions are common within the proposed project area. Data collected at the onsite station during the baseline year showed that the average annual wind speed was 21.7 km per hour (kph) [13.5 mi per hour (mph)] (AUC, 2012a). February produced the highest average monthly wind speed at about 25.7 kph [16 mph], and September recorded the lowest average monthly wind speed—slightly above 16.1 kph [10 mph] (AUC, 2012a). The average monthly wind speeds at the Antelope Mine station over that same

Table 3-16. Onsite and Regional Temperature Information* in Degrees Celsius[†]				
Month	Mean Daily Temperature		Mean Daily Minimum Temperature	Mean Daily Maximum Temperature
	Onsite	Antelope Coal	Antelope Coal	Antelope Coal
January	−5.28	−3.78	−8.94	1.94
February	−6.61	−3.39	−8.28	2.83
March	1.28	0.833	−4.28	7.72
April	3.61	6.33	0.111	12.3
May	7.33	11.8	5.33	17.5
June	15.3	17.3	10.4	23.8
July	22.3	23.2	14.4	29.2
August	21.9	21.3	13.7	28.6
September	15.9	15.2	7.50	22.4
October	9.94	6.83	1.00	14.4
November	−0.944	1.94	−4.28	6.89
December	−3.39	−4.28	−9.06	1.83
Annual	6.78	7.78	1.44	14.1

Source: Modified from AUC (2012a)
*Onsite values were collected over a single year, whereas Antelope Coal values were collected over a 25-year period.
[†]To convert Celsius (°C) to Fahrenheit (°F), multiply by 1.8 and add 32.

year were about 3.22 kph [2 mph] lower than those at the proposed Reno Creek ISR Project meteorological station, but followed the same pattern as those recorded at the onsite station. The average annual wind speed for the Antelope Mine station over the 25-year period from 1986 to 2011 was 17.5 kph [10.9 mph] (AUC, 2012a). The differences between the wind speeds at the two locations can be attributed to the slightly higher elevation and greater exposure of the proposed Reno Creek ISR Project meteorological station {1,548 m [5,080 ft]}, relative to the Antelope Mine station 1,425 m [4,675 ft] (AUC, 2012a).

SEIS Figure 3-27 shows the annual wind rose generated from the onsite data for the baseline year. Winds are predominately from the west-southwest and southwest. In the spring and summer, winds are also common from the northwest, north-northwest, and southeast.

SEIS Figure 3-28 shows the wind rose from the Antelope Mine station for both the baseline year and the 25-year period from 1986 to 2011. The wind speeds and directions are very similar for the 25-year and 1-year monitoring periods. Winds at the Antelope Mine station follow a similar pattern to the proposed Reno Creek ISR Project meteorological station, although the dominant winds are shifted slightly to the westerly and west-southwesterly directions.

3.7.1.3 Precipitation

As discussed in GEIS Section 3.3.6.1, the proposed project area is located within a semiarid region (NRC, 2009). Data collected at the onsite station show that the average annual precipitation is 34.0 cm [13.4 in] (AUC, 2012a). Onsite data indicate that the wettest month by far was May, with over 12.7 cm [5 in] of rain. With the exception of May and June, all other months recorded less than 2.54 cm [1 in]. Historical data from the Antelope Mine station over a 25-year time period, as well as the baseline-monitoring year, followed this same pattern, with peak rainfall at about 12.7 cm [5 in] in May and most other months below 2.54 cm [1 in]

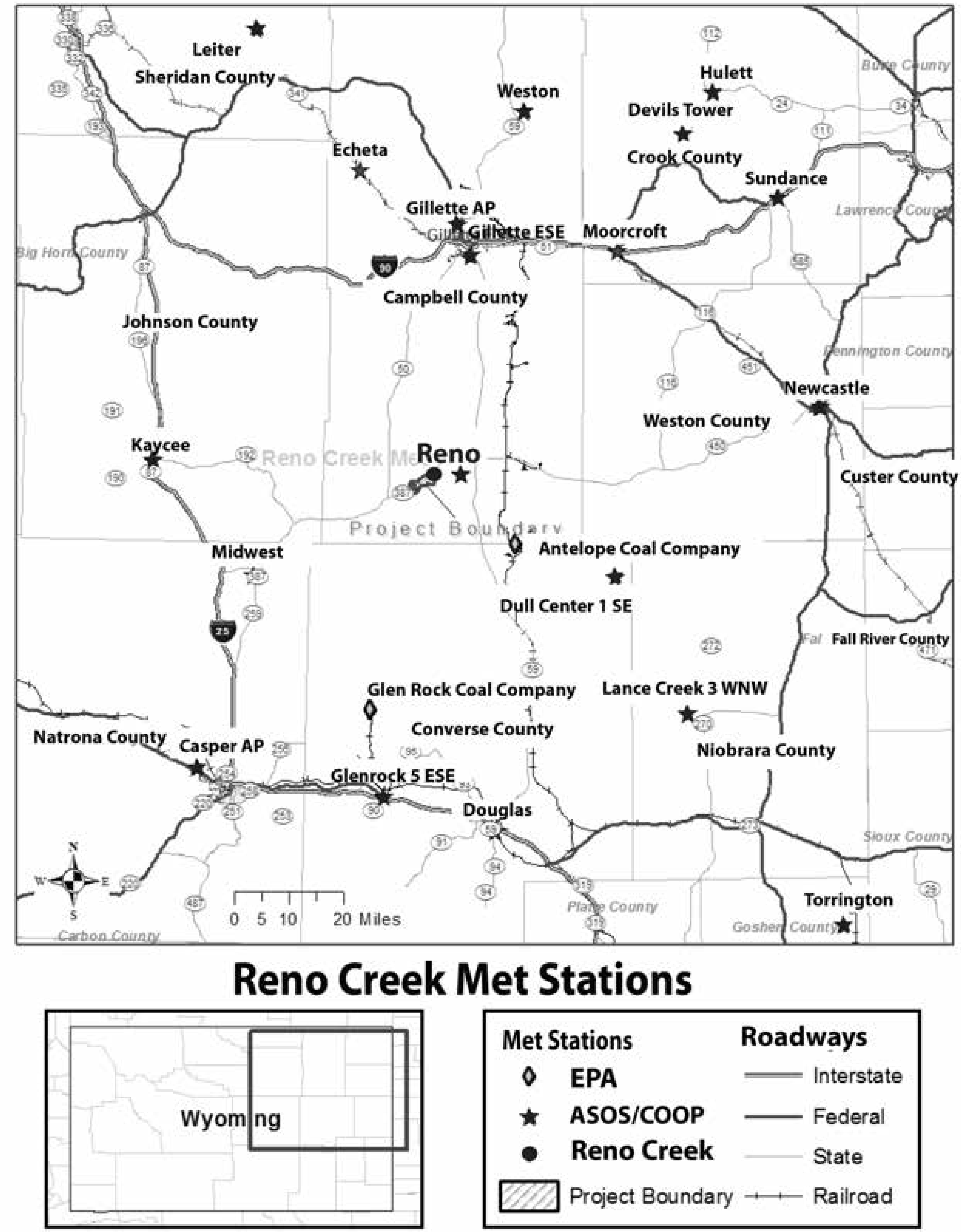

Figure 3-27. Meteorological Stations in the Vicinity of the Proposed Reno Creek ISR Project (AUC, 2014a)

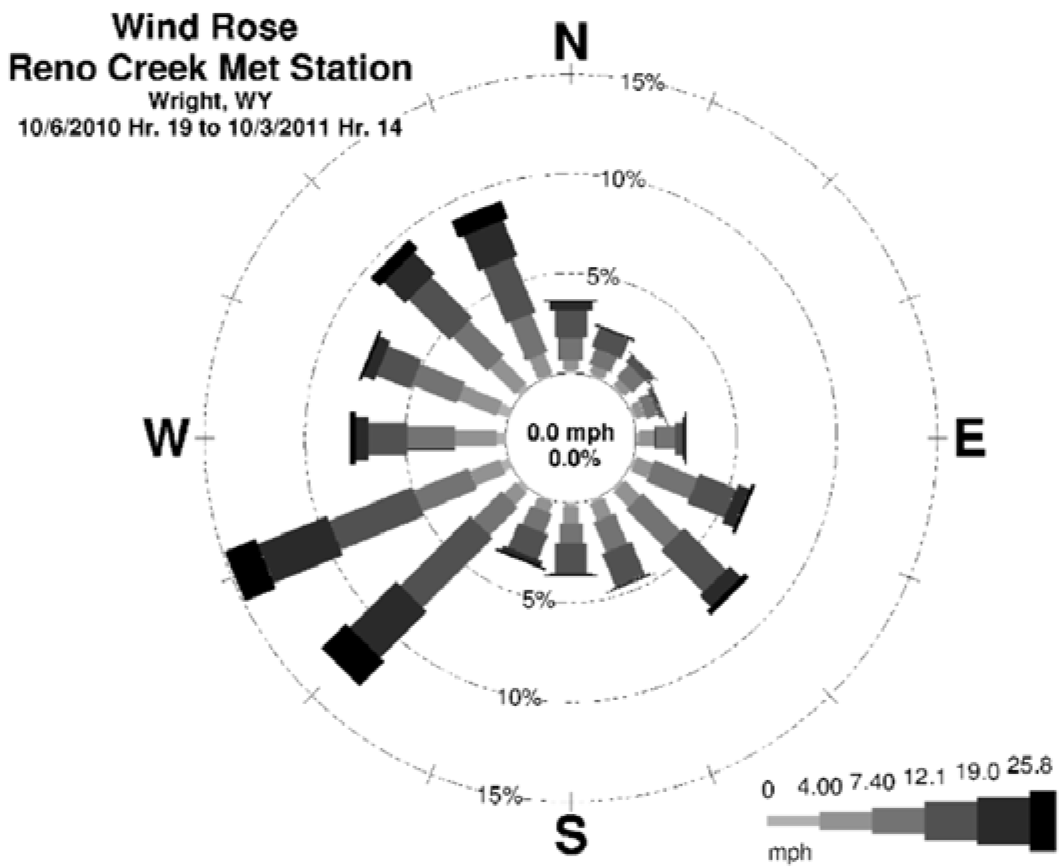

Figure 3-28. Baseline Year Wind Rose at the Proposed Reno Creek ISR Project (AUC, 2014a)

(AUC, 2012a). Nearby National Weather Service sites were used for snowfall analysis because neither the proposed Reno Creek ISR Project meteorological station nor the Antelope Mine station records snowfall data. The project region as a whole averages about 101 cm [40 in] of snow annually, with a range that varies between about 76.2 and 198 cm [30 and 78 in] (AUC, 2012a), depending on location.

3.7.1.4 Storm Events

For the location of the proposed Reno Creek ISR Project area, severe weather events mostly comprise either hail or damaging winds with an occasional tornado (AUC, 2012a). This SEIS section describes the occurrence of storm events over a 14-year period from 2000 to 2013, as documented in the National Climatic Data Center Storm Events Database.

Campbell County experienced 248 hail storms over the 14-year period; property damage was reported for only 16 of these hail storms (NCDC, 2014a). The National Climate Data Storm

Events Database records events where the hail size is at least 1.9 cm [0.75 in] in diameter. This database reports two types of wind events for Campbell County: high winds and thunderstorm winds. High winds are defined as sustained nonconvective winds of 64.4 kph [40 mph] or greater lasting for 1 hour or longer or winds (sustained or gusts) of 93.3 kph

[58 mph] for any duration on a widespread or localized basis. Thunderstorm winds are defined as winds arising from convection (occurring within 30 minutes of lightning being observed or detected) with speeds of at least 93.3 kph [58 mph] or winds of any speed {non-severe thunderstorm winds below 93.3 kph [58 mph]} producing a fatality, injury, or damage.

From 2000 to 2013, Campbell County experienced 47 high wind events (NCDC, 2014b) and 150 thunderstorm wind events (NCDC, 2014c). Tornadoes occur in Campbell County, but less frequently than hail or wind storm events. From 2000 to 2013, 21 tornadoes occurred in Campbell County (NCDC, 2014d). Over this time period, only four tornados exceeded the specifications for inclusion in the lowest severity category on the Fujita or Enhanced Fujita Tornado Damage Scale (the Enhanced Fujita scale replaced the old Fujita scale in 2007) (NCDC, 2014d). An increase in the Fujita Tornado Damage Scale number represents an increase in tornado severity. Tornadoes with Fujita or Enhanced Fujita values from F2 to F5 are considered strong to violent. The most severe tornado in Campbell County over this 14-year period was an F2 in 2005 (NCDC, 2014d).

3.7.1.5 Evaporation

As discussed in GEIS Section 3.3.6.1, pan evaporation rates for the Wyoming East Uranium Milling Region range from about 102 to 127 cm [40 to 50 in] (NRC, 2009). Pan evaporation rates can be used to estimate the evaporation rates of other bodies of water, such as lakes or ponds, and are applicable to the backup storage pond the applicant proposes. Pan evaporation rate data are typically available only from the spring to fall because freezing conditions often prevent collection of quality data during the remainder of the year. The Reno Creek pan evaporation gauge operated from April to October 2011. The total pan evaporation measured 121.9 cm [48 in] (AUC, 2012a). This value falls within the expected range identified in the GEIS.

3.7.2 Air Quality

3.7.2.1 Non-Greenhouse Gases

In 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards, EPA established the National Ambient Air Quality Standards (NAAQS) to promote and sustain healthy living conditions (see GEIS Sections 1.7.2.2 and 3.3.6.2). Primary NAAQS are established to protect public health, and secondary NAAQS are established to protect welfare by safeguarding against environmental and property damage. These standards define acceptable ambient air concentrations for six common air pollutants: nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), lead (Pb), and particulates (PM_{10} and $PM_{2.5}$)[1]. EPA requires states to monitor ambient air quality and evaluate compliance with the NAAQS.

Based on the results of these evaluations, EPA assigns areas to various NAAQS compliance classifications (e.g., attainment or nonattainment) for each of the six criteria air pollutants. These classifications characterize the air quality within a defined area. These defined areas range in size from portions of cities to large regions composed of many counties. The proposed

[1]Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.

Reno Creek ISR Project would be located in Campbell County, Wyoming, which is classified as an attainment area for each criteria pollutant (see 40 CFR 81.351). Based on this attainment classification, the air quality at the proposed project area is considered good. The nearest residence to the proposed Reno Creek ISR Project boundary is the Leavitt residence, located approximately 2.0 km [1.25 mi] to the southeast (see SEIS Figure 3-1). Along the path of predominant wind direction (SEIS Figure 3-28), the nearest residence is about 2.7 km [1.7 mi] east-northeast of the proposed project (AUC, 2012a). The nearest nonattainment area is the city of Sheridan, about 164.2 km [102 mi] northwest of the proposed Reno Creek ISR Project. The only other nonattainment area in Wyoming is the Upper Green River Basin in Lincoln, Sublette, and Sweetwater Counties, which is more than 321.9 km [200 mi] southwest from the proposed project area. The pollutant of concern in Sheridan is PM_{10}, whereas the pollutant of concern in the Upper Green River Basin is ozone.

SEIS Table 3-17 contains pollutant concentrations that reflect the existing ambient air conditions. NAAQS pollutants are not monitored within the proposed project area. The applicant contacted the WDEQ to obtain recommended ambient air concentrations deemed representative of the southern Powder River Basin and that are appropriate for the proposed project. As noted in SEIS Table 3-17, the values provided by the WDEQ are derived from several monitoring locations in the area.

EPA has revised the NAAQS since the publication of the GEIS. The following information updates the NAAQS as documented in GEIS Table 3.2-8. NAAQS that are no longer applicable include the sulfur dioxide 24-hour and annual standards, as well as the ozone 1-hour standard. New standards include a nitrogen dioxide 1-hour 100 ppb standard and a sulfur dioxide 1-hour 75 ppb standard. Revised standards include an ozone 8-hour 0.070 ppm standard, a $PM_{2.5}$ annual 12 $\mu g/m^3$ standard, and a rolling 3-month average 0.15 $\mu g/m^3$ lead standard. SEIS Table 3-18 contains the updated NAAQS. States may develop standards that are stricter or supplement the NAAQS. Wyoming has a supplemental PM_{10} annual standard at 50 $\mu g/m^3$ (WDEQ, 2012).

As discussed in GEIS Section 3.3.6.2, EPA also established Prevention of Significant Deterioration (PSD) standards that set maximum allowable concentration increases for particulate matter, sulfur dioxide, and nitrogen dioxide pollutants above baseline conditions in attainment areas (NRC, 2009). In part, the purpose of this requirement is to ensure that air quality in attainment areas remains good. There are several different classes of PSD areas. Different standards were developed for these different classifications, with Class I areas having the most stringent requirements. The proposed project area is located in a Class II area. The closest Class I area near the proposed project area is Wind Cave National Park located in Custer County, South Dakota, about 181.9 km [113 mi] away (AUC, 2012a).

EPA has revised the PSD standards since publication of the GEIS (documented in GEIS Table 3.2-9; NRC, 2009), as follows. New $PM_{2.5}$ standards have been added for two different timeframes: annual and 24 hours. SEIS Table 3-19 contains the updated PSD standards.

3.7.2.2 Greenhouse Gases and Climate Change

Temperature and precipitation are two parameters that can be used to characterize climate change. Average U.S. temperatures have increased between 0.72 and 1.06 °C [1.3 and 1.9 °F] since 1895, and temperatures in the U.S. are expected to continue to rise (GCRP, 2014). From 1991 to 2012, the average temperature in the region where the proposed Reno Creek ISR

Table 3-17. Assumed Ambient Air Quality Conditions for the Proposed Project Area					
Pollutant*	**Averaging Period**	**Form**	**Value† ($\mu g/m^3$)‡**	**Percent NAAQS§**	**Location**
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	680	1.7	Antelope Coal Mine
	8 hour	Not to be exceeded more than once per year	378	3.8	
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	21	11.2	Newcastle
	Annual	Annual mean	6	6.0	
Ozone	8 hour	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years	0.064	91.4	Campbell County
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	8	22.9	Newcastle
	Annual	Annual mean, averaged over 3 years	3.4	28.3‖	
Particulate Matter PM_{10}	24 hour	Not to be exceeded more than once per year on average over 3 years	40	26.7	Antelope Coal Mine
	Annual	Annual mean	15	30	
Sulfur Dioxide	1 hour	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	43.2	21.6	Newcastle
	3 hour	Not to be exceeded more than once per year	124.7	9.6	
	24 hour	Not to be exceeded more than once per year	16.3	Not applicable	
	Annual	Annual mean	1.3	Not applicable	

Source: Modified from AUC (2014) and WDEQ (2014)
*Operators do not currently monitor for lead, because of historically low levels in the state. The proposed Reno Creek ISR Project is not considered to be a source for airborne lead.
†Values are WDEQ recommendations provided to the applicant, except for ozone (AUC, 2014c). WDEQ did not provide a recommended ozone value. This value was obtained from the closest State of Wyoming Ambient Air Monitoring station that analyzed for ozone (WDEQ, 2014b).
‡To convert $\mu g/m^3$ to oz/yd^3, multiply by 2.7×10^{-8}.
§NAAQS = National Ambient Air Quality Standards
‖Compared to the 12 $\mu g/m^3$ primary standard rather than the 15 $\mu g/m^3$ secondary standard
There is no longer an annual PM_{10} particulate matter NAAQS. This percentage is calculated against Wyoming's supplemental annual PM_{10} particulate matter standard of 50 $\mu g/m^3$.

Table 3-18. National Ambient Air Quality Standards (NAAQS)				
Pollutant	**Primary/Secondary**	**Averaging Period**	**Level***	**Form**
Carbon Monoxide	Primary	1 hour	35 ppm	Not to be exceeded more than once per year
	Primary	8 hours	9 ppm	Not to be exceeded more than once per year
Lead	Primary and Secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	Annual	53 ppb	Annual mean
Ozone	Primary and Secondary	8 hours	0.070 ppm	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter 2.5 µm	Primary and Secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years
Particulate Matter 10 µm	Primary and Secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: Modified from EPA (2016)
*ppm = parts per million; ppb = parts per billion. To convert µg/m^3 to oz/yd^3, multiply by 2.7×10^{-8}.

Table 3-19. Prevention of Significant Deterioration Classes I and II Standards				
Pollutant	**Averaging Time**	**Class I Level (µg/m^3)***	**Class II Level (µg/m^3)**	**Form**
Nitrogen Dioxide	Annual	2.5	25	Annual mean
Particulate Matter 2.5 µm	24 hours	2	9	Not to be exceeded more than once per year
	Annual	1	4	Annual mean
Particulate Matter 10 µm	24 hours	8	30	Not to be exceeded more than once per year
	Annual	4	17	Annual mean

Table 3-19. Prevention of Significant Deterioration Classes I and II Standards (Continued)				
Pollutant	**Averaging Time**	**Class I Level ($\mu g/m^3$)***	**Class II Level ($\mu g/m^3$)**	**Form**
Sulfur Dioxide	3 hours	25	512	Not to be exceeded more than once per year
	24 hours	5	91	Not to be exceeded more than once per year
	Annual	2	20	Annual mean
Source: Modified from 40 CFR 52.21. *To convert $\mu g/m^3$ to oz/yd^3, multiply by 2.7×10^{-8}.				

Project area is located increased by approximately 0.83 °C [1.5 °F] compared to the 1951 to 1980 baseline (GCRP, 2014). The average temperature in the region where the proposed Reno Creek ISR Project area is located is projected to increase between 2.22 and 5.00 °C [4 and 9 °F] by the later part of this century (GCRP, 2014). Average U.S. precipitation has increased since 1990; however, some regions experienced increases greater than the national average, while other regions experienced decreased precipitation levels. From 1991 to 2012, the annual precipitation totals in the region where the proposed Reno Creek ISR Project area is located increased between 0 and 15 percent compared to the 1901 to 1960 baseline (GCRP, 2014). By the latter part of this century, U.S. Global Change Research Program forecasts a 0 to 10 percent decrease in precipitation during the summer and a 0 to 20 percent increase in precipitation for the fall, winter, and spring for the region of Wyoming, where the proposed Reno Creek ISR Project area is located (GCRP, 2014).

The EPA administrator determined that greenhouse gases (GHG) in the atmosphere may reasonably be anticipated to endanger public health and welfare (74 FR 66496). As described in the *Federal Register* notice, the primary scientific basis supporting the administrator's endangerment finding was major assessments by the U.S. Global Climate Research Program, the Intergovernmental Panel on Climate Change, and the National Research Council. The *Federal Register* notice also states that these assessments indicate that ambient concentrations of GHG emissions do not cause direct adverse health effects (e.g., respiratory or toxic effects), but rather cause indirect effects from the associated changes in climate. Based on the EPA's determination, NRC recognizes that GHGs may contribute to climate change and that climate change may have an effect on health and the environment.

GHGs, which can trap heat in the atmosphere, are produced by numerous activities, including the burning of fossil fuels and agricultural and industrial processes. GHGs include carbon dioxide, methane, nitrous oxide, and certain fluorinated gases. These gases vary in their ability to trap heat and in their atmospheric longevity. GHG emission levels are expressed as CO_2 equivalents (CO_2e), which is an aggregate measure of total GHG global warming potential described in terms of CO_2 and accounts for the heat-trapping capacity of different gases. The Center for Climate Strategies estimated that GHG-producing activities in Wyoming accounted for approximately 55.6 million metric tons [61.3 million short tons] of gross CO_2e emissions in 2005; levels of 60.3 and 69.4 million metric tons [66.5 and 76.5 million short tons] are forecasted for years 2010 and 2020, respectively (Center for Climate Strategies, 2007).

EPA promulgated a phased approach known as the Tailoring Rule to address GHG emissions under the Clean Air Act permitting programs (EPA, 2012). This rule focused on the nation's largest stationary source GHG emitters and established thresholds for greenhouse gas emissions that define whether sources are subject to EPA air permitting. As initially constituted, the Tailoring Rule specified that new sources, as well as existing sources with the potential to emit 90,718 metric tons [100,000 short tons] per year of CO_2e, were subject to EPA PSD and Title V requirements. Modifications at existing facilities that increase GHG emissions by at least 68,039 metric tons [75,000 short tons] per year of CO_2e were also subject to Title V requirements. Initially, the Tailoring Rule only applied to sources subject to permitting based on the emission levels of pollutants other than greenhouse gases (i.e., no sources were subject to permitting requirements due solely to greenhouse gas emissions). In the second phase or step of the Tailoring Rule, EPA extended the requirements to sources that would be subject to permitting based solely on the emission levels of greenhouse gases. However, in 2014, the U.S. Supreme Court invalidated the portions of the Tailoring Rule stating that sources could be subject to EPA air permitting based solely on greenhouse gas emissions. EPA is revising the Tailoring Rule in response to the U.S. Supreme Court decision (EPA, 2015).

3.8 Noise

How is sound measured?

The human ear responds to a wide range of sound pressures. The unit of measure used to represent sound pressure levels is the decibel (dB). Another common sound measurement is the A-weighted sound level (dBA). dBA is a sound level measure designed to simulate human hearing by placing less emphasis on lower frequency noises, because the human ear does

Due to the rural location of the proposed Reno Creek ISR Project area, the most significant ambient noise (i.e., background noise) is from traffic on State Highway 387, which traverses the project area (see SEIS Figure 3-1), and from CBM operations (AUC, 2012a). County Road 22 (Clarkelen/Turnercrest Road) and County Road 25 (Cosner Road) also traverse parts of the proposed project area and contribute to ambient noise (see SEIS Figure 3-1).

Ambient noise measurements were not part of the applicant's prelicensing studies. In undeveloped rural areas of the Wyoming East Uranium Milling Region, existing ambient noise levels range from 22 to 38 decibels (dBA) depending on wind and traffic (NRC, 2009). The EPA (2003) reported that levels of noise close to industrial facilities and transportation corridors in the PRB are likely to be in the range of 50 to 70 dBA. As discussed in SEIS Section 3.2.3, pipelines and infrastructure associated with CBM operations are located within and around the project area (see SEIS Figure 3-3). A CBM compressor station in the western portion of the proposed project area houses multiple engines that move natural gas from central gathering facilities and long high-pressure transmission pipelines (see SEIS Figure 3-1). Noise levels from CBM operations are expected to be unnoticeable from distances of 490 m [1,600 ft] and beyond (BLM, 2003). Rail lines utilized for shipping coal from mining operations in the PRB are distant from the proposed project area. Noise levels ranging from 75 to 85 dBA are typical of a train traveling at approximately 80 kph [50 mph] on grade at a distance of 30 m [100 ft] (FRA, 2010). As described in SEIS Section 3.3, the BNSF Railroad operates the closest rail line approximately 20 km [12.5 mi] east of the proposed project area.

Noise associated with the proposed activities is considered because it may interfere with persons residing in the surrounding area. There are currently four residences within 8 km [5 mi] of the proposed project (see SEIS Section 3.2). The closest occupied offsite residence (Leavitt residence) is approximately 2.0 km [1.25 mi] southeast of the proposed project (see SEIS Figure 3-1). This residence is within 3.2 km [2.0 mi] of production units 5 and 7, as depicted in SEIS Figure 2-5. Small communities within an 80-km [50-mi] radius of the proposed project include Gillette, Wright, Kaycee, Midwest, and Edgerton (see SEIS Figure 3-5). Populations within these communities range from 195 people in Edgerton to 29,087 people in Gillette (see SEIS Section 3.11). Noise levels are expected to be slightly higher in these communities than in surrounding rural areas, as a result of traffic and human activities. However, nearby small communities such as Wright, which is located 13 km [8 mi] from the proposed project, are too distant to be affected by noise levels at the proposed Reno Creek ISR Project. Larger urban communities (e.g., cities) experience ambient noise levels from street noise, traffic, emergency vehicles, and construction. Noise levels in urban areas range from approximately 45 to 78 dBA (WSDOT, 2012). The nearest city to the proposed project area is Gillette, which is located approximately 65 km [41 mi] to the north. Because of its distance from the proposed project area, Gillette is not expected to be affected by noise levels at the proposed project.

As described in SEIS Section 3.2.2, recreational activities in and around the proposed Reno Creek ISR Project area are limited. A parcel of state-owned land in the western portion of the project area offers limited potential for dispersed recreational activities that could be sensitive to noise impacts (see SEIS Figure 3-2). Other nearby recreational attractions that could be sensitive to noise impacts include the Thunder Basin National Grassland, Fort Reno historic site, and the Bozeman Trail. Although the Thunder Basin National Grassland exists within the proposed project area, lands encompassed by the Grassland within and surrounding the proposed project area are privately owned. Therefore, recreational activities on the Grassland within or near the proposed project area, such as biking, camping, hunting, hiking, horseback riding, and off-road vehicle use, would not be allowed without permission from the landowner. The Fort Reno site and the Bozeman Trail are quite distant from the proposed Reno Creek ISR Project area and are not expected to be affected by noise levels from the proposed project. The Fort Reno site is 61 km [38 mi] northwest of the proposed project area, and the Bozeman Trail passes 19 km [12 mi] west of the proposed project area.

Noise associated with the activities described in the proposed project can displace wildlife and interfere with wildlife breeding habits. SEIS Table 3-14 lists wildlife species observed during baseline surveys for the proposed Reno Creek ISR Project. These species include small mammals (e.g., badger, cottontail, white-tailed jackrabbit, and muskrat), avian species (e.g., mourning dove, ferruginous hawk, red-tailed hawk, Greater sage-grouse, golden eagle, and killdeer), and big game species (e.g., pronghorn antelope and mule deer). For more information on the species and populations of wildlife within and surrounding the proposed Reno Creek ISR Project area see SEIS Section 3.6.

The Federal Highway Administration (FHWA) and the WYDOT have noise impact assessment procedures and criteria to help protect public health and welfare from excessive vehicular traffic noise. As described in SEIS Table 3-20, FHWA-established Noise Abatement Criteria according to land use, recognizing that different areas are sensitive to noise in different ways. A person is considered to be impacted by noise according to WYDOT procedures when existing or expected future sound levels approach [within 1 decibels (dBA)] or exceed the Noise Abatement Criteria or when expected future sound levels exceed existing sound levels by a substantial amount (15 dBA). These criteria were used to assess impacts at the proposed Reno Creek ISR Project.

State Highway 387, which traverses the proposed project area, and Clarkelen Road, which would provide access to the proposed project area, are line sources of noise. Vehicular traffic sound at a distance of 15 m [50 ft] from the receptor has been estimated at 54 to 62 dBA for passenger cars and 58 to 70 dBA for heavy trucks (FHWA, 2011). Because noise from line sources, such as roads, is reduced by approximately 3 dBA per doubling of distance (FHWA, 2011), the maximum truck sound level of 70 dBA on the shoulder of either State

Table 3-20. Noise Abatement Criteria: 1-Hour, A-Weighted Sound Levels in Decibels (dBA)		
Activity Category	**L_{eq}(h)***	**Description of Activity Category**
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purposes.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

*L_{eq}(h) is an energy-averaged, 1-hour, A-weighted sound level in decibels (dBA).
Source: 23 CFR Part 772

Highway 387 or Clarkelen Road would diminish to the level of a Category “A” activity (57 dBA) approximately 480 m [1,575 feet] from the source.

However, noise dampening characteristics of topographic interference and vegetation are not part of these calculations (NRC, 2009). It is expected that sound levels beyond a distance of 480 m [1,575 ft] from SH 387 and Clarkelen Road would be approximately 40 dBA. This calculation produces a conservative estimate of a baseline for ambient noise that is slightly higher than the GEIS statement that existing ambient noise levels in the region range from 22 to 38 dBA (NRC, 2009). GEIS Figure 3.2-17 provides examples of sound levels for common activities (NRC, 2009).

3.9 Historical and Cultural Resources

GEIS Section 3.3.8 provides an overview of historic and cultural resources in the Wyoming East Uranium Region where the proposed Reno Creek ISR Project would be located (NRC 2009a). The proposed Reno Creek ISR Project would be located in the Northwestern Plains region. The archaeological record indicates that precontact habitation of the northwestern Plains began 13,000 years ago. Early populations comprised hunters and gatherers. Around 4,000 years ago, bison tracking led to open prairie living and the exploitation of open prairie resources. During the historic period, the earliest Euro-Americans in the region were French fur traders. It was not until the nineteenth century that the area was opened to homesteaders (AUC, 2012a).

While the NRC’s NEPA analysis assesses the potential impact of the proposed project for the broader category of both historic and cultural resources, the National Historic Preservation Act (NHPA) [54 U.S.C. § 300101 et seq.], specifically requires federal agencies to consider the effects of their undertakings on historic properties as defined under the NHPA and provide the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. The issuance of a source material NRC license is a federal undertaking that may affect either known or undiscovered historic properties located on or near the proposed Reno Creek ISR Project area. In accordance with the provisions of the NHPA, the NRC is required to identify historic properties in the area of potential effect (APE). The APE for this review is the area that may be directly (direct APE) or indirectly (indirect APE) impacted by the construction, operations, aquifer restoration, and decommissioning of the proposed project. The NRC is required to consult with the Wyoming Historic Preservation Office (WY SHPO), interested tribes and other parties when making determinations and seek WY SHPO concurrence before taking action. If it is determined that historic properties are present, the NRC is further required to assess and develop alternatives or propose measures that might minimize or mitigate any adverse effects of the undertaking on historic properties and describe them in the environmental assessment (EA) or SEIS.

Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places (NRHP). The criteria for eligibility are listed in 36 CFR 60.4 and include (i) association with significant events in history; (ii) association with the lives of persons significant in the past; (iii) embodiment of distinctive characteristics of type, period, or construction; or (iv) sites or places that have yielded or are likely to yield important information (ACHP, 2012). The National Park Service also requires that the property has integrity, or the ability of a property to convey its significance, to be listed in the NRHP (National Park Service, 2014).

The historic preservation review process, NHPA Section 106, is outlined in regulations the ACHP issued in 36 CFR Part 800. As allowed under 36 CFR 800.8, the NRC staff is conducting the Section 106 review process through NEPA for this proposed project. The NRC staff have consulted with the WY SHPO and consulted with interested tribes and the applicant when making preliminary determinations on the identification of historic properties that could be impacted by the proposed project. SEIS Section 3.9.3 discusses the NRC staff's preliminary determinations regarding whether a historic or cultural resource meets the eligibility criteria to be considered a historic property under the NHPA.

As noted in GEIS Section 3.3.8.4, there are no culturally significant places listed in either the NRHP or state registers in the Wyoming East Uranium Region. However, the proposed Reno Creek ISR Project area would be located 12 km [7.5 mi] from the Pumpkin Buttes. The Pumpkin Buttes have been identified as a Traditional Cultural Property (TCP) and have potential cultural affiliation with nine tribes (SWCA, 2006). There is a Programmatic Agreement (PA) between the Bureau of Land Management (BLM) and the WY SHPO regarding mitigation of adverse effects to the Pumpkin Buttes TCP. This PA was put in place for anticipated federal minerals development in Campbell County, Wyoming. The proposed Reno Creek ISR Project would be located at least 8.6 km [5.5 mi] outside the PA boundary. While the TCP is outside the PA boundary, the Pumpkin Buttes are visible from most of the proposed Reno Creek ISR Project.

Cultural resources investigations for the proposed Reno Creek ISR Project included a review of available archaeological literature, a search and evaluation of archaeological records and collections maintained by the WY SHPO, archaeological field investigations, and tribal consultation. Tribal consultation included a tribal cultural survey performed by Native American Tribes to identify places of religious or cultural importance. Sites identified include sites supporting past human activity containing artifacts, features, or architectural structures, and/or include sacred places important to Native American tribes.

The NRC will comply with Section 106 of the National Historic Preservation Act of 1966 (as amended), as well as the Archaeological Resources Protection Act of 1979, as amended [Public Law 96-95; 16 U.S.C. 470aa-mm], The Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001), The American Indian Religious Freedom Act

(16 U.S.C. 1996), and the Wyoming Antiquities Act of 1935 (Wyoming Statues 35-1-114 to 116). Applicable laws and regulations are discussed more fully in GEIS Appendix B[2] (NRC, 2009).

The Native American Graves Protection and Repatriation Act (25 U.S.C. 3001) requires federal agencies and museums that receive federal funding to consult with Native American tribes and Native Hawaiian organizations to inventory and repatriate human remains and other cultural items to tribes and lineal descendants who have cultural affiliation with those remains or items. It also requires consultation with tribes regarding the excavation of human remains and associated items on federal and tribal land.

The American Indian Religious Freedom Act (16 U.S.C. 1996) was established by the U.S. government to "protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites." Federal agencies are directed to consult with tribal governments in evaluating their policies and procedures for compliance with this policy (AIRFA, 1966).

The Archaeological Resources Protection Act of 1979 requires federal agencies to consult with Native American tribes prior to approving permits for archaeological excavations that could cause harm to places of religious and cultural importance to tribes [(16 USC 470cc(c)] on federal lands and prior to approving permits for archaeological excavations on tribal land [(16 USC 470cc(g)]. The NRC does not need to comply with this law since the proposed project does not take place on federal or tribal lands.

SEIS Section 3.9.1 outlines the regional cultural history for the proposed Reno Creek ISR Project. Subsequently, SEIS Section 3.9.2 presents the APE (direct and indirect) for the proposed Reno Creek ISR Project. SEIS Sections 3.9.3 and 3.9.4 describe the results of historic and cultural resource investigations and summarize the tribal consultation that was carried out for the proposed Reno Creek ISR Project.

3.9.1 Cultural History

GEIS Section 3.3.8 provided an overview of cultural and historic resources in the Wyoming East Uranium Region where the proposed Reno Creek ISR Project would be located (NRC, 2009). Within this portion of Wyoming, the area appears to have been inhabited by aboriginal hunting and gathering people for more than 13,000 years (AUC 2012a).

The proposed Reno Creek ISR Project would be located in the prehistoric cultural sub-area known as the Northwestern Plains. The Northwestern Plains stretch from central Alberta to southern Wyoming and from western North Dakota to western Montana. The PRB of central Wyoming has a diverse cultural setting that exhibits influence of both the Northern Plains archaeological chronologies and the Great Basin archaeological chronologies (AUC, 2012a; Francis and Loendorf, 2002). The PRB, which occupies more than 88,060 km^2 [34,000 mi^2], is bounded to the west by the Bighorn Mountains and the Casper Arch, to the east by the Black Hills uplift, and to the south by the Laramie Mountains and the Hartville uplift. This intermontane

[2]The NRC also follows the stipulations in Executive Order 13004 – Indian Sacred Sites and Executive Order 13175 and 13084 – Consultation and Coordination with Indian Tribal Governments (1998 and 2000, respectively). These Executive Orders are discussed more fully in GEIS Appendix B (NRC, 2009).

basin, lower in elevation than the surrounding mountains, features unglaciated rolling hills and prairies dissected by irregular meandering permanent and intermittent streams. The basin is primarily drained by the Powder River, though several other major rivers also have watersheds within it, including the Belle Fourche River (Dolton and Fox, 1996; Chapman et al., 2004).

The following sections provide a brief description for each of the cultural periods associated with the proposed Reno Creek ISR Project area and defined by the years before the present time (B.P.):

- Paleo-Indian Period (13,000 to 7,000 years B.P.)
- Early Archaic Period (7,000 to 5,000-4,500 years B.P.)
- Middle Archaic Period (5,000-4,500 to 3,000 years B.P.)
- Late Archaic Period (3,000 to 1,850 years B.P.)
- Late Prehistoric Period (1,850 to 400 years B.P.)
- Protohistoric Period (400 to 250 years B.P.)
- Historic Period (250 to 120 years B.P.)

3.9.1.1 Paleo-Indian Period

The prehistoric populations of the Northwestern Plains shared a single major economic adaptation that persisted over the course of 12,000 years, with only minor changes in tool technology and subsistence strategy (AUC, 2012a; Michlovic 1986; Reeves 1969). Throughout prehistory, the inhabitants of the Northwestern Plains subsisted as semi-nomadic hunters and gatherers, but the species of plants and animals they exploited and the methods they used varied over time. The adaptations of human inhabitants of the Northwestern Plains during the last 4,000 years largely reflected their dependence on bison (AUC, 2012a; Frison 1971).

Paleo-Indian culture is believed to have existed in the PRB as far back as 12,000 years ago. However, evidence to this effect is relatively sparse. The PRB is filled with deep sediment, and older artifacts are assumed to be well-covered. Since settlement by pioneers, archaeological finds have proceeded from the periphery of the basin toward the center; however, most known archaeological sites are around the edges of the PRB (AUC 2012a).

3.9.1.2 Early Archaic Period

The early part of the Plains Archaic Period occurred during a relatively dry climatic episode roughly 8,500 years ago. It is generally accepted that groups of people were concentrated in protected and humid locations, such as mountains, foothills, and major river valleys (AUC, 2012a; Husted 1969). This pattern of site distribution is not significantly different from that observed for the Paleo-Indian period and may reflect the continuation of a generalized subsistence strategy. Most sites of this type are believed to be associated with the Plains Archaic period and have been found in major river valleys. Occupation sites may include semi-subterranean houses and diagnostic artifacts associated with this time period take the form of side and corner notched projectile points (AUC, 2012a; Davis, 1976; Deaver et al., 1989; Greiser et al., 1983).

3.9.1.3 Middle Archaic Period

During the middle Plains Archaic Period, groups began to adopt increasingly specialized subsistence and settlement strategies. In the Northern Plains, greater attention was devoted to bison hunting, resulting in increasingly regular movement across open prairie settings. There is evidence of a developing interest in open prairie living and resource procurement. In the southern portion of the Northwestern Plains, particularly in Wyoming's basin/foothill regions, archaic sites show an emphasis on a broader range of subsistence resources. In addition to bison, deer, pronghorn, and elk, smaller animals, such as rabbit, rodents, and fish were exploited. There is also a greater emphasis on the utilization of plant resources. Associated with the exploitation of plant resources is an increase in the abundance of grinding stones and food preparation pits (AUC, 2012a; Frison, 1991:89).

3.9.1.4 Late Archaic Period

The late Plains Archaic Period is marked by further adaptations toward upland living and the exploitation of open prairie resources. Groups continued to occupy river valley and foothill settings while also devoting greater time and attention to the prairies. This change of focus is illustrated by their adoption of new cooperative hunting techniques and the development of the tipi, a specialized structure suited for open plains habitation.

Artifacts of the Plains Archaic Period have been recovered in greater numbers than Paleo-Indian or early Plains Archaic types (AUC, 2012a; Deaver and Deaver, 1988). Late Plains Archaic sites occur in basin/foothill regions, river valley settings (AUC, 2012a, Davis 1976), and in open prairie areas (AUC, 2012a; Deaver and Aaberg, 1977). With the continuation of the Atlantic climatic episode, periods of drought commonly occurred in the Great Plains. In many regions, this ecological stress caused indigenous populations to use a greater diversity of resources, which then resulted in corresponding modifications of subsistence strategies and weaponry point styles. In the Northern Plains, however, the subsistence patterns remained relatively stable and few differences in subsistence strategy from the Paleo-Indian tradition can be found.

3.9.1.5 Late Prehistoric Period

The Late Prehistoric Period is characterized by an increasing specialization toward upland living and the utilization of open prairie resources, most importantly bison. The vast majority of Late Prehistoric/Woodland sites occur in open prairies rather than in protected hills or river valleys. The bow and arrow replaced atlatls, darts, and spears which resulted in a much more efficient exploitation of upland game, particularly when employed with communal hunting techniques. The presence of pottery in Late Prehistoric/Woodland sites has led to several interpretations of the manner and significance of Eastern Plains influence in the Northwestern Plains. (AUC, 2012a).

3.9.1.6 Protohistoric period

The Protohistoric Period witnesses the beginning of European influence on prehistoric cultures of the Northwestern Plains. Additions to the material culture include, most notably, the horse and European trade goods, including glass beads, metal, and firearms. Projectile points of this period include side-notched, tri-notched, and unnotched points, with the addition of metal points. The occupants lead a nomadic lifestyle as hunter gathers (AUC, 2012a).

3.9.1.7 Historic Period

The historical period of Wyoming begins with the arrival of Euro-Americans. Unlike areas to the east, the first documented activities by Euro-Americans in Wyoming did not begin until the 1800s. Prior to this time there was no appreciable European presence in the region, with the exception of French fur traders. Beginning in the 1840s, emigrants of the “great western migration” passed along the Oregon-California Trail along the Platte and through South Pass, but few, if any, detoured through the PRB. The exceptions were those traveling the Bozeman Trail. The Bozeman Trail is located west of the proposed Reno Creek ISR Project area. It was a route used first by Native Americans and then later by traders and homesteaders moving west during the 19th century (AUC, 2012a).

During the late 19th century, the PRB was disputed hunting grounds between the Sioux, Blackfoot, and Crow nations. When gold was discovered in Montana during the 1860's, pioneers attempted to cross the PRB from the Platte River by means of the Bozeman Trail. For approximately the next 20 years, conflicts arose between the Native Americans and the new settlers. The last of the major Native American wars of the northern plains were fought in the PRB area (e.g. Fetterman, Wagonbox, and Crazy Woman Fights) (AUC, 2012a; Larson, 1990).

In 1911 (officially organized in 1913), Campbell County was created out of the western halves of Crook and Weston Counties. Campbell County was named after both John A. Campbell, the first governor of the territory of Wyoming, and Robert Campbell, who was part of an early expedition to this part of Wyoming from 1825 to 1835.

Following World War I, Campbell County had an intense period of homesteading due to the growth of the “dry farming” movement and cattle and sheep ranching. Small coal mines were developed around the area as early as 1909, and major oil discoveries in Eastern Campbell County in 1956 set off the oil boom in the area. This oil boom did not as whole change land use, but did add substantially to the economy of the area.

During the 1970's, the modern coal industry in Campbell County began to thrive. Major coal companies flocked to the County to harvest the PRBs low-sulfur coal. Railroad companies began adding more lines to ship the coal away, thus beginning a new age of railroad history in Gillette. Today coal remains a vital industry in Campbell County (AUC, 2012a; CCGov, 2011).

Uranium was discovered in the region in the 1950’s. During the 1970’s and 1980’s, the uranium industry acquired large tracts of subsurface uranium mineral rights and leases (AUC, 2012a; WSGC, 2011). Substantial historical exploration, development, and mine permitting were performed on the Reno Creek property. Beginning in the late 1960s and continuing into the mid-1980s, RME, a wholly owned mining subsidiary of the Union Pacific Railroad, drilled thousands of exploration borings on the Reno Creek property. Significant permitting studies, including the construction, successful operations, groundwater restoration, and subsequent reclamation of an ISR pilot plant, were also performed over the years. Restoration and stabilization of the groundwater was acknowledged and signed off by the NRC in March of 1986 (AUC, 2012a).

3.9.2 Area of Potential Effect

The area that may be directly or indirectly impacted by the proposed activity represents the APE. The indirect APE for the proposed Reno Creek ISR Project would consist of visual effects and noise sources. The direct APE would coincide with the footprint of ground disturbance during construction (e.g., wellfields, access roads, trunklines, etc.) with the potential for additional ground disturbance to occur during decommissioning activities. The NRC staff anticipate that due to construction activities, the largest area would be disturbed during the construction phase (see SEIS Section 4.2 for more information on the proposed land use footprint). Therefore, the land disturbed during the construction phase represents the upper bound of potential effects to the direct APE.

The proposed project area encompasses a total land area of 2,451 ha [6,057 ac], while the direct APE for the proposed project for all phases would total 651 ha [1,609 ac]. The direct APE impact area includes proposed project facilities, pipeline installation, access roads, wellfields, header houses, and impoundments. Wellfields and the space between the edges of the wellfields and monitoring well rings are also included in the direct impact area for the proposed Reno Creek ISR Project. The extent of the visual APE (indirect APE) includes areas within an 8 km [5 mi] radius of the CPP in the Reno Creek ISR Project area {i.e. the area within the proposed project plus an additional 3.2 km [2 mi] from the project boundary}. The CPP would be the tallest building constructed at the proposed Reno Creek ISR Project location.

3.9.3 Historic and Cultural Resources Investigations

The NRC staff reviewed cultural resources investigations prepared on behalf of the applicant for the proposed Reno Creek ISR Project area. A review of archival data (Class I cultural resource inventory) was conducted on June 6, 2010 by the applicant's contractor. The Class I inventory also included a review of the environmental setting, prehistoric and historic contexts, and BLM General Land Office (GLO) survey plats dating to 1882. The Class I inventory shows that between 1993 and 2008, a total of 977 ha [2,463 acres] of the proposed Reno Creek ISR Project area had been subjected to an archaeological survey which meets current Class III standards (Greer Services, 2011).

A total of 41 cultural localities were previously recorded within the proposed project area (Greer Services, 2011) (SEIS Table 3-21). Of the 41 cultural localities recommended not eligible for listing on the NRHP during pre-2010 field investigations, 9 are prehistoric sites, 8 are historic sites, 6 are multi-component sites (prehistoric and historic), and the remaining 18 are isolated finds. Of those isolated finds, 14 are prehistoric, 2 are historic, and 1 represents a multicomponent isolate (prehistoric and historic), and the temporal affiliation or function of the remaining isolate could not be determined (Greer Services, 2011).[3] None of the previously recorded 41 cultural localities met the requirements for NRHP eligibility according to the WY SHPO. After reviewing these recommendations and considering any comments received from other consulting parties, the NRC staff made a preliminary determination that these 41 sites and isolates are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations.

3.9.3.1 Class III Cultural Resource Investigations

Subsequent to the Class I inventory, the applicant's contractor conducted a Class III Intensive Survey (comprehensive field inventory) of the proposed Reno Creek ISR Project. Areas within the proposed project area that were previously surveyed to current Class III standards were not resurveyed. The Class III survey was conducted between August 5, 2010, and December 11, 2010 with some additional field visits conducted through August 17, 2011. This survey identified 33 new cultural resource areas in the proposed project area and reevaluated

[3]Wyoming SHPO indicates that isolated cultural localities are not eligible for listing in the NRHP.

Table 3-21. List of Previously Identified Archaeological Sites and Isolates Within the Proposed Project Area Determined Not Eligible for Listing in the National Register of Historic Places		
Historic Property (Site Number, or Structure Identification)	**Description**	**NRHP Determination**[†]
IF 6967-1	quartzite biface	Not Eligible
IF 6967-2	prehistoric lithic scatter and historic artifacts	Not Eligible
IF 6967-3	prehistoric lithic scatter	Not Eligible
IF 6967-4	projectile point, silicified wood	Not Eligible
IF 6967-5	prehistoric lithic scatter	Not Eligible
48CA2798	historic debris	Not Eligible
48CA2776	herder camp	Not Eligible
48CA2777	herder camp	Not Eligible
48CA2764	prehistoric campsite	Not Eligible
48CA2765	prehistoric campsite historic trash	Not Eligible
48CA2766	prehistoric campsite	Not Eligible
48CA2767	prehistoric lithic scatter	Not Eligible
48CA2769	prehistoric campsite	Not Eligible
48CA2770	prehistoric lithic scatter	Not Eligible
48CA2777	herder camp	Not Eligible
48CA2778	herder camp	Not Eligible
48CA2779	herder camp	Not Eligible
FA93-25-2	unmodified flake	Not Eligible
FA93-25-12	unmodified flake	Not Eligible
FA93-25-18	unmodified flake	Not Eligible
FA93-25-23	unmodified flake	Not Eligible
FA93-25-29	unmodified flake	Not Eligible
FA93-25-30	Late Archaic dart point	Not Eligible
RD93-8-IF-1	can	Not Eligible
RD93-8-IF-2	can	Not Eligible
48CA2771	prehistoric campsite historic trash	Not Eligible
48CA2772	prehistoric lithic scatter	Not Eligible
48CA2773	prehistoric campsite historic trash	Not Eligible
48CA2774	prehistoric lithic scatter	Not Eligible
48CA2775	prehistoric lithic scatter historic trash	Not Eligible
48CA2780	herder camp	Not Eligible
IF-14	unmodified flake	Not Eligible
IF-18	unknown	Not Eligible
48CA5077	prehistoric lithic scatter historic trash	Not Eligible
IF-9	biface	Not Eligible
IF-10	scraper	Not Eligible
48CA4987	prehistoric lithic scatter	Not Eligible
48CA4267	prehistoric lithic scatter	Not Eligible
48CA5073	prehistoric lithic scatter historic remains	Not Eligible
IF-13	unmodified flake	Not Eligible
48CA4868	Reno to Salt Creek Road	Not Eligible

Source: Greer Services, 2011. The WY SHPO has concurred with these recommendations.
[†]NRHP eligibility criteria are presented in Section 3.9 of this SEIS.

3 previously recorded resources. Of these, all localities were evaluated and recommended ineligible for listing in the NRHP. After reviewing these recommendations and considering any comments received from other consulting parties, the NRC staff made preliminary determinations that these 36 sites and isolates are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations.

Each site's integrity of location, design, materials, workmanship, feeling, and association are considered in the evaluation, as well as the NRHP's four main criteria:

- Criterion A – The site must make a contribution to the major pattern of American history
- Criterion B – The site is associated with significant people of the American past
- Criterion C – The site embodies distinctive characteristics
- Criterion D – The site has yielded or may be likely to yield information important to prehistory or history. (NRHP, 2011a)

Site and isolate definitions required by the WY SHPO were applied to all sites and isolates. These definitions are as follows:

- A *prehistoric site* is defined as 15 or more spatially restricted artifacts (no more than 30 meters between artifacts), or a location with one or more cultural features and/or potential for buried deposits.
- A *historic site* contains 50 or more spatially associated artifacts (excluding trash dumps or artifact scatters older than 50 years for which historical significance cannot be demonstrated), as above (with fragments of a single artifact counted as one item), or one or more cultural features.
- A *prehistoric isolate* is defined as 14 or fewer associated artifacts, no cultural features, and no known cultural deposits.
- A *historic isolate* is defined as 49 or fewer associated artifacts (excluding trash dumps and highway trash) and no cultural features.

3.9.3.1.1 Archaeological Sites

The combined results of the Class I inventory and Class III intensive survey identified a total of 74 cultural localities (i.e., 41 previously recorded and 33 new cultural resource areas) in the proposed Reno Creek ISR Project area. These cultural localities include 35 locations with prehistoric artifacts; 29 with historic artifacts, features, or structures; 9 with both prehistoric and historic artifacts; and, 1 isolated artifact of an unknown temporal affiliation (Greer Services, 2011). As previously stated, 41 of these cultural localities were inventoried during earlier surveys and have been previously determined ineligible for listing in the NRHP with WY SHPO concurrence. The 33 newly recorded resources were evaluated and recommended ineligible for listing in the NRHP. Three previously recorded sites were also revisited during the Class III survey. After reviewing these recommendations and considering any comments received from other consulting parties, the NRC staff made preliminary determinations that all 74 cultural localities are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations. The following contains a brief description of the historic and cultural resources that were evaluated for the proposed project.

Previously Recorded Sites Revisited

Three previously recorded sites were revisited during the 2010-2011 Class III survey of the Reno Creek ISR Project area. These sites include 48CA2775 (prehistoric campsite), 48CA4868 (Reno to Salt Creek Road) and 48CA5077 (historic ranch facility). The archaeological survey team reevaluated these sites under NRHP Criteria (Greer Services, 2011). The sites were not recommended eligible for listing in the NRHP.

Site 48CA4868 (Reno to Salt Creek Road)

The historic Reno to Salt Creek Road (48CA4868 Reno to Salt Creek Road) was first recorded by Jon Frizell (North Platte) in December 2003 as part of a CBM survey. Establishment of the road probably began around 1910 when the Reno Homestead was constructed. It was formally surveyed and mapped in 1924 (AUC, 2012a). By 1941, a petition signed by several people and sent to the Board of County Commissioner's office requested the road be designated as an "auto-gate County Road" (Frizell, 2003). The route was evaluated as not eligible for NRHP with WY SHPO concurrence (Frizell, 2003). Portions of the old road within previous survey areas were not re-inspected. According to the BLM and WY SHPO, the site does not meet any of the NRHP Criteria. The archaeological survey team reevaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA2775 (Prehistoric campsite)

Site 48CA2775 was first identified in 1993 and is a prehistoric campsite with a historic trash scatter (Greer Services, 2011). The site was evaluated as not eligible for the NRHP, based on no potential for information beyond locational data (Greer Services, 2011). The WY SHPO concurred that the site is not eligible. The archaeological survey team reevaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA5077 (Historic ranch facility)

Site 48CA5077 represents a prehistoric lithic scatter, historic debris, and a depression. The site was first recorded in 2004 as part of CBM survey. Historic materials appear to date between 1925 and 1940 and may be associated with the homestead patent for this area. In 2004, the site was evaluated as not eligible for the NRHP, based on no potential for information beyond locational data (Greer Services, 2011). The WY SHPO concurred that the site is not eligible. The archaeological survey team reevaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Newly Identified Resources

The 2010-2011 Class III intensive survey identified 33 new cultural localities in the Reno Creek ISR Project area and revisited three previously inventoried sites. Newly inventoried resources include 1 prehistoric site, 6 historic sites, and the remaining 26 are isolated finds (SEIS Table 3-22). Of those isolated finds, 11 are prehistoric, 13 are historic, and 2 represent multicomponent isolates (prehistoric and historic). The archaeological survey team evaluated

Table 3-22. List of Newly Identified (and Updated) Archaeological Sites and Isolates Within the Proposed Project Area Determined Not Eligible for Listing in the National Register of Historic Places

State Site/Isolate Number	Description	Recommendation for NRHP Determination†
48CA2775*	prehistoric campsite	Not Eligible
48CA5077*	historic ranch facility	Not Eligible
48CA4868*	Reno to Salt Creek Road	Not Eligible
48CA7084	prehistoric campsite	Not Eligible
48CA7085	historic homestead	Not Eligible
48CA7086	historic ranch facility(possible homestead)	Not Eligible
48CA7087	historic artifacts (possible homestead)	Not Eligible
48CA7088	historic artifacts (stock camp)	Not Eligible
48CA7089	historic homestead	Not Eligible
48CA7090	historic depression	Not Eligible
IF 7063-1	prehistoric campsite	Not Eligible
IF 7063-2	prehistoric isolate	Not Eligible
IF 7063-3	prehistoric isolate	Not Eligible
IF 7063-4	prehistoric lithic scatter	Not Eligible
IF 7063-5	historic artifacts	Not Eligible
IF 7063-6	prehistoric isolate	Not Eligible
IF 7063-7	prehistoric campsite	Not Eligible
IF 7063-8	prehistoric lithic scatter	Not Eligible
IF 7063-9	historic isolate	Not Eligible
IF 7063-10	historic herder camp	Not Eligible
IF 7063-11	prehistoric lithic scatter historic artifacts	Not Eligible
IF 7063-15	prehistoric isolate	Not Eligible
IF 7063-18	prehistoric isolate	Not Eligible
IF 7063-19	historic isolate	Not Eligible
IF 7063-20	historic isolate	Not Eligible
IF 7063-22	prehistoric lithic scatter	Not Eligible
IF 7063-23	prehistoric isolate	Not Eligible
IF 7063-25	historic herder camp	Not Eligible
IF 7063-26	historic livestock windbreak remains	Not Eligible
IF 7063-27	historic herder camp	Not Eligible
IF 7063-28	prehistoric lithic scatter historic artifacts	Not Eligible
IF 7063-30	historic livestock windbreak remains	Not Eligible
IF 7063-32	historic windmill remains	Not Eligible
IF 7063-33	historic windmill remains	Not Eligible
IF 7063-34	historic windmill remains	Not Eligible
IF 7063-36	historic artifacts	Not Eligible

Source: Greer Services, 2011. Recommended not eligible by Greer Services (2011) and the NRC.
*Update to previously recorded site.
†NRHP eligibility criteria are presented in Section 3.9 of this SEIS.

all 33 new cultural sites and isolates under NRHP Criteria (Greer Services, 2011). None were recommended eligible for listing in the NRHP. After reviewing the recommendations and considering any comments received from other consulting parties, the NRC staff made preliminary determinations that the sites are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations. The following contains a brief description of the historic and cultural resources that were evaluated for the proposed project.

Archaeological Sites

Site 48CA7084 represents a prehistoric campsite identified as a result of the Class III cultural resources survey performed for the proposed Reno Creek ISR project. The site is defined by the extent of a lithic scatter and a surface hearth. The lack of diagnostic artifacts and the lack of potential for buried cultural deposits does not allow determination of age, function, or archeological affiliation of the site. The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA7085 represents the remains of a historic homestead. The site is defined by the remains of a historic ranch. The site likely was occupied from at least 1916, when initial improvement of the property probably began. The remains were still present through the early 1970s. The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA7086 is the remains of a historic ranch facility. The site may have been used as early as 1919, when initial improvement of the property probably began for homesteading, but by about the 1950s, it appears to have been converted into its current function as a livestock facility. The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA7087, a former stock camp, is defined by a scatter of historic artifacts. The site may have been used as early as 1921, when initial patent improvement on the property may have begun. Remaining artifact fragments are typical of the 1920s to 1950s in general, so there is no clear indication of limited age or function. The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Also a former stock camp, Site 448CA7088 is a historic artifact scatter. Cultural affiliation of herder camps is generally assumed to be Euro-American because most herders in the west were of that descent. The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA7089 represents a historic homestead. The overall paucity of trash and evidence of out-buildings, however, indicates that this site was not occupied intensively, and not for a long period of time. The archaeological survey team evaluated the site under NRHP Criteria Greer Services, 2011). The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Site 48CA7090 is defined by a historic hand dug depression. Investigators suggest that the depression is the same size and shape as a homestead-era icehouse. It is assumed that it was associated with homestead-era activities and probably dates between about 1915 and 1930.

The archaeological survey team evaluated the site under NRHP Criteria (Greer Services, 2011). The site was not recommended eligible for listing in the NRHP.

Isolated Cultural Resources

Along with the 7 new archeological sites, the 2010-2011 Class III survey identified 26 new isolated resources in the Reno Creek ISR Project area. A total of 11 isolates are prehistoric, 13 are historic and 2 contain artifacts dating to both the prehistoric and historic periods. The majority of prehistoric isolates have limited quantities of associated artifacts. The WY SHPO defines a prehistoric isolate as 14 or fewer associated artifacts, with no cultural features, and no known cultural deposits. A historic isolate is defined as 49 or fewer associated artifacts (excluding trash dumps and highway trash) and no cultural features. The WY SHPO indicates that isolated cultural localities are not eligible for listing in the NRHP. The archaeological survey team evaluated the 26 new isolates under NRHP Criteria (Greer Services, 2011). These isolates were not recommended eligible for listing in the NRHP. After reviewing the recommendation and considering any comments received from other consulting parties, the NRC staff made preliminary determinations that these sites are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determination to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations. The following contains a brief description of the historic and cultural resources that were evaluated for the proposed project.

The proposed project area contains two multi-component isolated localities (IF 7063-11 and IF 7063-28). Both of these isolates are prehistoric lithic scatters with historic artifacts. IF 7063-11 represents an isolated resource containing nine prehistoric and four historic artifacts; no diagnostic lithic artifacts are associated with this isolate and there is no indication of previous cultural features, either prehistoric or historic. IF7063-28 represents a scatter of four lithic and four historic artifacts. The archaeological survey team evaluated these isolates under NRHP Criteria (Greer Services, 2011). These isolates were not recommended eligible for listing in the NRHP.

Isolated historic resources range from locations having 1 artifact to more than 30, or represent structural remains and/or landscape features. Five of the historic isolates (IF 7063-5, IF 7063-9, IF 7063-19, IF 7063-20, and IF 7063-27) have low quantities of artifacts (e.g., 1 to 5 artifacts). Three historic isolates represent windmill remains (IF 7063-32, IF 7063-33, and IF 7063-34). Each of these windmills appears to date to the 1950s and is associated with stock-watering facilities. Two of the historic isolates are livestock windbreak remains (IF 7063-26 and IF 7063-30). It is estimated that each was constructed during the late 1930s and used through the early 1960s. The archaeological survey team evaluated these isolates under NRHP Criteria (Greer Services, 2011). These isolates were not recommended eligible for listing in the NRHP.

Two of the historic isolates are identified as former herder camps (IF 7063-10 and IF 7063-25). IF 7063-10 is a small concentration of historic artifacts. Based on styles and conditions of these items, the site appears to date to the late 1930s or 1940s (Greer Services, 2011) and presumably is the discard area at a small temporary herder camp. IF 7063-25 represents a small concentration of historic artifacts. All artifacts appear to date to the late 1930s or 1940s (Greer Services, 2011). The archaeological survey team evaluated these isolates under NRHP Criteria (Greer Services, 2011). These isolates were not recommended eligible for listing in the NRHP.

IF 7063-36 is a historic trash dump consisting of a variety of historic materials. This appears to have been a single-episode dump, and from the kinds and conditions of the materials, it is estimated that they were discarded during the 1930s to 1940s. There are no indications of structures or any other cultural use or modification around the site or anywhere in the surrounding area. The archaeological survey team evaluated this isolate under NRHP Criteria (Greer Services, 2011). The isolate was not recommended eligible for listing in the NRHP.

3.9.3.1.2 Historic Standing Structures

A total of six historic structures were identified within the direct APE and are associated with historic archaeological sites (three windmills, one lambing/livestock shed, and the two livestock windbreaks) (Greer Services, 2011). No historic structures within the proposed project area are currently listed or recommended eligible for listing on the NRHP. The archaeological survey team evaluated these historic structures under NRHP Criteria (Greer Services, 2011). These historic structures were not recommended eligible for listing in the NRHP.

3.9.3.1.3 Places of Religious or Cultural Significance

Amendments to the NHPA passed in 1992 greatly expanded the role of Native American tribes in the Section 106 review process [54 U.S.C. § 306108]. These changes allowed tribes to assume the role of the WY SHPO for projects on tribal land [54 U.S.C. § 306102(b)(5)(b)] and recognized that historic properties of religious and cultural significance to Native American tribes or Native Hawaiians may be eligible for the NRHP listing; and required that federal agencies consult with any Native American tribe or Native Hawaiian organization that attaches significance to such sites [54 U.S.C. § 306102(b)(5)(b] (NHPA, 1966).

For Native American Tribes, places of religious or cultural significance represent the cultural localities or spaces that are linked to the cultural practices and beliefs of living Native American populations. Moreover, these places may be representative of their history and therefore may be considered an essential representation of a group’s cultural heritage. Places of religious or cultural significance may not be represented in archaeological or historic contexts.

3.9.3.1.4 Overview

Cultural resources that are considered sensitive and potentially sacred to modern Native American tribes include burials, rock art, rock features and alignments (such as cairns, medicine wheels, and stone circles), Native American trails, and certain religiously significant natural landscapes and features. Some of these resources may be formally designated as TCPs or sites of religious or cultural significance to Native American Tribes. A TCP is a site that may be eligible for inclusion on the NRHP because of its association with cultural practices or beliefs of a living community, which are (i) rooted in that community’s history and (ii) important in maintaining the continuing cultural identity of the community (NRHP, 2011) and meets the other criteria in 36 CFR 64.2.

The NRC staff identified tribes that may attach religious and cultural significant to historic properties in the area of potential effects and invite them to be consulting parties. Information regarding prior surveys of the proposed project area was sent to interested tribes. Representatives from 12 tribes also took part in the tribal cultural survey and are as follows: Crow Creek Sioux Tribe, Flandreau Santee Sioux Tribe, Yankton Sioux Tribe, Turtle Mountain Band of Chippewa, Fort Peck Assiniboine and Sioux, Northern Cheyenne Tribe, Northern Arapaho Tribe, Crow Tribe (Apsaalooke), Santee Sioux Nation, Fort Belknap Tribe, Chippewa

Cree Tribe, and the Cheyenne River Sioux Tribe. During the tribal cultural survey, six sites or features of religious or cultural significance were identified by the tribes. The Santee Sioux Tribe determined that the proposed Reno Creek ISR Project would not have an adverse effect on sites of historic or cultural significance to the tribe. The Northern Arapaho identified two sites of historic and cultural significance to their tribe. However, the Northern Arapaho did not recommend the sites eligible for listing in the NRHP. The Northern Arapaho tribe also recommended avoidance for two isolated cultural resources in the direct APE and one isolated resource that is adjacent to the direct APE.

As previously mentioned, BLM previously designated Pumpkin Buttes as a TCP and developed a PA between the BLM and the WY SHPO regarding mitigation of adverse effects for the anticipated federal minerals development in Campbell County, Wyoming. The proposed Reno Creek project area is geographically located 12 km [7.5 mi] from the Pumpkin Buttes, and at least 8.6 km [5.5 mi] outside of the PA boundary. The Pumpkin Buttes TCP has potential cultural affiliation with nine tribes.

3.9.3.1.5 Tribal Cultural Survey Results

The following sections provide an overview of places of religious and cultural significance to tribes and the results of the tribal cultural survey completed at the proposed Reno Creek ISR Project area.

Tribal Review of Previously Reported Archaeological Sites

While participating in the tribal cultural survey, some Native American tribes chose to revisit some previously recorded archaeological sites. In total, tribal representatives investigated four such sites and one isolate location, which are listed in SEIS Table 3-23. Tribal survey teams recorded sparse cultural artifact scatters within or adjacent to the boundaries of three known archaeological sites (48CA2765, 48CA4267, and 48CA7084). All of the newly recorded locations consist of individual artifacts. No new cultural features were recorded during these revisits. Tribal representatives elected to revisit Site 48CA7087 and isolate location IF-7063-11 but did not record any individual artifacts or features. None of the surveying tribes recommended previously recorded archaeological sites or isolates eligible for listing in the NRHP Criteria.

Tribal Sites: New Discoveries

Two of the six newly discovered cultural sites were identified on July 17, 2014 within the project area but outside the direct APE (see SEIS Table 3-24). Both of these sites (48CA7249 and 48CA7250) are located on property owned by the State of Wyoming. Four of the sites were located within the direct APE. One of these sites (48CA7252) is located on property owned by the State of Wyoming, while the remaining three sites (48CA7251, 48CA7253, and 48CA7254) are located on privately owned property. The Northern Arapaho Tribe provided formal recommendations for 48CA7252.

The tribal survey also resulted in the identification of 22 isolated artifact locations, designated as IA-01 to IA-22). Two of the isolated artifacts were located within the proposed project area but outside of the direct APE, while the remaining 20 isolated artifacts were located within the direct APE. While none of the tribes recommended these sites to be eligible for listing on the NHPA, the Northern Arapaho Tribe recommended avoidance for three of these 22 isolated artifacts (IA-05, IA-12, and IA-13) (Northern Arapaho Tribal Historic Preservation Office, 2015).

Table 3-23. Summary of Tribal Cultural Survey New Site/Feature Discoveries		
Tribal Survey Number	**Tribal Features/Artifacts**	**National Register of Historic Places Recommendation**[†]
48CA7249*	Spare cultural artifacts scatter	Recommended as Not Eligible
48CA7250*	Spare cultural artifacts scatter	Recommended as Not Eligible
48CA7251	Stone Circle	Recommended as Not Eligible
48CA7252	Prayer Circle; Fasting Circle;	Recommended as Not Eligible
48CA7253	Stone Circle	Recommended as Not Eligible
48CA7254	Stone Circle	Recommended as Not Eligible

*Sites 48CA7249 and 48CA7250 Wyoming are located on state land. All other sites are located on private land.
[†]NRHP eligibility criteria are presented in SEIS Section 3.9.

Table 3-24. Scenic Quality Evaluation Rating		
Key Factor	**Rating Criteria**	**Score**
Landform	Flat to rolling terrain with some areas of steeper topography in the background; few or no interesting landscape features.	1
Vegetation	Little variety in vegetation, which consists of grazed grassland with sage and other shrubs. There are a few large trees present on the site which offer some variety in form.	2
Water	Present, but not noticeable. Water bodies consist of small stock ponds, CBM outfalls, and surface runoff.	1
Color	Vegetation and soil have some subtle color variations but generally shift from green tones in the spring to tan tones throughout the remainder of the year.	2
Influence of Adjacent Scenery	Adjacent scenery is very similar to the proposed project area, and provides little variety in line, form, color, and texture.	1
Scarcity	Landscape is common for the region.	1
Cultural Modifications	Existing modifications consist of numerous oil and gas production facilities and infrastructure, and grazing activities.	0
	Total	8

Source: AUC, 2012a

Likewise, surveyors for the Cheyenne River and Yankton Sioux Tribes verbally communicated to the NRC staff recommendations for avoidance or mitigation (IA-12) to avoid ground disturbing impacts.

After reviewing the recommendations and considering any comments received from the tribes and other consulting parties, the NRC staff made preliminary determinations that the additional sites and isolates identified during the tribal survey are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations.

3.9.3.2 *Visual Impacts Assessment*

The Class III survey and the Tribal Cultural Survey did not identify sites recommended eligible for listing in the NRHP in the direct or indirect APE. The nearest known TCP is Pumpkin Buttes, which is located 12.8 km [8 mi] from the proposed Reno Creek ISR Project area. SEIS Section 4.9.1.1 describes the visual effects analysis conducted for the proposed Reno Creek ISR Project. This analysis does indicate that the proposed CPP location will be visible from the southeastern vantage of the Pumpkin Buttes.

3.9.4 Tribal Consultation

The federal government recognizes the sovereignty of federally recognized Native American tribes. Executive Order (EO) 13175 (November 2000), “Consultation and Coordination with Indian Tribal Governments,” excludes from the requirements of the order, “independent regulatory agencies,” as defined in 44 U.S.C. §3502(5).” However, Section 8 of EO 13175 does indicate that agencies such as NRC are, “encouraged to comply with the provisions” of EO 13175. While the NRC is exempt from the EO, the Commission is committed to carrying out meaningful consultation with Native American tribes.

Under Section 106 of the NHPA and the regulations at 36 CFR 800.2(c)(2)(B)(ii)(A), NRC must also provide Native American tribes “a reasonable opportunity to identify its concerns about historic properties, advise on the identification and evaluation of historic properties and evaluation of historic properties, including those of religious and cultural importance, articulate its views on the undertaking’s effects on such properties, and participate in the resolution of adverse effects.” To this end, the NRC identified 22 Native American tribes who attribute historical, cultural, and religious significance to the proposed Reno Creek ISR Project area. The NRC’s consultation with tribal governments began with formal notification letters dated March 27, 2013 (NRC, 2013).

Subsequently, the NRC invited all 22 tribes to participate in a meeting and site visit on March 12, 2014. As a result of the meeting, the NRC staff determined that there was sufficient interest in the project area to warrant a tribal cultural survey of the proposed Reno Creek ISR Project area. In May 2014, the NRC staff issued correspondence to all interested tribes to coordinate a tribal cultural survey for the purpose of identifying properties of religious and cultural significance to tribes (NRC, 2014). The NRC staff invited interested tribes to investigate any area within the Reno Creek ISR Project direct APE during the months of June and July 2014. The NRC staff also sent prior survey information regarding the proposed project area to interested tribes.

In all, representatives from 12 Native American tribes took part in the tribal cultural survey offered by the NRC in June and July 2014. The participating tribes include:

- Crow Creek Sioux Tribe
- Flandreau Santee Sioux Tribe
- Yankton Sioux Tribe
- Turtle Mountain Band of Chippewa
- Fort Peck Assiniboine and Sioux
- Northern Cheyenne Tribe
- Northern Arapaho Tribe
- Crow Tribe (Apsaalooke)
- Santee Sioux Nation

- Fort Belknap Tribe
- Chippewa Cree Tribe
- Cheyenne River Sioux Tribe

SEIS Section 1.7 describes consultation activities undertaken by the NRC staff with tribal governments. Consultation correspondence and meeting notes associated with the Section 106 process is presented in Appendix A. The NRC staff have considered tribal comments when making the required determinations under the NHPA. The NRC staff did not identify any historic properties affected by the proposed project. The WY SHPO concurred with staff's conclusion on October 11, 2016 (WY SHPO, 2016). The NRC staff also considered tribal comments when assessing potential impacts to historic and cultural resources in SEIS Chapter 4 and 5.

3.10 Visual and Scenic

The proposed project area is located in the PRB. The PRB extends over northeastern Wyoming and southeastern Montana. The PRB is bounded by the Hartville Uplift and the Laramie Range to the south, the Black Hills to the east, and the Big Horn Mountains to the west. The PRB is described as rolling prairie and dissected river breaks surrounding the Powder, Cheyenne, and Upper North Platte Rivers, and has less precipitation and less available water than neighboring regions (NRC, 2009). Within the project area, the landscape is characterized by flat to rolling topography with small ephemeral drainages with big sagebrush shrubland, meadow grassland, upland grassland, and breaks grassland vegetation. The proposed project area elevation ranges from 1,536 to 1,614 m [5,041 to 5,296 ft] above mean sea level with the highest elevation in the eastern portion (AUC, 2012a). Wetland surveys identified a total of 17.12 ha [42.23 ac] of wetlands within the proposed project area (for more information see SEIS Section 3.5.1.4). The Pumpkin Buttes are visible from the proposed project area, but range from 12 to 23 km [7.5 to 14 mi] away. Modified landscapes within the proposed project area include oil and gas production facilities and infrastructure, utilities, transportation infrastructure, agricultural infrastructure, and three residences. The Thunder Basin National Grassland covers approximately 77.2 percent {1,892 of 2,451 ha [4,675 of 6,057 ac]} of the proposed project area; however, all lands encompassed by the grassland are privately owned (AUC, 2012a).

Although the proposed project does not include any federal land (see SEIS Section 3.2), the applicant used the BLM Visual Resource Management (VRM) system to evaluate visual and scenic resources. The VRM system is the basic tool used by the BLM to inventory and manage visual resources. BLM evaluates the visual or scenic quality of the land using the Visual Resource Inventory to assess the scenic value of a property and ensure that its value is preserved (BLM, 1986). In compiling the inventory, BLM completed a scenic quality evaluation, a sensitivity-level analysis, and a delineation of distance zones for properties; each property or area is assigned to one of four VRM classes (BLM, 1984). Class I is most protective of visual and scenic resources, and Class IV is least restrictive.

- Class I: Preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention;

- Class II Objective: Retain the existing character of the landscape. The level of change to the characteristic landscape should be low;

- Class III Objective: Partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate; and

- Class IV Objective: Provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

The key factors of landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications were evaluated and scored according to the rating criteria. The criteria for each key factor range from high- to moderate-to-low quality, based on the variety of line, form, color, texture, and scale of the factor within the landscape. A score was associated with each rating criteria, with a higher score applied to greater complexity and variety for each factor in the landscape.

As stated in GEIS Section 3.3.9, the Wyoming East Uranium Region (which includes the proposed project area) does not contain any VRM Class I resources (NRC, 2009). There are few VRM Class II resources listed within the Wyoming East Uranium Region (NRC, 2009); however, those sites are approximately 63 km [40 mi] away from the proposed project area (AUC, 2012a). The majority of the Wyoming East Uranium Milling Region is categorized as VRM Class III (along highways) and Class IV (open grassland, oil and natural gas, or urban areas). Extensive landscape modification in urban areas and in several areas of oil, natural gas and coal production near Casper and Gillette, Wyoming have resulted in these areas being predominantly classified as VRM Class IV (NRC, 2009).

The Pumpkin Buttes have been identified as a TCP and have potential cultural affiliation with some Native American tribes (SWCA, 2006). There is a PA between the BLM and the WY SHPO regarding mitigation of adverse effects to the Pumpkin Buttes TCP. The proposed Reno Creek ISR Project would be located at least 8.6 km [5.5 mi] outside the PA boundary and outside the 3.2 km [2mi] Pumpkin Buttes TCP viewshed boundary (for more information on the Pumpkin Buttes, see SEIS Section 3.9). Using guidance in the GEIS (NRC, 2009) and utilizing the BLM VRM system, the applicant inventoried the landscape for the proposed project area and a 3.2 km [2 mi] buffer. The applicant rated the areas as VRM Class III (AUC, 2012a).

For the proposed Reno Creek ISR area, the CPP was selected for the viewshed evaluation because it would be the most noticeable (the largest and tallest) structure at the proposed project area. According to NUREG–1569 (NRC, 2003), if the visual resource evaluation rating is 19 or less, no further evaluation is required. Based on the visual and scenic resource survey the applicant conducted in July 2011, the total score of the scenic quality inventory for the proposed project would be 8 out of the possible 32, see SEIS Table 3-24 (AUC, 2012a). Therefore, under the NUREG–1569 guidance, no further evaluation would be required for existing scenic resources.

3.11 Socioeconomics

General socioeconomic factors associated with this region are described in GEIS Section 3.3.10 (NRC, 2009). Socioeconomic region of influence (ROI) is defined as the area where employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions in the region. This section describes current socioeconomic conditions and local community services within the ROI surrounding the proposed Reno Creek ISR Project area that may be directly or indirectly affected by the proposed project. The construction and operation of the proposed project (the CPP building, wellfields, roads, etc.) are expected to create demand for employees, goods, and services. Existing communities would provide the people, goods, and services required to construct and operate the proposed project. Personal income from wages and benefits would be spent on goods and services within other sectors of the communities and create additional opportunities for employment and income (i.e., indirect effects).

The proposed project would be located in a rural portion of southwest Campbell County, Wyoming. Communities expected to be part of the socioeconomic ROI for the proposed project are listed in SEIS Table 3-25. Most construction and operations workers are expected to come from the surrounding communities of Wright, Gillette, Antelope Valley/Crestview, and Sleepy Hollow in Campbell County. Additional workers are expected to come from smaller communities within an 80-km [50-mi] radius of the proposed project area, including Kaycee in Johnson County and Edgerton and Midwest in Natrona County. It is anticipated that the majority of workers would reside near the proposed project; therefore, Campbell County is expected to experience the most significant socioeconomic changes. Although Casper (Natrona County) is 105 km [65 mi] from the proposed project area, it is the largest city in the region and is expected to be a source of equipment, supplies, services, and workers (AUC, 2012a).

Demographics, income, housing, employment structure, local finance, education, and public services in the ROI surrounding the proposed project area are discussed in the following subsections. The socioeconomic information in these subsections incorporates 2000, 2010, and more recent U.S. Census Bureau (USCB) data accessed via American FactFinder, USCB 2008-2012 American Community Survey 5-Year Estimates, and USCB State and County Quickfacts (USCB, 2014). In addition, the Wyoming Department of Administration and Information (WDAI), the Wyoming Department of Revenue (WDOR), and the Wyoming Department of Education (WDOE) provided information on demographics and employment (WDAI, 2007, 2011, 2012), local finance (WDOR, 2007, 2013), and education (WDOE, 2014a-e), respectively.

3.11.1 Demographics

Population changes and projections for counties and communities within the ROI are shown in SEIS Table 3-26. Between 2000 and 2010, all counties and communities (with the exception of Midwest) experienced population growth. Between 2000 and 2010, population growth rates in Campbell and Johnson Counties (36.9 and 21.1 percent, respectively) exceeded the State of Wyoming growth rate of 14.1 percent. The highest growth among communities between 2000 and 2010 occurred in Gillette (48.1 percent) and Wright (34.1 percent).

Population in all of the counties and communities is projected to increase in coming years. Between 2010 and 2030, the populations of Campbell, Johnson, and Natrona Counties are projected to increase by approximately 43 percent, 22 percent, and 17 percent, respectively.

The projected population growth rate of Campbell and Johnson Counties is expected to outpace the state's projected population growth rate of approximately 18.6 percent between 2010 and 2030. Gillette and Wright are projected to have the highest growth rates among communities within the ROI. Between 2010 and 2030, the populations of Gillette and Wright are projected to increase by approximately 43 percent.

The demographic profiles for Campbell, Johnson, and Natrona Counties are presented in SEIS Table 3-27. All three counties have predominately white populations. Hispanic or Latino and Native American make up the main minority groups. Hispanic or Latino accounted for 7.8, 3.2, and 6.9 percent of the population in Campbell, Johnson, and Natrona Counties, respectively. Native Americans accounted for 1.2, 1.1, and 1.0 percent of the population in Campbell,

Table 3-25. Communities Surrounding the Proposed Reno Creek ISR Project Area			
Community	**County**	**2010 Population**	**Distance/Direction from Reno Creek Site**
Gillette	Campbell	29,087	69 km [43 mi]/N
Wright	Campbell	1,807	13 km [8 mi]/NE
Antelope Valley/Crestview	Campbell	1,658	64 km [40 mi]/N
Sleepy Hollow	Campbell	1,308	66km [41 mi]/N
Kaycee	Johnson	263	77 km [48 mi]/W
Edgerton	Natrona	195	53 km [33 mi]/SW
Midwest	Natrona	404	56 km [35 mi]/SW
Casper	Natrona	55,316	105 km [65 mi]/SW
Sources: AUC, 2012a; USCB, 2014			

Table 3-26. 2000–2010 Population Change and 2020/2030 Populations Projections for Counties and Communities Within the ROI					
State/County/City	**2000 Census**	**2010 Census**	**Percent Change 2000/2010**	**Population Projections**	
				2020	**2030**
State of Wyoming	493,782	563,626	14.1	622,360	668,830
Campbell County	33,698	46,133	36.9	56,890	66,060
Gillette	19,646	29,087	48.1	35,869	41,651
Wright	1,347	1,807	34.1	2,228	2,588
Antelope Valley/Crestview	1,642	1,658	1.0	—	—
Sleepy Hollow	1,177	1,308	11.1	—	—
Johnson County	7,075	8,569	21.1	9,450	10,450
Kaycee	249	263	5.6	290	321
Natrona County	66,533	75,450	13.4	82,490	88,320
Edgerton	169	195	15.4	213	228
Midwest	408	404	−1.0	442	473
Sources: USCB, 2014; WDAI, 2011					

Table 3-27. Demographic Profile of the 2010 Population in Counties Within the ROI				
Population Category	**Campbell County**	**Johnson County**	**Natrona County**	**Wyoming**
Race (percent of total population)				
White alone	93.2	96.5	92.8	90.7
Black/African American alone	0.3	0.2	0.9	0.8
American Indian, Alaskan Native alone	1.2	1.1	1.0	2.4
Asian alone	0.6	0.4	0.7	0.8
Native Hawaiian, Pacific Islander alone	0.0	0.0	0.1	0.1
Some Other Race	2.7	0.7	2.2	3.0
Two or More Races	2.1	1.1	2.4	2.2
Hispanic or Latino	7.8	3.2	6.9	8.9
White alone, not Hispanic or Latino	88.9	94.4	89.1	85.9
Population Density				
Persons per km² [mi²]	3.7 [9.6]	0.8 [2.1]	5.4 [14.1]	2.2 [5.8]
Population by Age/Percent of Total				
Under 5 years	4,063/8.8	573/6.7	5,377/7.1	40,203/7.1
5–19 years	10,164/22.0	1,479/17.3	14,720/19.5	111,310/19.7
20–39 years	14,059/30.5	1,798/21.0	20,554/27.2	151,828/26.9

Table 3-27. Demographic Profile of the 2010 Population in Counties Within the ROI (Continued)				
Population Category	**Campbell County**	**Johnson County**	**Natrona County**	**Wyoming**
40–64 years	15,231/33.0	3,131/36.5	25,407/33.7	190,195/33.7
+65 years	2,616/5.7	1,588/18.5	9,392/12.4	70,090/12.4
Total	46,133/100	8,569/100	75,450/100	563,626/100
Source: USCB, 2014				

Johnson, and Natrona Counties, respectively. The racial characteristics of the three-county area are slightly less diverse than the State of Wyoming.

The 40- to 64-year-old age group accounts for a third or more of the population in each of the counties and in the State of Wyoming (SEIS Table 3-27). The 40- to 64-year-old population in Wyoming is one of the highest in the nation and is a result of the in-migration of workers during the oil boom years in the late 1970s and early 1980s (WDAI, 2007). In Campbell and Natrona Counties, the 20- to 39-year-old population is comparable to the 40- to 64-year-old population.

3.11.2 Income

Income information for the ROI is presented in SEIS Table 3-28. According to USCB data, 2008–2012 median household and per capita incomes were significantly higher in Campbell County than in Johnson and Natrona Counties (USCB, 2014). Median household and per capita income levels in Johnson and Natrona Counties were similar to the statewide averages. The percentage of the population living below the poverty level in the three counties is lower than the statewide percentages (11.0 percent). Approximately 6.7 percent of the population of Campbell County, 8.8 percent of the population of Johnson County, and 9.3 percent of the population of Natrona County live below the poverty level (USCB, 2014). The percentage of families living below the poverty level in the three counties is also lower that the statewide percentage (7.2 percent). Approximately 6.0 percent of families in Campbell County, 5.8 percent of families in Johnson County, and 6.3 percent of families in Natrona County live below the poverty level (USCB, 2014).

3.11.3 Housing

Housing data for the three counties and seven communities within the proposed Reno Creek ISR Project ROI, including occupied and vacant units, are provided in SEIS Table 3-29. In 2010, the vacancy rate in Campbell and Natrona Counties was 9.4 percent, and in Johnson County the vacancy rate was 16.9 percent. Of the approximately 14,500 housing units in the seven communities within the ROI, which include single-family homes, multifamily housing, mobile homes, and rental units, approximately 13,000 units or 90 percent are occupied and approximately 1,500 units or 10 percent are vacant. Most occupied housing units in the seven communities within the ROI (about 9,000 or 70 percent) are owned rather than rented (USCB, 2014). Most vacant units in the seven communities are for rent (approximately 660 units or 45 percent) rather than for sale (approximately 210 units or 14 percent) (USCB, 2014). The median value of owner-occupied housing units is $201,100 in Campbell County, $215,300 in Johnson County, and $179,100 in Natrona County (USCB, 2014).

Temporary lodging within the ROI is located in Wright, Gillette, and Edgerton. Temporary lodging in Wright includes a mobile home park, two motels, a recreational vehicle (RV) park,

Table 3-28. 2008–2012 Income Information for Counties Within the ROI				
	Campbell County	**Johnson County**	**Natrona County**	**Wyoming**
Median Household Income (Annual Dollars)	77,090	57,175	55,786	56,573
Per Capita Income (Annual Dollars)	33,557	28,972	29,702	28,858
Families Living Below the Poverty Level (Percent)	6.0	5.8	6.3	7.2
Persons Below the Poverty Level (Percent)	6.7	8.0	9.3	11.0
Source: USCB, 2014.				

Table 3-29. 2010 Housing Units of Counties and Communities Within the ROI					
County/Community	**Total Housing Units**	**Occupied Units**		**Vacant Units**	
		Number	**Percent**	**Number**	**Percent**
Campbell County	18,955	17,172	90.6	1,783	9.4
Gillette	12,153	10,975	90.3	1,178	9.7
Wright	813	685	84.3	128	15.7
Antelope Valley/Crestview	644	593	92.1	51	7.9
Sleepy Hollow	447	435	97.3	12	2.7
Johnson County	4,553	3,782	83.1	771	16.9
Kaycee	134	115	85.5	19	14.2
Natrona County	33,807	30,616	90.6	3,191	9.4
Edgerton	111	90	81.1	21	18.9
Midwest	200	148	74.0	52	26.0
Total 7 Communities	14,502	13,041	89.9	1,461	10.1
Source: USCB, 2014					

and one hotel. In Gillette, temporary accommodations include 23 motels/hotels, two RV parks, and 22 campgrounds with RV hookups. One motor lodge is located in Edgerton.

3.11.4 Employment Structure

Based on information from the Wyoming Department of Administration and Information (WDAI), total employment (farm and nonfarm) in April 2010 was estimated to be 32,824 for Campbell County; 5,937 for Johnson County; and 52,286 for Natrona County (WDAI, 2012). In 2011, the unemployment rate in Campbell County was 4.6 percent, which is lower than the statewide rate of 6.0 percent. The unemployment rate in Johnson County was 7.1 percent, which exceeded the statewide rate, whereas the unemployment rate in Natrona County was 5.9 percent, which approximately matched the statewide rate.

The largest employment sector for Campbell County was mining, which accounted for about 26 percent of the labor force. Other major sources of employment in Campbell County were construction jobs (13 percent), government-related jobs (13 percent), and retail trade (8 percent) (WDAI, 2012). Major sources of employment in Johnson and Natrona Counties include mining (7 and 9 percent, respectively), construction jobs (10 and 8 percent, respectively), government-related jobs (18 and 12 percent, respectively), and retail trade (9 and 12 percent, respectively). Health care and social assistance is another major source of employment in Natrona County, accounting for 12 percent of the labor force.

3.11.5 Local Finance

Wyoming does not impose a corporate income tax or personal income tax. Wyoming has a four percent sales tax (WDOR, 2007). In addition, counties may impose two optional taxes, either for general or specific uses (WDOR, 2007). Each optional tax is limited to a maximum of 1 percent. Campbell County has a 6 percent total sales and use tax (4 percent state tax, 1 percent general use county option tax, and 1 percent specific use county option tax) (WDOR, 2013). Johnson and Natrona Counties have a 5 percent total sales and use tax (4 percent state tax and 1 percent general use county option tax) (WDOR, 2013). In 2013, sales and use tax revenues in Campbell, Johnson, and Natrona Counties totaled approximately $183 million, $14 million, and $127.5 million, respectively (WDOR, 2013). Wyoming law also allows counties to impose a local option lodging tax of not more than 4 percent (WDOR, 2007). Campbell and Johnson Counties both impose a 2 percent lodging tax, and Natrona County imposes a 3 percent lodging tax (WDOR, 2013). In 2013, lodging tax collections in Campbell, Johnson, and Natrona Counties totaled approximately $432,000, $163,000, and $1.3 million, respectively (WDOR, 2013).

Because Wyoming does not impose an income tax, local governments largely rely on property tax collections. The majority of the property tax revenues are directed to Wyoming's public schools. The approximate 2013 taxable valuation for all state and locally assessed property in Campbell, Johnson, and Natrona Counties was $5.8 billion, $785 million, and $1.25 billion, respectively (WDOR, 2013). Wyoming's property tax rate is 11.5 percent for industrial property and 9.5 percent for commercial, residential, and all other property.

Finally, the State of Wyoming levies taxes on the value of mineral production (a severance tax). Severance taxes associated with mineral recovery are levied by the Mineral Tax Division of the State of Wyoming Department of Revenue. Wyoming levies a uranium mineral severance tax of 4 percent (WDOR, 2013). Counties also levy an *ad valorum* property tax (gross products tax) on the previous year's mineral production. The Mineral Tax Division of the Wyoming Department of Revenue assesses the previous year's mineral production, which the counties use to bill and collect the *ad valorem* property tax from mineral taxpayers.

3.11.6 Education

Communities within the ROI with public school systems are Wright, Gillette, Midwest, and Kaycee. Public schools in Wyoming are generally organized at the county or subcounty level by school district. The Wright and Gillette public schools are part of Campbell County School District #1; Kaycee public schools are part of Johnson County School District #1; and Midwest public schools are part of Natrona County School District #1. Information concerning these school districts is presented in SEIS Table 3-30.

Most of the public schools in Campbell County School District #1 are located in Gillette and immediately surrounding communities. There are 15 elementary schools, 2 junior high schools, and 2 high schools in Gillette and the immediate surrounding communities (WDOE, 2014a). The Wright public schools consist of one elementary school (Cottonwood Elementary; kindergarten through 6th grade) and one junior-senior high school (Wright Junior and Senior High School; 7th through 12th grade). Fall enrollment for the 2012–2013 school year at Cottonwood Elementary was 293 students (WDOE, 2014a). At Wright Junior and Senior High School, fall enrollment for the 2012–2013 school year was 219 students (WDOE, 2014a).

Table 3-30. County Public School Districts Located Within the ROI	
Campbell County School District #1	
Number of students enrolled (K–12)	8,705
Number of schools	21
Student-teacher ratio	13.5
Johnson County School District #1	
Number of students enrolled (K–12)	1,287
Number of schools	5
Student-teacher ratio	10.8
Natrona County School District #1	
Number of students enrolled (K–12)	12,750
Number of schools	35
Student-teacher ratio	14.1
Sources: WDOE, 2014a,b,c,d,e	

The Kaycee public school serves kindergarten through 12^{th} grade. Fall enrollment for the 2012–2013 school year was 146 students (WDOE, 2014a). The Midwest public school system includes an elementary school with a half-day preschool, full-day kindergarten, and 1^{st} through 5^{th} grades, and a secondary school serving 6^{th} to 12^{th} grades. Fall enrollment for the 2012–2013 school year for the Midwest public schools was 183 students (WDOE, 2014a). Due to the low enrollment, class sizes in the Kaycee and Midwest public schools are fairly small. The student-to-teacher ratio at the Midwest schools is approximately 12 to 1 (WDOE, 2014e).

Wyoming has seven community colleges. The Northern Wyoming Community College District has a main campus in Sheridan (Sheridan College), a satellite college in Gillette (Gillette College), and outreach centers in Wright and Kaycee. The Gillette College campus is the closest post-secondary school to the proposed project area. The University of Wyoming at Casper and Casper College (one of Wyoming's seven community colleges) offer courses and degree programs taught in Casper.

3.11.7 Health and Social Services

Medical facilities and health services in the ROI are listed in SEIS Table 3-31. Hospitals and clinics are located in Campbell, Johnson, and Natrona Counties.

Campbell County Memorial Hospital in Gillette is the primary health care facility in Campbell County and provides emergency care and clinical outpatient operations. Hospital facilities include a 90-bed acute-care hospital, specialty clinics, a 150-bed long-term care facility, an inpatient hospice, and an ambulatory surgery center. Other services include a cancer care center, inpatient and outpatient behavioral health services, occupational health services, and rehabilitation services. Campbell County Memorial Hospital is designated as an Area Trauma Hospital by the Wyoming Department of Public Health Emergency Services. Campbell County Memorial Hospital has two walk-in branch clinics—one in Gillette and one in Wright.

The Wyoming Medical Center in Casper is the nearest hospital offering full service emergency services and is designated as a Regional Trauma Hospital by the Wyoming Department of

Table 3-31. Hospitals, Clinics, and Health Services in Campbell, Johnson, and Natrona Counties	
Hospitals	**Location**
Campbell County Memorial Hospital	Gillette
Wyoming Medical Center	Casper
Johnson County Healthcare Center Hospital	Buffalo
Clinics	**Location**
CCMH Walk-in Clinic	Gillette
CCMH Wright Walk-in Clinic	Wright
Johnson County Healthcare Center Clinic	Buffalo
Health Services	**Location**
Public Health Nursing	Gillette
Wyoming Department of Family Services	Gillette

Public Health Emergency Services. The Wyoming Medical Center is a 191-bed acute-care hospital offering comprehensive medical services. Emergency services at Wyoming Medical Center include Wyoming Life Flight, the state's only air ambulance service.

The Johnson County Healthcare Center, located in Buffalo, is the primary health care facility in Johnson County. It includes a 25-bed acute-care hospital, outpatient medical clinic, and a 50-bed long-term care facility. Johnson County has a sheriff's office headquartered in Buffalo. The Town of Kaycee has a police department with one full-time officer. Natrona County has a sheriff's office headquartered in Casper with resident deputies in Midwest. The Town of Midwest also has a police department. The Wyoming Department of Health has a Public Health Nursing office in Gillette. This office provides primary and preventative health services, including family planning; immunizations; Supplemental Nutrition Program for Women, Infants, and Children (WIC); and maternal and family health. The Wyoming Department of Family Services has a local office in Gillette, which provides assistance for connecting with community resources; reporting child and adult abuse and neglect; and applying for programs, including Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), and Medicaid.

Police, fire department, and ambulance services in the ROI are listed in SEIS Table 3-32. In Campbell County, emergency medical services (EMS) are provided by Campbell County Memorial Hospital and the Campbell County Fire Department. Campbell County Memorial Hospital EMS has two stations—one in Gillette and one in Wright. The Campbell County Fire Department has 10 stations: 8 stations in Gillette, 1 station in Wright, and 1 station in Rozet.

The Campbell County Fire Department is a combination fire department consisting of career and volunteer firefighters.

Johnson County has a volunteer fire department in Buffalo and fire control districts in Buffalo (Johnson County Fire District) and Kaycee (Powder River Fire District). Natrona County has a volunteer fire department in Midwest and a fire protection district with two stations in Casper and Evansville. The Natrona County Fire Protection District is staffed by career firefighters.

Table 3-32. Police, Fire Department, and Ambulance Services in Campbell, Johnson, and Natrona Counties	
Police	**Location**
Campbell County Sheriff's Office	Gillette, Wright
Natrona County Sheriff's Office	Casper, Midwest
Johnson County Sheriff's Office	Buffalo
Gillette Police Department	Gillette
Kaycee Police Department	Kaycee
Midwest Police Department	Midwest
Fire Departments	
Campbell County Fire Department	10 stations (8 in Gillette, 1 in Wright, and 1 in Rozet)
Buffalo Volunteer Fire Department	Buffalo
Johnson County Fire District	Buffalo
Powder River Fire District	Kaycee
Midwest Volunteer Fire Department	Midwest
Natrona County Fire Protection District	Casper, Evansville
EMS/Ambulance	
Campbell County Memorial Hospital	Gillette, Wright
Campbell County Fire Department	Gillette, Wright, Rozet
Wyoming Medical Center	Casper
Johnson County Healthcare Center	Buffalo

Campbell County has a sheriff's office headquartered in Gillette with a substation in Wright. The City of Gillette also has a police department. The Campbell County Sheriff's Office contracts with the Town of Wright to provide law enforcement services. The Wright substation has five deputies who provide routine and emergency coverage for the Town of Wright and southern Campbell County.

3.12 Public and Occupational Health

This section summarizes the natural background radiation levels in and around the proposed Reno Creek ISR Project area. Descriptions of these levels are known as "preoperational" or "baseline" radiological conditions, and, unless otherwise noted, would be used for evaluating any future changes to site conditions during operations and potential reclamation obligations during eventual decontamination and decommissioning of the proposed Reno Creek ISR Project. This section also describes applicable safety criteria and radiation dose limits that have been established for the protection of public and occupational health and safety.

Radiation dose is a measure of the amount of ionizing energy that is deposited in the body. Ionizing radiation is a natural component of the environment and ecosystem, and members of the public are exposed to natural radiation continuously. Radiation doses to the general public occur from radioactive materials found in the Earth's soils, rocks, and minerals. Radon (Rn-222) is a radioactive gas that escapes into ambient air from the decay of uranium (and its progeny, radium-226) found in most soils and rocks. Naturally occurring low levels of uranium and radium are also found in drinking water and foods. Cosmic radiation from outer space is another natural source of exposure and ionizing radiation dose. In addition to natural sources of radiation, there are artificial or manmade sources that contribute to the dose the general public receives. Medical diagnostic procedures using radioisotopes and x-rays are a primary manmade radiation source. The National Council on Radiation Protection and Measurements

(2009) estimates the annual average dose to the public from all natural background radiation sources (terrestrial and cosmic) is {3.1 millisieverts (mSv) [310 millirem (mrem)]}. Due to the increase in medical imaging and nuclear medicine procedures, the annual average dose to the public from all sources (natural and human made) is 6.2 mSv [620 mrem] (NCRP, 2009).

3.12.1 Baseline Radiological Conditions

In accordance with NRC regulations at 10 CFR Part 40, Appendix A, Criteria 7 and 7A, the applicant developed and implemented a preoperational monitoring program to establish baseline radiological conditions for the proposed project area (AUC, 2012i; 2015b). For this program, the applicant performed radiological surveys and sampling of soils, air, surface water, groundwater, and biota at the proposed project from September 2010 through December 2011 (AUC, 2012i), then supplemented or revised surveys, as applicable, in response to NRC requests for additional information (AUC, 2014a–c), and then compiled all preoperational monitoring results in AUC (2015b). The applicant followed guidance in NUREG–1569 (NRC, 2003) and NRC Regulatory Guides 4.14 (NRC, 1980), 3.46 (NRC, 1982a), and 3.8 (NRC, 1982b), as applicable (AUC, 2012i; 2015b). Results of this baseline radiological monitoring are described in the following subsections. These results provide data on radiological conditions that would be used to evaluate potential changes in future site conditions from routine facility operations or accidental or unplanned releases, if a license is issued.

In response to the NRC requests for additional information, the applicant relocated 2 of 6 air sampling stations and committed to collecting 12 months of environmental samples at these new stations, collecting a final round of vegetation samples, and documenting the results in an updated preoperational monitoring report for the NRC review (AUC 2015a,b). This update affects the monitoring results described in this section for airborne particulate, airborne radon, ambient gamma, soil, and vegetation. Therefore, if the NRC issues the license in the future, it will be conditioned on receiving this updated information prior to pre-operational NRC inspection and start of operations. Upon receipt, the NRC staff would review the updated information and evaluate whether the SEIS needs to be supplemented.

3.12.1.1 Soils

The applicant performed a baseline gamma radiation survey to evaluate gamma exposure rates and soil radionuclide concentrations. The applicant conducted global positioning system (GPS)-based unshielded gamma-ray surveys at 100-m [328-ft] transect intervals, increased densities of 50 m [160 ft] in areas of known ore deposits, and 100 percent coverage in areas where correlations with soil samples were developed (AUC, 2012i). The applicant also collected surface soil samples to 5 cm [2 in] depths at 300 m [984 ft] intervals along 8 transects of a radial grid centered on the proposed CPP location, and at the air sampling locations. Depth profile soil samples at 0.33-m [1.09 ft] intervals to a depth of 1 m [3 ft] were taken at the proposed CPP location and at 750 m [2,500 ft] to the north, south, east, and west of that location (AUC,2012i; 2015b).

The objective of the gamma-ray surveys is to characterize and quantify baseline or preoperational radiation levels and radionuclide concentrations in soils throughout the proposed project area. Detailed gamma-ray survey results are provided in the applicant's technical report (AUC, 2012i). Gamma-ray exposure rates ranged from 7.4 to 23 μR/hr with a mean of 13.6 μR/hr (AUC, 2012i).

The soil samples were analyzed for Ra-226. Additionally, 10 percent of the samples and samples at air monitoring stations were analyzed for uranium, thorium (Th-230), and lead (Pb-210) (AUC, 2012i; 2014b; 2015b). Results of the soil sampling are summarized in SEIS Tables 3-33 and 3-34.

Over the area sampled, the mean and median radium-226 (Ra-226) surface soil concentrations were both 0.037 Bq/g [1.0 pCi/g]. The minimum radium-226 (Ra-226) surface soil concentration was 0.018 Bq/g [0.50 pCi/g], and the maximum concentration was 0.089 Bq/g [2.4 pCi/g]. For comparison, background radium-226 (Ra-226) levels in soil in the United States typically average 0.037 Bq/g [1.0 pCi/g] (NCRP, 2009). Uranium concentrations ranged from 0.01 to 0.02 Bq/g [0.4 to 0.7 pCi/g]. Thorium (Th-230) concentrations ranged from 0.018 to 0.037 Bq/g [0.50 to 1.0 pCi/g]. Lead (Pb-210) concentrations ranged from 0.037 to 0.18 Bq/g [1.0 to 4.8 pCi/g].

All subsurface soil samples were analyzed for uranium, thorium (Th-230), radium (Ra-226), and lead (Pb-210) (AUC, 2012i; 2014b; 2015b). Over the entire site area, the mean and median subsurface radium-226 (Ra-226) concentrations based on 15 samples were both 0.044 Bq/g [1.2 pCi/g], and measurements ranged from 0.022 to 0.088 Bq/g [0.6 to 2.4 pCi/g]. The remaining radionuclides were sampled from the center grid location, with a mean uranium concentration across all depths of 0.044 Bq/g [1.2 pCi/g], Th-230 concentration of 0.026 Bq/g [0.7 pCi/g], and lead (Pb-210) concentration of 0.048 Bq/g [1.3 pCi/g] (AUC, 2014b). The thorium (Th-230), radium (Ra-226), and uranium mean subsurface results are comparable to surface sampling results. The lead (Pb-210) subsurface soil sampling results are slightly lower than the mean results for uranium in surface soils, but both sets are within the range of background.

3.12.1.2 Sediment and Surface Water

Sediment and surface water sampling was conducted at upstream and downstream locations in perennial streams and ephemeral stream drainage channels where water is present during a portion of the year within the proposed project area (AUC. 2012a; 2015b). A total of 41 sediment samples were analyzed for radium-226 (Ra-226), and 25 samples were analyzed for uranium, thorium (Th-230), and lead (Pb-210) (AUC, 2012i; 2014b). Radium (Ra-226) concentrations range from <0.007 to 0.0729 Bq/g [<0.2 to 1.97 pCi/g] and average 0.0514 Bq/g [1.39 pCi/g]. Uranium concentrations in sediments range from 0.02 to 0.12 Bq/g [0.5 to 3.3 pCi/g] and average 0.0422 Bq/g [1.14 pCi/g]. Thorium (Th-230) concentrations range from 0.01 to 0.0559 Bq/g [0.3 to 1.51 pCi/g] and average 0.030 Bq/g [0.81 pCi/g]. Lead (Pb-210) concentrations range from 0.037 to 0.14 Bq/g [1.0 to 3.7 pCi/g] and average 0.081 Bq/g [2.2 pCi/g].

A total of 41 surface water samples were analyzed for radionuclides, including uranium, gross alpha, radium (Ra-226), thorium (Th-230), lead (Pb-210), and polonium (Po-210) (AUC, 2012i; AUC, 2014b). Results are summarized here along with EPA drinking water standards for radionuclides (MCLs) for context. Three of the stream samples (SW1, SW8, and SW18) exceeded the EPA MCL for gross alpha {555 Bq/m^3 [15 pCi/L]} in drinking water, as established in 40 CFR Part 141. Gross alpha concentrations ranged from 74 to 681 Bq/m^3 [2.0 to 18.4 pCi/L]. Total suspended uranium concentrations ranged from below the detection limit of <0.0003 to 0.0021 mg/L [<0.0003 to 0.0021 ppm], while the range of total dissolved uranium was <0.0003 to 0.0266 mg/L [<0.0003 to 0.0266 ppm]. These uranium results are below the EPA MCL for total uranium in 40 CFR 141.66 of 0.03 mg/L [0.03 ppm].

Table 3-33. Surface Soil Baseline Radiological Sampling Results (pCi/g)					
Radionuclide	**Mean**	**Median**	**Minimum**	**Maximum**	**Sample Size**
Ra-226	1.0	1.0	0.5	2.4	54
U-natural*	0.5	0.5	0.4	0.7	7
Pb-210	2.1	1.5	1.0	4.8	7
Th-230	0.7	0.7	0.5	1.00	7
Source: AUC, 2012i; 2014b; 2015b					

Table 3-34. Subsurface Soil Baseline Radiological Sampling Results (pCi/g)					
Depth	**Mean***	**Median**	**Minimum**	**Maximum**	**Sample Size**
Ra-226					
0–33	1.3	1.2	0.6	2.4	5
33–66	1.3	1.4	1.1	1.5	5
66–100	1.1	1.0	0.8	1.6	5
All Depths	1.2	1.2	0.6	2.4	15
U-natural					
0−33	0.7	NA	NA	NA	1
33−66	1.4	NA	NA	NA	1
66−100	1.5	NA	NA	NA	1
Pb-210					
0−33	1.5	NA	NA	NA	1
33−66	1.2	NA	NA	NA	1
66−100	1.3	NA	NA	NA	1
Th-230					
0−33	0.7	NA	NA	NA	1
33−66	0.9	NA	NA	NA	1
66−100	0.6	NA	NA	NA	1
*Single measurements reported for U-natural, Pb-210, and Th-230 NA = Not Applicable Source: AUC, 2012i; 2014b; 2015b					

Total suspended radium-226 (Ra-226) concentrations ranged from <7 to 104 Bq/m^3 [<0.2 to 2.8 pCi/L], while the range of total dissolved radium-226 (Ra-226) is <7.4 to 63 Bq/m^3 [<0.2 to 1.7 pCi/L]. These radium-226 (Ra-226) results are below the EPA MCL for combined radium in 40 CFR 141.66 of 185 Bq/m^3 [5.0 pCi/L]. While most dissolved radium-228 (Ra-228) measurements were at or near the detection limit of 37 Bq/m^3 [1.0 pCi/L], one quarterly sample from SW19 reported a radium-228 (Ra-228) concentration of 204 Bq/m^3 [5.5 pCi/L] that resulted in total combined radium that exceeded the combined radium EPA MCL. Total suspended thorium (Th-230) concentrations ranged from <7 to 30 Bq/m^3 [<0.2 to 0.9 pCi/L], while the results for total dissolved thorium (Th-230) ranged from <7 to 20 Bq/m^3 [<0.2 to 0.5 pCi/L]. Total suspended and dissolved polonium (Po-210) concentrations were all less than or equal to 37 Bq/m^3 [1 pCi/L], except for one quarterly dissolved sample (SW18) that was 59 Bq/m^3 [1.6 pCi/L]. These results, when added to radium-226 (Ra-226), are below the EPA MCL for gross alpha in 40 CFR 141.66 of 560 Bq/m^3 [15 pCi/L] (excluding uranium and radon, but including radium-226). Total suspended lead (Pb-210) concentrations ranged from <40 to 230 Bq/m^3 [<1 to 6.3 pCi/L], while the range of total dissolved lead (Pb-210) was <40 to 350 Bq/m^3 [<1 to 9.5 pCi/L]. Lead (Pb-210) concentrations greater than 40 Bq/m^3 [1 pCi/L] are above the EPA MCL for beta/photon radioactivity in 40 CFR 141.66 of 0.04 mSv/yr [4 mrem/yr], based on a drinking water dose calculation that assumes water consumption at the rate of 2 L/d [0.5 gal/d] for 365 days per year and Federal Guidance No. 11 dosimetry (EPA, 1988). Dissolved lead (Pb-210) concentrations exceeded 40 Bq/m^3 [1 pCi/L] in 22 percent of the samples. Suspended lead (Pb-210) concentrations exceeded 40 Bq/m^3 [1 pCi/L] in 27 percent of the samples. The applicant's preoperational and operational surface water monitoring programs are discussed in SEIS Sections 7.2.4 and 7.3.3.

3.12.1.3 Air (Ambient Gamma, Radon, and Particulates)

The applicant conducted air particulate, ambient gamma dose, and ambient radon concentration sampling at five air monitoring stations {three onsite stations; one offsite station located approximately 1.7 km [1.1 mi] west of the southwestern boundary of the proposed project area; and another offsite station located approximately 2.1 km [1.3 mi] east of the northeastern boundary of the proposed project area} (AUC, 2012i; AUC, 2014b; 2015b).

The applicant placed high-sensitivity optically-stimulated dosimeters (OSLs) at each of the five air monitoring stations established for the proposed Reno Creek ISR Project to measure ambient gamma dose rates. Ambient gamma radiation dosimeters were replaced quarterly over a 1-year period (AUC, 2014b). Based on the gamma dose rate monitoring results, projected quarterly average gamma doses at the sample locations ranged from 0.291 to 0.343 mSv [29.1 to 34.3 mrem] (AUC, 2014b). These values are within the range of reported background levels from natural radiation sources in the region and the United States, including cosmic radiation, external terrestrial radiation, and naturally occurring radon (NCRP, 2009).

The applicant placed tracketch radon detectors at each of the five air monitoring station locations to measure ambient radon (Rn-222) concentrations in air. Radon (Rn-222) detectors were replaced quarterly over a 1-year period (AUC, 2014b; 2015b). Ambient radon concentrations ranged from 2 to 37 Bq/m^3 [<0.06 to 1.0 pCi/L] and averaged 20 Bq/m^3 [0.54 pCi/L]. The reported average ambient radon (Rn-222) concentrations are within the range of background levels reported for the region (NCRP, 2009).

The applicant conducted continuous air particulate sampling over a 1-year period (July 2012 to July 2013) at each of the five air monitoring station locations. Air sampler filters were collected and analyzed on a quarterly basis. Particulates were collected using air samplers and analyzed for radium (Ra-226), uranium, thorium (Th-230), and lead (Pb-210) (AUC, 2012i; AUC, 2014b; 2015b). Results of the air particulate sampling are summarized, as follows:

- Radium (Ra-226) concentrations ranged from below detection limits to a maximum of 1.0×10^{-11} Bq/cm^3 [2.7×10^{-16} µCi/mL]. The maximum concentration is less than 0.03 percent of the effluent release limit of 3.3×10^{-8} Bq/cm^3 [9.0×10^{-13} µCi/mL] specified in 10 CFR Part 20, Appendix B.

- Uranium concentrations ranged from below detection limits to a maximum of 7.8×10^{-12} Bq/cm^3 [2.1×10^{-16} µCi/mL]. The maximum concentration is less than 0.02 percent of the effluent release limit of 3.3×10^{-7} Bq/cm^3 [9.0×10^{-12} µCi/mL] specified in 10 CFR Part 20, Appendix B.

- Thorium (Th-230) concentrations ranged from below detection limits to a maximum of 9.2×10^{-12} Bq/cm^3 [2.5×10^{-16} µCi/mL]. The maximum concentration is less than 0.01 percent of the effluent release limit of 1.1×10^{-7} Bq/cm^3 [3.0×10^{-12} µCi/mL] specified in 10 CFR Part 20, Appendix B.

- Lead (Pb-210) concentrations ranged from 3.4×10^{-10} Bq/cm^3 [9.3×10^{-15} µCi/mL] to a maximum of 9.2×10^{-10} Bq/cm^3 [2.5×10^{-14} µCi/mL]. The maximum concentration was 4.2 percent of the effluent release limit of 2.2×10^{-8} Bq/cm^3 [6.0×10^{-13} µCi/mL] specified in 10 CFR Part 20, Appendix B.

3.12.1.4 Groundwater

As described in SEIS Section 3.5, the applicant conducted initial preoperational groundwater sampling of wells at the proposed Reno Creek ISR Project area from August 2010 through April 2012 (AUC, 2014b; 2015b). This baseline study consisted of 43 groundwater wells sampled on a quarterly basis for a year. These wells are listed in SEIS Table 3-11. The wells were selected based on the potential influence of proposed operations on groundwater resources (AUC, 2012i). The locations of all groundwater sampling wells are shown in SEIS Figure 3-23, and the formation sampled in each well is listed in SEIS Table 3-11. Radiological constituents sampled in each well included gross alpha, radium (Ra-226), uranium, lead (Pb-210), polonium (Po-210), and radon (Rn-222) (AUC, 2014b; 2015b). Results of preoperational groundwater sampling are discussed in SEIS Section 3.5.3.2 and summarized as follows:

- The MCL for uranium {0.03 mg/L [0.03 ppm]} was exceeded in 17 percent of the well samples. Of these samples above the MCL, 75 percent were located in the production zone aquifer, 21 percent were in domestic and stock wells, and 4 percent in the shallow water table unit. The uranium concentrations exceeding the MCL ranged from 0.0304 to 0.661 mg/L [0.0304 to 0.661 ppm].

- The MCL for dissolved combined radium (Ra-226 and Ra-228) {185 Bq/m^3 [5 pCi/L]} was exceeded in about 23 percent of the well samples. Of these samples above the MCL, 90 percent were located in the production zone aquifer, 8 percent were in domestic and stock wells, and 2 percent in the underlying aquitard unit. The combined radium concentrations exceeding the MCL ranged from 190 to 25,900 Bq/m^3 [5.1 to 701 pCi/L].

- The MCL for gross alpha {555 Bq/m^3 [15 pCi/L]} was exceeded in about 38 percent of the well samples. Of these samples above the MCL, 62 percent were located in the production zone aquifer, 19 percent were in domestic and stock wells, 13 percent in the underlying aquitard unit, and 6 percent in the shallow water table unit. The gross alpha concentrations exceeding the MCLs ranged from 644 to 171,700 Bq/m^3 [17.4 to 4640 pCi/L].

- Although EPA has not finalized an MCL for radon (Rn-222), a value of 11,100 Bq/m^3 [300 pCi/L] was previously proposed (56 FR 33050).[4] The proposed EPA MCL for radon (Rn-222) was exceeded in about 52 percent of the well samples. Of the samples that exceeded the proposed MCL, 45 percent were located in the production zone aquifer, 36 percent were in domestic and stock wells, 8 percent in the underlying aquitard unit, 8 percent in the overlying aquifer, and 3 percent in the shallow water table unit. The radon (Rn-222) concentrations in samples exceeding the proposed limit ranged

[4]EPA has twice proposed the same limit and although it has not been issued as a final regulation, neither EPA nor the NRC has concluded that the limit is insufficient to protect health.

from 11,400 to 1.05×10^8 Bq/m^3 [307 to 2.83×10^6 pCi/L]. The wells with the highest radon (Rn-222) concentrations included wells that are directly in mapped orebodies in the production zone aquifer, such as wells PZM2, PZM10, PZM8, and PZM17.

3.12.1.5 Vegetation, Livestock, and Fish

The applicant collected vegetation samples for two of three planned sampling times during the grazing season and at three locations that exhibited the highest predicted radionuclide concentrations downwind of the proposed CPP location at the proposed Reno Creek ISR Project area (AUC, 2015b,c). Composite samples of the vegetation were analyzed for Ra-226, uranium, thorium (Th-230), lead (Pb-210), and polonium (Po-210) (AUC, 2015b,c). Results of the vegetation sampling are summarized as follows:

- Radium (Ra-226) concentrations ranged from 0.36 to 1.7 Bq/kg [9.7 to 45 pCi/kg] and averaged 0.92 Bq/kg [25 pCi/kg]

- Uranium concentrations ranged from 0.15 to 1.1 Bq/kg [4.1 to 29 pCi/kg] and averaged 0.37 Bq/kg [10 pCi/kg]

- Thorium (Th-230) concentrations ranged from 0.13 to 0.56 Bq/kg [3.6 to 15 pCi/kg] and averaged 0.23 Bq/kg [6.3 pCi/kg]

- Lead (Pb-210) concentrations ranged from 5.2 to 16 Bq/kg [140 to 440 pCi/kg] and averaged 9.2 Bq/kg [250 pCi/kg]

- Polonium (Po-210) concentrations ranged from 0.037 to 0.52 Bq/kg [<1 to 14 pCi/kg] and averaged 0.21 Bq/kg [5.6 pCi/kg]

In comparison to corresponding shallow {0–5 cm [0–2 in]} soil samples collected from air monitoring stations, radionuclide concentrations in the vegetation samples are one to two orders of magnitude lower. Lead (Pb-210) concentrations in the vegetation samples were significantly higher than the other radionuclides and may be due to the higher relative abundance of lead (Pb-210) in air particulates from radon decay products.

The applicant provided livestock sampling results based on the food sampling guidance in Regulatory Guide 4.14 (NRC, 1980) in the preoperational monitoring report (AUC, 2015b). For this sampling, AUC procured three meat samples from a local rancher that has pastures adjacent to the proposed CPP location. The samples were analyzed for radium (Ra-226), uranium, thorium (Th-230), lead (Pb-210), and polonium (Po-210). Results of the livestock sampling are summarized as follows:

- Radium (Ra-226) concentrations ranged from 0.089 to 0.11 Bq/kg [2.4 to 3.1 pCi/kg] and averaged 0.10 Bq/kg [2.7 pCi/kg]

- Uranium concentrations ranged from 0.15 to 0.44 Bq/kg [4.1 to 12 pCi/kg] and averaged 0.27 Bq/kg [7.2 pCi/kg]

- Thorium (Th-230) concentrations ranged from 0.037 to 0.10 Bq/kg [1.0 to 2.8 pCi/kg] and averaged 0.067 Bq/kg [1.8 pCi/kg]

- Lead (Pb-210) concentrations ranged from 0.18 to 0.48 Bq/kg [4.8 to 13 pCi/kg] and averaged 0.37 Bq/kg [9.9 pCi/kg]

- Polonium (Po-210) concentrations ranged from 0.037 to 0.074 Bq/kg [<1 to 2.0 pCi/kg] and averaged 0.048 Bq/kg [1.3 pCi/kg]

For context, the NRC staff consider these livestock meat concentrations are at low levels that would contribute a minor dose to humans if consumed. Considering factors commonly used to convert radionuclide intake to human dose (ICRP, 1996) and the magnitude of the radionuclide concentrations, the greatest dose from consumption of this meat would be from lead (Pb-210). If a person consumed 29 kg [64 lb] of this meat annually at the maximum measured lead (Pb-210) concentration 0.48 Bq/kg [13 pCi/kg], the annual intake of lead (Pb-210) would be the product of the consumption rate and the meat concentration 13.9 Bq/yr [377 pCi/yr]. Based on a radionuclide-specific intake-to-dose coefficient from the International Commission on Radiological Protection of 6.9×10^{-7} Sv/Bq [2.5×10^{-3} mrem/pCi] (ICRP, 1996), the NRC staff estimate an intake of this magnitude would produce an annual dose of 0.0096 mSv [0.96 mrem] (i.e., 2.5×10^{-3} mrem/pCi × 377 pCi/yr). This estimated dose is a small fraction of the annual natural background dose of 3.1 mSv [310 mrem] described in SEIS Section 3.12.

No fish sampling was conducted based on the lack of available habitat (AUC, 2012i; 2015b).

3.12.2 Public Health and Safety

The NRC has a statutory responsibility, pursuant to the Atomic Energy Act of 1954, as amended, to protect public health and safety. The NRC's regulations in 10 CFR Part 20 specify annual dose limits to members of the public of 1 mSv [100 mrem] total effective dose equivalent (TEDE) with no more than 0.02 mSv [2 mrem] in any 1-hour period from any external sources. This public dose limit from NRC-licensed activities is a fraction of the background radiation dose, as discussed in SEIS Section 3.12.1.

A review of the surrounding area indicated there are several ISR facilities within 80 km [50 mi] of the proposed Reno Creek ISR Project area (NRC, 2009):

- Smith Ranch-Highland—This operational ISR facility is located approximately 72 km [45 mi] southeast of the proposed Reno Creek ISR Project

- Moore Ranch—This recently licensed but not yet operational ISR facility would be located approximately 16 km [10 mi] southeast of the proposed Reno Creek ISR Project

- Nichols Ranch and Hank Units—These recently licensed but not yet operational ISR facilities would be located approximately 24 km [15 mi] west-northwest of the proposed Reno Creek ISR Project

- Willow Creek—These licensed and operating ISR facilities are approximately 32 km [20 mi] (Willow Creek Christensen Ranch) and 48 km [30 mi] northwest (Willow Creek Irigaray) of the proposed Reno Creek ISR Project

- North Butte and Ruth—These licensed but not operating satellite ISR facilities are located approximately 24 km [15 mi] northwest and 32 km [20 mi] west of the proposed Reno Creek ISR Project

- Reynolds Ranch—This licensed but not operating satellite ISR facility is located 60 km [37 mi] south of the proposed Reno Creek ISR Project

Several inactive and decommissioned conventional uranium mills are in the 80-km [50-mi] radius. However, because of their relative distances, none of these projects are considered to represent an appreciable source of radiation exposure in and around the proposed Reno Creek ISR Project area. Therefore, the natural background represents the only radiation exposure to individuals in the area surrounding the proposed Reno Creek ISR Project area. Other than CBM activities, there are no major sources of nonradioactive, chemical releases to the atmosphere or water-receiving bodies in the immediate area surrounding the proposed project area.

The public health in a region is assessed by reviewing health studies conducted in the region over a period of time. Neither the applicant nor NRC staff identified health studies about radiological and chemical exposures in the vicinity of the proposed project area.

3.12.3 Occupational Health and Safety

Radiation Protection Standards at 10 CFR Part 20 concern occupational health and safety risks to workers and provide limits on worker exposure to radiation. The regulations provide annual radiation dose limits for workers and incorporate the principal of maintaining doses “as low as is reasonably achievable” (ALARA), taking into consideration the purpose of the licensed activity and its benefits, technology for reducing doses, and the associated health and safety benefits. A maximum annual occupational dose is determined by the more limiting of two calculated dose equivalents: (i) 0.05 Sv [5 rem] TEDE and (ii) the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 0.5 Sv [50 rem]. The lower dose equivalent calculated is the maximum annual occupational dose. The lens of the eye is limited to a dose equivalent of 0.15 Sv [15 rem], and the skin (of the whole body or any extremity) is limited to a shallow dose equivalent of 0.5 Sv [50 rem]. Radiation safety measures that comply with these 10 CFR Part 20 standards must be implemented at ISR facilities to protect workers and to ensure radiation exposures and doses are below occupational limits as well as ALARA.

Industrial hazards and exposure to nonradioactive pollutants are also of concern with respect to occupational health and safety, which for an ISR operation can include common industrial airborne pollutants associated with service equipment (e.g., vehicles), fugitive dust emissions from access roads and wellfield activities, and various chemicals used in the ISR process. Industrial safety aspects associated with the use of hazardous chemicals at the proposed Reno Creek ISR Project would be regulated by the State of Wyoming. The types of chemicals and impacts are discussed in SEIS Section 4.13.

The Occupational Safety and Health Administration (OSHA) does not compile data on workplace total recordable incident rates and lost-time incident rates specific to the ISR industry. Statistics for injuries and illnesses for the ISR industry are included in the category “Other Metal Ore Mining,” which includes both underground and surface (open pit) uranium mines (OSHA, 2010). Total recordable incidence rates and total lost-time incidents for the “Other Metal Ore Mining” category for years 2003 to 2008 are listed in SEIS Table 3-35. Total recordable incidents are work-related deaths, illnesses, or injuries resulting in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid. A lost-time incident is a recordable incident that results in one or more days away from work, days of restricted work activity, or both, for affected employees.

Table 3-35. Total Recordable Incidence Rates and Total Lost-Time Incidents for the Category "Other Metal Ore Mining"*		
Year	Recordable Incidence Rate (Per 100 Employees)	Total Lost-Time Incidents (Per 100 Employees)
2008	3.6	2.2
2007	3.5	2.0
2006	3.8	2.6
2005	6.0	4.4
2004	<15 total cases	—
2003	<15 total cases	—

Source: OSHA (2010)
*Includes underground and surface uranium mining.

The incident rate is used for measuring and comparing work injuries, illnesses, and accidents within and between industries and can indicate the impacts of operations on occupational health.

OSHA data for specific injury/illness and lost time in the ISR industry are not available, although the applicant provided an estimate based on the expected annual labor hours at the proposed Reno Creek ISR Project and the 2010 Wyoming mineral recovery industry total annual nonfatal occupational injury and illness rate (WYDWS, 2010). Based on this information, the applicant estimated operations at the proposed Reno Creek ISR Project could have 1.3 nonfatal occupational injuries and illnesses per year of operation. The NRC staff consider the estimate to be conservative, based on differences in workplace hazards between ISR operations and conventional mining.

3.13 Waste Management

SEIS Section 2.1.1.1.6 describes the types and volumes of liquid and solid waste that could be generated by operation of the proposed Reno Creek ISR Project. This section describes the environment that could potentially be affected by the disposition of liquid and solid waste streams generated by the proposed project. The analysis of waste management impacts is located in SEIS Section 4.14.

3.13.1 Liquid Waste Disposal

Liquid wastes generated from the proposed Reno Creek ISR Project would include drilling fluid, well development and well test waters, stormwater, waste petroleum products and chemicals, sanitary wastewater, and liquid byproduct material, including production bleed, process solutions, laboratory chemicals, plant washdown water, and restoration water. Process solutions include process bleed, elution and precipitation brines, and resin transfer wash. Detailed descriptions of the wastes generated by the proposed project and the applicant's proposed disposition are provided in SEIS Section 2.1.1.1.6 and are briefly summarized here. The Solid Waste Disposal Act, defines hazardous waste as a subset of solid waste. Therefore, waste petroleum products and chemicals meeting the definition of hazardous waste, are, by definition considered a solid waste and discussed further in SEIS Section 3.13.2.

The applicant would dispose of drilling fluids in mud pits adjacent to drilling pads and anticipates obtaining WDEQ WYPDES permits to surface discharge well development water (AUC, 2012a) from constructed wellfields. The applicant proposes to collect stormwater and discharge to surface water in accordance with a WDEQ WYPDES permit. The applicant proposes to dispose of sanitary wastewater from restrooms and lunchrooms in a WDEQ-permitted septic system. The applicant proposes to dispose of liquid byproduct material using Class I deep disposal wells, as described under the proposed project in SEIS Section 2.1.1.1.6. The applicant has been authorized by WDEQ to drill, complete, and operate four Class I deep disposal wells, as described in SEIS Section 2.1.1.1.6, and thereby inject radionuclide-bearing liquid waste streams into the Teckla Sandstone member of the Lewis Formation and Cretaceous Teapot Sandstone of the Mesaverde Formation (WDEQ, 2015). Before the permitted Class I deep disposal wells can be operated, an aquifer exemption must be identified and requested by WDEQ and approved by EPA (SEIS Section 2.1.1.1.4) for the aquifer (or portion thereof) that is the discharge zone for the disposal well (currently pending).

The permitted Class I deep disposal well discharge zones vary in depth between 2,130 and 2,400 m [7,000 and 7,860 ft] below the ground surface (WDEQ, 2015). The applicant's Class I deep disposal well permit application (AUC, 2012a) describes the environmental conditions the applicant evaluated to determine the suitability of the locations for hosting Class I deep disposal wells, including (i) the water quality within the receiver interval (the location where liquid byproduct material would be injected), (ii) the presence of hydrocarbons within the receiver interval, (iii) the hydraulic properties of the receiver interval, (iv) the presence of underground sources of drinking water above the receiver interval, (v) the nature and thickness of materials separating the receiver interval from identified underground sources of drinking water above the receiver, and (vi) the nature of strata or aquifers below the receiver interval. The applicant's permit application describes each well location receiver interval as containing water that is not suitable as a source of underground drinking water, based on the concentrations of TDS, hydrocarbons, and other undesirable constituents such as chloride and barium. Additionally, the applicant's permit application explained that each proposed Class I deep disposal well is located between thick confining units of low-permeability shale that separate the receiver interval from potential underground sources of drinking water. Although the WDEQ permit describes nine wells that penetrate one or both of the confining units within the proposed injection well's area of review, the supporting analysis for the permit indicates that no wellbore conditions represent a pathway for injected fluids to impact an underground source of drinking water (WDEQ, 2015).

3.13.2 Solid Waste Disposal

Solid wastes generated from the proposed Reno Creek ISR Project would include solid byproduct material, nonhazardous solid waste, and hazardous waste.

Solid byproduct material (including radioactively contaminated soils or other media) that does not meet NRC unrestricted release criteria must be disposed of at a licensed facility, as required by 10 CFR Part 40, Appendix A, Criterion 2. As described in SEIS Section 2.1.1.1.6, the proposed project would generate solid byproduct material that does not meet NRC criteria for unrestricted release. In addition to the regulatory requirements, if an NRC license is granted, the NRC staff would require, by license condition, an agreement to be in place before operations begin to ensure the availability of sufficient disposal capacity. The applicant has identified the Pathfinder Mines Corporation, Shirley Basin (Wyoming) Facility; the Energy Fuels Inc., White Mesa Uranium Mill, Blanding, Utah; and the EnergySolutions LLC, Clive Disposal Facility, Clive, Utah, as potential disposal locations for solid byproduct material, but a disposal agreement is not yet in place (AUC, 2012a). These sites are described in more detail in the following paragraphs.

The Pathfinder Mines Corporation Shirley Basin Facility is a decommissioned uranium mill site that presently includes both reclaimed and operating NRC-licensed tailings impoundments and an operating solution pond for ISR byproduct material. The site is located approximately 232 km [144 mi] (AUC, 2012a) from the proposed Reno Creek ISR Project. Under an agreement with WDEQ (WEQC, 2013), the licensee must obtain approval from WDEQ to allow any additional ISR operations to dispose of byproduct material at the site.

The Energy Fuels Inc., White Mesa site is an operating conventional uranium mill in Blanding, Utah, approximately 1,070 km [666 mi] (AUC, 2012a) from the proposed Reno Creek project. The White Mesa site constructed an additional 1,452,654 m^3 [1,900,000 yd^3] of tailings impoundment capacity in 2011 (UDEQ, 2011, 2010a, 2010b); however, in accordance with its state-granted license (UDEQ, 2010b), the operator must obtain approval from the Utah Department of Environmental Quality (UDEQ) to accept ISR waste. Furthermore, the operator may not receive more than 3,823 m^3 [5,000 yd^3] of ISR wastes from any single source (UDEQ, 2010b).

The EnergySolutions Clive Disposal Facility, the largest commercial low-level radioactive waste disposal facility, is located approximately 129 km [80 mi] west of Salt Lake City, Utah, and approximately 913 km [567 mi] (AUC, 2012a) from the proposed Reno Creek ISR Project. The facility is licensed by the State of Utah to receive byproduct material, Class A low-level radioactive waste, mixed waste (combined radioactive and hazardous wastes), and naturally occurring radioactive material. The facility is accessible by both rail and highway (EnergySolutions, 2015).

All proposed phases of the proposed Reno Creek ISR Project would generate nonhazardous solid waste. The applicant has proposed to dispose of nonhazardous solid waste offsite in a WDEQ-permitted municipal landfill. The nearest municipal solid waste facility is the Campbell County landfill in Gillette, Wyoming 80 km [50 mi] north of the proposed Reno Creek ISR Project}. The NRC staff estimated the Campbell County landfill has capacity to dispose of nonhazardous solid waste and construction and demolition waste for approximately 18 years after year 2014. This estimate is based on the available capacity the operator provided in 2010 (CCPW, 2010) and the additional capacity consumed since that time (CCPW, 2014). The current projected average annual rate of nonhazardous solid waste received at the landfill is 50,377 t/yr [55,566 T/yr], with approximately 73 percent municipal solid waste and 27 percent construction and demolition waste (CCPW, 2014). The NRC staff converted the average annual rate of waste received of 50,377 t/yr [55,566 T/yr] to a volume of 106,280 m^3 [138,900 yd^3] by applying a density factor of 0.36 t/m^3 [0.4 T/yd^3] (Wyoming Office of State Lands and Investments, 2007). The annual amounts of waste received at waste facilities are provided in SEIS Section 4.14 to show how the proposed project's generation rate compares with the regional generation from other sources in the impact analysis.

AUC proposes to maintain future contact with Campbell County Public Works regarding the status of the Campbell County Landfill (AUC, 2014a). If capacity at the landfill becomes a concern, AUC would dispose of nonhazardous solid waste generated by the proposed project at another WDEQ-permitted facility. A large regional nonhazardous solid waste landfill is located near Casper, Wyoming, in Natrona County, approximately 140 km [84 mi] southwest of the proposed Reno Creek ISR Project. The volume of waste the Casper landfill receives annually is over 90,662 t [100,000 T], based on previously reported values (Wyoming Office of State Lands and Investments, 2007). The NRC staff converted that annual rate of waste received to a volume of 191,280 m^3 [250,000 yd^3] by applying a density factor of 0.36 t/m^3 [0.4 T/yd^3] (Wyoming Office of State Lands and Investments, 2007). The permitted capacity of the Casper landfill is 317,000,000 m^3 [414,000,000 yd^3] of compacted solid waste, and the life expectancy is over 1,000 years (Uranium One, 2010).

The applicant expects the proposed Reno Creek ISR Project to be classified as a Conditionally Exempt Small Quantity Generator of hazardous waste under the Resource Conservation and Recovery Act. WDEQ would determine whether that classification applies to the proposed facility (see Section 2.1.1.1.6). Waste petroleum products and chemicals meeting the definition of hazardous waste would be stored in small quantities until they are disposed of offsite, in accordance with all applicable local, state, and federal regulatory requirements, as described in SEIS Section 2.1.1.1.6. The applicant would not generate mixed waste from any of the proposed waste management options. Mixed waste consists of a mixture of hazardous waste (as defined by the Resource Conservation and Recovery Act) and radioactive waste (as defined by the Atomic Energy Act).

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4 ENVIRONMENTAL IMPACTS OF CONSTRUCTION, OPERATIONS, AQUIFER RESTORATION, AND DECOMMISSIONING ACTIVITIES AND MITIGATIVE ACTIONS

4.1 Introduction

The Generic Environmental Impact Statement (GEIS) for In Situ Leach Uranium Milling Facilities (NRC, 2009) evaluated the potential environmental impacts of implementing in situ recovery (ISR) operations in four distinct geographic regions, including the Wyoming East Uranium Milling Region where the proposed Reno Creek ISR Project would be located. This chapter evaluates the potential environmental impacts from the Proposed Action (Alternative 1) and the No-Action Alternative (Alternative 2). Other reasonable alternatives considered at the proposed Reno Creek ISR Project included alternative sites, alternative lixiviants, conventional mining and milling, and conventional mining and heap leach processing. These alternatives were eliminated from detailed analysis for reasons described in supplemental environmental impact statement (SEIS) Section 2.2.

This chapter analyzes the four lifecycle phases of ISR uranium extraction (construction, operations, aquifer restoration, and decommissioning) at the proposed Reno Creek ISR Project consistent with the analytical approach used in the GEIS (NRC, 2009). The results of the GEIS impact analyses for the Wyoming East Uranium Milling Region, as summarized in SEIS Table 1-1, were used to focus the site-specific environmental review at the proposed Reno Creek ISR Project. If the GEIS concluded there could be a range of impacts on a particular resource area (e.g., the impacts could range from SMALL to LARGE), then that resource area was evaluated in greater detail within this site-specific SEIS. The site-specific analyses in this chapter also note where (i) the U.S. Nuclear Regulatory Commission (NRC) staff obtained new information during its independent site-specific review and (ii) whether the potential impacts fit in the range of the GEIS analyses or whether the new information would be significant enough that it would change the expected impact beyond that discussed in the GEIS.

SEIS Sections 4.2 through 4.14 evaluate the impacts from both the Proposed Action (Alternative 1), which includes construction, operations, aquifer restoration, and decommissioning using Class I deep disposal wells for management of process-related liquid waste streams, and the No-Action Alternative (Alternative 2), which means no ISR facilities would be built or operated at the proposed Reno Creek ISR Project. The No-Action Alternative is assessed to provide a baseline to compare the potential impacts from the proposed project.

The NRC established a standard of significance for assessing environmental impacts in the conduct of environmental reviews based on the Council of Environmental Quality (CEQ) regulations, as described in the NRC guidance in NUREG–1748 (NRC, 2003a) and summarized as follows:

SMALL: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered.

MODERATE: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

4.2 Land Use Impacts

Potential environmental impacts to land use at an ISR facility may occur during all phases of the facility life cycle (NRC, 2009). Impacts could include (i) land disturbance associated with construction, operations, and decommissioning activities; (ii) grazing and access restrictions; and (iii) competing access for mineral rights (e.g., leasing of land for both uranium and oil and gas exploration and development).

The potential environmental impacts on land use from construction, operations, aquifer restoration, and decommissioning for the proposed Reno Creek ISR Project are detailed in the following sections.

4.2.1 Proposed Action (Alternative 1)

As described in SEIS Section 3.2, the proposed Reno Creek ISR Project area encompasses approximately 2,451 hectares (ha) [6,057 acres (ac)] (AUC, 2012a). Surface ownership within the proposed project area consists of 2,192 ha [5,417 ac] of privately owned land and 259 ha [640 ac] of State of Wyoming owned land (see SEIS Table 3-2). There are four residences within 8 km [5 mi] of the proposed project area (see SEIS Figure 3-2). As described in SEIS Section 3.2, livestock grazing on rangeland is the primary land use within and surrounding the proposed project area. Oil and gas and coalbed methane (CBM) facilities and infrastructure are also located on land within and surrounding the proposed project area.

Land within the proposed project area would be converted temporarily from its primary use as rangeland to use as an ISR facility, with facilities constructed and wellfields brought into production over time (AUC, 2012a). Subsurface mineral rights within the proposed project area are divided among several private owners, the State of Wyoming, and the Federal Government (see SEIS Table 3-2). The applicant maintains mining claims on federal minerals and holds mineral leases on privately and state-owned minerals within the proposed project area (see SEIS Section 3.2 and SEIS Table 3-2). At the end of ISR operations, final site reclamation would occur during decommissioning and all lands would be returned to their current land use.

As summarized in SEIS Table 1-1, the NRC staff concluded in the GEIS that depending on the phase of the facility life cycle, potential impacts on land use in the Wyoming East Uranium Milling Region could range from SMALL to LARGE (NRC, 2009). The impact conclusions that contributed to a greater than SMALL impact finding in the GEIS addressed potential alterations to ecological, historical, and cultural resources. In this SEIS, the potential ecological impacts on land use are presented in SEIS Section 4.6 and the potential historical and cultural resource impacts on land use are presented in SEIS Section 4.9. In addition, impacts to soils from surface disturbances are addressed in SEIS Section 4.4. Therefore, the following discussion assesses land use impacts at the proposed Reno Creek ISR Project considering proposed land disturbances and associated access restrictions that could limit other mineral extraction activities, grazing activities, or recreational activities.

4.2.1.1 Construction Impacts

As described in GEIS Section 4.3.1.1, potential impacts to most aspects of land use from the construction of an ISR facility in the Wyoming East Uranium Milling Region would be SMALL. Land disturbances during the construction phase would be temporary and limited to small areas within permitted boundaries. After construction, disturbed areas around well sites, staging areas, and trenches would be immediately reseeded and restored. Changes to land use due to grazing restrictions and limits on recreational activities would be limited because restricted areas would be small and other land is available for these activities. In the GEIS, the NRC staff concluded that land use impacts would be SMALL when the amount of land disturbed by ISR facilities ranged from 49 to 753 ha [120 to 1,860 ac]. (NRC, 2009)

Construction activities would have the largest direct land use impact within the proposed Reno Creek ISR Project area. Activities associated with ISR facility construction include topsoil stripping, trenching, excavating, backfilling, compacting, grading, and building assembly. Construction of the central processing plant (CPP) facility (e.g., the CPP building, ancillary buildings, backup pond, parking area, and storage areas), the initial production unit and associated wellfields, access roads, deep disposal wells, and pipelines is expected to take 9 to 12 months to complete (AUC, 2012a). Construction of the initial production unit would be followed by development of additional production units during the project’s anticipated 11-year operational phase (AUC, 2012a). Construction of each production unit is anticipated to take 1 to 2 years, with three to seven wellfields in various stages of construction at one time (AUC, 2012a). Wellfield construction would include installation of injection, production, and monitor wells; header houses; pipelines; and utilities.

A breakdown of estimated land disturbance for facilities and infrastructure at the proposed Reno Creek ISR Project is provided in SEIS Table 4-1. A total of 62.4 ha [154.3 ac] of land or 2.5 percent of the proposed project area is estimated to be potentially disturbed by activities associated with construction of CPP facility, production units, access roads, deep disposal wells, and pipelines.

To mitigate the impacts of surface disturbance during construction, the applicant would (i) restore and reseed areas disturbed by facility construction, production unit development, and pipeline installation as soon as practicable; (ii) coordinate construction efforts with oil and gas production companies operating within the proposed project area (currently Williams Production RMT Company, Yates Petroleum Corporation, Lance Oil and Gas Company, and Bill Barrett Corporation, Ballard Petroleum, True Oil, EOG, and Peak Powder River); (iii) use existing county roads and oil and gas access roads to the extent possible to limit new access road construction; (iv) utilize existing topography during access road construction to minimize cut and fill; (v) minimize secondary and tertiary access road widths; and (vi) locate access roads, pipelines, and utilities in common corridors (AUC, 2012a).

The applicant would restrict and control access to the CPP facility (including the backup pond), production units, and deep disposal wells with fences (AUC, 2012a). The CPP facility would be located on approximately 6.3 ha [15.5 ac] and surrounded by a controlled access area fence throughout the life of the project. Production units would be constructed on land currently used for livestock grazing and would be fenced using four-line stranded barbed wire to restrict access to livestock. Fenced areas around production units are estimated to encompass 187 ha [461 ac] (AUC, 2012a). Monitoring wells around production units would not be fenced; however,

Table 4-1. Estimated Land Disturbance (Alternative 1)	
Central Processing Plant (CPP) Site Facility*	6.3 ha [15.5 ac]
Production Units†	36.1 ha [89.3 ac]
Access Roads	9.4 ha [23.3 ac]
Deep Disposal Wells	1.6 ha [4.0 ac]
Pipelines	9.0 ha [22.2 ac]
Total	*62.4 ha [154.3 ac]*
Source: AUC, 2012a. *Includes CPP, ancillary buildings, backup pond, parking area, laydown area, and storage areas. †Includes header houses, mud pits, topsoil storage areas, and pipelines.	

access to monitoring wells would be controlled by installing protective locked covers (AUC, 2014b).

The applicant would construct up to four deep disposal wells. Each disposal well site would encompass approximately 0.4 ha [1.0 ac] and would be fenced to exclude livestock and wildlife. The fenced areas around the CPP facility, production units, and deep disposal wells total approximately 195 ha [481 ac] or about 8 percent of the proposed project area of 2,451 ha [6,057 ac] (AUC, 2012a). However, because production unit development would occur in a sequential manner, fencing would be removed after operations and reclamation of each production unit is completed. Therefore, concurrently fenced areas around the CPP facility, production units, and deep disposal wells are expected to be significantly less than 8 percent of the proposed project area.

As described in SEIS Section 3.2.1, the primary land use within the proposed project area is livestock grazing on private and state-owned rangeland. No commercial crop production takes place within the proposed project area. The applicant would mitigate potential impacts to livestock grazing by restoring and reseeding disturbed areas as soon as practicable (AUC, 2012a). As described previously, production unit development would occur in phases, resulting in temporary livestock grazing restrictions (e.g., fencing would be removed after operations and reclamation of each production unit is completed). As described in SEIS Section 3.2, the applicant holds a mineral lease for the parcel of state-owned land within the proposed project area. State-owned lands in Wyoming are administered by the Office of State Lands and Investments, Board of Land Commissioners (BLC). The applicant has committed to submitting a written request to the BLC to restrict livestock grazing access within proposed production units to be constructed on the parcel of state-owned land within the proposed project area (AUC, 2014a). Therefore, the exclusion of grazing from production unit areas over the course of the proposed project would be expected to have a minor impact on local livestock production. In addition, the applicant would establish surface use agreements with surface owners/lessees to compensate for the temporary loss of land.

Recreational activities, primarily hunting, are limited within the proposed project area (see SEIS Section 3.2.2). There is no public access to private lands within the proposed project area. Hunting on privately owned land would be restricted over the life of the project to protect workers (AUC, 2012a). BLC has extended to the public the privilege of using legally accessible state-owned land for recreational purposes, such as hunting. Hunters can legally access the state land within the proposed project area via County Road 22 (Clarkelen Road). However, the BLC can close or restrict designated state-owned lands where recreational use has the potential for abuse or damage to lessee interests, or public or lessee safety. The applicant has committed to submitting a written request to the BLC to restrict hunting on the parcel of state-owned land within the proposed project area (AUC, 2014a). This request would be based on public health and safety concerns and would be designed to prevent damage to surface equipment within fenced production unit areas on the state-owned land (AUC, 2014a).

As described in SEIS Section 3.2.2, the proposed project area spans two Wyoming Game and Fish Department (WGFD) pronghorn and mule deer Herd Units: Pumpkin Buttes and North Converse. As described previously, concurrently fenced areas within the proposed project area would be less than 8 percent of the proposed project area, which would limit disruptions to the movement of big game populations.

As described in SEIS Section 3.2.3, known minerals being recovered within the proposed project area include conventional oil and gas and CBM. Two oil-producing wells and 46 CBM-producing wells are located within the proposed project area. To avoid impacts between proposed construction of ISR facilities and infrastructure with existing oil and gas and CBM infrastructure (e.g., buried water lines, power lines, and gas pipelines), the applicant has committed to using One Call of Wyoming to identify all existing utility infrastructure in construction areas prior to any earthmoving activities (AUC, 2014a). All utilities (e.g., buried pipelines and power lines) are required by state law to be a member of One Call of Wyoming, which is administered by the Wyoming Department of Transportation (WYDOT). Before excavating, individuals and companies are required by Wyoming law to contact One Call of Wyoming to request the location of underground utilities in the area to be excavated. The applicant has also committed to mitigate potential impacts to competing access for mineral rights by developing working relationships with the oil and gas production companies operating within the proposed project area (currently Williams Production RMT Company, Yates Petroleum Corporation, Lance Oil and Gas Company, and Bill Barrett Corporation, Ballard Petroleum, True Oil, EOG, and Peak Powder River). The applicant has committed to developing similar relationships with other companies should other minerals be discovered and developed during the life of the proposed project (AUC, 2012a).

In the GEIS, the NRC staff defined land use impacts to be SMALL when the amount of land disturbed by ISR facilities ranged from 49 to 753 ha [120 to 1,860 ac] (NRC, 2009). The land area projected to be disturbed by construction activities for the proposed Reno Creek ISR Project area {62.4 ha [154.3 ac]} falls at the low end of land disturbance estimates in the GEIS. In addition, the land area projected to be disturbed by construction activities accounts for only 2.5 percent of the 2,451 ha [6,057 ac] proposed project area. The applicant committed to use the following mitigation measures to minimize the impacts of surface disturbance: restore and reseed disturbed areas as soon as practicable; limit construction of new access roads; minimize cut and fill during access road construction; and use common corridors when locating access roads, pipelines, and utilities (AUC, 2012a).

Fenced areas around the CPP facility and deep disposal wells would be relatively small in comparison to the permitted area of the proposed project. Furthermore, fenced areas around production units would be temporary and would be removed after operational and reclamation phases are completed in the production units. Prohibiting grazing within fenced areas during construction would have only a SMALL impact on local livestock production. There is no public access to privately owned lands within the project area. The applicant would submit a request to the BLC to restrict hunting within proposed production units constructed on state-owned land within the proposed project area. Therefore, impacts to recreational activities (primarily big game hunting) are expected to be SMALL. To mitigate the impacts of competing mineral rights, the applicant has committed to developing working relationships with oil and gas companies operating within the proposed project area. Therefore, the NRC staff conclude that overall land use impacts during construction would be SMALL.

4.2.1.2 Operations Impacts

The NRC staff concluded in the GEIS that additional land disturbances and access restrictions are not expected while operational activities are ongoing. Because impacts from access restrictions and land disturbances would be similar to or less than construction impacts, the NRC staff concluded in the GEIS that the overall potential impacts on land use from operational activities at an ISR facility would be SMALL (NRC, 2009).

For the proposed Reno Creek ISR Project, the primary changes to land use during the operations phase would be land disturbance and access restrictions from the expansion of active production units and development of new production units. Land disturbance and access restrictions would result from drilling new wells and constructing additional header houses and pipelines.

Fencing would be used to restrict livestock grazing from the CPP facility, deep disposal wells, and production units during the operations phase. During the operational life of the project, fencing around production units will remove 187 ha [461 ac] of land from livestock grazing (AUC, 2012a). The applicant would restore and reclaim production units concurrently, as operations are completed and moved to the next production unit (AUC, 2012a). As uranium recovery activities cease at a production unit, the area would be restored and reopened to grazing while a new production unit is developed. The sequential movement of active operations from one production unit to the next would minimize potential impacts to grazing and livestock production throughout the operational life of the project.

As described in SEIS Section 4.2.1.1, recreational activities, primarily hunting, are limited within the proposed project area. Recreational activities on state-owned land within the proposed project area provide only dispersed recreational activities. Hunting on privately owned land would be restricted over the life of the project to protect workers (AUC, 2012a). In addition, the applicant would submit a request to the BLC to restrict hunting within proposed production units constructed on state-owned land within the proposed project area (AUC, 2014a). As discussed previously, the applicant would restore and reclaim production units concurrently, as operations are completed and moved to the next production unit. The sequential movement of active operations from one production unit to the next would minimize the potential impacts of fencing on the movement of big game populations within the proposed project area.

In summary, impacts due to land disturbance during the operations phase of the proposed project would be limited to the production units and would be less than those impacts expected during the construction phase. Access restrictions during the operations phase would be similar to the construction phase. The CPP facility and deep disposal wells would remain fenced. Temporary fencing around operational production units would restrict livestock grazing and recreational use. Once operations are completed in a production unit, the production unit would be restored and reopened to grazing and recreational use. Therefore, the NRC staff conclude that the overall impacts to land use from operations would be SMALL.

4.2.1.3 Aquifer Restoration Impacts

As discussed in the GEIS, because aquifer restoration would use the same infrastructure that is present during operations phases, land use impacts from aquifer restoration are expected to be similar to or less than operations impacts. As aquifer restoration proceeds and wellfields are closed, operational activities would diminish. Therefore, the NRC staff concluded in the GEIS that aquifer restoration impacts to land use would be SMALL (NRC, 2009).

For the proposed Reno Creek ISR Project, the aquifer restoration phase would use the same operational infrastructure and require the same level of infrastructure maintenance as the operations phase. Land disturbance impacts from aquifer restoration would decrease as fewer wells and header houses are used. Additionally, equipment traffic and related impacts would diminish. Livestock grazing and recreational use restrictions would be similar to those for the operations phase. For example, fencing would be used to restrict livestock grazing from the CPP facility, deep disposal wells, and active production units during the aquifer restoration phase. NRC staff conclude that the potential impacts to land use during the aquifer restoration phase would be comparable to those of the operations phase and would be SMALL.

4.2.1.4 Decommissioning Impacts

The NRC staff concluded in the GEIS that decommissioning an ISR facility would temporarily increase land-disturbing activities, such as dismantling, removing, and disposing of materials, equipment, and excavated contaminated soils. Access restrictions would remain in place until decommissioning and reclamation are complete, although a licensee may decommission and reclaim the site in stages. Reclamation of land to preexisting conditions and uses would help to mitigate potential long term impacts. The NRC staff concluded in the GEIS that impacts to land use during decommissioning could range from SMALL to MODERATE and would be SMALL after decommissioning and reclamation activities are complete (NRC, 2009).

Decommissioning of the proposed Reno Creek ISR Project would be based on an NRC approved decommissioning plan, and all decommissioning activities would be carried out in accordance with 10 CFR Part 40 and other applicable federal and state regulatory requirements. During decommissioning, land disturbed by the proposed project would be returned to its preoperational condition, including surface topography and drainage patterns, and available for its preoperational use of livestock grazing (AUC, 2012a).

Decommissioning of surface and subsurface facilities in individual production units would commence after planned aquifer restoration and stabilization activities received final regulatory approval from NRC and Wyoming Department of Environmental Quality (WDEQ) (see SEIS Section 2.1.1.1.5). The applicant would submit a decommissioning plan for NRC review and approval at least 12 months before the planned commencement of final decommissioning (AUC, 2012a). Final decommissioning activities would include final production unit decommissioning, plugging and abandonment of all deep disposal wells), access road reclamation, process building and equipment decommissioning, and revegetation. Prior to commencing decommissioning activities, a radiological survey would be conducted on all process equipment and area soils. Any contaminated equipment that could not be decontaminated onsite would be properly disposed of at a licensed disposal facility. All contaminated soil would be disposed of at a licensed byproduct material disposal facility (AUC, 2012a). For further information about waste disposal for the proposed Reno Creek ISR Project, see SEIS Section 4.14.

Production unit decommissioning includes plugging and abandonment of wells and removal and disposal of wellfield equipment. Wells would be plugged and abandoned in accordance with WDEQ rules and regulations (WDEQ, 2013a). Plugging and abandonment procedures include removing piping, pumps, and equipment suspended in the well casing; filling the casing from the total depth to just below the ground surface with cement grout or bentonite; cutting off the surface casing below ground; and restoring and reseeding the disturbed area. Wellfield equipment that would be removed includes production, monitoring, and deep disposal wells; wellhead covers; pipelines; valves; and buried electrical cable. All downhole pipe and electrical cable, pipelines (e.g., flow, feeder, and trunk lines), and valves would be disposed of as byproduct material in a licensed disposal facility (AUC, 2012a). Following production unit decommissioning, disturbed areas would be recontoured and revegetated.

Access roads constructed at the proposed project would be removed and reclaimed unless landowners/lessees request that the roads be retained (AUC, 2012a). In those cases, maintenance and disposition of the roads would become the responsibility of the landowner/lessee. Access roads would be removed in accordance with NRC and WDEQ regulations and the desires of the surface landowners. Disturbed areas associated with road and culvert removal would be graded to a contour consistent with the surrounding topography. Contouring would be followed by topsoil replacement and revegetation.

Unless the landowner requests that buildings be retained for private use, the applicant would decommission the CPP facility and remaining infrastructure when aquifer restoration is completed and approved by the NRC and WDEQ. All structures, equipment, pipe, and other materials would be dismantled and decontaminated and either disposed of in accordance with applicable regulations or salvaged and removed to another facility for use. Equipment that cannot be decontaminated to release limits for alpha and beta-gamma radiation, as specified in NRC Regulatory Guide 1.86, would be disposed of in a licensed byproduct disposal facility (AUC, 2012a).

Revegetation of disturbed areas would be carried out in accordance with a WDEQ Reclamation Plan and Restoration Action Plan (RAC) (AUC, 2012b). Topsoil would be redistributed across disturbed areas to a depth approximately equal to preconstruction conditions. After replacing topsoil, the disturbed areas would be seeded using drill or broadcast methods with a seed mix selected in consultation with landowners and WDEQ.

At the end of decommissioning, all lands would be returned to their preoperational land use of livestock grazing. Livestock grazing and recreational activities would no longer be restricted. Landowners/lessees may request that access roads and buildings be retained for private use. Contouring and revegetation of decommissioned areas (e.g., the CPP facility, access roads, and production units) would lessen the land disturbance impacts caused by earlier phases of the proposed project. The land use impacts for disturbed areas would be MODERATE until vegetation is established in revegetated areas. Once vegetation has been established in reclaimed areas, the NRC staff conclude that land use impacts from decommissioning of the proposed project would be SMALL.

4.2.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, NRC would not license the proposed Reno Creek ISR Project and the land would continue to be available for other uses. Impacts such as soil disturbances and access restrictions to current land uses from the proposed project would not occur.

Construction impacts would be avoided because ISR processing facilities would not be constructed, wells would not be drilled, and pipelines would not be laid. Operational and aquifer restoration impacts would also be avoided because no subsurface injection of lixiviant would occur. Impacts to land use from decommissioning would not occur, because unbuilt ISR processing facilities and infrastructure require no decontamination, and unstrapped land surfaces require no reclamation or revegetation. The current land uses on and near the project area, including livestock grazing, natural resource extraction, and recreation, would remain essentially unchanged under the No-Action Alternative.

4.3 Transportation Impacts

As described in GEIS Section 4.3.2, potential transportation impacts at an ISR facility may occur during all phases of the facility life cycle. Impacts would result from workers commuting to and from the site and from the shipment of construction equipment and materials, operational processing supplies, ion-exchange resins, yellowcake product, and waste materials (NRC, 2009).

The potential environmental impacts from transportation during the construction, operations, aquifer restoration, and decommissioning phases of the proposed Reno Creek ISR Project are detailed in the following sections.

4.3.1 Proposed Action (Alternative 1)

The regional and local transportation infrastructure that would serve the proposed Reno Creek ISR Project is described in SEIS Section 3.3. Access to the proposed Reno Creek ISR Project from nearby communities would be from State Highway 387, which traverses the project area (see SEIS Figure 3-1). Access from State Highway 387 to the location of the proposed Reno Creek CPP is along Clarkelen Road (County Road 22) (see SEIS Figure 3-1). The transportation activities for the proposed Reno Creek ISR facility are described in SEIS Section 2.1.1.1.7. For the proposed project, these activities include workers commuting to and from the proposed project and road transportation of construction equipment and materials, operational processing supplies, yellowcake, and waste materials.

4.3.1.1 Construction Impacts

The NRC staff concluded in GEIS Section 4.3.2.1 that ISR construction activities would generate low levels of additional traffic (relative to local traffic counts) and would not significantly increase traffic or accidents on many of the roads in the region. Roads that have low traffic counts could be moderately impacted by the additional workers commuting during periods of peak employment. Therefore, the NRC staff concluded in the GEIS that the construction phase of ISR projects would result in transportation impacts that ranged from SMALL to MODERATE (NRC, 2009).

As described in SEIS Section 3.3, the proposed project area is accessed by Clarkelen Road (also known as County Road 22) and State Highways 387, 50, and 59. The applicant estimated traffic generated by the proposed construction activities, including transportation of equipment, supplies, waste materials, and workers (AUC, 2012a, 2014a), and this analysis is described in SEIS Section 2.1.1.1.7. The NRC staff's impact analysis first compared the proposed traffic estimates and data with the information evaluated in GEIS Section 2.8 and then evaluated the estimated percentage increase in existing traffic that could result from the proposed Reno Creek ISR Project.

The NRC impact analysis found that the overall magnitude of the proposed daily construction traffic is less than the construction traffic evaluated in GEIS Section 2.8 (NRC, 2009). Commuting workers constitute the majority of road traffic the applicant described for the construction phase. The applicant estimated 27 worker trips to the proposed project daily, which is well below the upper range of 200 commuting worker trips to a site considered in the GEIS. The applicant has estimated that the initial facility construction requiring these workers would take 1 year (AUC, 2012a). The applicant's proposed equipment and supply shipments, however, were higher than those assumed in GEIS Section 2.8: two trips per day for the proposed project compared to 0.24 trips per day considered in GEIS Section 2.8.

SEIS Table 4-2 compares the magnitude of the NRC staff's estimated local traffic counts from proposed construction activities with existing traffic counts on regional and local state highways. Considering SEIS Table 4-2, the proposed traffic, if allocated completely to the individual road segments, would noticeably increase the existing traffic on State Highway 387, but would not substantially increase traffic on more heavily traveled road segments, such as State Highway 59 traveling from Gillette to Wright. State Highway 387 traverses the proposed project area and is the primary transportation route to the proposed project from nearby communities. Auto traffic on State Highway 387 is projected to increase by 8 percent, and truck traffic was projected to increase by 1.1 percent. Combined auto and truck traffic on State Highway 59 was projected to increase by 2.1 percent north of Wright (Reno Junction North traffic counter location) and by 1.7 percent south of Gillette (Gillette South traffic counter location) (see SEIS Figure 3-6). The projected increase in traffic on State Highway 387 (8 percent increase in auto traffic and 1.1 percent increase in truck traffic) is a noticeable change in conditions. The NRC staff further evaluated the projected increases in traffic by considering the ability of the roads to accommodate the increased traffic. When the projected traffic for all the state highways in the analysis is evaluated (ranging from 1,117 to 5,949 vehicles per day based on the sum of projected auto and truck traffic for each road), the magnitude of traffic is not expected to exceed the existing road capacity. The conclusion that existing road capacity would not be exceeded is based on consideration of road capacity estimates provided by the Campbell County Coal Belt Transportation Study (Kadrmas, Lee, and Jackson, Inc., 2010) (see SEIS Section 3.3). The study estimated a rural 2-lane highway hourly capacity of 1,375 vehicles per hour based on WYDOT automated daily traffic count information on state highways in Campbell County. Therefore, the NRC staff conclude that the regional and local state highways could accommodate the additional traffic from the proposed project.

The projected daily traffic on Clarkelen Road, the county road providing access to the CPP from State Highway 387, would experience a noticeable increase over existing traffic considering both autos and trucks. As described in SEIS Section 3.3, Clarkelen Road is currently used for agricultural and oil and gas activities in the area. The segment of Clarkelen Road from State Highway 387 to the proposed location of the CPP is approximately 550 m [1,800 ft]. This segment may require improvements (e.g., supplemental gravel resurfacing) to accommodate trucks and heavy equipment access during the construction phase of the proposed project (AUC, 2012a). The applicant has committed to mitigation measures to reduce impacts to the county road system potentially affected by the proposed project. Mitigation measures include (i) improving signage; (ii) enforcing speed limits for AUC employees and contractors; and (iii) performing routine assessments of road conditions (AUC, 2012a). The applicant has committed to work with Campbell County to provide necessary upgrades to affected portions of the county road system (AUC, 2012a). Prior to construction of the proposed project, the

Table 4-2. Estimated Daily Traffic on Regional and Local State Highways for the Construction Phase of the Proposed Reno Creek ISR Project						
Road Segment	**Traffic Count***		**Projected Traffic Increase†**		**Percent Increase‡**	
	Auto	**Truck**	**Auto**	**Truck**	**Auto**	**Truck**
State Highway 59 North of Wright (Reno Junction North)	3,568	784	54	5	1.5	0.6
State Highway 59 South of Gillette (Gillette South)	5,056	834	54	5	1.1	0.6
State Highway 387 (Pine Tree Junction)	621	437	54	5	8.0	1.1

Sources: AUC (2012a, 2014a); WYDOT (2013a,b)
*Traffic counts are annual average daily traffic for both directions of travel (SEIS Section 3.3). The NRC staff calculated the auto traffic count as the difference between the all vehicle count and reported truck count. Data for all roads are for year 2013 and are from Wyoming Department of Transportation (2013,a,b).
†Projected traffic increase is the proposed project daily two-way traffic. Proposed construction phase two-way traffic is double the round trips reported in SEIS Table 2-6.
‡This analysis assumes all projected traffic will travel on each road. If the proposed project traffic used multiple routes, then this analysis overestimates impacts to each road segment.

applicant would define coordination efforts with Campbell County in a required County Development Plan (AUC, 2012a). Considering the limited duration of construction activities (1 to 2 years), the mitigation measures to reduce traffic impacts and the relatively short segment of Clarkelen Road that would be impacted by traffic accessing the proposed project, the NRC staff conclude that the increase in traffic volumes to the local county road system during construction would result in SMALL impacts. Based on the available capacity on the state highway road system in Campbell County, the NRC staff conclude that the potential traffic impacts to the state highway road system providing access to the proposed project area from nearby communities would be SMALL.

4.3.1.2 Operations Impacts

As described in GEIS Section 4.3.2.2, the low level of facility-related traffic during operations activities would not noticeably increase traffic or the occurrence of accidents on most roads, although local, less traveled roads could be moderately impacted during periods of peak employment. GEIS Section 4.3.2.2 also assessed the potential for and consequence from accidents involving the transportation of hazardous chemicals and radioactive materials. The NRC staff recognized in the GEIS the potential for high consequences from a severe accident involving transportation of hazardous chemicals in a populated area. The probability of such accidents occurring was determined to be low because of the small number of shipments, comprehensive regulatory controls, and the applicant's use of best management practices (BMPs). For radioactive material shipments (yellowcake, ion-exchange resins, or byproduct material), compliance with transportation regulations was expected to limit radiological risk for normal operations. The NRC staff concluded in GEIS Section 4.3.2.2 that there would be a low radiological risk from transportation accidents. The use of emergency response protocols would help to mitigate the consequences of any severe accidents that involved the release of uranium. The NRC staff concluded in the GEIS that the potential environmental impact from transportation during operations would range from SMALL to MODERATE (NRC, 2009).

The proposed operational transportation activities for the proposed Reno Creek ISR Project are similar to those evaluated in GEIS Section 4.3.2.2, including employee commuting and truck shipments of yellowcake, processing chemicals, hazardous materials, and byproduct material. The types of impacts evaluated are also similar to those evaluated in the GEIS, including impacts to traffic and potential hazards associated with shipment of yellowcake, byproduct material, and hazardous materials.

Traffic that would be generated by these proposed project operations is described in SEIS Section 2.1.1.1.7. The overall magnitude of proposed operational transportation is comparable to the operational transportation evaluated in GEIS Section 4.3.2.2. Commuting workers constitute the majority of road traffic the applicant described for the operations phase. The applicant estimated the number of commuting workers' trips to the proposed project would be within the range considered in the GEIS (30 vehicle trips for the proposed project compared to 20 to 200 trips considered in the GEIS). For trucking activities, processing chemical shipments were greater than GEIS Section 2.8 values. The proposed operational byproduct shipments are comparable to the GEIS values, and proposed yellowcake shipments are at the low end of the range considered in the GEIS.

SEIS Table 4-3 compares the magnitude of the NRC staff's estimated increase in local traffic counts from proposed operations activities. The projected traffic for the operations phase for all road segments evaluated is comparable to the projected traffic from the construction phase. Considering SEIS Table 4-3, the proposed traffic, if allocated completely to the individual road segments, would noticeably increase the existing traffic on State Highway 387 but would not substantially increase traffic on more heavily traveled road segments, such as State Highway 59 traveling from Gillette to Wright. As noted previously, State Highway 387 traverses the proposed project area and would be the primary transportation route to the proposed project from nearby communities. Auto traffic on State Highway 387 was projected to increase by 8.8 percent, and truck traffic was projected to increase by 3.1 percent. Auto and truck traffic on State Highway 59 was projected to increase by 3.3 percent north of Wright (Reno Junction North traffic counter location) and by 2.8 percent south of Gillette (Gillette South traffic counter location) (see SEIS Figure 3-6). The projected increase in traffic on State Highway 387 (8.8 percent increase in auto traffic and 3.1 percent increase in truck traffic) is a noticeable change in conditions. The NRC staff further evaluated the projected increases in traffic by considering the ability of the roads to accommodate the increased traffic. When the projected traffic for all the state highways in the analysis is evaluated (ranging from 1,132 to 5,964 vehicles per day based on the sum of projected auto and truck traffic for each road), the magnitude of traffic would not be expected to exceed the existing road capacity. As discussed previously, the conclusion that existing road capacity would not be exceeded is based on consideration of road capacity estimates provided by the Campbell County Coal Belt Transportation Study (Kadrmas, Lee, and Jackson, Inc., 2010) (see SEIS Section 3.3). The study estimated a rural 2-lane highway hourly capacity of 1,375 vehicles per hour based on WYDOT automated daily traffic count information on state highways in Campbell County. Therefore, the NRC staff conclude that the regional and state highways could accommodate the additional traffic from the proposed project.

The projected daily traffic on Clarkelen Road, the county road providing access to the CPP from State Highway 387, would experience a noticeable increase over existing traffic from both autos and trucks. As described in the previous section, the applicant has committed to work with Campbell County to provide necessary upgrades to affected portions of the county road system (AUC, 2012a). The applicant has also committed to implement mitigation measures to reduce

Table 4-3. Estimated Daily Traffic on Regional and Local State Highways for the Operations Phase of the Proposed Reno Creek ISR Project						
Road Segment	**Traffic Count***		**Projected Traffic Increase†**		**Percent Increase‡**	
	Auto	**Truck**	**Auto**	**Truck**	**Auto**	**Truck**
State Highway 59 North of Wright (Reno Junction North)	3,568	784	60	14	1.6	1.7
State Highway 59 South of Gillette (Gillette South)	5,056	834	60	14	1.2	1.6
State Highway 387 (Pine Tree Junction)	621	437	60	14	8.8	3.1

Sources: AUC (2012a, 2014a); WYDOT (2013a,b)
*Traffic counts are annual average daily traffic for both directions of travel (SEIS Section 3.3). The NRC staff calculated the auto traffic count as the difference between the all vehicle count and reported truck count. Data for all roads are for year 2013 and are from Wyoming Department of Transportation (2013,a,b).
†Projected traffic increase is the proposed project daily two-way traffic. Proposed operations phase two-way traffic is double the round trips reported in SEIS Table 2-6.
‡This analysis assumes all projected traffic will travel on each road. If proposed project traffic used multiple routes, then this analysis overestimates impacts to each road segment.

impacts to the county road system potentially affected by the proposed project. Mitigation measures include (i) improving signage; (ii) enforcing speed limits for AUC employees and contractors; and (iii) performing routine assessments of road conditions (AUC, 2012a).

Considering the magnitude of projected traffic from the proposed Reno Creek ISR Project, the mitigation measures to reduce traffic impacts, and the relatively short segment of Clarkelen Road that would be impacted by traffic accessing the proposed project, the NRC staff conclude that the increase in traffic volumes to the local county road system during operations would result in SMALL impacts. Based on the available capacity on the state highway road system in Campbell County, the NRC staff conclude that the potential traffic impacts to the state highway road system providing access to the proposed project area from nearby communities would also be SMALL.

The potential radiological accident risk associated with yellowcake product shipments was evaluated in GEIS Section 4.3.2.2. The yellowcake transportation analysis assumed shipment volumes that ranged from 34 to 145 yellowcake shipments per year, which could result in a risk of 0.01 and 0.04 latent cancer fatalities, respectively, considering accident probabilities and consequences (NRC, 2009). The proposed yellowcake transportation activities for the proposed Reno Creek ISR Project are described in SEIS Section 2.1.1.1.7. These activities would be similar in approach to the activities evaluated in the GEIS Section 4.3.2.2, and the quantities of material that would be shipped, the number of shipments, and the shipment distances are within the magnitude of the yellowcake transportation activities evaluated in the GEIS. The applicant has estimated approximately 52 yellowcake shipments per year would be needed for the proposed project or an average of one shipment per week. This estimate is based on the proposed 0.9-million-kg [2-million-lb] annual yellowcake production rate and an assumed 17,300-kg [38,460-lb] capacity per yellowcake shipment (AUC, 2012a). By comparison, the GEIS does not differ significantly; it considers yellowcake shipped in drums that hold approximately 430 kg [950 lb] and shipments carrying 40 drums per load for a total shipment capacity of 17,200 kg [38,000 lb]. Therefore, the radiological accident risk associated with yellowcake shipment at the proposed Reno Creek ISR Project can be considered similar to the GEIS risk analysis. The shipment volume would not significantly affect the project-related traffic relative to the expected commuting workforce.

GEIS Section 4.3.2.2 reported that previous accidents involving yellowcake releases result in up to 30 percent of shipment contents being released (NRC, 2009). To limit the risk of an accident involving yellowcake transport, the applicant has proposed that all such materials would be transported in accordance with U.S. Department of Transportation (USDOT) and NRC regulations, handled as low specific-activity materials, and shipped by a licensed transport company that specializes in shipment of yellowcake (AUC, 2012a). The transport companies would have standing contracts with environmental emergency response contractors for spill cleanup. In addition, the applicant would develop a communication and emergency response plan with state and local authorities for all transport and emergency conditions (AUC, 2012a). The NRC staff conclude that the consequences of such accidents would also be limited because the applicant has committed to develop emergency response and standard operating procedures (AUC, 2012a, 2014a) for yellowcake and other transportation accidents that could occur during shipment to or from the proposed Reno Creek ISR Project. The applicant also proposes to ensure its personnel and the carrier would receive training on these emergency response procedures and that information about the procedures would be provided to state and local agencies (AUC, 2012a, 2014a). Therefore, the NRC staff conclude that the impact from a potential accident involving yellowcake transportation during the operations phase of the proposed project would be SMALL.

The potential impacts from operational byproduct material shipments were evaluated in GEIS Section 4.3.2.2. The NRC staff concluded in the GEIS the SMALL risks from transporting yellowcake during operations would bound the risks expected from byproduct material shipments, owing to the concentrated nature of shipped yellowcake, the longer distance yellowcake is shipped relative to byproduct material, and the relative number of shipments of each material. The proposed operational byproduct material transportation activities for the Reno Creek ISR Project are described in SEIS Section 2.1.1.1.7. The applicant proposed to temporarily store operational byproduct material and then ship the material to an offsite disposal facility that is licensed to accept byproduct material. Byproduct material disposal facility options are described in SEIS Section 3.13.2. The applicant's estimated annual generation of 76.5 m^3 [100 yd^3] of byproduct material (including unusable contaminated equipment, filters, and spent ion-exchange resin) would comprise approximately five shipments per year (SEIS Section 2.1.1.1.7). This magnitude of operational byproduct material shipping is at the low end of the range documented in the GEIS of 2.5 to 15 shipments per year (NRC, 2009). Transportation safety would be maintained by the applicant's proposed adherence to applicable NRC and USDOT transportation requirements, the applicant's proposed use of licensed third-party carriers, and the applicant's proposed emergency response measures (AUC, 2012a). Based on the preceding analysis, the NRC staff conclude that the applicant's proposed operational byproduct material shipment activities are consistent with the impact analysis in GEIS Section 4.3.2.2, and therefore environmental impacts of the proposed shipments would be bounded by impacts from the proposed yellowcake shipments (SMALL).

The potential impacts from transportation of process chemical supplies were also evaluated in GEIS Section 4.3.2.2. The potential safety hazards associated with process chemicals the applicant intends to use for the proposed project (see SEIS Section 4.13.1.2.3) were also described and evaluated in GEIS Sections 2.11.2 and 4.3.11.2.4 (NRC, 2009). The planned operational hazardous chemical and fuel shipments for the proposed Reno Creek ISR Project are described in SEIS Section 2.1.1.1.7. The applicant would store, use, and receive shipments of the following chemicals: sodium chloride (NaCl), sodium carbonate (Na_2CO_3), sodium hydroxide (NaOH), hydrochloric acid (HCl), sulfuric acid (H_2SO_4), hydrogen peroxide (H_2O_2), carbon dioxide (CO_2), oxygen (O_2), diesel fuel, gasoline, and bottled gases (AUC, 2012a). The types of chemicals and fuels shipped align with the materials evaluated in the GEIS (NRC, 2009). The applicant estimated the magnitude of operational chemical supply shipments to be approximately three shipments per day and the magnitude of fuel shipments (diesel, gasoline, and propane) to be approximately one shipment per day (AUC, 2012a).

Transportation risks associated with incoming, onsite, and outgoing shipments involve potential in-transit accidents. The process chemicals and fuels described in the applicant's proposal are commonly used in industrial applications, and they would be transported following applicable USDOT hazardous materials shipping provisions. If an accident occurred, spill response would be handled via emergency response procedures, although a spill of nonradiological materials would be reportable to the appropriate state agency, U.S. Environmental Protection Agency (EPA) and USDOT (NRC, 2009). Spill material would be recovered or removed and the affected areas reclaimed. The applicant would maintain transportation safety by following applicable USDOT hazardous materials transportation requirements (AUC, 2012a). Based on these considerations, the NRC staff conclude that the environmental impacts from operational hazardous chemical shipments would be SMALL.

The NRC staff conclude that the increase in traffic volumes would result in SMALL impacts to the local county road system and state highway road system servicing the proposed Reno Creek ISR Project. Based on the low radiological risks from transportation accidents and the implementation of the applicant's additional safety practices as previously discussed, the overall impacts from the proposed transportation activities during the operations phase would be SMALL.

4.3.1.3 Aquifer Restoration Impacts

The NRC staff concluded in GEIS Section 4.3.2.3 that the magnitude of transportation activities during aquifer restoration would be lower than for the construction and operations phases. Aquifer-restoration-related transportation activities would be primarily limited to supply shipments, waste shipments, onsite transportation, and employee commuting. The NRC staff concluded in the GEIS that transportation impacts from aquifer restoration would range from SMALL to MODERATE for the same reasons discussed previously for the operations phase (NRC, 2009).

At the proposed Reno Creek ISR Project, commuting workers constitute the majority of road traffic the applicant proposes for the aquifer restoration phase. The applicant estimated the number of worker trips per day to the project area would be 16 (compared to 20 to 200 worker trips per day considered in GEIS Section 2.8). In addition, the applicant estimated that two vehicles would travel to and from the project area daily for commercial delivery and pickup (AUC, 2014a).

SEIS Table 4-4 compares the magnitude of the NRC staff's estimated increase in local traffic counts from proposed aquifer restoration activities. The projected auto traffic for the aquifer restoration phase for all road segments evaluated is lower than the projected traffic from the construction and operations phases, and the projected truck traffic is similar to the construction phase. Considering the data detailed in SEIS Table 4-4, the proposed traffic, if allocated completely to the individual road segments, would increase the existing traffic on

Table 4-4. Estimated Daily Traffic on Regional and Local State Highways for the Aquifer Restoration Phase of the Proposed Reno Creek ISR Project						
Road Segment	**Traffic Count***		**Projected Traffic Increase†**		**Percent Increase‡**	
	Auto	**Truck**	**Auto**	**Truck**	**Auto**	**Truck**
State Highway 59 North of Wright (Reno Junction North)	3,568	784	32	5	0.9	0.6
State Highway 59 South of Gillette (Gillette South)	5,056	834	32	5	0.6	0.6
State Highway 387 (Pine Tree Junction)	621	437	32	5	4.9	1.1

Sources: AUC (2012a, 2014a); WYDOT (2013a,b)
*Traffic counts are annual average daily traffic for both directions of travel (SEIS Section 3.3). The NRC staff calculated the auto traffic count as the difference between the all vehicle count and reported truck count. Data for all roads are for year 2013 and are from Wyoming Department of Transportation (2013,a,b).
†Projected traffic increase is the proposed project daily two-way traffic. Proposed aquifer restoration phase two-way traffic is double the round trips reported in SEIS Table 2-6.
‡This analysis assumes all projected traffic will travel on each road. If proposed project traffic used multiple routes, then this analysis overestimates impacts to each road segment.

State Highway 387 but would not substantially increase traffic on more heavily traveled road segments, such as State Highway 59 traveling from Gillette to Wright. Auto traffic on State Highway 387 was projected to increase by 4.9 percent, and truck traffic was projected to increase by 1.1 percent. Auto and truck traffic on State Highway 59 was projected to increase by 1.5 percent north of Wright (Reno Junction North traffic counter location) and by 1.2 percent south of Gillette (Gillette South traffic counter location) (see SEIS Figure 3-6). The projected increase in traffic on State Highway 387 (4.9 percent increase in auto traffic and 1.1 percent increase in truck traffic) would be a noticeable change in conditions. However, as discussed previously, based on a road capacity estimate provided by the Campbell County Coal Belt Transportation Study (Kadrmas, Lee, and Jackson, Inc., 2010), State Highway 387 could accommodate the projected increase in traffic from the proposed project.

The projected daily traffic on Clarkelen Road, the county road that would provide access to the CPP from State Highway 387, would experience a noticeable increase over existing traffic considering both autos and trucks. As described in the previous section, the applicant has committed to work with Campbell County to provide necessary upgrades and maintenance to affected portions of the county road system (AUC, 2012a).

Considering the magnitude of projected traffic from the proposed Reno Creek ISR Project, the mitigation measures to reduce traffic impacts, and the relatively short segment of Clarkelen Road that would be impacted by traffic accessing the proposed project, the NRC staff conclude that the increase in traffic volumes to the local county road system during aquifer restoration would result in SMALL impacts. Based on the available capacity on the state highway road system in Campbell County, the NRC staff conclude that the potential traffic impacts to the state highway road system providing access to the proposed project area from nearby communities during aquifer restoration would also be SMALL.

4.3.1.4 Decommissioning Impacts

The NRC staff concluded in GEIS Section 4.3.2.4 that transportation activities during decommissioning at ISR facilities and the potential impacts would be similar to the construction and operations phases, except the magnitude of transportation activities (e.g., number and types of waste and supply shipments, excluding yellowcake shipments) from decommissioning would be lower than for the operations phase. The NRC staff concluded in the GEIS that the potential radiological risks from transportation accidents during decommissioning would be bounded by the estimates of risk for yellowcake transportation during operations based on the concentrated nature of the shipped yellowcake, the greater distance yellowcake is shipped compared to the byproduct material destined for a licensed disposal facility, and the number of shipments of yellowcake relative to byproduct material. The NRC staff concluded in the GEIS that the potential transportation impacts during decommissioning would be SMALL because of the reduced transportation activities (NRC, 2009).

The proposed decommissioning traffic estimates for the Reno Creek ISR Project are described in SEIS Section 2.1.1.1.7. The NRC staff derived these estimates from information provided by the applicant. During decommissioning, the applicant projects a small increase in truck traffic and commuting workers due to the increased number of contractors and shipments associated with decommissioning activities. The applicant estimated the number of worker trips per day to the proposed project area would be 6 (compared to the 20 to 200 worker trips per day considered in GEIS Section 2.8). In addition, the applicant estimated that two vehicles would travel to and from the proposed project area daily for commercial delivery and pickup (AUC, 2014a).

Proposed decommissioning byproduct shipments (100 to 200 shipments per year) would be up to double the number considered in the GEIS (100 shipments per year) (NRC, 2009). Estimated nonhazardous solid waste shipments (104 shipments per year) were greater than GEIS Section 2.8 values (44 shipments per year).

SEIS Table 4-5 compares the magnitude of the NRC staff's estimated increase in local traffic counts from proposed decommissioning activities. The projected combined auto and truck traffic for the decommissioning phase for all road segments evaluated is lower than the projected traffic from the construction, operations, and aquifer restoration phases. Considering the data detailed in SEIS Table 4-5, the proposed traffic, if allocated completely to the individual road segments, would not substantially increase traffic on the state highway road segments in the table. The projected daily traffic on Clarkelen Road, the county road providing access to the CPP from State Highway 387, would experience a noticeable increase over existing traffic considering both autos and trucks. As described in the previous section, the applicant has committed to work with Campbell County to provide necessary upgrades and maintenance to affected portions of the county road system (AUC, 2012a).

Another potential transportation impact from proposed decommissioning activities is the radiological risk from the transportation of byproduct material for offsite disposal. The NRC staff determine that the potential radiological accident risk associated with byproduct material shipments would be low based on the calculated risks from concentrated yellowcake shipments discussed previously in SEIS Section 4.3.1.2 and in GEIS Section 4.3.2.2.

Relative to powdered yellowcake, decommissioning byproduct material is in a form that would be less dispersible (i.e., less likely to cause public exposure if released) and easier to clean up if

Table 4-5. Estimated Daily Traffic on Regional and Local State Highways for the Decommissioning Phase of the Proposed Reno Creek ISR Project						
Road Segment	**Traffic Count***		**Projected Traffic Increase†**		**Percent Increase‡**	
	Auto	**Truck**	**Auto**	**Truck**	**Auto**	**Truck**
State Highway 59 North of Wright (Reno Junction North)	3,568	784	12	12	0.3	1.5
State Highway 59 South of Gillette (Gillette South)	5,056	834	12	12	0.2	1.4
State Highway 387 (Pine Tree Junction)	621	437	12	12	1.9	2.7

Sources: AUC (2012a, 2014a); WYDOT (2013a,b)
*Traffic counts are annual average daily traffic for both directions of travel (SEIS Section 3.3). The NRC staff calculated the auto traffic count as the difference between the all vehicle count and reported truck count. Data for all roads are for year 2013 and are from Wyoming Department of Transportation (2013,a,b).
†Projected traffic increase is the proposed project daily two-way traffic. Proposed decommissioning phase two-way traffic is double the round trips reported in SEIS Table 2-6.
‡This analysis assumes all projected traffic will travel on each road. If proposed project traffic used multiple routes, then this analysis overestimates impacts to each road segment.

an accident involving release occurred. The byproduct material would be transported and disposed of at a licensed facility. The applicant has committed to implementing additional BMPs to reduce the risk of accidents including (i) enforcing safe driving and emergency response procedures and training for personnel and truck drivers; (ii) installing communication systems to connect trucks to shipper/receiver/emergency responders; and (iii) enforcing speed limits on the proposed project area to increase driver safety and to reduce collisions with big game, livestock, and other vehicles (AUC, 2012a). All shipments would be required to comply with applicable NRC and USDOT regulations governing the transportation of radioactive material (including quantity limits, packaging requirements, and conveyance dose rate limits). Based on the preceding analysis, the NRC staff conclude that the potential radiological risks from the proposed transportation of decommissioning byproduct material would be low and therefore the potential environmental impacts from the proposed radioactive material transportation would be SMALL.

In conclusion, because of the low estimated traffic for the proposed Reno Creek ISR Project relative to existing road traffic in the region surrounding the proposed project area, the NRC staff conclude that the potential traffic-related transportation impacts during decommissioning would be SMALL. The low radiological risk from potential transportation accidents in comparison to the accident risks evaluated for the operations phase (i.e., no interstate transport of yellowcake) supports the NRC staff's conclusion that the radiological risks from transportation of decommissioning byproduct material for offsite disposal would also be SMALL. Therefore, the NRC staff conclude that the overall transportation impacts related to the decommissioning phase would be SMALL.

4.3.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, traffic volumes and patterns would remain the same as described in SEIS Section 3.3. There would be no transportation of materials to and from the project area to support licensed activities. There would be no transportation of either radionuclide or solid waste attributable to the proposed project because the facility would neither be licensed nor constructed and operated.

4.4 Geology and Soils Impacts

As discussed in the GEIS, environmental impacts on geology and soils occur during all phases of an ISR facility life cycle; however, the direct impacts on geology and soils would be concentrated during the construction phase (NRC, 2009).

The potential environmental impacts to geology and soils during construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project are discussed in the following sections.

4.4.1 Proposed Action (Alternative 1)

The principal impacts to geology and soils at the proposed project would be caused by earthmoving activities during construction of the CPP and associated facilities, access roads, production units, deep disposal wells, utilities, and pipelines. Earthmoving activities affecting soils would include ground clearing, topsoil stripping, excavation, backfill, compaction, grading, and pipeline trenching. Potential soil impacts from earthmoving activities include soil loss, compaction, increased salinity, loss of soil productivity, and soil contamination.

As described in SEIS Section 3.2, the proposed Reno Creek ISR Project area encompasses 2,451 ha [6,057 ac] (AUC, 2012a). The applicant estimates that 62.4 ha [154.3 ac] of land or 2.5 percent of the proposed project area would potentially be disturbed by construction activities and require topsoil salvage (see SEIS Section 4.2.1.1; SEIS Table 4-1). The average topsoil salvage depth over the proposed project area is 0.4 m [1.31 ft]. The applicant estimates that approximately 24.9 ha-m [202 ac-ft] of salvageable topsoil is present within the 62.4 ha [154.3 ac] of potential land disturbance (AUC, 2012a). Based on soil survey results, the potential for wind and water erosion within the proposed project area varies from slight to severe (see SEIS Section 3.4.2). Surface horizons throughout the proposed project area have a fine-loamy to sandy texture, making the soils more susceptible to erosion from wind than water.

The primary potential geologic hazard for the proposed project is earthquakes. As discussed in SEIS Section 3.4.3, faulting has not been identified across the entirety of the proposed project area (AUC, 2012a). Structure maps and structural cross-sections constructed from historic and recent geophysical and lithologic logs do not indicate the presence of faults within mineralized sandstones, confining units, and marker beds at the proposed project (AUC, 2012a,b). In addition, according to the U.S. Geological Survey Quaternary Fault and Fold Database, no capable faults (active faults) with surface expression occur within or near the proposed project area, demonstrating a historically low seismic potential.

4.4.1.1 Construction Impacts

As described in GEIS Section 4.3.3.1, the principal impacts on geology and soils are caused by earthmoving activities during construction of ISR surface facilities, access roads, wellfields, and pipelines. Earthmoving activities affecting soils include ground clearing, topsoil removal, and preparation of land surfaces before construction of facility structures. Such structures include the processing plant, header houses, access roads, drilling sites, and associated structures. Excavating and backfilling trenches for pipelines and cables would also impact soils. (NRC, 2009)

The NRC staff concluded in the GEIS that the impact on geology and soils from construction activities is dependent on local topography, surface and bedrock geology, and soil characteristics. Earthmoving activities are normally limited to a small portion of the project area. Consequently, earthmoving activities would result in a SMALL disturbance of soils—impacts that are commonly mitigated using accepted BMPs. Construction activities would increase the potential for wind and water erosion due to the removal of vegetation and the physical disturbance that would result from vehicle and heavy equipment traffic. These activities, however, would result in SMALL impacts if equipment operators adopt construction BMPs to either prevent or substantially reduce erosion. (NRC, 2009)

Impacts on soils would occur largely during the construction phase of the proposed Reno Creek ISR Project, when most of the ground disturbance takes place. As described previously, 62.4 ha [154.3 ac] or 2.5 percent of the total 2,451-ha [6,057-ac] project area would be disturbed as a result of earthmoving activities. Topsoil would be removed, stockpiled, and stabilized for later use in the decommissioning phase of the proposed project. The applicant would implement BMPs related to topsoil handling, stormwater control, sediment control, and wind erosion protection to mitigate potential soil loss. Topsoil removed from building sites, drilling sites, storage areas, and access roads would be salvaged in accordance with WDEQ guidelines and conditions of the WDEQ Permit to Mine (AUC, 2012a). Stockpiles would be constructed and maintained in accordance with WDEQ rules and regulations (WDEQ, 2014). Mitigation measures to avoid wind and water erosion would include (i) placing stockpiles on leeward hill sides when practicable and out of drainage channels, (ii) building stockpiles with slopes of 3:1 grade or flatter, and (iii) seeding stockpiles as soon as practicable with an appropriate seed mix (AUC, 2012a).

If necessary, the applicant would implement additional mitigation measures to limit potential soil loss from disturbed areas at the proposed project. These mitigation measures include (i) wetting exposed soil during construction, (ii) revegetating disturbed areas as soon as practicable after disturbance, and (iii) implementing stormwater and sediment-control measures (AUC, 2012a). The applicant would construct a stormwater control system within the CPP area to route stormwater away from disturbed areas. The system would include (i) sloping pavement with slot drains in areas adjacent to the CPP, (ii) connecting conveyance pipes to the slot drains to discharge stormwater away from facilities, (iii) grading the CPP area to drain downgradient, and (iv) constructing culverts to divert runoff from secondary roads that cross ephemeral stream channels (AUC, 2012a). Sediment-control measures proposed by the applicant to minimize soil loss include (i) avoiding construction and soil disturbance in sensitive areas; (ii) implementing sediment control BMPs, such as silt fencing, sediment logs, and straw bale check dams; (iii) incorporating wing ditches into topsoil stockpiles; and (iv) promptly restoring and reseeding disturbed areas (AUC, 2012a).

Construction activities have the potential to compact soils. Compaction of soils could lead to decreased infiltration and increased stormwater runoff. To mitigate the effects of compaction at the proposed project, the applicant would use existing roads where practicable (AUC, 2012a). In addition, the applicant would minimize secondary access road widths and implement a single direction of travel policy to access production units (AUC, 2012a). During decommissioning, soils that have undergone compaction during all phases of the project would be ripped as needed to loosen soils, recontoured, and reseeded.

During production unit development at the proposed project, well construction, exploration drilling, and delineation drilling would also affect soils. As discussed in SEIS Section 2.1.1.1.2, drilling activities would include the construction of mud pits. During excavation of mud pits, topsoil would be separated from the subsoil and placed in a temporary stockpile (AUC, 2012a). The subsoil would be removed and placed next to the mud pit. When use of the mud pit is complete (usually within 30 days of initial excavation), the applicant would redeposit the subsoil in the mud pit followed by topsoil replacement (AUC, 2012a). The applicant would follow similar procedures for pipeline and utility trench construction.

Where subsoil is removed in other construction areas, such as the CPP area, it would generally not be stockpiled (AUC, 2012a). Rather, the subsoil would be utilized as fill to construct backup storage pond embankments and primary access roads. Subsoil removed during the construction phase would be replaced during decommissioning.

Potential soil contamination could also occur from spills and leaks of fuel and lubricants from heavy construction equipment and other vehicles that would be operated during construction of the proposed project. Potential soil contamination resulting from fuel and oil leaks would be promptly cleaned up and contaminated soil removed and disposed offsite in an approved disposal facility (AUC, 2012a). During well construction, potential soil contamination resulting from the spread of drilling fluid and drilling mud would be mitigated by directing drilling fluids and muds into mud pits.

The applicant has been authorized by WDEQ to drill, complete, and operate four deep Class I disposal wells and thereby inject radionuclide-bearing liquid waste streams into the Teckla Sandstone member of the Lewis Formation and the Teapot Sandstone of the Mesaverde Formation at depths between approximately 2,130 and 2,400 m [7,000 and 7,860 ft] below ground surface (WDEQ, 2015a). These wells would be used for the disposal of process solutions, including brine and excess permeate. The applicant's drilling, completion, and testing of these wells is governed by the Underground Injection Control (UIC) Class I Permit from WDEQ (WDEQ, 2015a). The surface and subsurface areas disturbed by these wells would be very limited.

While the NRC staff conclude that impacts to soils from construction would be SMALL, the NRC staff recognize that alternative methods to manage drilling fluids are available that the applicant could choose to implement to further limit the potential impacts from the use of mud pits during well drilling activities. Alternatives or mitigating measures to the use of mud pits include, for example, lining the mud pits with an impermeable membrane, offsite disposal of potentially contaminated drilling mud and other fluids, and the use of portable tanks or tubs to contain drilling mud and other fluids. In addition, if mud pits are not backfilled within 30 days, the NRC staff recommend that the applicant employ operational practices (e.g., netting or screening) to deter birds and other wildlife from the mud pits.

The NRC staff conclude that the environmental impacts to geology and soils from construction activities at the proposed Reno Creek ISR Project would be SMALL. This finding is based on the NRC staff's evaluation of (i) the proposed project area's historically low seismic potential (see SEIS Section 3.4.3), (ii) the limited area that would be disturbed by construction activities, (iii) the applicant's commitments to BMPs to limit soil loss, (iv) the applicant's commitment to mitigation methods to limit soil compaction and contamination, and (v) the applicant's commitment to use procedures to construct mud pits and pipeline trenches that would limit soil loss and soil contamination.

4.4.1.2 Operations Impacts

As discussed in GEIS Section 4.3.3.2, during ISR operations, a non-uranium-bearing (barren) solution or lixiviant is injected through wells into the mineralized zone. The lixiviant moves through the host rock, dissolving uranium and other metals. Production wells withdraw the resulting "pregnant" lixiviant, which now contains uranium and other dissolved metals, and pump it to a processing facility for further uranium recovery and purification. During ISR operations, the removal of uranium and other metals would permanently change the composition of uranium-bearing rock formations. However, the uranium mobilization and recovery process in the target sandstones does not result in the removal of rock matrix; therefore, no significant matrix compression or ground subsidence is expected. Consequently, impacts on geology from ground subsidence at ISR projects would be SMALL. (NRC, 2009)

In GEIS Section 4.3.3.2, the NRC staff discussed the potential soil impacts from ISR operations resulting from the need to transfer barren and pregnant uranium-bearing lixiviant to and from the processing facility in aboveground and underground pipelines. If a pipe ruptures or fails, lixiviant could be released and (i) pond on the surface, (ii) run off into surface water bodies, (iii) infiltrate and adsorb in overlying soil and rock, or (iv) infiltrate and percolate to groundwater. In the case of spills from pipeline leaks and ruptures, licensees are expected to initiate immediate spill responses using onsite standard operating procedures (e.g., NRC, 2003b, Section 5.7). As part of the monitoring requirements at ISR facilities, licensees must report certain spills to the NRC within 24 hours. Regular inspection and monitoring also occurs to minimize the potential for spills and leaks through early detection. (NRC, 2009)

Additionally, failure of settling and holding pond liners or embankment systems may negatively affect soils (NRC, 2009). Licensees would be expected to construct and monitor settling and holding pond liners and embankments in accordance with NRC-approved plans to conduct regular soil monitoring. Such actions would tend to mitigate impacts to soils. Based on these considerations, the NRC staff concluded in GEIS Section 4.3.3.2 that impacts to soils from spills during operations could range from SMALL to LARGE, depending on the volume of soil affected by the spill, but that the immediate response requirement to report spills at ISR facilities, the mandated spill recovery actions, and the required routine monitoring programs would reduce the potential impact from spills to SMALL. (NRC, 2009)

The applicant's operational activities at the proposed Reno Creek ISR Project are consistent with the operations analyzed in the GEIS (see SEIS Section 2.1.1.1.3). Soil disturbance during the estimated 11-year operations phase of the proposed project would be limited primarily to earthmoving activities associated with production unit development (e.g., preparing and constructing drill sites and mud pits, expanding pipelines, and constructing wellfield access roads). Therefore, the amount of soil disturbance resulting from earthmoving activities during the project's operations phase would be less than that for the construction phase.

During development of production units during the operations phase, construction activities may increase the risk for both wind and water erosion of soils due to removal of vegetation and disturbance from heavy equipment. Measures to mitigate soil erosion during the operations phase would be similar to those described previously for the construction phase. These measures would include (i) diversion of surface runoff around disturbed areas; (ii) implementation of water velocity dissipation structures; (iii) use of BMPs, such as silt fencing and retention ponds to control sedimentation; and (iv) salvaging and stockpiling topsoil from drilling sites and access roads in accordance with WDEQ rules and regulations to avoid wind and water erosion (AUC, 2012a).

The removal of uranium from target sandstones [i.e., the Production Zone Aquifer (PZA)] at the proposed project would occur at depths ranging from 52 to 137 m [170 to 450 ft] below ground surface (see SEIS Section 3.4.1.2). During ISR operations, the lixiviant dissolves the uranium-mineral coatings on the sandstones in the targeted ore zone. This geochemical change in the rock would result in mineralogical changes to the ore zone, but it would not affect or remove the rock matrix in the ore-bearing sandstones. In addition, net withdrawal of fluid from the target sandstones during operations and aquifer restoration would be on the order of 1 percent or less (AUC, 2012a). Therefore, no significant matrix compression would result from the proposed uranium recovery operations. Because rock matrix is not removed during the uranium mobilization and recovery process and dewatering of uranium source formations is not expected, no subsidence is expected from the collapse of overlying rock strata into the PZA.

Based on historical ISR operations in the Wyoming East Uranium Milling Region, reactivation of geologic faults is not anticipated (NRC, 2009). As established in SEIS Section 3.4.3, earthquake activity in the area of the proposed Reno Creek ISR Project is very low. Potential effects associated with increased earthquake risk resulting from the operation of deep disposal wells would be avoided by maintaining injection pressures at a level that does not exceed the fracture pressure of the receiving rock formation. In accordance with 40 CFR 144.28(f)(6)(i), for Class I and Class III disposal wells, the operator must not exceed an injection pressure at the wellhead, which would be calculated to assure that the pressure during injection would not initiate fractures in the injection and confining unit. To ensure that formation fracture pressures were not exceeded, the applicant has committed to monitoring and maintaining injection pressures in Class I and Class III UIC wells at a level that does not exceed fracture pressures specified in its UIC permits (AUC, 2012c).

Negative effects to soils during operations may occur due to soil compaction, primarily from vehicles travelling on production unit access roads. Potential effects from soil compaction would be most noticeable on tertiary access roads in the production units. The tertiary access roads would be two-track roads without gravel surfacing. During operations, these roads would be used primarily for monitoring well sampling and mechanical integrity testing. The effects of soil compaction on the tertiary access roads would be mitigated during production unit decommissioning by ripping compacted soils and then recontouring and revegetating the disturbed access road surfaces.

Soil contamination risks during operations include potential spills from pipelines, wells, header houses, and process vessels. Within the CPP area, soil contamination risks include potential leaks of process fluids or chemicals from pipelines, chemical storage tanks, and the backup pond. The applicant would implement an NRC-required well and pipeline flow and pressure monitoring program to detect unexpected loss of pressure due to equipment failure, a leak, or a problem with well integrity. Monitoring would include continuous measurement of flows and pressures for injection and recovery trunklines and feeder lines, leak detection sensors in valve manholes, and leak detection sensors in wellhead sumps (AUC, 2012a). In the CPP, containment of process fluid spills and leaks would be provided by curbs, berms, and sumps for chemical storage tanks, process vessels, and all piping and equipment. The backup pond within the CPP area would be constructed with a double liner and leak detection system and would be inspected regularly (AUC, 2012a). The applicant would also collect and monitor soils for contamination along transportation routes and in production unit areas where spills and leaks are possible (AUC, 2012a).

To minimize soil contamination due to spills and leaks of radiological and chemical constituents above baseline levels, the applicant would be required to establish immediate spill detection, response, containment, and cleanup protocols and standard operating procedures by its NRC license (NRC, 2009). For example, in the case of a leaking pipeline, immediate spill response would include the applicant shutting down the leaking pipeline, recovering as much of the spilled fluid as possible, and collecting samples of the affected soils for comparison of constituent-concentration values (e.g., uranium, radium, and other constituents) to baseline conditions. Soils affected by spills or leaks would be analyzed for compliance with 10 CFR Part 40, Appendix A, Criterion 6(6) cleanup standards. Any soils contaminated with process fluids resulting from spills or leaks would be sampled, removed, and transported as necessary to a licensed byproduct disposal facility (AUC, 2012a).

In summary, based on analyses of the depth of the ore production zones and because the operations phase would not involve the removal of rock matrix, the NRC staff find that the impacts to geology from subsidence at the proposed project would be SMALL. Applicant commitments to implement mitigation measures to avoid soil erosion would limit soil loss during operations. Spills and leaks in the CPP building would be contained by curbs, berms, and sumps. Systems and procedures would be in place to monitor and clean up soil contamination resulting from any pipeline and wellfield spills, pond leaks, or vehicle accidents. Therefore, the NRC staff conclude that impacts to geology and soils during the operational phase of the proposed project would be SMALL.

4.4.1.3 Aquifer Restoration Impacts

As described in GEIS Section 4.3.3.3, aquifer restoration programs typically use a combination of (i) groundwater transfer; (ii) groundwater sweep; (iii) reverse osmosis (RO), permeate injection, and recirculation; (iv) stabilization; and (v) water treatment and surface conveyance (NRC, 2009). The groundwater sweep and recirculation process does not remove rock matrix, nor would dewatering occur within the aquifer; therefore, no significant matrix compression or ground subsidence is expected. The water pressure in the aquifer decreases during restoration because a negative water balance must be maintained in the wellfield undergoing restoration to ensure water flows from the edges of the wellfield inward; this reduces the spread of contaminants outside of the wellfield. The influx of fluid would change the reservoir pressure but would not reactivate any local faults because the change in reservoir pressure is limited by recirculation of treated groundwater. The NRC staff concluded in the GEIS that ISR operations are unlikely to reactivate any local faults and are extremely unlikely to cause earthquakes. After analyzing these conditions, the NRC staff concluded in the GEIS that the environmental impact of aquifer restoration to the geology of the Wyoming East Uranium Milling Region would be SMALL. (NRC, 2009)

In GEIS Section 4.3.3.3, the NRC staff also concluded that impacts on soils from spills during aquifer restoration would range from SMALL to LARGE, depending on the volume of soil affected by the spill. Because of the requirements for immediate spill response at ISR facilities, for spill-recovery actions, and for routine monitoring programs, the NRC staff concluded in the GEIS that impacts from spills would be SMALL. (NRC, 2009)

The applicant’s aquifer restoration program includes the use of groundwater transfer, groundwater sweep, and RO treatment with permeate injection to restore groundwater in production units (AUC, 2012b). The PZA occurs at depths ranging from 52 to 137 m [170 to 450 ft] below ground surface (see SEIS Section 3.4.1.2). Rock matrix would not be removed by groundwater transfer and groundwater sweep during aquifer restoration. Net withdrawal of fluid from the target sandstones during aquifer restoration would be on the order of 1 percent or less (AUC, 2012a). Therefore, no significant matrix compression or ground subsidence is expected during aquifer restoration activities. For these reasons, the subsidence or collapse of overlying rock strata into the ore zone during the aquifer restoration phase is not expected. Therefore, the NRC staff conclude that the environmental impact on geology during aquifer restoration would be SMALL.

Potential effects to soils during aquifer restoration include soil compaction and contamination from spills and leaks. Because there would be less traffic in the production unit areas, and less transport of uranium-bearing solutions in pipelines, the risks of soil compaction and the potential for contamination would be less than those occurring during the operations phase (NRC, 2009). The spill and leak detection program described for the operations phase in SEIS Section 4.4.1.2 would continue during aquifer restoration because the CPP area and production unit infrastructure would continue to be used during aquifer restoration. In addition, potential soil contamination resulting from spills and leaks would continue to be mitigated through regulatory requirements for immediate spill response, implementation of spill recovery and cleanup actions, and pipeline flow and pressure monitoring. Therefore, the NRC staff conclude that the potential impacts to soils during aquifer restoration would be SMALL.

4.4.1.4 Decommissioning Impacts

As indicated in GEIS Section 4.3.3.4, the decommissioning of ISR facilities includes the following activities: (i) dismantling process facilities and associated structures, (ii) removing buried piping, and (iii) plugging and abandoning wells using accepted practices. The main impacts to the geology and soils at the project during decommissioning would result from land reclamation activities and cleaning up contaminated soils. (NRC, 2009)

The GEIS also states that a licensee is required to submit a decommissioning plan to the NRC for review and approval before decommissioning and reclamation activities may begin. The NRC regulations require an applicant to submit a final decommissioning plan to the NRC for review and approval at least 12 months prior to the planned decommissioning of a wellfield or any portion of an ISR facility (NRC, 2003a). Any soils that have the potential to be contaminated would be surveyed to identify and clean up areas with elevated radionuclide concentrations in accordance with NRC regulations at 10 CFR Part 40, Appendix A, Criterion 6 (6). The goal of reclamation is to return the proposed project area to preproduction conditions by replacing topsoil and reestablishing vegetation communities (NRC, 2009).

The NRC staff concluded in the GEIS that the impacts on geology and soils from decommissioning would be noticeable but SMALL. Disruption and/or displacement of existing soils would be relatively small in scale. Changes in the size and location of impervious surfaces would be measureable, but would involve only a few hectares [acres] of compacted soil beneath buildings and parking lots. These changes would not be on a large enough scale to alter existing natural conditions. (NRC, 2009)

As described in SEIS Section 4.2.1.4, the applicant would restore disturbed lands at the proposed project area to their prior use of livestock grazing during decommissioning. The CPP facilities would be decontaminated according to regulatory standards and the applicant’s NRC-approved decommissioning plan. Buildings would be demolished and transported to a licensed disposal facility or would be turned over to the landowner. Production unit decommissioning would include plugging and abandonment of wells in accordance with WDEQ rules and regulations and removal and disposal of wellfield equipment. Baseline readings of soils, vegetation, and radiological data would guide and provide a basis to evaluate final reclamation efforts. Any soils that have the potential to be contaminated would be surveyed to identify and clean up areas with elevated radionuclide concentrations in accordance with NRC regulations at 10 CFR Part 40, Appendix A, Criterion 6(6). Any contaminated soils would be disposed of in licensed disposal facilities. As discussed in SEIS Section 4.2.1.4, stockpiled topsoil would be redistributed over disturbed surfaces, which would be recontoured to match existing topography. Final revegetation would consist of seeding with a seed mixture approved by WDEQ and landowners (AUC, 2012a).

Impacts to geology and soils are expected as reclamation progresses. For example, the risk of compacting soil would increase due to increased heavy equipment operation. Soils that have undergone compaction would be ripped as needed to loosen soils and then recontoured and reseeded. The result of decommissioning and reclamation would be to return the land to uses that existed before proposed ISR activities began. Due to the nature of the impacts on the land, the applicant's goal of decommissioning and reclaiming the proposed project area to preproduction conditions, and the fact that the magnitude of expected soil disturbance is within the range evaluated in the GEIS, the NRC staff conclude that the environmental impacts of the decommissioning phase on geology and soils would be SMALL.

4.4.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, a license authorizing operation of an ISR facility would not be issued; therefore, construction and operation of the facility would not occur and aquifer restoration and decommissioning would not be needed. Buildings would not be constructed, wells would not be drilled, production units would not be developed, and pipelines connecting the wellfields to the CPP would not be constructed. Earthmoving activities would not disturb or compact soils; therefore, existing topography would be unchanged. The geology of the area would be unaffected by the proposed project because no fluids would be injected into the subsurface for uranium extraction or liquid waste disposal. Current land uses affecting soils on and near the proposed project area (grazing land for livestock, natural resource extraction, and recreational activities) would continue.

4.5 Water Resources Impacts

4.5.1 Surface Water Impacts

Potential environmental impacts to surface water resources from an ISR facility may occur during all phases (construction, operations, aquifer restoration, and decommissioning) of the ISR facility life cycle (NRC, 2009). Construction of roads and stream crossings, stormwater erosion, runoff, spills or leaks of fuel and lubricants, or discharge of wellfield fluids could cause water quality degradation due to contaminated stormwater runoff, sediment loading, and discharge of treated wastewater. In addition, groundwater extraction during operations and aquifer restoration could deplete flow in nearby streams and springs.

4.5.1.1 Proposed Action (Alternative 1)

As described in SEIS Section 3.5.1.1, the proposed Reno Creek ISR Project area crosses the boundary between the Upper Belle Fourche River and the Antelope Creek drainage basins (see SEIS Figure 3-11), with approximately 80 percent of the area draining into the Upper Belle Fourche River. These drainage basins include the proposed project surface facilities (comprising the CPP and ancillary structures), wellfields and production units, access roads and utility infrastructure. All drainage channels within the proposed project area are ephemeral in nature, flowing for short durations in response to snowmelt or local precipitation events. Other surface water features within the proposed project area include man-made reservoirs or stock ponds and permitted discharge sites for CBM dewatering activities. Potential impacts to surface water resources would result from sediment loading due to land surface disturbing activities, spills of fuel and lubricant from heavy equipment operations, spills of process liquid in the CPP or production units, and excessive rainfall and runoff events. The potential environmental impacts to surface water resources during the construction, operations, aquifer restoration, and decommissioning phases of the proposed Reno Creek ISR Project are discussed in the following sections.

4.5.1.1.1 Construction Impacts

As described in GEIS Section 4.3.4.1.1, potential impacts to surface waters from construction of an ISR facility in the Wyoming East Uranium Milling Region would be SMALL. Stormwater runoff during construction would be controlled through a Storm Water Pollution Prevention Plan (SWPPP) as part of a Wyoming Pollutant Discharge Elimination System (WYPDES) permit issued by WDEQ. Wastewater discharges from construction activities and well pump tests would be regulated by an appropriate discharge permit from WDEQ. BMPs would be implemented to control sediment loading to surface waters. In the GEIS, the NRC staff concluded that surface water impacts during construction would be SMALL based on compliance with the applicable federal and state regulations and permit conditions, the implementation of BMPs, and other mitigation measures. (NRC, 2009)

During construction of the proposed Reno Creek ISR Project, potential impacts to surface waters would come from land surface disturbance, hydrocarbon spills, and surface runoff. As noted in SEIS Section 2.1.1.1.2, land surface disturbance would involve removal of vegetation and soils to build the CPP, develop the production units, construct access roads, and install pipelines and electrical power lines. As discussed in SEIS Section 4.2.1.1, land disturbance would affect approximately 62.4 ha [154.3 ac], or 2.5 percent of the proposed project area. Construction would be planned and conducted to minimize impacts to the surface drainages (AUC, 2012a). The combined area of these disturbances is small relative to the project area and the watershed areas. Furthermore, the NRC staff found very limited surface water resources within the project area, because existing drainage channels are ephemeral and often dry. However, water quality degradation may occur in these drainages due to sediment loads generated from erosion and land surface disturbing activities. These impacts would be reduced by construction of temporary sediment control features and implementation of BMPs during construction, including use of sediment logs and silt fences (AUC, 2012a). These mitigation measures would be implemented until vegetation is reestablished on the affected land areas.

In addition to sediment loading from land surface disturbances, the use of heavy duty vehicles and machinery for construction may lead to spillage of fuels and lubricants. When transported with surface runoff generated from local rainstorms and snowmelt events, these spills may cause water quality impairment to the nearby receiving stream channels and drainages. Also, direct spillage into water bodies may occur during construction of stream crossings for access roads and pipelines. Because the occurrence of surface water in the proposed Reno Creek ISR Project area is limited and surface water flow in the surface drainages is ephemeral, there is minimal potential for water quality degradation from hydrocarbon spills during construction. Furthermore, SEIS Section 1.6.2 notes that the applicant would obtain a general construction permit and a WYPDES permit in accordance with WDEQ regulations. As part of the WYPDES permit, the applicant would develop a SWPPP which would include monitoring requirements to control surface water contamination (AUC, 2012a). Combined with BMP implementation, compliance with requirements of these permits would protect surface drainages from excessive stormwater discharges and reduce potential water quality impacts.

Because the applicant commits to adopting measures to control erosion and sediment loading to surface water bodies, including implementation of stormwater BMPs and compliance with state-issued permits, the NRC staff conclude that impacts to surface water resources during the construction phase would be SMALL.

4.5.1.1.2 Operations Impacts

According to GEIS Section 4.3.4.1.2, stormwater discharges would be controlled through a SWPPP as part of a WYPDES permit issued by WDEQ. This permit includes monitoring requirements to control pollution, contamination, or degradation of waters of the state. In addition, BMPs (e.g., concrete curbs and berms) would be used to prevent runoff contamination from accidental spills or leaks. Furthermore, licensees wishing to discharge treated wastewater to a surface water body must obtain a WYPDES permit from WDEQ containing numerical discharge limits for various pollutants. Based on these requirements, the NRC staff concluded in the GEIS that surface water impacts during operation of an ISR facility would be SMALL. (NRC, 2009)

Due to reduction in the land surface areas disturbed during operations at the proposed Reno Creek ISR Project, potential impacts to surface water bodies from sediment loading would be less than those of the construction phase. Although some amount of land surface disturbance would still occur during the operations phase, such disturbances would be limited to the areas of new production units and pipelines installed concurrently with operations in previously built production units. The applicant would continue to implement BMPs to control storm runoff and sediment transport from these continual surface-disturbing activities (AUC, 2012a).

The more significant impacts during operations at the proposed Reno Creek ISR Project would be attributable to surface runoff and runoff-induced erosion from developed areas, and any chemical spills at the CPP and production units.

Because of the low regional precipitation and the ephemeral surface drainages observed in the surrounding watershed areas, the average seasonal runoff generated from the project area is expected to be minimal. However, occasional excessive precipitation events could produce unusually high runoff volumes, leading to soil erosion around the CPP site and at other surface facilities. The applicant has committed to mitigation measures, including the installation of diversion ditches, culverts, and energy dissipaters to control peak surface water flows due to storm runoff within the developed areas of the proposed Reno Creek ISR Project. These structures would reduce flow concentration and velocities, thereby reducing the potential for runoff-induced soil erosion and sediment generation.

Accidental releases of process liquids due to spills at the CPP or production units could lead to surface water quality impairment if such spills are discharged into surface drainages or mixed with storm runoff. The applicant has committed to the installation of sumps and secondary berms and curbs to contain accidental spills within the process buildings (AUC, 2012a). In addition, regular inspections and preventive maintenance procedures would be implemented during the operations phase (AUC, 2012a). Furthermore, the applicant would continue to implement a SWPPP as part of a WYPDES permit issued by WDEQ. This permit protects surface water by limiting the discharge volume and prescribing concentration limits to discharged water.

Because of the limited surface disturbances; low regional precipitation and minimal average seasonal runoff; installation of surface drainage features and spill containment structures; and implementation of BMPs, a SWPPP, and spill prevention and control procedures, the NRC staff conclude that the potential impact to surface water resources during operations at the proposed Reno Creek ISR facility would be SMALL and would be further reduced by the applicant's proposed mitigation measures described previously.

4.5.1.1.3 Aquifer Restoration Impacts

As discussed in the GEIS Section 4.3.4.1.3, because aquifer restoration would use the same infrastructure that is present during the operations phase, the potential impacts to surface water resources due to aquifer restoration activities are expected to be similar to or less than operations impacts. Key activities during this phase would include management of treated wastewater through direct land application, discharge to solar evaporation ponds, or discharge to surface waters such as streams or rivers. The intensity of surface activities is expected to diminish as aquifer restoration proceeds and as wellfields are closed. Therefore, the NRC staff concluded in the GEIS that aquifer restoration impacts to surface waters would be SMALL. (NRC, 2009)

Aquifer restoration at the proposed Reno Creek ISR Project would involve treatment by reverse osmosis methods, with the resulting effluent disposed of in Class I deep disposal wells. Thus, the potential impact to surface water resources would be water quality impairment due to leaks and spillage of untreated groundwater, process chemicals, and effluent. Additionally, land surface disturbances may occur, but these would be minimal in comparison to disturbances during the construction phase. Therefore, potential sediment loading to surface water bodies would be significantly less than that expected during construction. Adherence to WYPDES permit requirements to protect surface water and spill prevention and control procedures implemented during the operations phase would continue during aquifer restoration. Therefore, the NRC staff conclude that there would be a SMALL impact to surface water resources during the aquifer restoration phase of the proposed Reno Creek ISR Project.

4.5.1.1.4 Decommissioning Impacts

As discussed in the GEIS Section 4.3.4.1.4, decommissioning an ISR facility would involve removal of piping, stream crossings, and other facility infrastructure as part of activities expected to return the affected land and waters to preconstruction status. These activities would temporarily increase the potential for sediment loading along with stormwater runoff to surface waters. Because stormwater runoff would be controlled through implementation of a SWPPP, the NRC staff concluded in the GEIS that impacts to surface water resources during decommissioning would be SMALL. (NRC, 2009)

During the decommissioning phase of the proposed Reno Creek ISR Project, the CPP, other facility buildings, and pipelines would be removed. Also, production and disposal wells would be plugged and abandoned, topsoil would be restored to previously disturbed areas, and the land surface would be recontoured and revegetated. Potential impacts to surface water bodies would result from temporary soil disturbances and spillage of fuels and lubricants attributable to these activities. These impacts would be of similar intensity as the construction phase. The applicant stated that surface water impacts would be minimized through sediment control features, adherence to WYPDES permit requirements, and BMPs similar to those implemented during the construction phase. Furthermore, cleanup and reclamation of previously disturbed land surfaces would mitigate long-term impacts to surface water resources. Because of the preventive and mitigative measures the applicant would implement, the NRC staff conclude that the potential impact to surface water resources during the decommissioning phase of the proposed Reno Creek ISR Project would be SMALL.

4.5.1.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, there would be no additional impact to surface water resources because the proposed Reno Creek ISR Project would not be undertaken. There would be no construction of a CPP, facility buildings, production units and wellfields, or access roads. No pipelines would be laid. Therefore, land surface disturbances associated with these activities would not occur and additional sediment loading to surface water bodies would be avoided. In addition, because there would be no shipments of construction materials, products, and byproduct materials to or from the project area, spills of fuels and lubricants would not occur. The current land uses affecting surface waters, which are primarily livestock ranching and CBM activities, would persist.

4.5.2 Groundwater Impacts

Potential environmental impacts on groundwater at the proposed Reno Creek ISR Project area could occur during all phases of the ISR facility life cycle, but primarily during operations and aquifer restoration. At ISR sites, ore-bearing aquifers are typically separated from adjacent aquifers at varying depths by confining units, also known as aquitards. If the confining units do not effectively isolate the ore-bearing aquifer from the hydrogeological system, the aquifers above and below the uranium-bearing aquifer can be adversely affected during ISR operations and aquifer restoration.

The NRC staff reported in the GEIS that ISR facility impacts on groundwater resources can result from surface spills, leaks from buried piping, consumptive water use (i.e., water removed from available supplies without return to a water resource system), horizontal and vertical excursions of lixiviant from production aquifers, degradation of water quality from changes in production zone aquifer chemistry, and liquid waste management practices involving deep disposal wells. (NRC, 2009)

Stratigraphic nomenclature for units of interest present in the Wasatch Formation at the proposed Reno Creek ISR Project (in descending order):

- Shallow Water Table Unit (SM Unit): Partially saturated discontinuous sand unit that exhibits aquifer characteristics based on its local use as a livestock water supply.
- Overlying Aquifer (OM Unit): Discontinuous water-bearing sand unit exhibiting aquifer characteristics based on geologic and potentiometric data.
- Overlying Aquitard (OA): Laterally continuous sequence of clays and silt providing confinement between the production zone and overlying aquifers.
- Production Zone Aquifer (PZA): Discrete continuous aquifer consisting of interbedded sandstone, shale, and mudstone units. Sandstone units are hosts for uranium mineralization at the proposed project.
- Underlying Aquitard (UA): Laterally continuous sequence of mudstones and clays providing confinement between the production zone and underlying aquifers.
- Underlying Unit (UM Unit): Discontinuous water-bearing sand unit that does not meet the definition of an aquifer based on well yields and hydraulic conductivity estimates.

4.5.2.1 Proposed Action (Alternative 1)

As described in SEIS Section 2.1.1, ISR methods would be used to recover uranium from sandstone-hosted uranium orebodies in the lower part of the Eocene Wasatch Formation. As described in SEIS Section 3.4.1.2, the Wasatch Formation outcrops at the surface in the proposed project area and consists of interbedded mudstones, shales, and sandstones. Structural cross-sections illustrating the hydrostratigraphy within the Wasatch Formation at the proposed Reno Creek ISR Project area are displayed in SEIS Figures 3-16 to 3-22. The nomenclature used to describe hydrostratigraphic units within the Wasatch Formation for the proposed project is described in the accompanying text box. The host aquifer for uranium mineralization is termed the PZA. The PZA is a laterally continuous aquifer that ranges in thickness from less than 23 m [75 ft] to as much as 67 m [220 ft]. As described in SEIS Section 3.5.2.3, aquifer conditions in the PZA change from saturated in the western part of the project area to partially saturated in the eastern part of the project area. The PZA is confined by overlying and underlying aquitards across the entire site. These aquitards are termed the Overlying Aquitard (OA) and Underlying Aquitard (UA) and consist of laterally continuous sequences of clay, silt, and mudstone. The thickness of the OA ranges from 7.6 to 30.5 m [25 to 100 ft] and the thickness of the UA ranges from 46 to 76 m [150 to 250 ft]. Discontinuous aquifers termed the Shallow Water Table Unit (SM Unit) and the Overlying Aquifer Unit (OM Unit) are present above the OA and a discontinuous water-bearing sand unit termed the Underlying Unit (UM Unit) is present within the UA below the PZA.

Potential impacts to groundwater at the proposed Reno Creek ISR Project may result from pumping water to meet required consumptive water demands and from potential water quality degradation. Surface or near-surface activities that could introduce contaminants into soils would be more likely to impact shallow aquifers (the SM and OM Units). Activities associated with production and aquifer restoration would impact groundwater in the PZA, as well as groundwater in overlying and underlying aquifers (the SM, OM, and UM Units). In addition, groundwater in deeper aquifers used for liquid waste disposal could be impacted. As described in SEIS Section 2.1.1.1.6, the applicant has been authorized by the WDEQ to operate four Class I deep disposal wells to dispose of ISR process-related liquid waste streams into the Teckla Sandstone member of the Lewis Formation and Cretaceous Teapot Sandstone of the Mesaverde Formation (WDEQ, 2015). The permitted Class I deep disposal well discharge zones vary in depth between 2,130 and 2,400 m [7,000 and 7,860 ft] below ground surface (WDEQ, 2015).

Detailed discussion of the potential impacts on groundwater resources from construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project are provided in the following sections.

4.5.2.1.1 Construction Impacts

The NRC staff reported in the GEIS that potential impacts to groundwater during construction of an ISR facility are from the consumptive use of groundwater, injection of drilling fluids and mud during well drilling, and spills of fuels and lubricants from construction equipment. Surface activities that can introduce contaminants into soils are more likely to affect shallow (near-surface) aquifers during construction. The NRC staff concluded in the GEIS that during construction, groundwater use is limited and groundwater quality is protected by implementing BMPs, which include spill prevention and cleanup programs. In addition, the volume of drilling fluids and mud to be introduced into the environment during well installation is limited.

Therefore, the NRC staff concluded in the GEIS that construction impacts to groundwater resources would be SMALL. (NRC, 2009)

Consumptive water use during the construction phase of the proposed Reno Creek ISR Project would be limited to routine activities such as dust suppression, cement mixing, and drilling support (AUC, 2012a). As described in the GEIS, the volume of water used in these activities is small relative to pumpable water and would have a SMALL impact to groundwater supplies within the Wyoming East Uranium Milling Region (NRC, 2009). The applicant has not defined the water source for construction activities. As described in SEIS Section 3.5.2.4, domestic and stock wells with existing water rights within the proposed project area are completed in the OM Unit and PZA. Therefore, the NRC staff consider these aquifers to be the most likely source of water for construction activities.

Potential groundwater quality impacts to shallow aquifers (i.e., the SM and OM Units) that could occur during construction include the introduction of drilling fluids and muds into the environment during well installation, discharge of pumped water to the surface during hydrologic testing, and spills or leaks of fuels and lubricants from construction equipment and vehicles. Within the proposed project area, the SM Unit occurs 12 to 24 m [40 to 80 ft] below ground surface and the OM Unit occurs 21 to 66 m [70 to 215 ft] below ground surface (see SEIS Section 3.5.2.3). As described in SEIS Section 3.5.2.3, both of these units are discontinuous and overlain by a thick sequence of mudstone and silt. Therefore, the potential for spills and leaks of fuels and lubricants from equipment and vehicles, for discharge of pumped water, and for drilling fluids to be introduced to groundwater are low and the impact of such releases would be SMALL.

As described in SEIS Section 2.1.1.1.2, the applicant plans to use standard mud rotary drilling techniques to construct production, injection, and monitoring wells. To minimize potential soil contamination during well installation, drilling fluids and muds would be directed to temporary mud pits in accordance with WDEQ requirements (AUC, 2012a). The volume of drilling fluids and mud used during well installation would be limited by using the smallest quantity of water that is technically practicable for well drilling and development (AUC, 2012a). Impacts to groundwater during well drilling would be further limited by the nature of the bentonite or polymer-based drilling additives in the drilling fluids. These additives are designed to limit infiltration in an aquifer (i.e., to a few inches) and to isolate the drill hole from the surrounding geologic materials via a wall-cake or veneer of drilling-fluid filtrate, further reducing the potential for impacts. Thus, the impacts to groundwater quality in shallow aquifers from well installation activities would be SMALL.

After wells are installed, some water may be pumped from aquifers for well development or hydrologic testing, such as pumping tests. This water would be discharged to the surface in accordance with construction and industrial/mining stormwater WYPDES permits that the applicant must obtain from WDEQ (see SEIS Section 1.6.2). These permits protect shallow aquifers by limiting the discharge volume and prescribing concentration limits to discharged water. The applicant has not yet submitted applications for the WYPDES permits to WDEQ (see SEIS Table 1-2).

Spills of fuels and lubricants could also impact shallow groundwater quality during facility construction and wellfield installation. The applicant has committed to the following BMPs to protect shallow groundwater quality: (i) developing and implementing a spill response and cleanup plan to contain and remediate affected soil or surface water; (ii) training employees in spill detection, containment, and clean up procedures; and (iii) monitoring shallow aquifers in the proposed project area (i.e., the SM or OM Units) to ensure that, in the event of fuel or lubricant leaks or spills, the impacts to groundwater would be detected (AUC, 2012a, 2015). If these BMPs are properly implemented, the NRC staff anticipates that the impact to shallow groundwater from spills of fuels and lubricant would be SMALL.

As described in SEIS Section 2.1.1.1.2, a WDEQ-administered Class III UIC program regulates the design and construction of injection, production, and monitoring wells. The applicant has committed to construct all injection, production, and monitoring wells using methods approved by WDEQ and in compliance with WDEQ construction requirements for casing types and annular sealing techniques. Proper annular sealing techniques ensure that vertical migration pathways are not created outside the casing or inside the borehole. The WDEQ construction requirements would prevent the migration of fluids between the PZA and surrounding aquifers. In addition, Class I deep disposal wells would also be designed and constructed according to WDEQ requirements to prevent the migration of fluids between the permitted discharge zones (the Tekla and Teapot Sandstones) and surrounding underground sources of drinking water (USDWs). Prior to entering service, all wells would undergo Mechanical Integrity Testing (MIT) of the casing to verify that the well casing would not fail, which could cause water loss and fluid migration across confining units (AUC, 2012a). Because WDEQ UIC permit requirements for construction and testing of Class I and Class III wells would prevent migration of fluids between aquifers as described above, the NRC staff anticipates that impacts to the PZA and surrounding aquifer and deep aquifers targeted for disposal of liquid byproduct material would be SMALL.

Based on the NRC staff analysis, the potential impacts from consumptive groundwater use and on groundwater quality during the construction phase at the proposed Reno Creek ISR Project are consistent with those in the GEIS (i.e., SMALL). Consumptive groundwater use would be limited to routine activities, such as dust suppression, mixing cements, and drilling support, and would have a SMALL impact. The impact to groundwater quality in shallow aquifers during the construction phase would be SMALL based on the occurrence of a thick sequence of mudstone and silt overlying shallow aquifers, the limited volume of drilling fluids and mud used during well installation, the applicant’s adherence to WYPDES permit requirements, and the applicant’s implementation of BMPs to protect water quality in the event of leaks and spills of fuels and lubricants. Based on WDEQ UIC requirements for Class I and Class III well design, construction, and testing, the impact to groundwater quality in the PZA and surrounding aquifers and deep aquifers would also be SMALL.

4.5.2.1.2 Operations Impacts

GEIS Section 4.3.4.2.2 discussed potential environmental impacts to shallow (near-surface) aquifers during ISR operations. During this phase, shallow aquifers could potentially be affected by lixiviant leaks from pipelines, wells, or header houses and from liquid waste management practices, such as the use of settling and holding ponds. Potential environmental impacts to groundwater resources in the production and surrounding aquifers also include consumptive water use and changes to water quality that could result from normal operations in the production aquifer and from possible horizontal and vertical lixiviant excursions beyond the production zone. Disposal of processing wastes by deep well disposal during ISR operations could also impact groundwater in deep aquifers. (NRC, 2009)

Operations Impacts to Shallow (Near-surface) Aquifers

In the GEIS, the NRC staff discussed the potential environmental impacts to shallow (near-surface) aquifers during ISR operations. A network of buried pipelines transports lixiviant between the header house and the satellite or main processing facility. Piping connects injection and production wells to manifolds inside the header houses. Failure of pipeline fittings or valves, or failure of well mechanical integrity in shallow aquifers, could result in leaks and spills of pregnant and barren lixiviant, with adverse impacts on water quality in shallow aquifers. The potential environmental impacts of pipeline, valve, or well integrity failure depend on the depth to shallow groundwater; the current and anticipated future uses of shallow groundwater for domestic, agricultural, and livestock water demands; and the degree of hydraulic connection between shallow aquifers, production aquifers, and regionally important aquifers. Shallow aquifers may also be affected by hazardous wastewater leaks and spills from settling and holding ponds. The NRC staff concluded in the GEIS that the potential environmental impacts of pipeline, valve, or well integrity failures to shallow aquifers could be MODERATE to LARGE, if

- The groundwater table in shallow aquifers is close to the ground surface (i.e., small travel distances from the ground surface to the shallow aquifers)
- The shallow aquifers are important sources for local domestic or agricultural water supplies
- Shallow aquifers are hydraulically connected to other locally or regionally important aquifers.

The potential environmental impacts could be SMALL if shallow aquifers have poor water quality or yields are not economically suitable for production, and if they are hydraulically separated from other locally and regionally important aquifers. (NRC, 2009)

In some parts of the Wyoming East Uranium Milling Region, local shallow aquifers (alluvium type) exist, and they usually yield small quantities of water only for local uses. Hence, potential environmental impacts due to spills and leaks from pipeline networks or failures of well integrity in shallow aquifers would be expected to be SMALL to MODERATE, depending on site-specific conditions. Potential impacts would be reduced based on flow monitoring to detect pipeline leaks and spills early and implementation of required spill response and cleanup procedures. In addition, preventive measures would limit the likelihood of well integrity failure during operations. (NRC, 2009)

As discussed in the previous section, the shallow aquifers (SM and OM Units) in the proposed Reno Creek ISR Project area are discontinuous and are overlain by continuous mudstone and silt. The SM Unit at the proposed project area occurs 12–24 m [40–80 ft] below ground surface and the OM Unit occurs at various depths ranging from 21–66 m [70–215 ft] below ground surface. In addition, the shallow aquifers are not known to be hydraulically connected with more significant local and regional water supply aquifers, such as the Fort Union Formation, Lance Formation, and Fox Hills Sandstone. As described in SEIS Section 3.5.2.3, the PZA, which is within the Lower Wasatch Formation, is hydraulically separated from shallower aquifers by the OA, which ranges in thickness from 7.6 to 30.5 m [25 to 100 ft] across the proposed project area. Groundwater quality data presented in SEIS Table 3-11 indicate that groundwater in SM and OM Unit wells exceed State of Wyoming standards for Class I (domestic) and Class II (agricultural) groundwater use and is only suitable for Class III (livestock) and Class IV (industrial) use. During ISR operations, groundwater quality in shallow aquifers at the proposed Reno Creek ISR Project area has the potential to be impacted by accidental spills or leaks from chemical storage areas, process solution vessels, or the backup storage pond, as well as by spills and leaks of lixiviant from failure of pipelines or valves or a break in the casing of a well. NRC-required leak detection, spill response, and cleanup programs would greatly reduce the potential impact on shallow groundwater from any surface releases during the operations phase. Within wellfield facilities, the applicant has committed to continuously monitoring wellfield flows to detect any variations in flow or pressure that could indicate a leak in the pipelines or wells (AUC, 2012a). The applicant has also committed to monitoring shallow aquifers (the SM and OM Units, where present) to detect impacts to groundwater from process fluid spills due to pipeline and valve failure (AUC, 2015). In addition, the applicant has committed to the following mitigation measures to detect and control potential adverse impacts of spills and leaks in processing facilities, pipeline infrastructure, and wellfields:

- Installing automated equipment capable of detecting leaks and shutting down pump systems;
- Equipping facilities and manholes with leak detectors having audible and visible alarms;
- Performing periodic (every 5 years) MIT of wells to detect potential leakage;
- Constructing buried wellfield pipelines with corrosion-resistant high density polyethylene (HDPE);
- Constructing piping within the CPP with corrosion-resistant high density polyethylene (HDPE), polyvinyl chloride (PVC), or stainless steel;
- Hydrostatically testing piping prior to use;
- Using piping rated for pressures greater than the maximum operating pressure; and
- Providing thrust blocking at pipe bends and valves (AUC, 2012a).

The backup storage pond would be designed following guidelines described in NRC Regulatory Guide 3.11 for embankment systems (NRC, 2008). Adherence to these guidelines would ensure that the backup storage pond meets NRC requirements for groundwater protection at 10 CFR Part 40, Appendix A, Criterion 5 and groundwater protection standards established under WDEQ water quality rules and regulations (AUC, 2012a). Furthermore, the applicant has committed to the following mitigation measures to minimize the impacts of leaks from the backup pond:

- Limiting backup pond use to when deep disposal wells are not functioning due to maintenance or MIT
- Using two layers of low permeability liners
- Equipping the pond with a leak detection system

- Regularly (every 2 weeks) monitoring the leak detection system for the presence of moisture; and

- In the event of a pond leak, notifying the NRC within 48 hours of leak verification and repairing the leak as quickly as possible (AUC, 2012a).

Based on the NRC staff analysis, the potential impacts on shallow groundwater during the operations phase of the proposed project are consistent with GEIS criteria for a SMALL impact. The shallow aquifers (the SM and OM Units) have poor water quality and are hydraulically separated from locally and regionally important aquifers. Implementation of required spill response and cleanup procedures and the applicant's commitments to mitigation measures to detect, control, and minimize potential adverse impacts of spills and leaks in processing facilities, pipeline infrastructure, storage ponds, and wellfields would reduce potential impacts to shallow aquifers. Therefore, the NRC staff conclude that impacts to shallow (near-surface) groundwater during operations for the proposed project would be SMALL.

Operations Impacts to Production and Surrounding Aquifers

The potential environmental impact to groundwater in the production and surrounding aquifers is related to consumptive groundwater use and groundwater quality.

<u>Water Consumptive Use</u>

The NRC staff reported in the GEIS that impacts of consumptive water use would be localized in the Wyoming region and would be SMALL to MODERATE, depending on aquifer characteristics. Near a wellfield, the impact of consumptive use could be MODERATE if there are local water users who use the production aquifer (outside of the exempted zone) or if the production aquifer is not well isolated from other aquifers that are used locally. However, because localized drawdown near wellfields would dissipate after pumping stops, these localized effects are expected to be temporary (1 to 2 years). After consideration of these factors, the NRC staff concluded in the GEIS that impacts of consumptive water use would be SMALL in most cases. (NRC, 2009)

Based on information available from the Wyoming State Engineer's Office, the applicant provided an inventory of groundwater wells (e.g., location, use, and completion depth) within a 3.2-km [2-mi] radius of the proposed project boundary (AUC, 2012a, b). As described in SEIS Section 3.5.2.4, the applicant identified 49 groundwater wells within the 3.2 km [2 mi] radius. Of the 49 wells, 3 are used for domestic purposes, 4 are used for domestic/stock purposes, 30 are used for stock watering, 1 is used for industrial purposes, and 11 are used for miscellaneous purposes (AUC, 2012b). The majority of these wells are completed in the OM Unit or the PZA. Fifteen of the 49 groundwater wells are located within the proposed project area and include 6 wells whose water rights have been cancelled, 8 wells that are appropriated for stock watering, and 1 well (Taffner #1) that is appropriated for domestic/stock use.

The applicant has plugged and abandoned the Taffner #1 well in accordance with WDEQ rules and regulations (AUC, 2012a, 2014b). Of the eight stock watering wells within the proposed project area, four are completed in the OM Unit, two in the PZA, and one in the sandstone interval below the PZA (AUC, 2012a, b). The applicant investigated the two stock wells completed in the PZA (GW5 and GW9) to determine if new stock wells would need to be developed within the proposed project area (AUC, 2014b). The locations of these wells are shown in SEIS Figure 3-23. With the approval of the land/well owner, the applicant plugged and abandoned well GW9 in accordance with WDEQ rules and regulations. Well GW5 is located approximately 700 m [2,300 ft] outside the closest proposed aquifer exemption zone in an area with no known mineralization. The applicant would conduct periodic sampling of well GW5 as part of its operational groundwater monitoring program as described in SEIS Section 7.3.4.

No stock or domestic water wells would be located in the currently proposed wellfield areas (as shown in SEIS Figure 2-5) (AUC, 2012a). If future development within the proposed project area includes an area(s) where a stock well is located in the PZA, the applicant has committed to the following mitigation measures:

- Replacing the wells with new wells completed in either shallower or deeper aquifers that are not impacted by ISR operations or

- Providing another source of stock water (AUC, 2012a)

In addition, consistent with Regulatory Guide 4.14 (NRC, 1980), the applicant would measure water levels, as well as water quality, in domestic and stock wells within 2 km [1.2 mi] of the wellfields before operations and every 3 months during operations to evaluate the impacts of ISR operations on groundwater (AUC, 2012a). If significant effects to either domestic or stock wells were observed (e.g., the water levels drop to a point that impairs the usefulness of the wells), the applicant has proposed the following mitigation measures:

- Lowering the pump level in the wells, if possible;

- Deepening the wells, if possible; or

- Replacing the wells with new wells completed in aquifers that are not affected by ISR operations (AUC, 2012a).

The applicant evaluated the potential impact of operations on groundwater quantity in surrounding wells using a groundwater model (AUC, 2012b). The applicant's groundwater model estimated drawdown (reduction in hydraulic head)) assuming (i) maximum projected extraction rates of 41,640 Lpm [11,000 gpm]; (ii) a 1 percent production bleed rate; and (iii) a restoration bleed rate of between 3 and 9 percent. The groundwater model assumed the first four years of the simulation would include only the production phase, while the remaining years had concurrent production and aquifer restoration phases. The applicant's simulation predicted maximum drawdowns between 5.8 and 10.4 m [19 and 34 ft] at wellfields in the partially saturated PZA and between 6.1 and 16.7 m [20 to 55 ft] at wellfields in the fully saturated portion of the PZA. Simulated production at the maximum projected rates of 41,640 Lpm [11,000 gpm] and a 1 percent bleed for a period of several years did not result in dewatering of the aquifer or excessive drawdown outside the project area. The estimated drawdowns at various locations along the proposed project area boundary ranged from 0 to7.6 m [0 to 25 ft] and simulated drawdown of approximately 1.5 m [5 ft] or more extended several kilometers beyond the proposed project area. Based on the available head and saturated thickness of the PZA across the proposed project area, the applicant concluded that a drawdown of 1.5 m [5 ft] would not adversely impact offsite groundwater users (AUC, 2012b).

The NRC staff reviewed the applicant's groundwater model and found that the results of the predictive simulations could be biased because of model construction and lack of consistency with details of the applicant's "conceptual site model." Perceived biases in model construction included the use of a one-layer model and general head boundary conditions. In addition, aquifer heterogeneities, which are prevalent within the proposed project area, were not incorporated into the model. In order to independently evaluate the effects of the perceived biases on groundwater quantity in surrounding wells, the NRC staff revised the groundwater model to establish its own model using parameters consistent with the applicant's conceptual site model for the project and with reported site-specific data. NRC staff revisions to the groundwater model and the reasoning for the revisions are listed as follows:

- The applicant's pumping test data at well PZM5 yielded low hydraulic conductivities, but the applicant's model did not extend those properties to the proposed locations of nearby production areas—the NRC staff's model extended the low conductivity to the proposed production areas, consistent with the applicant's conceptual model;

- The applicant's model was a one-layer model that could not simulate vertical flow nor account for vertical heterogeneities in the PZA—the NRC staff developed a five-layer model that incorporated some aspects of the vertical heterogeneity and flow, consistent with reported data;

- The applicant's model accounted for horizontal heterogeneities by using large areas of varying properties—the NRC staff's model accounted for and tested the potential for preferred migration paths, consistent with a fluvial depositional environment;

- The applicant's model resulted in the use of large storage values in the partially saturated portion of the PZA—the NRC staff's model reduced the usage of large storage values to a limited interval, and thus the effective storage of the model was consistent with observed data; and

- The applicant's model contained general head boundary conditions that were effectively constant head boundary conditions—the NRC staff's model modified the general head boundary to minimize boundary effects.

Predicted drawdowns for simulations with the NRC staff's groundwater model were greater than those predicted by the applicant's groundwater model. For example, the applicant reported a maximum drawdown of 16.7 m [55 ft] at Production Unit 10 at the end of year 9 (AUC, 2012b). The staff's model predicted a maximum drawdown of 28.9 m [95 ft], almost twice the maximum drawdown predicted by the applicant's model. As described previously, the thickness of the PZA ranges from 23 to 61 m [75 to 200 ft] across the proposed project area. Therefore, the greater drawdowns predicted by the staff's model indicate that a significant portion of the available water column in the PZA could be used during normal operations. These greater drawdowns, in turn, could result in greater drawdown in wells at and outside the proposed project area boundary than those predicted by the applicant's model.

Considering the difference between the applicant's and NRC staff's estimates for drawdown, the NRC staff finds that the potential impact from groundwater consumptive use during the operations phase of the proposed Reno Creek ISR Project could be MODERATE. However, as described above, there would be no domestic wells and a limited number of stock wells (eight wells) within the proposed project area during ISR operations. Moreover, the applicant has committed to and proposed mitigation measures to detect and reduce the potential adverse impacts on consumptive use of groundwater. These mitigation measures include: (i) measuring water levels in domestic and stock wells within 2 km [1.2 mi] of the wellfields before operations and every 3 months during operations, (ii) lowering pump levels in wells or deepening or replacing wells affected by ISR operations, and (iii) providing another source of water for stock wells affected by ISR operations. Therefore, NRC staff conclude that the impact from groundwater consumptive use during ISR operations with mitigation would be SMALL.

Excursions and Groundwater Quality

The NRC staff reported in the GEIS that degradation of groundwater quality in the production aquifer would occur during ISR operations. In order for ISR operations to occur, the uranium-bearing production aquifer must be exempted as an underground source of drinking water (USDW) through the Wyoming UIC program. When production at a wellfield has ceased, the licensee would be required to initiate aquifer restoration activities to restore the production aquifer to baseline or preoperational class-of-use conditions, if possible. If the aquifer cannot be returned to preoperational conditions, the NRC regulations require that the production aquifer be returned to the maximum contaminant levels provided in 10 CFR Part 40, Appendix A, Table 5C or to alternate concentration limits approved by the NRC. For these reasons, potential impacts to the water quality of the uranium-bearing production zone aquifer as a result of ISR operations would be expected to be SMALL. (NRC, 2009)

Groundwater quality in the overlying and underlying aquifers and adjacent aquifers could also be degraded if horizontal or vertical lixiviant excursions occur beyond the production zone. During normal ISR operations, inward hydraulic gradients are expected to be maintained by production bleed so that groundwater flow is toward the production zone from the edges of the wellfield. If this inward gradient is not maintained, horizontal excursions can occur and lead to the spread of leaching solutions in the ore-bearing aquifer beyond the mineralization zone and the wellfield. The potential environmental impacts of vertical excursions to groundwater quality in surrounding aquifers would be SMALL if the vertical hydraulic head gradients between the production aquifer and the adjacent aquifer are small, the vertical hydraulic conductivity of the confining units is low, and the confining units are sufficiently thick. On the other hand, the environmental impacts could be MODERATE to LARGE if confinements are discontinuous, thin, or fractured (i.e., high vertical hydraulic conductivities). To reduce the likelihood and consequences of potential excursions at ISR facilities, the NRC requires licensees to establish and implement an excursion monitoring program prior to starting operations, which would include corrective actions to stop or reverse an excursion. Based on preventive measures the licensee would implement to reduce horizontal and vertical excursions (i.e., maintaining inward hydraulic gradients through production bleed and implementing an excursion monitoring program), the NRC staff concluded in the GEIS that potential impacts of ISR operations on water quality of a uranium-bearing production zone aquifer would be SMALL. (NRC, 2009)

Groundwater quality data presented in SEIS Table 3-11 indicate that groundwater in the PZA does not meet State of Wyoming standards for Class I (domestic), Class II (agricultural), and Class III (livestock) groundwater use and is only suitable for industrial (Class IV) use. Parameters exceeding Class I standards included gross alpha, sulfate, manganese, iron, cadmium, lead, total dissolved solids, pH, and combined radium-226/228. Parameters exceeding Class II standards included gross alpha, sulfate, manganese, selenium, vanadium, pH, and combined radium-226/228. Parameters exceeding Class III standards included gross alpha, vanadium, pH, and combined radium-226/228. Thus, the PZA water quality meets the criteria for exemption as an USDW, as described in SEIS Section 2.1.1.1.2. As documented in SEIS Table 2-1, the EPA approved an aquifer exemption request for the PZA; specifically, production zones in the Lower Wasatch Formation at depths between 52 m [170 ft] and 138 m [450 ft] (EPA, 2015).

To prevent horizontal excursions, inward hydraulic gradients need to be maintained in the production aquifer during ISR operations (NRC, 2009). These inward hydraulic gradients are created by the net groundwater withdrawals (production bleeds) maintained through continued pumping during ISR operations. For the proposed Reno Creek ISR Project, the applicant plans to maintain an average 1 percent production bleed rate (AUC, 2012a). Results of the applicant's groundwater modeling demonstrated that an average 1 percent bleed rate is sufficient to maintain an inward gradient in the PZA during ISR operations (AUC, 2012a). The inward hydraulic gradients would ensure that groundwater flow in the PZA is toward operating wellfields and that horizontal excursions would not occur.

NRC regulations require that the licensee of an ISR facility take preventive measures to reduce the likelihood and consequences of potential excursions. An applicant must design and install a monitoring network capable of detecting both horizontal and vertical excursions from the production zone. The applicant's excursion monitoring program is detailed in SEIS Sections 2.1.1.1.3 and 7.3.1.2. As described in these sections, a ring of monitoring wells encircling the production zone is required for early detection of horizontal excursions. The applicant's groundwater model determined that the distance between the perimeter ring monitor wells should be no more than 152 m [500 ft], and the distance between these monitoring wells and the production patterns should also be no more than 152 m [500 ft] for production units located within the fully saturated portion of the PZA. The model determined that a distance of 122 m [400 ft] between the perimeter ring monitoring wells and 122 m [400 ft] between these monitoring wells and the production patterns for production units located within the partially saturated portion of the PZA is appropriate. The NRC staff evaluated the distance to and spacing of the perimeter wells to assess the probability of an excursion migrating past the monitoring well ring. For example, in a fluvial environment consistent with the applicant's conceptual model, the width of a channel sand deposit could be a preferred path for fluid migration and be less than 152 m [500 ft]. Therefore, the NRC staff found the applicant's proposed 152 m [500 ft] spacing distance of the perimeter wells in the fully saturated portion of the PZA to be inadequate. The staff has proposed and the applicant has agreed to a license condition that requires a 122 m [400 ft] distance to, and spacing of, the perimeter wells for a wellfield in either the fully or partially saturated portions of the PZA (AUC, 2015).

If excursions are detected in the monitoring well ring, corrective actions to either stop or reverse fluid movement (i.e., excursions) are required. The applicant would need to modify wellfield operations, as necessary, to correct the excursion. As described in SEIS Section 2.1.1.1.3, corrective actions would include increasing sampling frequency to weekly, increasing the pumping rates of production wells in the area of the excursion to increase the net bleed, and pumping individual wells to enhance recovery of solutions. If these actions do not retrieve the excursion within 60 days, the applicant would suspend injection of lixiviant into the production zone adjacent to the excursion until the excursion is retrieved and the upper control limit parameters are no longer exceeded.

Vertical excursions may also occur in aquifers overlying or underlying the production zone aquifer. As described in SEIS Section 3.5.2.3 and illustrated in SEIS Figures 3-17 through 3-22, the PZA is confined by aquitards (the OA and UA Units) across the entire proposed project area. The OA ranges in thickness from 7.6 to 30.5 m [25 to 100 ft] and consists of a laterally continuous sequence of clays and silt. The thickness of the UA ranges from 46 to 76 m

[150 to 250 ft] and consists of a laterally continuous sequence of undifferentiated mudstones and clay. Therefore, the thickness of the OA {7.6 to 30.5 m [25 to 100 ft]} and the UA {46 to 76 m [150 to 250 ft]} would minimize the potential of vertical excursions reaching surrounding aquifers.

The applicant reported two sets of permeability data for the aquitards: one relative to air 4.55×10^{-6} to 9.1×10^{-6} cm/sec [1.3×10^{-2} to 2.6×10^{-2} ft/day] and the other relative to brine 5.46 × 10¯10 to 8.2×10^{-10} cm/sec [1.56×10^{-6} to 2.34×10^{-6} ft/day]. Based on the staff's analysis, the air permeability values likely represent high permeability siltstones in the aquitards. Therefore, assuming the two sets of permeability (one for the mudstones and one for the siltstones in the aquitard), and each set represents 50 percent of the aquitard, the staff estimated a vertical hydraulic conductivity for the aquitards of 3.0×10^{-8} cm/sec [8.6×10^{-5} ft/day]. This low hydraulic conductivity value, which is consistent with the expected rate of groundwater flow through a relatively impermeable clay, would limit the potential impacts of vertical excursions.

Steep hydraulic gradients in which the potentiometric head of the production zone is above that of the overlying or underlying aquifers could also result in a vertical excursion. Potentiometric head measurements in wells within the proposed project area exhibit a consistent downward gradient (AUC, 2012a,b). Therefore, vertical excursions of lixiviant would be more likely to impact aquifers underlying the PZA, such as the UM Unit. Potentiometric head differences between the PZA and the UM Unit vary between 0.6 and 10.8 m [2 and 36 ft], yielding vertical gradients of between 0.02 and 0.26. These vertical hydraulic gradients are low and would further minimize the potential impacts of vertical excursions.

Vertical excursions can be caused by improperly cemented well casings, well casing failures, and improperly abandoned exploration drillholes. The applicant would use its MIT program to mitigate the impacts of potential vertical excursions resulting from borehole failure of injection, production, and monitoring wells (see SEIS Section 2.1.1.1.2). After well installation, the applicant would conduct periodic MITs on each well to check for leaks and cracks in the well casing, as required by WDEQ regulations. Because the MIT program reduces the likelihood of poor well integrity, the impacts from excursions involving failure or damage to a well casing would be SMALL.

As described in SEIS Section 3.4.1.2, within the proposed Reno Creek ISR Project area, former operators drilled approximately 2,665 exploration holes and an additional 215 drill holes are within 0.8 km [0.5 mi] of the proposed project boundary. From 2010 through 2012, the applicant drilled an additional 807 exploration holes. Of these holes, 45 were cased and would remain in place as groundwater monitoring wells. The remaining 762 were plugged and abandoned, in accordance with WDEQ rules and regulations. The applicant has committed to plugging old drill holes and abandoning exploration wells that may be encountered within the proposed project area per WDEQ requirements (AUC, 2012a). In addition, the NRC staff has proposed and the applicant has agreed to a license condition that would require abandonment of all historic drill holes within a wellfield before testing for a wellfield hydrogeologic data package (AUC, 2015). This commitment would ensure that all historic drill holes are properly abandoned before ISR activities at a wellfield are initiated; therefore, any historic drill holes would not be a pathway for lixiviant migration to overlying or underlying aquifers.

In summary, the NRC staff conclude that potential impacts from excursions to groundwater quality in the production zone and surrounding aquifers at the proposed Reno Creek ISR Project during operations would be SMALL because

- the EPA has approved an USDW aquifer exemption for the PZA,
- inward hydraulic gradients would be maintained to ensure groundwater flow is toward the production zone,
- the applicant's NRC-mandated groundwater monitoring plan would ensure that excursions are detected and corrected,
- aquitards confining the production zone have low permeabilities and are of sufficient thickness to minimize the potential vertical migration of lixiviant to overlying and underlying aquifers,
- the applicant would properly plug and abandon or mitigate any previously drilled wells and exploration drill holes that may potentially impact the control and containment of wellfield solutions within the proposed project area, and
- the applicant's required MIT program would mitigate the impacts of potential vertical excursions resulting from borehole failure.

Operations Impacts to Deep Aquifers Below the Production Aquifers

Under the Safe Drinking Water Act (SDWA), EPA has statutory authority to regulate deep disposal well activities that may affect the environment. Underground injection of fluid requires a permit from EPA or from a state UIC program under the SDWA. WDEQ has been authorized to administer the UIC program in Wyoming and is responsible for issuing permits for deep well disposal at the proposed Reno Creek ISR Project. The GEIS concluded that the potential environmental impact of injecting liquid byproduct material into deep aquifers below the ore-bearing aquifers would be SMALL if the aquifers were located below a USDW, if water production from deep aquifers was not economically feasible, or if the groundwater quality from these aquifers would not be suitable for domestic or agricultural uses (e.g., high salinity) and if they were confined above by sufficiently thick and continuous low permeability layers. (NRC, 2009)

The applicant has been authorized by WDEQ to drill, complete, and operate four Class I deep disposal wells and thereby dispose of liquid waste streams into the Upper Cretaceous Teckla and Teapot Sandstones at depths between approximately 2,130 and 2,400 m [7,000 and 7,860 ft] below ground surface (WDEQ, 2015). The Lewis Shale, a low-permeability marine shale with an approximate thickness of 274 m [900 ft] in the proposed project area overlies the target interval (see SEIS Section 3.5.2.2 and SEIS Figure 3-15). The Upper Cretaceous Steele Shale underlies the Teapot and Teckla Sandstones (see SEIS Figure 3-15). The Steele Shale is a low-permeability marine shale member with an approximate thickness of 152 m [500 ft] in the proposed project area (WDEQ, 2015).

As described in SEIS Section 3.5.2.2, Lower Tertiary strata of the Wasatch and Fort Union Formations and Upper Cretaceous strata of the Lance Formation and Fox Hills Sandstone, which overlie the Lewis Shale, are or have the potential to be USDWs. However, as discussed in SEIS Section 3.5.3.1, waters in Upper Cretaceous formations deeper than the Fox Hills Sandstone near the proposed Reno Creek ISR Project area are typically saline (i.e., they have elevated dissolved solids concentrations), which prohibits their use for domestic or municipal water supply. Specifically, concentrations of total dissolved solids in the Teckla and Teapot Sandstones are greater than 3,000 mg/L [3,000 ppm] and cannot reasonably be expected to provide a source of water for domestic, stock, or agricultural use (WDEQ, 2015). Because of their chemical characteristics (i.e., highly saline), the Teckla and Teapot Sandstones do not meet WDEQ requirements for designation as USDWs.

The applicant’s Class I deep disposal well permit includes disposal well construction, operations, and MIT requirements to prevent movement of fluid from the permitted disposal wells into any USDW (WDEQ, 2015). In addition, the UIC permit includes operational monitoring requirements to ensure that the effects of deep disposal wells on surrounding formations is evaluated regularly and appropriate measures are taken in the event of malfunction of the disposal system or noncompliance with permit conditions. Operational monitoring would include continuous monitoring of injection rate and pressure and quarterly monitoring of injectate (waste stream) quality. Finally, the UIC permit stipulates that upon permit expiration or termination or cessation of injection activities, all wells shall be plugged and abandoned in accordance with WDEQ rules and regulations (WDEQ, 2015).

In summary, the NRC staff conclude that impacts to deep aquifers below the production zone from disposal of liquid byproduct material in deep wells during ISR operations would be SMALL because

- the target aquifers for Class I deep disposal wells (i.e., the Teckla and Teapot Sandstones) are confined above and below by sufficiently thick and continuous low-permeability layers,
- groundwater quality in the target aquifers is not suitable for domestic, stock, or agricultural uses (e.g., high salinity), and therefore do not meet WDEQ requirements for designation as USDWs,
- the applicant’s Class I deep disposal well permit includes operational monitoring requirements to ensure that the impact of injection wells on surrounding formations is evaluated regularly and appropriate measures are taken to correct failure of the injection system, and
- upon permit termination, all deep disposal wells would be plugged and abandoned in accordance with WDEQ requirements.

4.5.2.1.3 Aquifer Restoration Impacts

GEIS Section 4.3.4.2.3 describes the potential environmental impact on groundwater resources during aquifer restoration and states the impact is from groundwater consumptive use, excursions and groundwater quality, and waste management practices, including the potential deep disposal of brine slurries from RO. (NRC, 2009)

In general, aquifer restoration continues until the NRC and applicable state requirements for groundwater quality are met. As discussed in GEIS Section 2.5, NRC licensees are required to return wellfield water quality parameters to the standards in 10 CFR Part 40, Appendix A, Criterion 5B(5) or to another standard approved in their NRC license. Potential environmental impacts are affected by the restoration techniques chosen, the severity and extent of the contamination, and the current and future use of the production and surrounding aquifers. Consequently, the NRC staff concluded in the GEIS that the potential environmental impacts of groundwater quantity and quality during restoration could range from SMALL to MODERATE depending on site conditions. Rather than negatively impacting the groundwater quality during aquifer restoration, the water quality would improve as restoration continues. (NRC, 2009)

Aquifer Restoration Impacts to Shallow (Near-surface) Aquifers

As with the operations phase, a network of buried pipelines is used during aquifer restoration for transporting fluids between the pump house and the CPP facility (NRC, 2009). These pipelines are also used to connect injection and production wells to manifolds inside the header houses. However, the fluids transported in these pipelines during aquifer restoration are generally less concentrated than during operations. The potential failure of pipeline fittings or valves, or a failure of or damage to a well casing, could result in leaks and spills that could impact the water quality in shallow aquifers. As discussed in SEIS Section 4.5.2.1.1, the applicant has committed to implementing leak detection and spill prevention-cleanup programs and mitigation measures to detect and limit the potential impacts of leaks and spills in processing facilities, pipeline infrastructure, storage ponds, and wellfields (AUC, 2012a). The applicant has also committed to monitoring shallow aquifers (the SM and OM Units) to detect effects on groundwater from process fluid spills due to pipeline and valve failure (AUC, 2015). In addition, the WDEQ-mandated UIC program would require preventive measures, such as periodic MITs of well casings to detect potential leakage.

Implementation of required leak detection and spill response and cleanup procedures and the applicant's commitments to mitigation measures to detect, control, and minimize potential adverse impacts of spills and leaks in processing facilities, pipeline infrastructure, storage ponds, and wellfields would reduce potential effects to shallow aquifers. Therefore, the NRC staff conclude that impacts to shallow (near-surface) groundwater during the aquifer restoration phase of the proposed project would be SMALL.

Aquifer Restoration Impacts to Production and Surrounding Aquifers

As described in SEIS Section 2.1.1.1.4, the applicant is planning three phases of aquifer restoration: groundwater sweep, groundwater transfer, and groundwater treatment. The groundwater treatment involves RO with permeate injection and reductant addition. The actual restoration sequence would be based on operating conditions. The applicant would conduct aquifer restoration concurrently with ISR operations: as each production wellfield ceases operations, aquifer restoration would commence, even while other production units are still in recovery (per the phased approached as described in SEIS Section 2.1.1) (AUC, 2012b). The proposed aquifer restoration process would begin following the permanent cessation of lixiviant injection, continuing through active restoration and postrestoration stability monitoring, and concluding with NRC and WDEQ approval of successful restoration for each production unit.

<u>Water Consumptive Use</u>

The potential environmental impact to groundwater in the production and surrounding aquifers during aquifer restoration is related to consumptive groundwater use and groundwater quality. Hydraulic control of the former production zone during each restoration phase would be maintained by establishing an inward hydraulic gradient through restoration bleed. During concurrent production and aquifer restoration of the production units, the average total bleed would increase to as much as 1.2 percent of the lixiviant flow (AUC, 2012b). Thus, water consumption during concurrent production and restoration of the production units would be slightly higher than during production alone. During aquifer restoration only, the average bleed rate is expected to be 9 percent (AUC, 2012a). However, due to lower flow rates during aquifer restoration, the consumption rate would be less than the consumption rates incurred during the production only and concurrent production and aquifer restoration phases. During concurrent production and aquifer restoration, the applicant estimates that the groundwater restoration flow rate would include 3,785 Lpm [1,000 gpm] from the wellfields in the groundwater treatment stage and 189 Lpm [50 gpm] in the groundwater sweep stage. After flowing through the ion exchange columns, the restoration RO units would receive 3,785 Lpm [1,000 gpm]. The secondary RO unit would receive (i) the remaining 189 Lpm [50 gpm] and (ii) 435 Lpm [115 gpm] of the waste stream from the production circuit. All permeate generated by RO and secondary RO units would be injected into the wellfields undergoing groundwater treatment. Combining the two permeate streams would result in a less than 10 percent bleed rate (AUC, 2012a). When all the production units have been depleted and only groundwater restoration activities are occurring, the applicant estimates that the flow rate would include 3,785 Lpm [1,000 gpm] from the wellfields in the groundwater treatment stage and 189 Lpm [50 gpm] from the wellfields in the groundwater sweep stage. The RO unit would receive 3,785 Lpm [1,000 gpm] while the secondary RO unit would receive 984 Lpm [260 gpm]. All of the permeate generated by the restoration and secondary RO units would be injected into the wellfields undergoing groundwater treatment. About 38 Lpm [10 gpm] is estimated to be withdrawn from the CPP water supply well at times when only groundwater restoration is occurring.

As discussed in SEIS Section 4.5.2.1.2, the applicant evaluated the impact of concurrent production and restoration operations on surrounding wells using a groundwater model that assumed a (i) maximum projected extraction rate of 41,640 Lpm [11,000 gpm]; (ii) 1 percent production bleed; and (iii) restoration bleed rate between 3 and 9 percent (AUC, 2012b). Results of the modeling indicated a simulated drawdown of approximately 1.5 m [5 ft] or more extending several miles beyond the proposed project area in response to concurrent ISR production and aquifer restoration. Much of the drawdown extended into the fully saturated and more confined portions of the PZA where there is greater available head. The model results were based on the maximum proposed extraction volume of 41,640 Lpm [11,000 gpm] and therefore the regional drawdown represented a conservative evaluation of regional effects (AUC, 2012b). However, as described previously, when all the production units have been depleted and only groundwater restoration activities are occurring, estimated extraction volumes would decrease to 3,785 Lpm [1,000 gpm] from the wellfields in the groundwater treatment stage and 189 Lpm [50 gpm] from the wellfields in the groundwater sweep stage. Consequently, potential drawdown in wells within and surrounding the production zone during aquifer restoration would be less than during concurrent production and aquifer restoration.

After production and aquifer restoration are completed and groundwater withdrawal ceases at the proposed project, the groundwater levels in the PZA would recover with time as a result of natural recharge (NRC, 2009). The time it would take for groundwater levels in the production zone to recover is dependent on the hydraulic properties of the aquifer (e.g., permeability and transmissivity) and can be predicted based on numerical modeling. The applicant's groundwater model predicted 2.13 to 3.35 m [7 to 11 ft] of residual drawdown within the proposed project area 5 years after aquifer restoration is completed (AUC, 2012b). However, as described in SEIS Section 4.5.2.1.2, results of the NRC staff's revisions to the applicant's groundwater model predicted greater maximum drawdown in the production units. Therefore, the applicant's predicted residual drawdown {2.13 to 3.35 m [7 to 11 ft] 5 years after aquifer restoration is complete} could underestimate the time it would actually take for groundwater levels in the PZA to recover.

In summary, because estimated extraction volumes from the wellfields would decrease during aquifer restoration, potential drawdown in wells within and surrounding the production zone during aquifer restoration would be less than during concurrent production and aquifer restoration. However, considering the difference between the applicant's and the NRC staff's estimates for drawdown, the NRC staff find that the potential impact from groundwater consumptive use during aquifer restoration at the proposed Reno Creek ISR Project could be MODERATE. As described in SEIS Section 4.5.2.1.2, the applicant has proposed and committed to mitigation measures to reduce the potential impacts on consumptive use of groundwater. Consistent with Regulatory Guide 4.14 (NRC, 1980), the applicant would measure water levels in domestic and stock wells within 2 km [1.2 mi] of the wellfields before operations and every 3 months during operations to evaluate the impacts on groundwater (AUC, 2012a). If significant impacts to either domestic or stock wells are observed, the applicant has proposed to (i) lower the pump level in the wells, if possible; (ii) deepen the wells, if possible; or (iii) replace the wells with new wells completed in aquifers that are not impacted by wellfield operations (AUC, 2012a). In addition, if future development within the proposed project area includes an area(s) where a stock well is located in the PZA, the applicant has committed to (i) replacing the wells with new wells completed in either shallower or deeper aquifers that are not impacted by ISR operations or (ii) providing another source of stock water. Implementation and adherence to these mitigation measures would limit any adverse impacts from consumptive use of groundwater. Therefore, the NRC staff conclude that the potential impact from groundwater consumptive use during aquifer restoration would be SMALL.

Excursions and Groundwater Quality

The potential impacts to water quality of the PZA as well as overlying and underlying aquifers during aquifer restoration would be less than from operations because no lixiviant would be used during aquifer restoration. The potential for vertical and horizontal excursions during aquifer restoration would be similar to those described for the operations phase. However, the magnitude of impacts would be less because the injection and recovery rates would be lower during aquifer restoration than during operations, the addition of lixiviant would have ceased, and water quality in the PZA would improve throughout active aquifer restoration.

As described in SEIS Section 2.1.1.1.4, the applicant would implement a restoration monitoring plan to detect and correct horizontal and vertical excursions and to determine whether water quality has been restored to the NRC's restoration standards. In addition, continued implementation of the applicant's leak-detection and spill prevention-cleanup program and preventive measures, such as periodic MIT of well casings, would ensure that potential impacts to surrounding aquifers are SMALL. Moreover, restoration of the production aquifer in compliance with WDEQ and NRC requirements would ensure that groundwater within the exemption boundary would not threaten surrounding groundwater.

In summary, the potential impacts to water quality of the PZA as well as overlying and underlying aquifers during aquifer restoration would be less than from operations because no lixiviant would be used during aquifer restoration. The NRC review and approval of the wellfield restoration plan would ensure that the NRC's restoration standards are met and that they are protective of public health and the environment. Therefore, the NRC staff conclude that the impacts to groundwater quality in production zone and surrounding aquifers from aquifer restoration at the proposed Reno Creek ISR Project would be SMALL.

Aquifer Restoration Impacts to Deep Aquifers Below the Production Aquifers

As discussed in the GEIS, underground disposal of waste streams into deep aquifers requires a permit from EPA or the authorized state. The deep aquifers suitable for disposal must have poor water quality, have low water yields, or be economically infeasible for production. They also need to be hydraulically separated from overlying aquifer systems. Under these conditions, the potential environmental impacts would be SMALL. (NRC, 2009)

In SEIS Section 4.5.2.1.2, the NRC staff assessed the potential environmental impacts from disposal of liquid byproduct material into deep aquifers below the production zone at the proposed Reno Creek ISR Project during operations. The staff concluded that potential impacts to deep aquifers below the production zone from deep well disposal would be SMALL because

- The proposed target aquifers for Class I deep disposal wells at the proposed project (i.e., the Teckla and Teapot Sandstones) are confined above and below by sufficiently thick and continuous low-permeability layers,

- Groundwater quality in the target aquifers is not suitable for domestic, stock, or agricultural uses due to high salinity, and therefore do not meet WDEQ requirements for designation as USDWs, and

- The applicant's Class I deep disposal well permit includes operational monitoring requirements to ensure that the impact of the deep disposal wells on surrounding formations is evaluated regularly and appropriate measures are taken in case of malfunction of the disposal system or noncompliance of permit conditions.

Consequently, the NRC staff conclude that the potential environmental impacts from Class I deep well disposal of brine slurries from RO on deep aquifers below the production zone during aquifer restoration would be SMALL.

4.5.2.1.4 Decommissioning Impacts

In the GEIS, the NRC staff noted that the environmental impacts to groundwater during dismantling and decommissioning of ISR facilities are primarily associated with consumptive use of groundwater, potential spills of fuels and lubricants, and well abandonment. The consumptive groundwater use could include water use for dust suppression, revegetation, and reclamation of disturbed areas. The potential environmental impacts during the decommissioning phase are expected to be similar to potential impacts during the construction phase. Groundwater consumptive use during the decommissioning activities would be less than groundwater consumptive use during ISR operations and groundwater restoration activities. Spills of fuels and lubricants during decommissioning activities could affect shallow aquifers. Implementation of BMPs during decommissioning can help to reduce the likelihood and magnitude of such spills. Based on consideration of best management practices to minimize water use and spills, impacts to the groundwater resources in shallow aquifers from decommissioning would be SMALL. (NRC, 2009)

The applicant would continue to implement a spill prevention-cleanup program to reduce the potential impacts of spills of fuels and lubricants during decommissioning (AUC, 2012a). The applicant would implement mitigation measures to control erosion and stormwater runoff that could impact shallow aquifers. The applicant's WYPDES permit requirements, which limit discharge volumes and prescribe concentration limits to discharged water, would ensure that stormwater runoff would not contaminate shallow groundwater.

After ISR operations are completed, improperly abandoned wells could affect aquifers above the production aquifer by providing hydrologic connections between aquifers. As part of the restoration and reclamation activities, all monitoring, injection, and production wells would be plugged and abandoned in accordance with the WDEQ requirements (see SEIS Section 2.1.1.1.5). In addition, the applicant would submit decommissioning plans, including detailed plans for plugging and abandoning wells to the NRC for review and approval. If this process is properly implemented and the abandoned wells are properly isolated from the flow domain, the environmental impacts to groundwater in the production zone and surrounding aquifers and deep aquifers used for liquid waste disposal during the decommissioning phase would be SMALL.

4.5.2.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, a license authorizing operation of an ISR facility would not be issued; therefore, construction and operation of the facility would not occur and aquifer restoration and decommissioning would not be needed. Consumptive use of groundwater would not occur. Liquid byproduct material would not be generated; therefore, there would be no threat to groundwater quality. Historic and exploration wells that have already been constructed would be plugged and abandoned to prevent potential degradation and contamination (AUC, 2012a). The current land uses on and near the project area, including grazing lands and recreational activities, would continue. Consequently, the No-Action Alternative would result in no impacts to groundwater.

4.6 <u>Ecological Impacts</u>

The proposed project could affect the ecology of the proposed Reno Creek ISR Project area, including both flora and fauna. The NRC reported in GEIS Section 4.3.5 that these effects could occur during all phases of the ISR facility life cycle (NRC, 2009). In general, effects could include removal of vegetation from the site and an increased risk of soil erosion and weed invasion); modification of existing vegetative communities as a result of site activities; loss of sensitive plants and habitats; and the potential spread of invasive species and noxious weed populations. Effects to wildlife could include loss, alteration, and/or incremental fragmentation of habitat; reduction in forage; displacement of and stresses on wildlife; and direct or indirect mortalities. Aquatic species could be affected by disturbance of stream channels, increases in suspended sediments, fuel spills, and habitat reduction. Potential environmental impacts to ecological resources from construction, operations, aquifer restoration, and decommissioning from activities associated with the proposed Reno Creek ISR Project and the No-Action Alternative are provided in the following sections.

4.6.1 Proposed Action (Alternative 1)

The staff's ecological impact analysis for the proposed Reno Creek ISR Project involved evaluating interactions between the proposed project activities and the local animals and habitat that could be affected by the proposed project. Typical ISR facility life cycle phases (construction, operations, aquifer restoration, and decommissioning) can have direct and indirect impacts on local habitat and wildlife populations. As described in Chapter 9 of this SEIS, these potential impacts are both short term (lasting until successful reclamation is achieved) and long term (persisting beyond successful completion of reclamation). If an applicant or licensee adheres to recommended BMPs from appropriate agencies, the potential ecological impacts could be mitigated. The NRC staff correspondence with the applicant and state and federal agencies was ongoing throughout the SEIS development process for the proposed project and is described in Appendix A. If new information is received before the final SEIS is issued, Appendix A will be updated with that information.

The potential environmental impacts and related mitigation measures for ecological resources for the proposed project and alternative are discussed in the following sections.

4.6.1.1 Construction Impacts

The potential impacts to ecological resources, specifically for vegetation and wildlife (including protected species) during construction as a result of the proposed project would be consistent with the findings described in the GEIS, and are summarized in the following sections.

The terrestrial ecology of the proposed Reno Creek ISR Project area is discussed in SEIS Section 3.6.1. Potential impacts to terrestrial vegetation and wildlife, including protected species, from construction of the proposed project are described in this section.

Construction Impacts on Vegetation

As discussed in GEIS Section 4.3.5.1, during construction, terrestrial vegetation may be affected through (i) removal of vegetation from the milling site (and associated reduction in wildlife habitat and forage productivity and an increased risk of soil erosion and weed invasion); (ii) modification of existing vegetative communities; (iii) loss of sensitive plants and habitats as a result of clearing and grading; and (iv) potential spread of invasive species and noxious weed populations (NRC, 2009). The percentage of vegetation removed and land disturbed by construction activities evaluated in the GEIS (from less than 1 percent up to 20 percent) would cause a SMALL impact compared to the total permit area and surrounding plant communities. The GEIS evaluated ISR facilities that ranged in facility size from 1,000 to 7,000 ha [2,471 to 17,297 ac] with disturbed area estimates of 49 to 753 ha [120 to 1,860 ac]. Additionally, the NRC staff concluded in the GEIS that clearing of herbaceous vegetation in an open grassland or shrub steppe community would be expected to have a short-term SMALL impact if active revegetation measures are used, given the rapid colonization of annual and perennial species in the disturbed areas. The clearing of wooded areas could have a long-term impact given the pace of natural succession, and such impacts could range from SMALL to MODERATE, depending on the amount of surrounding woody areas. Invasive plant species and noxious weeds may invade areas disturbed by construction, but would be expected to be controlled with appropriate spraying techniques, and therefore impacts would be SMALL. (NRC, 2009)

The applicant estimates that for the proposed Reno Creek ISR Project, the total amount of soil and vegetation disturbed during all phases of ISR activities would be approximately 62.4 ha [154.3 ac] (AUC, 2014a). During the construction phase, approximately 54.28 ha [134.14 ac] of previously undisturbed vegetation would be disturbed. SEIS Table 4-6 provides the land disturbance by vegetation type (as well as water coverage and previously disturbed land amounts) during the construction phase. SEIS Figure 4-1 depicts the proposed wellfield locations in relation to the vegetation communities. The applicant proposes constructing up to 15 sequentially phased production units (production wellfields) (AUC, 2012a), with 1 to 7 wellfields in each production unit (see SEIS Chapter 2 for more information on the phased approach). However, according to the proposed project schedule (SEIS Table 2-1), no more than 6 out of the 15 production units would be under construction at the same time, reducing the amount of surface area disturbed at any one time.

Topsoil stripping, excavation, backfill, compaction, grading, utility and pipeline trenching, increased traffic, and storage areas associated with construction activities would result in direct and indirect impacts to vegetation. These potential impacts include: an increased potential for nonnative species invasion establishment, shifts in species composition; changes in vegetative density; soil erosion; changes in visual aesthetics; reduction of wildlife habitat; reduction in livestock forage, and expansion from invasive and noxious species found within the proposed project area that include Canada thistle, Russian olive, field bindweed, Japanese brome, and cheatgrass (see SEIS Section 3.6.1.1). Secondary and tertiary access roads would be constructed for access to the facilities and production units (AUC, 2012a), which would directly impact vegetation by clearing and grading activities. Areas along pipelines and adjacent to roads, the CPP, impoundments, and well pads would experience soil compaction from heavy equipment and vehicular traffic, making it more difficult for vegetation to reestablish.

Cheatgrass, in particular, is a growing threat for Wyoming sagebrush habitats because of its ability to change fire and vegetation patterns (WGFD, 2010). Cheatgrass is the dominant introduced (nonnative) annual grass in the meadow grassland and breaks grassland plant communities in the proposed project area and was observed at almost all baseline vegetation sample locations(AUC, 2012a).

The potential impacts to vegetation during the construction phase of the proposed project would be mitigated by the applicant’s commitment that employees would use only existing and proposed roads in the proposed project area to minimize vegetation impacts from increased traffic (AUC, 2012a). In addition, the applicant has committed to using common corridors for the locations of access roads, pipelines, and utilities, and to minimize secondary and tertiary access road widths as practicable (AUC, 2012a, 2014a). WDEQ requires that mine operations include temporary seeding for reclamation during the first spring or fall with WDEQ-approved seed mixes (WDEQ, 2006). The applicant has committed to reseed areas where topsoil has been removed during construction, typically within one construction season, using a WDEQ-approved seed mixture (AUC, 2012a). The NRC staff expect that rapid reseeding would restore most vegetative cover within the first growing season (NRC, 2009). Some native plant populations bordering disturbed areas can also be expected to spread into those disturbed areas, which would facilitate the revegetation process. Once permanent revegetation efforts are complete, it would likely require 2 to 4 years for grasses to be reestablished, but it could take 10 or more years for mature shrub communities to be reestablished (Connelly et. al, 2004; BLM, 2010; 2015). Sagebrush shrubland, the largest vegetation type within the proposed project area, can be particularly slow to reestablish. Consequently, preconstruction vegetation communities and subcommunities (i.e., shrub-steppe) may be different than post-construction communities (i.e., grass dominated) for several years, or possibly decades, which could alter the composition and abundance of both plant and wildlife species in the area (BLM, 2010).

Table 4-6. Disturbed Land by Vegetation and Other Land Cover Types for the Proposed Reno Creek ISR Project During Construction					
Big Sagebrush Shrubland Hectares [Acres]	**Upland Grassland Hectares [Acres]**	**Meadow Grassland Hectares [Acres]**	**Breaks Grassland Hectares [Acres]**	**Water Hectares [Acres]**	**Previously Disturbed/ Developed Land Hectares [Acres]**
47.4 [117.1]	2.5 [6.1]	3.7 [9.2]	0.7 [1.74]	0.06 [0.15]	4.45 [1.8]
Source: AUC, 2014a					

The impact from the construction phase of previously undisturbed vegetation (primarily in the big sagebrush shrubland vegetation community) would affect approximately 54.28 ha [134.14 ac], or about 2.2 percent of the proposed project area. Construction of wellfields would be phased; therefore, not all of the impacts would occur at the same time. The applicant estimates that constructing the buildings, initial wellfields, and waste disposal systems for the proposed Reno Creek ISR Project would take approximately 9 years (SEIS Figure 2-1). However, vegetation could still experience impacts from construction for a longer duration (10 or more years), especially within the sagebrush shrubland communities. The applicant has committed to revegetation measures that would reduce the overall impacts. Because the applicant has committed to revegetation measures, the NRC staff conclude that construction impacts on vegetation from the proposed project would be SMALL. Reestablishment of native shrub species could be hindered by yearlong grazing pressure. Large ungulates (i.e., wild and domestic animals with hooves) are attracted to more succulent, younger plants and they often concentrate in newly seeded locations during the critical early-growth stage. The NRC staff recommend that the applicant apply mitigations such as fencing off areas with young vegetation, which would reduce these types of disturbances where possible. In addition, WGFD recommended to control cheatgrass (McMahan, 2013a,b) by ensuring that earth moving equipment is cleaned prior to entering the site, obtaining weed-free seed mix products, conduct spot treatment of invasive species with a WDEQ-approved herbicide, and implementing a WDEQ-approved vegetation monitoring program (AUC, 2014a). The NRC staff further recommend that the applicant consider using seed mixes for revegetation that benefit pollinators, birds, and other wildlife. These additional recommended mitigations could further reduce impacts to ensure that the potential impacts to vegetation remain SMALL.

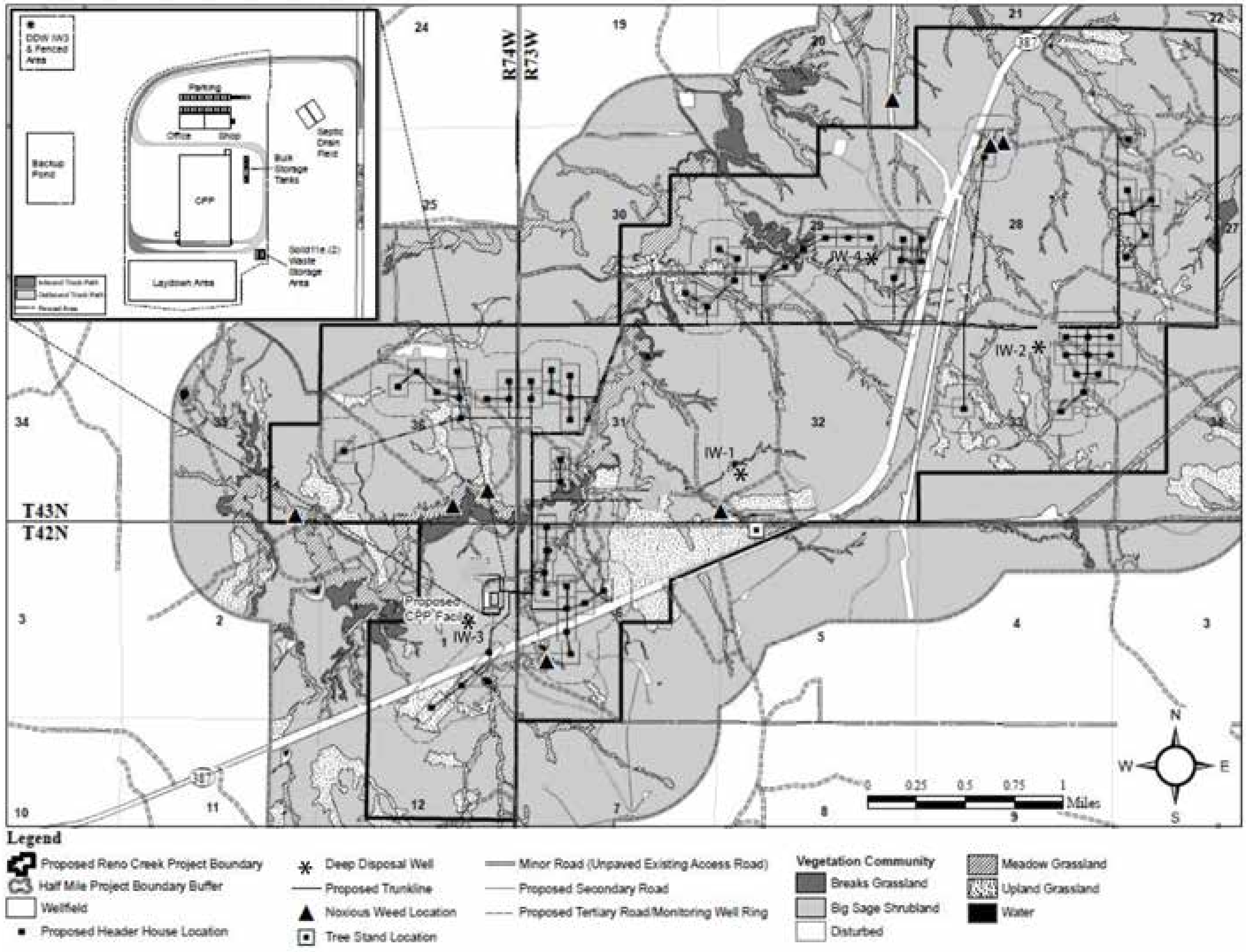

Figure 4-1. Map of Proposed Reno Creek ISR Project Facilities and Vegetation Communities (AUC, 2014a, 2016)

As discussed in SEIS Section 3.6.3, no federally listed threatened or endangered plant species or critical habitat are known to occur within the proposed project area. Therefore, the NRC staff conclude that there would be no effect on federally listed plant species during the construction phase, and thus, potential impacts on these species would be SMALL.

Construction Impacts on Wildlife

The GEIS evaluation of impacts during construction included terrestrial wildlife that may be affected through (i) habitat loss or alteration and incremental habitat fragmentation, (ii) displacement of wildlife from project construction, and (iii) direct and/or indirect mortalities from project construction. These impacts could result from noise and dust generated during construction, increased presence and activities of workers, and construction of above-ground power lines. The NRC staff noted in the GEIS that construction impacts to wildlife habitat would be minimized by timely reseeding of disturbed areas following construction. In general, wildlife would be expected to disperse from the proposed project area as construction activities begin, although smaller, less mobile species could perish during clearing and grading. Habitat fragmentation, temporary displacement, and direct or indirect mortalities would be possible; thus, the potential impact on terrestrial wildlife from construction could range from SMALL to MODERATE. (NRC, 2009)

As previously stated, certain vegetative communities in the proposed project area could be difficult to reestablish, which would affect approximately 54.28 ha [134.14 ac] of wildlife habitat in the proposed project area, or about 2.2 percent of the proposed project area. Consequently, wildlife species associated with specific habitats, such as grasslands and big sagebrush, could be reduced in number or replaced by generalist species with more generic habitat requirements until reseeding of certain vegetation occurs or reclamation matures to its preconstruction vegetation type. Wildlife species associated with habitat types within the project area are provided in SEIS Table 3-14. The primary habitats for the majority of wildlife species observed during baseline wildlife surveys in the proposed project area are the big sagebrush shrubland and upland grassland communities.

Most of the effects to wildlife from construction of the proposed Reno Creek ISR Project would be due to habitat-related disturbances, such as habitat alteration, fragmentation, or increased competition for and reduction of the approximately 54.28 ha [134.14 ac] of available land that would be disturbed. Direct effects such as injuries or mortality to individual animals and removal of wildlife habitat during construction would occur during topsoil stripping, trenching, excavating, backfilling, compacting, grading, and building construction. Construction of the CPP facilities (e.g., the CPP building, ancillary buildings, backup pond, parking area, laydown area, and storage areas), the initial production wellfield and associated wellfield infrastructure, access roads, deep disposal wells, backup storage pond, mud pits, and pipelines would be expected to take 9 to 12 months to complete (SEIS Figure 2-1) (AUC, 2012a). Construction of subsequent production wellfields is expected to be completed by the end of year 8 (SEIS Figure 2-1). Direct effects could include increased mortality of wildlife from traffic collisions and encounters with humans. Indirect effects, such as displacement, loss of forage, erosion, and changes in predator/prey populations, could result from clearing and grading, increased noise, traffic, dust, or other disturbances associated with the construction activities of the proposed project. Fugitive dust could be generated from travel on unpaved roads and bare land (see fugitive dust analysis in SEIS Sections 4.7.1.1 and 4.7.1.2). Fugitive dust could increase localized air and visual disturbances to wildlife and settle on plants, making them unpalatable to wildlife. Indirect effects due to vegetation alteration affecting wildlife habitat typically persist longer than direct effects to individual animals due to the length of time (months to decades depending on the type of plant community) required for vegetation to reestablish and become habitable.

Specific effects on groups of wildlife (e.g., mammals, birds, reptiles and amphibians, and aquatic species) are discussed in the following sections.

Mammals

Big Game

Pronghorn antelope and mule deer were the only two big game species observed during the applicant's baseline wildlife surveys and are the most likely big game species to be impacted by the proposed project. The proposed project area provides nonessential winter and yearlong range to pronghorn antelope and yearlong range for mule deer. No other big game species are expected to be present in the proposed project area (BLM, 2015). No crucial big-game habitats or migration corridors are recognized by the WGFD within the proposed project area or the surrounding 1.6-km [1-mi] perimeter (see SEIS Section 3.6.1.2.1).

As previously stated, most impacts to wildlife would be from habitat-related disturbances as a result of construction related activities, increased traffic, and human encounters. The following paragraphs address specific construction impact considerations for big game. The winter and yearlong range carrying capacity for pronghorn antelope and the yearlong range carrying capacity for mule deer within the proposed project area could be impacted during the construction phase of the proposed project due to the loss of forage and habitat of approximately 54.28 ha [134.14 ac], or 2.2 percent of the proposed project area. There would be no direct effects on big game crucial habitat, critical or key winter or summer ranges, or migration corridors. However, white-tailed deer and elk could be indirectly affected during construction by displaced pronghorn antelope and mule deer populations that move from the proposed project area into offsite habitat. Adequate habitat for pronghorn antelope and mule deer exists in the surrounding area, and big game could return to the affected project areas once vegetation is restored and the areas become productive enough to support big game. In addition to loss of forage, accidental spills from drilling fluids, muds from well drilling, and lubricants and hydrocarbons from equipment and refueling during construction could directly affect the vegetation, making in unpalatable to animals, in the immediate area of the spill temporarily until spill response and cleanup activities are completed.

The applicant has committed to implementing mitigation measures such as reduced speed limits to reduce the risk of vehicular collision and resulting potential big game mortalities. Reducing speed limits would also reduce fugitive dust on unpaved roads. The applicant has committed to apply water or chemical dust suppressant to control fugitive dust emissions from unpaved roads (AUC, 2014a). The applicant has committed to using common corridors to locate access roads, pipelines, and utilities, and to minimize secondary and tertiary access road widths as practicable (AUC, 2012a, 2014a). In addition, the applicant has committed to ensuring the use of existing and proposed roads where possible to avoid altering or disturbing habitat and wildlife movement patterns (AUC, 2012a). The applicant's proposed phased approach to wellfield development would limit the effects on the movement of big game through the proposed project area. The phased construction approach would also reduce the effects of habitat loss by reducing the amount of habitat affected at one time. The applicant has committed to reseeding areas where topsoil would be removed during construction (AUC, 2012a), which would provide big game with grass and forage within a few years of habitat disturbance. The applicant has committed to implement a spill prevention and cleanup plan prior to construction activity (AUC, 2012b), which would ensure that accidental spills do not significantly affect wildlife. Furthermore, as stated in the GEIS, big game are highly mobile species that would likely travel to suitable habitat near the proposed project area during the construction phase (NRC, 2009). The mitigation measures previously described that the applicant has committed to would reduce the impacts on big game to be SMALL.

Small and Medium-sized Mammals

As described in SEIS Section 3.6.1.2.2, a variety of small- and medium-sized mammals could potentially be present within the proposed Reno Creek ISR Project area. These include a variety of predators and furbearers, such as coyote, red fox, raccoon, bobcat, badger, beaver, and muskrat. Prey species observed during the applicant's field surveys included badgers, muskrat, jackrabbits, and cottontails. These species are cyclically common and widespread throughout the region and are important food sources for raptors and other predators such as foxes. Bats are unique small mammals in that they fly and are discussed later in this section.

As previously stated, habitat related disturbances, increased traffic, and human encounters, would affect wildlife the most from construction related activities. The following paragraphs address specific construction impact considerations for small and medium-sized mammals. As discussed previously for big game, small- to medium-sized mammals (e.g., coyotes, foxes) could be temporarily displaced to other habitats during construction activities. However, direct mortalities could be higher for smaller mammal species (e.g., voles, ground squirrels, mice) than for other wildlife because of the likelihood they would retreat into burrows if disturbed and thus potentially be killed by vehicles, topsoil scraping, or staging activities. Small- and medium-sized mammal species do have higher reproductive potential than large wildlife species that require large home ranges and occur in lower densities (i.e., large mammals) thereby making smaller species less vulnerable to habitat loss (BLM, 2009). However, the NRC staff anticipate that the proposed project area will not be uninhabitable when construction ends, and some animals may return to their previously occupied habitats (NRC, 2009).

As previously described, the applicant has committed to revegetating disturbed areas, driving on existing and proposed roads, and adhering to mandated spill recovery procedures. These measures would reduce potential impacts on small- and medium-sized mammals. Because small- and medium-sized mammals repopulate quickly and require smaller habitats, construction activities are not expected to significantly affect these species' populations within the proposed project area. A smaller percentage of small- and medium-sized mammals compared to big game species are likely to move to suitable habitat near the proposed Reno Creek ISR Project area during construction. However, the NRC staff expect that the area will not be uninhabitable when construction ends; therefore, the potential impact to small and medium-sized mammals from construction of the proposed Reno Creek ISR Project would be SMALL. Potential construction impacts to specific ESA and FWS species of concern, such as black-tailed prairie dogs (*Cynomys ludovicianus*) are discussed later in this section.

Bats

Although, as explained in SEIS Section 3.6.1.2.2, the applicant did not conduct bat surveys as part of the baseline wildlife surveys, habitat within the proposed project area is favorable for bats. No bats were observed during the applicant's baseline wildlife surveys; however, these species may be easily overlooked because they are not usually observed during daytime survey methods, which is when the applicant conducted baseline wildlife surveys for the proposed project area. Bats often roost in deep crevices or under bridges and culverts, which are also difficult to survey. These species may be attracted to the applicant's proposed storage ponds and structures.

As previously stated, most effects to wildlife from construction related activities would be from habitat-related disturbances, increased traffic, and human encounters. Specific construction impact considerations for bats include the potential for direct effects from loss and modification of habitat and increased mortality from decreased water quality (WGFD, 2005a). Habitat loss could occur from construction activities in areas near rocky outcrops where bats could be present. Negative effects on water quality could occur from construction activities along drainages and either artificial or natural stream beds or wetlands. Applicant commitments previously described for the phased construction approach and revegetation would limit the loss of bat habitat. In addition, the applicant's commitment to use existing roads where possible would reduce the possibility of disturbing ground-level bat habitat. Because bats are highly mobile animals, construction activities are not expected to significantly affect bat populations within the proposed project area. Consistent with the GEIS findings, the NRC staff anticipate that some individual animals would likely move to suitable habitat near the proposed Reno Creek ISR Project area during construction and that the proposed project area would be habitable after construction ends (NRC, 2009). Therefore, the proposed project would have a SMALL impact on bats. Potential construction impacts to the Northern long-eared bat (*Myotis septentrionalis*) are further discussed later in this section.

<u>Raptors</u>

As described in SEIS Section 3.6.1.2.3, the applicant reported several raptor species observed during baseline wildlife surveys including golden eagle (*Aquila chrysaetos),* ferruginous hawk (*Buteo regalis),* red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), and northern harrier (*Circus cyaneus*). Ferruginous hawk, Swainson's hawk, and red-tailed hawk are the only raptor species that have been reported to nest within the proposed project area (BLM, 2014; AUC, 2012a), and individual ferruginous hawks were occasionally observed soaring and foraging during baseline wildlife surveys (AUC, 2012a). Raptor species of concern in Campbell County that could occur at the proposed project area are listed in SEIS Table 3-15. SEIS Figure 4-2 depicts the raptor nests in relation to construction activities planned for the proposed Reno Creek ISR Project. As shown in SEIS Figure 4-2, two inactive ferruginous hawk nests are located within the proposed project area close {less than 0.2 km [0.12 mi]} to proposed secondary and tertiary roads associated with two of the production wellfields. BLM reported in 2013 that the condition of these two nests were fair and poor (BLM, 2014).

As previously stated, most impacts to wildlife would be from habitat-related disturbances as a result of construction related activities, increased traffic, and human encounters. Potential impacts to raptors from the construction of the proposed Reno Creek ISR Project include indirect effects such as nest desertions or reproductive failure as a result of increased presence of humans and noise from traffic and construction activities; and temporary reductions in prey populations. Some raptors may continue to use nests as they acclimate to the proposed project construction activities and could return to inactive nests within the proposed project area. Direct effects could include destruction of nests and deaths from collisions with traffic and equipment. Presence and construction of power lines may also result in direct and indirect effects. Avian collision and electrocution with overhead power lines, a direct effect, could occur year-round throughout the life of the proposed project. Indirect effects from overhead power lines on

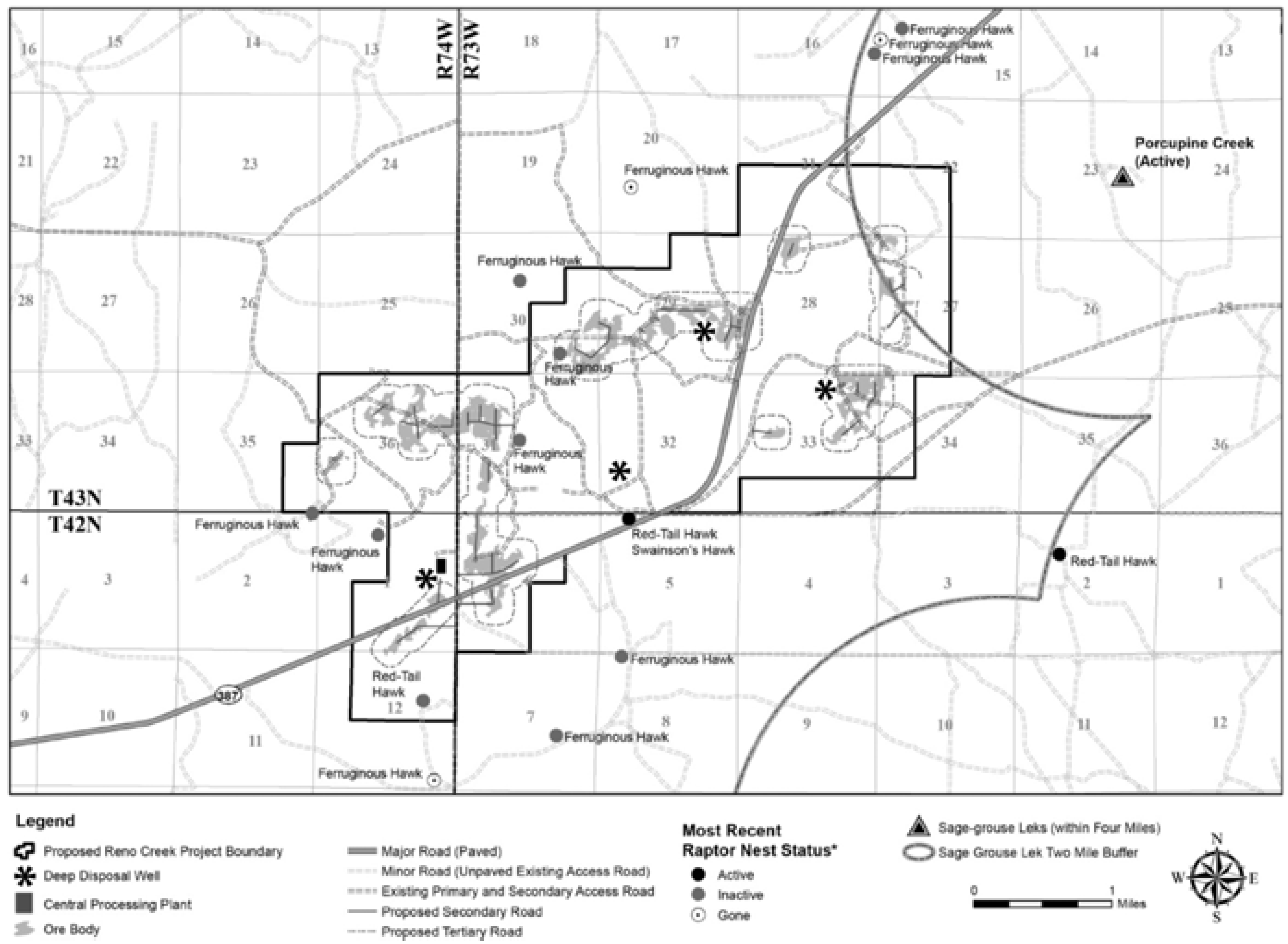

Figure 4-2. Map of Raptor Nest and Sage-Grouse Lek Locations and Proposed Facilities in the Proposed Reno Creek ISR Project Area (AUC, 2014a, 2016; BLM, 2014)

raptors could include nesting disruption and displacement of prey species, which may reduce food availability within the area. The NRC staff anticipate that these indirect effects to raptors from overhead power lines would affect a broader group of avian and mammal species than collisions or electrocutions of avian species alone.

Although the ferruginous hawk nests surveyed in the proposed project area are reported as inactive, ferruginous hawks infrequently build new nests and prefer to repair and reuse old nests (Neal, 2010). Ferruginous hawks may also return to their previous nesting territory even though their previously used nests have been removed or destroyed (Neal, 2010). Effects from construction activities on individual ferruginous hawks would be lower in the proposed project area compared to a higher potential if the nests were active. However, should construction affect any raptor species constructing a nest or returning to an inactive nest during its respective breeding season, direct and indirect impacts could occur.

The applicant has been in routine contact with WGFD regarding avian mitigation measures and has committed to prepare a detailed preoperational plan that reflects mitigation measures outlined by the WGFD for oil and gas development (AUC, 2014b). The applicant has also committed to conduct annual raptor nest surveys during the breeding season (AUC, 2012a). The WDEQ describes the necessary measures an applicant must take to obtain a permit to mine, including consulting with U.S. Fish and Wildlife Services (FWS) if mine activities could potentially affect the nest of any raptor species (WDEQ, 1994). As also required by WDEQ (2000) rules and regulations Chapter 2, Section 1(f), the applicant must consult with both the WGFD and FWS prior to submission of the permit to mine application and incorporate mitigation plans resulting from consultations into the permit to mine application. The applicant has committed to acquire appropriate permits and provide mitigations in accordance with FWS requirements if an active raptor nest needs to be disturbed (AUC, 2012a). The applicant has committed to mitigation measures to limit noise and vehicular traffic (AUC, 2012a) during the construction phase of the proposed project, which will limit potential impacts for all birds. The applicant has committed to use existing power line infrastructure where possible to minimize the construction of new overhead power lines (AUC, 2014a). In addition, the applicant has committed to mitigation measures to follow guidelines suggested by the Avian Power Line Interaction Committee (APLIC, 2006), which would reduce overall impacts to all birds, including raptors (AUC, 2014a). For example, constructing new overhead power lines and retrofitting old power lines with a 150-cm (60-in) distance between energized conductors or hardware and grounded conductors or hardware limits the risk for birds to be electrocuted (APLIC, 2006).

The applicant’s planned facilities for the proposed project (SEIS Figure 4-2) show that the small stand of trees located just north of Highway 387, where an active red-tailed hawk/Swainson’s hawk nest is located, is not within 0.4 km [0.25 mi] of proposed construction activities. Therefore, NRC does not expect this active nest to be directly affected by construction activities. Removal of any active migratory bird nest or removal of any structure that contains an active nest (e.g., a tree, fence post, or power line pole) is prohibited by law (FWS, 2015a). In addition, nest manipulation is not allowed without a permit (FWS, 2015a). Also, all native migratory birds, their feathers and body parts, nests, eggs, and nestling birds are protected by the federal Migratory Bird Treaty Act (MBTA), making it unlawful to, hunt, shoot, wound, kill, trap, capture, or sell birds listed under this convention. All the bird species observed during baseline wildlife surveys for the proposed project area are protected under the MBTA (AUC, 2012a; 70 FR 12710). Eagles are additionally protected by the Bald and Golden Eagle Protection Act (BGEPA) (FWS, 2015a). The applicant would be responsible for complying with these acts during all phases of the proposed Reno Creek ISR Project, limiting potential effects on birds from the proposed project.

Based on the applicant's commitment to conduct annual raptor nest monitoring and requirements to implement WGFD- and FWS-approved mitigation measures as previously described, and the applicant's obligation to follow state and federal laws if raptor nests would be directly affected, the NRC staff conclude that the potential impact to raptor species during the construction phase of the proposed Reno Creek ISR Project would be SMALL.

The applicant could further reduce effects on raptors from construction by following FWS recommendations that construction of surface facilities, including roads, should not occur within the spatial/seasonal buffer of any nest (occupied or unoccupied) when raptors are in the process of courtship and nest site selection (FWS, 2015a,b) and by burying overhead power lines after step-down. Buffer recommendations may be modified on a site-specific or project-specific basis by consulting with the FWS Wyoming Ecological Services office and the WGFD (AUC, 2012a). The FWS- and WGFD-recommended disturbance-free dates and spatial buffers to protect raptors and songbirds are provided in SEIS Table 4-7. FWS recommendations do not supersede WGFD disturbance-free dates and buffer zones if WGFD dates and zones are more restrictive (FWS, 2015b). These recommendations may be included in the previously discussed preoperational plan that the applicant has committed to develop to further reduce potential effects on other birds during the construction phase. Specifically, for the raptor nests located within the proposed project area and 1.6-km [1-mi] buffer, FWS recommends that no surface disturbances should occur within 0.4 km [0.25 mi] of an occupied or unoccupied red-tailed hawk nest or a Swainson's hawk nest during its breeding season (FWS, 2015a,b). The FWS-recommended timing buffer for a red-tailed hawk nest is from February 1 through August 15, and from April 1 through August 31 for a Swainson's hawk nest (FWS, 2015a,b). WGFD does not have a recommended timing and spatial buffer for the red-tailed hawk. WGFD and FWS recommend that no surface disturbances should occur within 1.6 km [1 mi] of occupied or unoccupied ferruginous hawk nests during its breeding season (WGFD, 2014; FWS, 2015a,b). FWS's recommended timing buffer is March 15 through July 31 (FWS, 2015a), and WGFD's recommended timing buffer is from April 1 through July 31 (WGFD, 2014). Should the applicant choose to follow these additional WGFD and FWS recommended mitigations, in addition to mitigation measures outlined in a FWS-reviewed bird mitigation and monitoring plan incorporated into the mine permit, effects on raptors would be reduced and the potential impacts to raptors would remain SMALL.

Upland Game Birds

The only upland game birds observed during the wildlife surveys for the proposed Reno Creek ISR Project are the mourning dove (*Zenaida macroura*) and Greater sage-grouse (*Centrocercus urophasianus*). As stated in SEIS Section 3.6.1.2.3, gray partridge (*Perdix perdix*) could potentially occur within the proposed project area but were not observed during the baseline wildlife surveys. Grey partridge populations appear relatively stable in the region, although populations do fluctuate as a result of naturally occurring phenomena, such as drought, fire, and floods (BLM, 2013). Mourning doves are a common bird in Wyoming and can be found across fields to woodlands and residential areas. Essentially all of the State of Wyoming provides habitat that supports mourning doves, including the proposed project area and immediate area that surrounds the proposed project area.

Table 4-7. FWS and WGFD Recommended Seasonal Wildlife Timing and Spatial Buffers				
Species (Common Name)	FWS Timing Buffer Dates	FWS Spatial Buffer Zone	WGFD Timing Buffer Dates	WGFD Spatial Buffer Zone
Raptors	Kilometers [Miles]		Kilometers [Miles]	
Bald Eagle	January 1–August 15	0.8 [0.5]	February 15–August 15	0.8 [0.5]
Ferruginous Hawk*	March 15–July 31	1.6 [1]	April 1–July 31	1.6 [1]
Golden Eagle	January 15–July 31	0.8 [0.5]	February 1–July 31	0.8 [0.5]
Merlin	April 1–August 15	0.8 [0.5]	April 1–August 15	0.8 [0.5]
Northern Goshawk	April 1–August 15	0.8 [0.5]	April 1–August 15	0.8 [0.5]
Peregrine Falcon	March 1–August 15	0.8 [0.5]	March 15–August 15	0.8 [0.5]
Prairie Falcon	March 1–August 15	0.8 [0.5]	March 1–August 15	0.8 [0.5]
Swainson's Hawk*	April 1–August 31	0.4 [0.25]	None	None
Red-tailed Hawk*	February 1–August 15	0.4 [0.25]	None	None
Short-eared Owl	March 15–August 1	0.4 [0.25]	None	None
Burrowing Owl	April 1–September 15	0.4 [0.25]	None	None
Osprey	April 1–August 31	0.4 [0.25]	None	None
Cooper's Hawk	March 15–August 31	0.4 [0.25]	None	None
Sharp-shinned Hawk	March 15–August 31	0.4 [0.25]	None	None
Northern Harrier	April 1–August 15	0.4 [0.25]	None	None
Merlin	April 1–August 31	0.8 [0.5]	None	None
American Kestrel	April 1–August 31	0.2 [0.125]	None	None
Common Barn Owl	February 1–September 15	0.2 [0.125]	None	None
Northern Saw-whet Owl	March 1–August 31	0.4 [0.25]	None	None
Boreal Owl	February 1–July 31	0.4 [0.25]	None	None
Long-eared Owl	February 1–August 15	0.4 [0.25]	None	None
Great Horned Owl	December 1–September 30	0.2 [0.125]	None	None
Northern Pygmy-Owl	April 1–August 1	0.4 [0.25]	None	None
Eastern Screech-Owl	March 1–August 15	0.2 [0.125]	None	None

Table 4-7. FWS and WGFD Recommended Seasonal Wildlife Timing and Spatial Buffers (Continued)				
Species (Common Name)	**FWS Timing Buffer Dates**	**FWS Spatial Buffer Zone**	**WGFD Timing Buffer Dates**	**WGFD Spatial Buffer Zone**
Raptors	**Kilometers [Miles]**		**Kilometers [Miles]**	
Western Screech-Owl	March 1–August 15	0.2 [0.125]	None	None
Great Gray Owl	March 15 – August 31	0.4 [0.25]	None	None
Other			**Meters [Feet]**	
Greater sage-grouse (occupied leks)	March 15–June 30 July 1–March 14	3.2 km [2 mi] 0.4 km [0.25 mi]	March 15–June 30 July 1–March 14	3.2 km [2 mi] 0.4 km [0.25 mi]
Songbirds	None	None	April 1–August 31	91 m [300 ft]
Great Blue Heron	None	None	February 15–August 7	251 m land/154 m water [825 ft land/500 ft water]
*Species nests (active and inactive) previously observed in the proposed Reno Creek ISR Project area Sources: FWS, 2015a,b; WGFD, 2014; Mead, 2015				

SEIS Section 3.6.1.2.3 explains that three occupied Greater sage-grouse leks are located between 1.6 and 6.4 km [1 and 4 mi] east and southeast of the proposed project area (AUC, 2012a; BLM, 2015). The Porcupine Creek lek, located east of the northeast corner of the proposed project boundary, is within 3.2 km [2 mi] of proposed Reno Creek production wellfields and a deep disposal well location (see SEIS Figure 4-2). In addition, the eastern and southeastern portion of the proposed project area is identified as a WGFD Crucial Habitat Priority Area and an Enhancement Habitat Priority Area for the sagebrush/mixed grassland habitat within Greater sage-grouse complexes. As previously stated in SEIS Section 3.6.1.2.1,approximately 1,913.87 ha [4,729.27 ac], or 78 percent, of the proposed project area is covered by the big sagebrush shrubland vegetative community (AUC, 2012a). Approximately 31 percent of the big sagebrush shrubland vegetative community is composed of big sagebrush (*Artemisia tridentata)* (AUC, 2012a). However, the proposed project area and the location of the three Greater sage-grouse leks are not within Greater sage-grouse core population areas, or PHMAs,(WGFD, 2011). This means that although the proposed project area contains nesting and winter habitat for Greater sage-grouse, the proposed Reno Creek ISR Project area is not identified as necessary to maintain Greater sage-grouse populations (WGFD, 2010).

As discussed in SEIS Section 3.6.1.2.1, the eastern portion of the proposed project area and 1.6 km [1 mi] buffer is identified as a WGFD Crucial Habitat Priority Area and Enhancement Habitat Priority Area (see SEIS Figure 3-26), which are habitats that WGFD considers important to maintain or enhance. This habitat would be disturbed during construction activities; therefore, some upland game birds will be displaced and some upland game bird habitat loss would occur. Potential direct and indirect effects described previously in this section for raptors would be similar to potential impacts to upland game birds. The applicant has committed to (i) reseed disturbed areas as soon as reasonably possible to establish vegetative cover (AUC, 2012a);

(ii) using only existing and proposed roads in the proposed project area (AUC, 2012a); (iii) constructing new roads, power lines, and pipelines in the same corridors where possible to reduce overall disturbance and minimize new surface disturbance (AUC, 2012a); and (iv) conducting annual spring monitoring of the Porcupine Creek Greater sage-grouse lek, in coordination with the WGFD biologist in Gillette, Wyoming (AUC, 2014a). All lands disturbed by proposed construction activities would be revegetated following WDEQ reclamation requirements as soon as possible (AUC, 2012a), which would restore the habitat loss experienced from proposed construction activities. This is especially important in sagebrush plant communities to mitigate potential adverse effects on sagebrush-obligate species such as Greater sage-grouse (FWS, 2013). In addition, the applicant has committed to mitigation measures designed to limit noise and vehicular traffic (AUC, 2014a) during the construction phase of the proposed project, which would limit potential impacts for all birds. The applicant also has committed to mitigation measures to follow guidelines suggested by the Avian Power Line Interaction Committee (APLIC, 2006), which would reduce overall impacts to upland game birds.

As previously stated, all of the bird species observed during baseline wildlife surveys for the proposed project are protected under the MBTA (AUC, 2012a; 70 FR 12710). The applicant would be responsible for complying with the MBTA to limit potential effects on birds from proposed project activities. Due to the proposed phased construction approach, a noncontiguous area of habitat for migratory birds would be disturbed {54.28 ha [134.14 ac]} within the proposed project area, or 2.2 percent of the entire project area at any one time. Because of the applicant's commitment to implement monitoring and mitigation measures, reseed disturbed areas as soon as reasonably possible to establish vegetative cover, and the applicant's obligation to follow state and federal laws, the NRC staff conclude that potential impacts to upland game birds during the construction phase of the proposed Reno Creek ISR project would be SMALL.

As described in SEIS Section 3.6.3, the State of Wyoming has set forth protective stipulations for Greater sage-grouse both inside and outside core population areas, or PHMAs. Projects located within 3.2 km [2 mi] of an occupied lek outside core population areas are expected to follow the Wyoming recommendations for avoiding and minimizing impacts. This means that surface-disturbing or disruptive activities, or a combination of both, should not occur from March 15 through June 30 within 3.2 km [2 mi] of an active lek to protect breeding activities. WGFD has informed the applicant that WDEQ expects "sage-grouse non-core area stipulations and recommendations to be abided by" (AUC, 2014a). Should the applicant choose to follow these additional Wyoming recommended mitigations, effects to Greater sage-grouse could be reduced to ensure that the potential impacts to Greater sage-grouse remain SMALL.

<u>Nongame and Migratory Birds, Waterfowl, and Shorebirds</u>

As described in SEIS Section 3.6.1.2.3, nine waterfowl, shorebirds, and other wetland birds were observed during the wildlife surveys, including mallard (*Anas platyrhynchos*), Northern pintail *(Anas acuta),* green-winged teal *(Anas crecca*), American wigeon (*Anas Americana)*, Northern shoveler (*Anas clypeata)*, eared grebe (*Podiceps nigricollis)*, bank swallow (*Riparia riparia)*, red-winged blackbird (*Agelaius phoeniceus)*, and Wilson's phalarope (*Steganopus tricolor)*. In northeastern Wyoming, mallard, Northern pintail, green-winged teal, American wigeon, and Northern shoveler are FWS birds of management concern (FWS, 2011). The Northern pintail is also a WGFD Species of Greatest Conservation Need (SGCN). Mallards, Northern pintails, green-winged teals, American wigeons, and Northern shovelers are duck species that arrive in Wyoming to nest in March and April. Although these birds may feed and nest in upland areas with plant stubble or in fields, open shallow water is necessary for these birds to complete their life cycle (WGFD, 1994). Eared grebes are diving birds that breed in shallow waters. Open water serves as a temporary stopover area for water fowl and shorebirds during spring and fall migration, nesting in the spring, and brood rearing in the summer (WGFD, 1994).

Thirteen avian species associated with grasslands and shrub-steppe habitats occur within the proposed project area and the 1.6-km [1-mi] buffer (AUC, 2012a) (SEIS Table 3-14). Species of concern, including avian SGCN listed on SEIS Table 3-15, could also be present within the proposed project area during the construction phase. Although breeding bird surveys were not conducted for the proposed Reno Creek ISR Project, based on observations during the baseline wildlife surveys, three species [Brewer's sparrow (*Spizella breweri*)*,* lark bunting (*Calamospiza melanocorys*), and vesper sparrow *(Pooecetes gramineus*)] were assumed to be breeding within the proposed project area (AUC, 2012a). Migrating shorebirds that could occur at the proposed project area such as the Wilson's phalorpe, bank swallows, and red-winged black birds depend on wetland environments along rivers and streams for food and nesting (WGFD, 2010). The long-billed curlew is the only BLM-sensitive species and FWS bird of conservation concern found in Campbell County that could also occur at the proposed project area (SEIS Table 3-15).

Vegetation clearing, road construction, noise, and increased human and equipment activity associated with construction activities adversely impact waterfowl and shorebirds (WGFD, 2010). In addition, disruption of water features, loss of wetlands, construction of surface impoundments for waste management, and installation of aboveground power lines could indirectly impact waterfowl in the proposed project area. Approximately 13.27 ha [32.81 ac] of the total 17.12 ha [42.23 ac], or 77.7 percent, of wetlands located within the proposed project area are designated as temporarily flooded or seasonally flooded (AUC, 2012a) isolated pockets of surface water due to precipitation events and intermittent discharge from CBM outfalls. After flooding ceases, the water table usually lies well below the soil surface for most of the growing season, significantly limiting surface water and available habitat for waterfowl.

As previously stated, the applicant has committed to implement mitigation measures that would limit potential impacts for all birds, such as those WGFD- and FWS-approved mitigations incorporated into the permit to mine application and following guidelines suggested by the Avian Power Line Interaction Committee. In addition, the applicant has committed to avoiding sensitive areas, such as wetlands, during access road construction and using BMPs in the occurrence of stream channel crossings, which would limit potential impacts to waterfowl and shorebirds (AUC, 2012a). In addition, the applicant is responsible for complying with the MBTA to limit potential effects on birds from the proposed project. Because the temporary presence of surface water at the proposed Reno Creek ISR Project area provides relatively little habitat to support large groups of waterfowl or shorebirds, the NRC staff anticipate fewer direct effects to avian species from construction activities such as vehicle collisions and nest destruction compared to a higher potential for indirect impacts such as effects from noise and habitat alteration. Potential impacts on waterfowl, shorebirds, and other wetland birds are likely to be minimal during construction for the proposed project considering the limited amount of wetland habitat within the proposed project area and the applicant's commitment to avoid such areas. Likewise, the phased approach would limit the effects on migratory avian species, reducing the amount of surface area disturbed at any one time. The NRC staff anticipate that the proposed project would not influence migratory movement patterns, because most bird species are able to leave the area. Therefore, the NRC staff conclude that impacts on nongame and migratory birds, waterfowl, and shorebird populations from proposed construction activities for the proposed project would therefore be SMALL.

BLM's interim guidance for migratory birds (BLM, 2012) recommends that pre-disturbance clearances are conducted within 7 days prior to the disturbance in order to detect any newly arriving nesting birds. If active nests with eggs or young are located within the proposed project area, the applicant should establish buffers around those nests, construction activities should be delayed until all young have fledged, and the applicant should consult with the FWS. Buffer distances for bird species should be developed in coordination with FWS to determine appropriate mitigations. However, the WGFD determined that annual monitoring protocols provided by the applicant in the WDEQ large-mine application are adequate (AUC, 2014a). Should the applicant choose to follow these additional recommended mitigations, the overall effects would be reduced and potential impacts to nongame, migratory birds, waterfowl, and shorebirds would remain SMALL.

Reptiles and Amphibians

As described in SEIS Section 3.6.1.2.4, the applicant reported that a single short-horned lizard and chorus frog were the only reptile and amphibian, respectively, observed during baseline wildlife surveys (AUC, 2012a). Although baseline wildlife surveys targeting reptiles and amphibians were not required by WDEQ or conducted, there is suitable habitat within the proposed project area to support a variety of reptiles and amphibians, including CBM discharge reservoirs, scattered stock ponds, riparian areas, wetlands, and rocky outcrops.

Potential impacts to reptiles and amphibians from construction activities at the proposed Reno Creek ISR Project would primarily result in the mortality of individual reptiles and amphibians, destruction of habitat, degradation of water quality from surface-disturbing activities that cause erosion, and exposure to accidental spills. Construction of wellfields could result in direct mortalities to basking reptiles and amphibians, and to reptiles that spend the winter underground in rocky outcrops and crevices. The construction of proposed secondary and tertiary roads, header houses, monitoring wells, and trunklines that cross wetlands and potential riparian areas would occur primarily in the western half of the proposed project area. The mapped wetlands in relation to the proposed disturbed areas are provided in SEIS Figure 4-3.

The applicant stated that the amount of wetlands located within the proposed project area that would be disturbed by the proposed project totals approximately 1.6 ha [3.9 ac], or 9.2 percent of the total wetlands located within the proposed project area (AUC, 2014a). All jurisdictional wetland disturbances would be mitigated in accordance with U.S. Army Corps of Engineers (USACE) requirements found in the USACE permit under the Clean Water Act. The applicant has committed to avoiding sensitive areas such as wetlands during access road construction and using temporary sediment-control features, such as silt fencing or straw bales, in the occurrence of stream channel crossings to prevent indirect impacts due to erosion and habitat destruction (AUC, 2012a). The applicant would ensure that employees use only existing and proposed roads in the project area, which would minimize surface disturbance and erosion (AUC, 2012a). The applicant would also use common corridors while locating access roads, pipeline, and utilities, and will minimize secondary and tertiary access road widths as practicable (AUC, 2012a). Accidental surface spills from drilling fluids, muds from well drilling, and lubricants and hydrocarbons from equipment and refueling during construction could temporarily

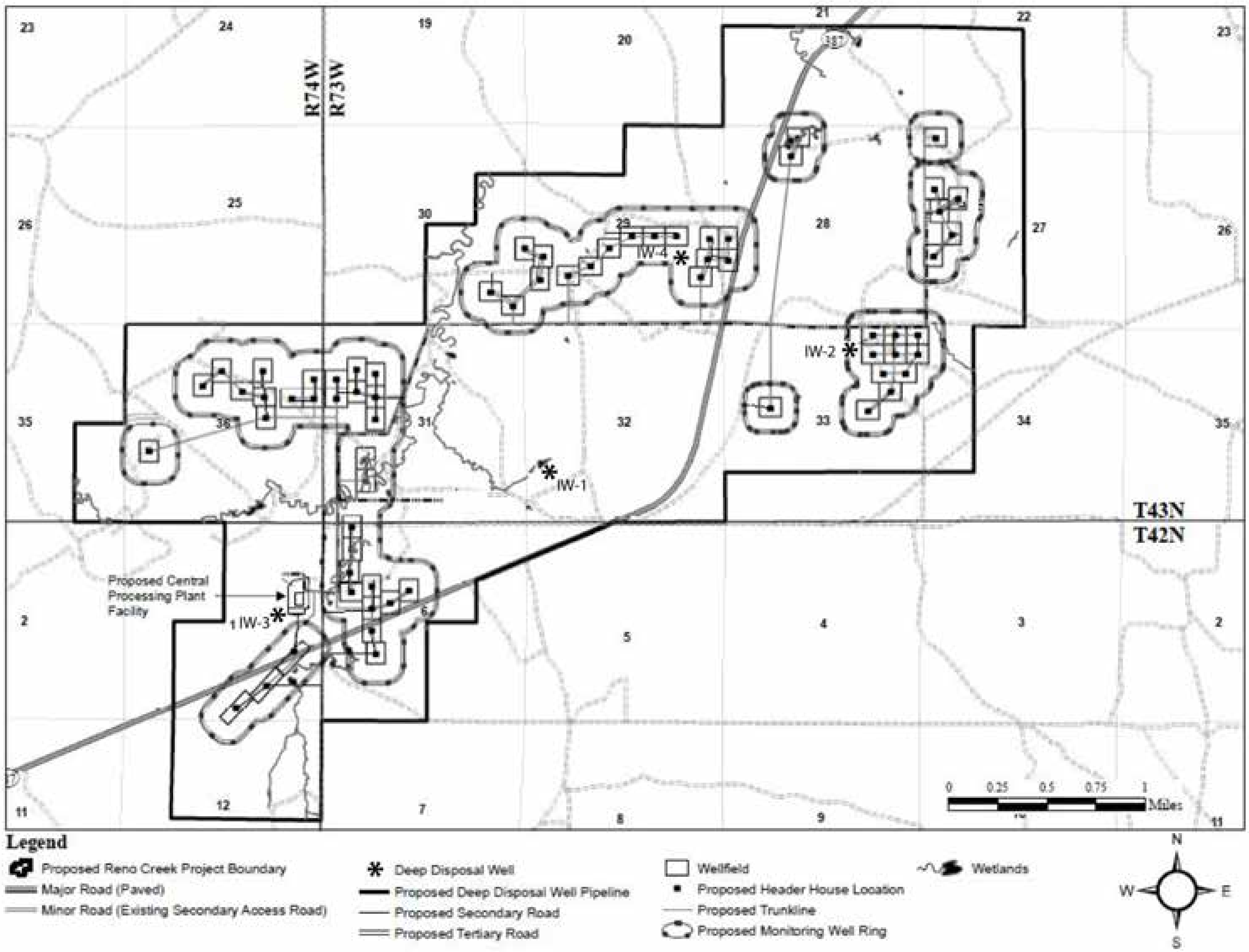

Figure 4-3. Map of Wetland Locations in the Proposed Reno Creek ISR Project Area and Proposed Facilities (AUC, 2014b, 2016)

affect the immediate area of the spill until spill response and cleanup activities are completed. The applicant committed to implementing a spill prevention and cleanup plan prior to initiating construction activities (AUC, 2012a,b), which would ensure that accidental spills during construction do not significantly affect wildlife or riparian areas. The applicant stated that topsoil stockpiles and as much as practicable of the disturbed areas will be seeded as soon as reasonably possible to establish vegetative cover to minimize wind and water erosion (AUC, 2012a). If active revegetation measures are used with WDEQ-approved seed mixtures, NRC staff expect that rapid colonization by annual and perennial herbaceous species in the disturbed staging areas and rights-of-way would restore most vegetative cover within the first growing season (NRC, 2009). In addition, consistent with conclusions made in the GEIS, the NRC staff expect that the proposed project area would be habitable after construction ends (NRC, 2009).

Impacts on reptiles and amphibians are likely to be minimal during construction for the proposed project considering the limited impacts on riparian zones within the proposed project area, the applicant's commitment to use of erosion-control measures, implement a spill prevention and cleanup plan, and reseed disturbed areas and topsoil stockpiles. Therefore, potential erosion and siltation impacts to reptiles and amphibians would be localized and temporary (e.g., during storm events or when snow melts). Given the mitigation measures the applicant has committed to and the limited amount of wetlands and potential riparian areas that would be disturbed {1.6 ha [3.9 ac] of wetlands}, the NRC staff expect no major changes or reductions in reptile or amphibian populations. Therefore, NRC staff conclude that impacts to reptiles and amphibians from construction of the proposed Reno Creek ISR Project would be SMALL.

To further minimize impacts to riparian areas where amphibians are concentrated, WGFD staff recommend that equipment should be serviced and fueled away from streams and riparian areas, and that equipment staging areas should be at least 91 m [300 ft] from riparian areas (AUC, 2014a). In addition, the applicant could enforce seasonal closure of roads if reptile and amphibian mortalities are observed on the roads during the breeding season when young are emerging from breeding areas. These additional recommended mitigation measures would ensure that potential impacts to reptiles and amphibians from construction of the proposed Reno Creek ISR Project would remain SMALL.

<u>Aquatic Species</u>

Because of the limited and ephemeral nature of surface water within the proposed project area, the occurrence of aquatic species is also limited. Additional information on surface water at the proposed project area is provided in SEIS Section 3.5.1.1. As stated in SEIS Section 3.6.2, CBM discharge reservoirs, scattered stock ponds, and wetlands and ponds found in the proposed project area that are seasonal in nature do not provide sufficiently deep water habitat for fish. In addition, there is no year-round source of surface water sufficient to maintain aquatic plant species. However, potential impacts to the limited aquatic and semiaquatic species (e.g. tadpoles, algae, or insect larvae) at the proposed project site would occur primarily along drainages and scattered stock ponds. Direct impacts to potential aquatic habitat would be limited to periods of stream channel disturbances and wetland encroachment during construction activities. Construction activities have the potential to result in minor spills of drilling fluids, muds from drilling, and fuels and lubricants from heavy equipment operation and refueling. As previously described in this section, the applicant has committed to mitigation measures, including using temporary sediment-control features during construction, until vegetation can be reestablished and implementing a spill prevention and cleanup plan that would limit direct impacts from stream disturbances and spills. WDEQ regulations require that the applicant follow provisions in a WYPDES permit that would address stormwater drainage impacts from erosion and sedimentation during construction activities (AUC, 2012b).

As stated in SEIS Section 4.5.1.1.1, the NRC staff expect planned construction activities for the proposed project would have a SMALL impact on surface water. Because there is insufficient deep water habitat to support aquatic species and the applicant committed to implementing mitigation measures that would limit effects from construction on drainages, the NRC staff conclude that potential impacts to aquatic species and habitats would be SMALL. Therefore, the NRC staff conclude that potential impacts to aquatic species and habitats from the construction phase for the proposed project would be SMALL.

WGFD provided the following additional recommendations in its comments on AUC's large mine permit application that, if the applicant followed, would further minimize impacts to aquatic resources of the Belle Fourche River (AUC, 2014a): (i) equipment should be serviced and fueled away from streams and riparian areas, (ii) equipment staging areas should be at least 91 m [300 ft] from riparian areas, and (iii) the spread of aquatic invasive species should be prevented. Based on the applicant's implementation of these recommendations the potential impacts on aquatic species and habitat remain SMALL.

Protected Species and Species of Concern

Wildlife surveys for the proposed Reno Creek ISR Project have not identified federally listed threatened or endangered species within the proposed project area or the 1.6-km [1-mi] buffer area around the proposed project area (AUC, 2012). The NRC staff initially requested information for federally listed species on October 17, 2013 (NRC, 2013); the FWS provided an initial response in March 2015 (FWS, 2015b). The NRC staff obtained an updated species list from the FWS Information Planning and Conservation (IPaC) website in February 2016 (FWS, 2016a). FWS staff identified one federally threatened plant species, the Ute ladies' tresses, or its recognized habitat, and one threatened mammal species, the Northern long-eared bat (NLEB), that could occur in the proposed project area. The FWS (2015a) also identified Sprague's pipit (*Anthus spragueii)*, a federal candidate species, that could occur in the proposed project area because of its historical use of the north central and northwest portions of Wyoming. However, as explained in SEIS Section 3.6.3, this species is rare in Wyoming and was not observed during the applicant's baseline wildlife surveys. Therefore, NRC staff do not expect Sprague's pipit to occur in the proposed project area and, thus, the proposed project would not affect this species. The affected environment of these species was previously discussed in this SEIS Section 3.6.3.

Potential direct impacts from proposed construction activities on the federally threatened Ute ladies' tresses could include removal of individual plants by land surface-clearing activities, burial by soil stockpiles or construction materials, or destruction by being run over by equipment or vehicles. Potential indirect impacts to the Ute ladies' tresses could occur from the modification of vegetation structure, species composition, and areal extent of vegetation cover types within the proposed project area. Indirect impacts could include short-term and long-term increased potential for nonnative species expansion that would overrun the Ute ladies' tresses. As explained in SEIS Section 3.6.3, although undocumented populations may be present in southern Campbell County (BLM, 2015), this species has not been observed in Campbell County (Heidel, 2007), was not observed during baseline wildlife surveys, and is not known to occur within the proposed project area (WGFD, 2010; AUC, 2012a; Heidel, 2012). Therefore, construction activities from the proposed project would not affect Ute ladies' tresses.

Potential direct impacts from proposed construction activities on the federally threatened NLEB include mortality or disturbance during roosting or hibernation. Potential indirect impacts include loss of habitat and exposure to chemicals or solutions from accidental spills during proposed construction activities. Based on the NRC staff's review of the applicant's proposed activities, the NRC staff conclude that the proposed project is not likely to disturb the small stand of trees located within the proposed project area because no planned activities are identified within 0.8 km [0.5 mi] of the tree stand. In addition, the sequenced, noncontiguous (phased) development of production units would limit the amount of land undergoing development at any one time and thus reduce the potential for disturbing or injuring bats that may be present in underground voids. As stated in SEIS Section 3.6.3, the greatest threat to NLEB is white-nose syndrome (FWS, 2016b). The state of Wyoming, including the proposed project area, is not located within the white-nose syndrome zone. FWS has finalized a special rule under the authority of the Endangered Species Act (ESA) that does not prohibit incidental take (i.e., harassment, harm, pursuit, hunting, shooting, wounding, killing, trapping, capturing or collection) of NLEB during otherwise lawful activities in areas not yet affected by white-nose syndrome (FWS, 2016b); however, all of Wyoming's bats are protected from intentional take (WGFD, 2005). Therefore, construction activities from the proposed project would not result in unacceptable takes of bats, and thus there would be no effect on the NLEB under Section 7 of the ESA.

Five FWS avian species of conservation concern and FWS management concern [ferruginous hawk, Swainson's hawk, Brewer's sparrow (*Spizella breweri),* McCown's longspur (*Calcarius mccownii)*, and sage thrasher (*Oreoscoptes montanus)*], and one species of FWS management concern [Northern pintail (*Anas acuta)*] were observed during the applicant's wildlife surveys within the proposed Reno Creek ISR Project area (see SEIS Table 3-15). Potential impacts to these species would be no different than those previously explained in other sections for similar species (raptors and nongame and migratory birds, waterfowl, and shorebirds). As discussed in SEIS Section 3.6.3, FWS species of concern that could potentially occur within the proposed project area include the bald eagle (*Haliaeetus leucocephalus*), black-tailed prairie dog (*Cynomys ludovicianus*), and mountain plover (*Charadrius montanus*). As described in SEIS Section 3.6.3, bald eagles were not observed during baseline wildlife surveys, and the nearest bald eagle nest is more than 14.5 km [9 mi] from the proposed project area; therefore, NRC staff does not expect bald eagles to occur within the proposed project area. As also described in SEIS Section 3.6.3, no black-tailed prairie dogs or their colonies or mountain plover were observed within the proposed project area. However, black-tailed prairie dog colonies are located between 0.8 and 4.8 km [1 and 3 mi] away from the proposed project area (BLM, 2015a). Black-tailed prairie dog colonies provide habitat for a number of species including mountain plover. Potential impacts to these species would be no different than those previously explained in other sections for similar species (small mammals and nongame and migratory birds, waterfowl, and shorebirds). These species discussed in this paragraph are not afforded protection under the ESA (see SEIS Section 3.6.3). As previously stated in this section, all birds that could potentially occur within the proposed project area are protected under the MBTA. Eagles are additionally protected by the BGEPA.

As noted previously in this section, the applicant has committed to specific mitigation measures that would be implemented during the construction phase. These include the applicant reseeding disturbed areas, limiting noise and traffic, conducting annual raptor surveys, implementing measures to limit erosion and sedimentation, and implementing a spill prevention and cleanup plan, etc. Because the applicant would observe permit requirements and implement the appropriate mitigation measures to reduce the impacts to all ecology, the NRC staff conclude that the potential environmental impacts to ecology, including protected species and species of concern, during the proposed Reno Creek ISR Project construction would be SMALL.

4.6.1.2 Operations Impacts

As discussed in GEIS Section 4.3.5.2, wildlife habitats could be altered by operations (fencing, traffic, and noise), and limited wildlife mortalities could occur due to conflicts between species habitat and operations. However, the GEIS also noted that WGFD specifies fencing construction techniques to minimize impediments to big game movement. As further indicated in GEIS Section 4.3.5.2, temporary contamination or alteration of soils could occur from operational leaks and spills and possibly from transportation or land application of treated wastewater. However, detection and response to leaks and spills (e.g., soil cleanup) and eventual survey and decommissioning of all potentially impacted soil would limit the magnitude of impacts to terrestrial ecology. The implementation of spill detection and response plans would mitigate impacts to aquatic species from spills around well heads and from pipeline leaks. Mitigation measures, such as fencing constructed in accordance with WGFD recommendations, WDEQ rules and regulations concerning drilling, leak detection and spill response plans, and periodic wildlife surveys, would also limit the potential impact. Therefore, the NRC staff conclude in the GEIS that the impact to wildlife and vegetation would be SMALL. (NRC, 2009)

Terrestrial Species

<u>Vegetation</u>

Only minor effects to vegetative communities would occur during the operations phase due to clearing activities for staggered wellfield expansion. The potential for these effects to occur during operations is less than that during construction, due to smaller areas of land being disturbed. Invasive and noxious weeds could potentially colonize disturbed areas. In addition, material spills and failure of backup pond liners or embankment systems could also occur during the operations phase, which could kill vegetation exposed to the spilled material. The applicant has committed to revegetate disturbed areas and soil stockpiles with a WDEQ-approved seed mixture, which would prevent the establishment of competitive weeds and restore habitat to native species (AUC, 2012a). The backup storage pond would be designed in accordance with NRC and WDEQ regulations being either self-contained or would have a means of secondary containment, thus limiting the amount of material that could potentially affect vegetation (AUC, 2012b). In addition, the applicant stated that the CPP will be constructed with secondary containment structures (e.g., concrete berms and floor sumps) to stop fluids from spilling on the ground immediately around the CPP if a tank or process vessel fails (AUC, 2012). The applicant has also proposed to minimize vehicular access to specific roads to reduce damage to vegetation. Because a small amount of land would be disturbed during the proposed operations phase and because of the lower number of vehicles accessing the proposed project area, and because of the applicant's commitment to mitigation measures, the potential impacts on vegetation would be SMALL during the operations phase of the proposed project.

Wildlife

The potential impacts to mammals, raptors, upland game birds, waterfowl, shorebirds, raptors, amphibians, and reptiles during operations at the proposed Reno Creek ISR Project would be similar to or less than those described earlier for the construction phase because earthmoving activities and the amount of traffic would be limited compared to the construction phase. In addition, the potential for wildlife to access the surface impoundments would be minimized by the installation of fencing around the mud pits and the backup storage pond. Potential exposure of wildlife to the backup storage pond and temporary mud pit constituents, and the potential failure of pond liners or embankment systems, could potentially impact wildlife. Mammals, amphibians, bats, and birds, including hawks, owls, waterfowl, and songbirds, are attracted to storage ponds and mud pits by mistaking them for fresh bodies of water (FWS, 2009). Insects trapped in storage ponds and mud pits also attract songbirds, bats, amphibians, and small mammals. As discussed in other sections of this chapter, there will be less noise and less traffic during the operations phase of the proposed project compared to the construction phase; therefore, the potential to disrupt wildlife populations would be reduced along with a decrease in the probability of vehicular collisions. Approximately 195 ha [481 ac], or approximately 8 percent of the proposed project area, would be fenced to limit access to operations (i.e., the CPP, wellfields, the backup pond, and disposal wells) (AUC, 2012a). Thus, livestock grazing and recreational activities would be restricted from ISR surface facilities during the operations phase.

As previously stated in this section for impacts from construction on ecological resources, the applicant has committed to mitigation measures that would also limit potential effects on wildlife during the operations phase. These mitigations include implementing speed limits, driving on existing roads, following spill response plans, minimizing vehicular access to specific roads, reseeding disturbed areas, limiting noise and traffic, conducting annual raptor surveys, taking measures to limit erosion and sedimentation, designing the backup storage pond to contain releases as much as possible if leaks occur, and following mandated spill response activities. The applicant has committed to restore and reclaim wellfields sequentially, as proposed operations are completed, which would limit potential impacts on grazing and recreational uses throughout the operational life of the proposed project (AUC, 2012a). The applicant also has committed to employing operational practices that include installing visual deterrents at the backup storage pond to startle or make the birds feel uncomfortable and otherwise prevent the birds from using the backup storage pond (AUC, 2014a). FWS recommends that immediate removal of the drilling fluids after well completion and restoring the area as soon as possible is the key to preventing wildlife mortality in temporary mud pits (FWS, 2009). The applicant has committed to reclaiming and restoring mud pits by backfilling and grading in accordance with WDEQ requirements (AUC, 2012a). Mud pits would be reseeded after construction of the wells is complete (AUC, 2012a). WDEQ has extensive experience in managing potential impacts from mud pits and storage ponds because they are a standard component of exploration for natural resources, and this experience would be reflected in the requirements included in the WDEQ Permit to Mine. The WDEQ guidelines for in situ mine operators include implementing a wildlife monitoring and mitigation plan as part of the mine operations plan (WDEQ, 2013b). WGFD (2004) and WDEQ (1994) also specify fencing construction techniques to minimize impediments to big game movement.

The applicant described the expected chemical constituents and estimated concentrations in wastewater that would be stored in the backup storage pond (AUC, 2014a). The NRC staff evaluated the toxicity of the proposed wastewater solutions and the potential for planned wastewater management activities to impact wildlife. Selenium, in particular, is identified by the

FWS as a constituent of concern in ISR wastewater because of low wildlife health effects thresholds in some sensitive species when compared with concentrations of selenium measured in ISR wastewater (FWS, 2007). The wildlife health effects thresholds described here refer to the concentration of a chemical in water that is known to cause health effects in wildlife based on scientific studies. The NRC staff also compared the applicant's estimated wastewater concentrations (AUC, 2014b) with EPA's chronic (long-term), exposure-based water quality criteria (guidance) established for the protection of aquatic life in fresh water and found the estimated concentration ranges of arsenic, cadmium, chloride, chromium, lead, nickel, and selenium expected in the backup storage pond water to exceed the EPA chronic and acute exposure-based water quality aquatic life criteria (EPA, 2014). Additionally, the applicant's estimated concentrations of selenium expected in the backup storage pond water exceed levels referenced by FWS (2007) as hazardous to aquatic birds. In summary, some of the chemical constituent concentrations in proposed wastewater solutions that would be stored in the backup storage pond may exceed levels known to cause impacts to wildlife. The NRC staff conclude that impacts to individual animals would be possible even with the practices proposed by the applicant and the WDEQ regulatory controls that would be imposed by permit conditions, which include monitoring, setting action levels, and requiring corrective actions if those controls do not limit all direct exposures of wildlife to wastewater solutions. However, because the applicant has committed to employing mitigations such as perimeter fencing and the avian-deterrent system around the backup storage pond, the NRC staff conclude that the direct exposure of wildlife to wastewater solutions would be limited and would not affect a noticeable number of animals. Therefore, potential impacts to terrestrial wildlife during the proposed operations phase would continue to be SMALL. The NRC staff anticipate that the applicant would follow WGFD and FWS spatial and timing buffers previously explained for the construction phase to ensure potential impacts to avian species during operations remain SMALL.

To further minimize impacts to birds and other wildlife, the NRC staff recommend that mud pits be backfilled within 30 days of initial excavation. In addition, if the mud pits are not backfilled within 30 days, the NRC staff recommend that the applicant employ operational practices (e.g., netting or screening) to deter birds and other wildlife from the mud pits. These additional recommended mitigation measures would ensure that potential impacts to wildlife from operations of the proposed Reno Creek ISR Project would remain SMALL.

Aquatic Species

For the same reasons explained for construction impacts on terrestrial wildlife, the NRC staff expect that potential operations impacts to aquatic species would be similar to or less than those described earlier for the construction phase because earthmoving activities and the amount of traffic would be more limited compared to the construction phase, thus reducing erosion and impacts to water quality. As previously stated, some of the chemical constituent concentrations in proposed wastewater solutions that would be stored in the backup storage pond may exceed levels known to cause impacts to aquatic life. Leak-detection systems and spill-response plans would reduce the potential impacts to aquatic species from spills around wellheads and leaks from pipelines by preventing contamination of soils, surface waters, or wetlands. The NRC staff conclude that direct chronic exposure of sensitive aquatic species to the applicant's estimated concentrations in wastewater could adversely impact exposed individual animals. However, because of regulatory controls to protect wildlife, including aquatic species, and because of the limited occurrence of surface water that supports aquatic life within the proposed project area, the NRC staff conclude that potential impact to aquatic species would be SMALL.

Protected Species and Species of Concern

No federally listed or proposed threatened and endangered species would be affected during the operations phase because Ute ladies' tresses have not been identified at the proposed Reno Creek ISR Project area, and the proposed project area is not located within the NLEB white-nose syndrome zone where take of this species is prohibited. Potential impacts to protected species and species of concern during the proposed project's operations would be the same or less than those discussed previously for the construction of the proposed Reno Creek ISR Project because there would be fewer humans present outdoors on the site itself and fewer vehicles being used. In general, activities that may result in impacts would be limited. In addition, mitigation measures previously explained in this section would be implemented during the construction phase and would continue to be employed during the operations phase to ensure that potential operations impacts to all wildlife, including protected species and species of concern, remain SMALL.

4.6.1.3 Aquifer Restoration Impacts

GEIS Section 4.3.5.3 describes potential impacts to ecological resources during the aquifer restoration phase that are similar to potential impacts during operations. These impacts could include habitat disruption, spills and leaks, and animal mortalities. Because existing (in-place) infrastructure will be used during aquifer restoration, little additional ground disturbance would occur, and therefore potential impacts would be SMALL. (NRC, 2009)

During aquifer restoration, potential impacts to ecological resources from the proposed Reno Creek ISR Project would remain similar to those described previously for the operations phase and would be consistent with the findings described in the GEIS. As noted for the operations phase, the already in-place infrastructure from the construction phase (i.e., roads) would continue to be used, and little additional ground disturbance would occur during the aquifer restoration phase. Planned activities using existing infrastructure during the aquifer restoration phase are described in SEIS Section 4.2. Because construction and drilling equipment are not used during the aquifer restoration phase, the NRC staff expect effects from human presence, noise, and wildlife mortalities from equipment to decrease compared to human presence, noise, and wildlife mortalities expected during the operations phase. Also, because the existing infrastructure would be in place, the potential impacts to vegetation and wildlife from aquifer restoration activities at the proposed project area would be similar to or less than that experienced during the operations phase, and wildlife would have already retreated or learned to tolerate the presence of humans or noise. The applicant expects that no vegetation would be disturbed during the aquifer restoration phase (AUC, 2014a). In addition, the quantity of liquid waste handled during the aquifer restoration phase would decrease compared to the volumes of liquid waste generated during operations as described in SEIS Section 2.1.1.1.6. During the aquifer restoration phase, the liquid byproduct material generated, which would be composed of RO brine and aquifer restoration bleed, would be injected in Class I deep disposal wells.

As with the operations phase, potential impacts to vegetation and wildlife exposed to leaks and spills during aquifer restoration would be mitigated by implementing leak-detection systems and spill-response protocols. The applicant has obtained a WDEQ Class I disposal permit that requires well integrity testing and operational leak detection monitoring, leak mitigation measures, and reporting requirements (AUC, 2015a). The eventual radiation survey of all potentially impacted soils and sediments would limit the magnitude of overall impacts to terrestrial and aquatic ecology during the proposed project aquifer restoration phase. In addition, continued implementation of mitigation measures, such as perimeter fencing and the avian-deterrent system, would ensure that impacts to vegetation and terrestrial species would be minimized during aquifer restoration activities. Because aquifer restoration activities would produce similar effects on ecology compared to operations, and because the applicant would continue to implement similar mitigation measures, the potential impacts to vegetation and terrestrial and aquatic species would not increase beyond those of the operations phase. Therefore, the potential impacts to vegetation and wildlife during aquifer restoration would be SMALL.

There would be no expected impacts to protected species during aquifer restoration beyond those which occurred during the construction and operations phases of the proposed project, because the existing infrastructure would be in place. As previously stated, no further disturbance to vegetation or wildlife habitat is expected to occur in the proposed project area. Additionally, Ute ladies' tresses have not been identified at the proposed Reno Creek ISR Project area, and the proposed project area is not located within the NLEB white-nose syndrome zone where take of this species is prohibited; thus, there would be no effect on these species under Section 7 of the ESA. The overall impact to protected species during aquifer restoration would be SMALL.

4.6.1.4 Decommissioning Impacts

The NRC staff concluded in the GEIS that land use impacts (affecting ecology) from decommissioning an ISR facility would be comparable to, but overall less than, those described for construction and would further decrease as decommissioning and reclamation proceed. As described in GEIS Section 4.3.5.4, during decommissioning and reclamation, there would be temporary land disturbance from soil excavation, recovery and removal of buried piping, and demolition and removal of structures. Wildlife would be temporarily displaced, but would be expected to return after decommissioning and reclamation are complete and vegetation and habitat are reestablished. Wildlife could come in conflict with heavy equipment or vehicles. Decommissioning and reclamation activities could also result in temporary increases in sediment load in local streams, but aquatic species would recover quickly as sediment load decreases. However, revegetation and recontouring would restore habitat previously altered during construction and operations. As a result, the potential impacts to ecological resources during decommissioning are expected to be SMALL. (NRC, 2009)

The NRC staff expect that the potential ecological impacts of decommissioning for the proposed Reno Creek ISR Project would be consistent with the findings described in the GEIS. Potential impacts would include increased human presence, construction and field equipment presence, ground vibrations, noise, and land disturbance compared to the aquifer restoration phase, but be less than the construction phase. The proposed project's decommissioning would be phased over approximately the last 12 to 18 months of the proposed Reno Creek ISR Project lifetime (AUC, 2012a). Stockpiled topsoil would be used to regrade the land to the contours that existed during the applicant's prelicensing site characterization efforts, as required by WDEQ, and be reseeded with native vegetation when the buildings and structures are removed as described earlier (see SEIS Section 2.1.1). An additional loss of 4.8 ha [12 ac] of vegetation communities {59 ha [146 ac] during decommissioning} beyond those disturbed during the construction phase {54.28 ha [134.14 ac] during construction} would occur (AUC, 2014a). WDEQ requires that project operators reclaim vegetation in accordance with rules and regulations for final bond release (WDEQ, 2006). WDEQ recommends that the large-scale mine permit require (i) the collection of baseline vegetation data within land application areas, (ii) concurrent and interim reclamation in all areas where mining or land disturbance is completed, (iii) that revegetation success be equivalent to vegetative cover in reference areas using WDEQ-approved statistical methods, and (iv) that established quantitative and qualitative vegetation parameters serve as reclamation standards for final bond release (WDEQ, 2014). However, final permit conditions may change based on the final determination by the WDEQ (WDEQ, 2006). As explained in SEIS Section 4.6.1.1 under construction, sagebrush shrubland vegetation can be difficult and time consuming to reestablish. For these reasons, the NRC staff conclude that there would be a MODERATE impact on vegetation from decommissioning due to the nature of the slower-established plants that compose the sagebrush shrubland plant community. Once sagebrush shrubland vegetation has been reestablished to WDEQ-approved reclamation standards for final bond release, this impact would be SMALL.

In addition to the slight increase of habitat loss compared to the construction phase, during the decommissioning of the proposed project, wildlife could either come in conflict with heavy equipment or be disrupted by noise. As previously stated, the applicant is required by WDEQ to reclaim vegetation for final bond release. The applicant expects that the average number of daily vehicle round trips would decrease compared to the construction, operations, and aquifer restoration phases (see SEIS Section 2.1.1.1.7). The greatest source of noise would be experienced in the production units from equipment used during plugging and abandonment of wells (production, injection, monitoring, and deep disposal), and would be similar to, or less than, the noise generated during the construction phase (see SEIS Section 4.8.1.4; NRC, 2009). As a result of these impacts, wildlife would likely move elsewhere either on the Reno Creek ISR Project area or onto other lands. Temporarily displaced wildlife could return to the Reno Creek ISR Project area after the proposed project's decommissioning and site restoration and reclamation are complete. WGFD reviewed the applicant's reclamation plan and determined that if the plan is implemented, adequate habitat should be restored for wildlife when the project area is reclaimed (McMahan, 2013a,b). Further, as required by NRC regulations, the applicant would be required to submit a decommissioning plan as well as its restoration action plan for Commission review and approval (AUC, 2012b); these documents would address ecological impacts such as vegetation restoration. Consequently, the decommissioning impacts of the proposed Reno Creek ISR Project on area ecology would be similar to those experienced during construction. Thus, the impacts to terrestrial animals and all aquatic species during decommissioning would be SMALL.

There would be no effects to protected species during decommissioning of the proposed project. This finding is based on the fact that Ute ladies' tresses have not been identified at the proposed project area, and the proposed project area is not located within the NLEB white-nose syndrome zone where take of this species is prohibited. The overall impact to protected species during decommissioning would be SMALL.

4.6.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the proposed Reno Creek ISR Project would not be licensed and the land would continue to be available for other uses. Under the No-Action Alternative, there would be no ISR facility construction, operations, aquifer restoration, or decommissioning associated with the proposed Reno Creek ISR Project; therefore, there would be no land disturbance from the proposed project that could impact either vegetation or wildlife populations. The proposed project area would continue to support vegetation communities and wildlife habitat typical of the region, as characterized in SEIS Section 3.6. Land would continue to be used for livestock grazing. Grazing of existing vegetation, particularly the grassland communities, would continue. Under the No-Action Alternative, if current grazing practices continue, only a few individual species could be affected as a result of land management decisions (e.g., overgrazing or conflicts between cattle and other species); however, other species would be likely to relocate to suitable nearby habitats.

4.7 Air Quality Impacts

Potential environmental impacts on air quality could occur during all four phases of the proposed Reno Creek ISR Project. These four phases are construction, operations, aquifer restoration, and decommissioning. This SEIS also addresses the environmental impacts on air quality during the peak year. The peak year accounts for the time when activities associated with all four phases occur simultaneously and thereby accounts for the maximum emissions the proposed project would generate in any one year. SEIS Chapter 2 includes additional information on the applicant’s proposed phased approach. Nonradiological air emission impacts primarily involve fugitive emissions from vehicles traveling on unpaved roads and combustion engine emissions from vehicles and diesel equipment. In general, nonradiological emissions from pipeline system venting, resin transfer, and elution would be expected to be at such low levels that they would be negligible; therefore, such emissions were not considered in the analysis. In addition, radon could also be released from well system relief valves, resin transfer, or elution. Potential radiological air impacts, including radon release impacts, are addressed in the Public and Occupational Health and Safety Impacts analyses in SEIS Section 4.13.

4.7.1 Proposed Action (Alternative 1)

As described in SEIS Section 3.7.2, Campbell County, Wyoming, where the proposed Reno Creek ISR Project would be located, is designated as an attainment area for all National Ambient Air Quality Standards (NAAQS) pollutants and is located in a Class II area for Prevention of Significant Deterioration (PSD) designation. The closest Class I area to the proposed project is Wind Cave National Park, which is located in Custer County, South Dakota, approximately 181.9 km [113 mi] to the east. The attainment status of the area surrounding the proposed project area provides a measure of current air quality conditions and affects considerations for allowing new emission sources.

Distinctions Between NEPA Analysis and Regulatory Air Permitting

Distinctions between the National Environmental Policy Act of 1969 (NEPA) as amended, analysis in this SEIS and air permitting include the roles of the various regulators, the emission inventory used in the analyses, and the purpose for comparing the emission inventories and pollutant concentrations to regulatory thresholds. Pursuant to NEPA, the NRC is responsible for assessing the potential environmental impacts from the proposed project; however, the NRC does not have the authority to develop or enforce nonradiological air emissions regulations to control the equipment and machinery that licensees use. The EPA and the WDEQ have the authority to develop air quality regulations. For the proposed Reno Creek ISR Project, the authority to enforce these regulations and require any implementation of mitigation to reduce nonradiological air emissions rests with the WDEQ rather than with the NRC. To ensure the air quality of Wyoming is adequately protected, in addition to addressing all NRC regulatory requirements pertaining to radiological emissions, NRC applicants and licensees must comply with all applicable state and federal air quality regulatory compliance and permitting requirements.

The applicant has submitted the air quality permit information to WDEQ and approval is pending (see SEIS Table 1-2). Regulatory determinations for air permits (e.g., comparing project emissions to EPA PSD and Title V thresholds to determine if the source should be classified as a major source) may only consider stationary sources. This SEIS compares the proposed Reno Creek stationary emissions to the PSD and Title V thresholds. However, this SEIS also compares the combined stationary, mobile, and fugitive emissions from the proposed Reno Creek ISR Project to these thresholds. The NRC staff opted to consider the inventory from the combined sources because mobile and fugitive sources account for the majority of the proposed project emissions (see SEIS Table 2-4). Furthermore, the emission inventory that serves as the input for the proposed Reno Creek site-specific modeling in this SEIS includes stationary, mobile, and fugitive sources.

The NRC staff have characterized the magnitude of air effluents from the proposed project in part by comparing the emission levels to PSD and Title V thresholds and the modeled concentrations to regulatory standards such as NAAQS. This characterization is meant to provide context for understanding the magnitude of the proposed Reno Creek ISR Project's air effluents, which are mostly from mobile and fugitive sources rather than stationary sources and identify what emissions the analysis should focus on for potential environmental effects. The comparison of pollutant concentrations to NAAQS and PSD increments in this SEIS does not document or represent a formal determination for air permitting or regulatory compliance, which is outside the NRC's jurisdiction. Appendix C, Section C-2 of the SEIS contains additional information on air permitting and the relationship between air permitting and the SEIS analysis.

Potential SEIS Impacts Analyzed with Site-Specific Air Dispersion Modeling

Site-specific air dispersion modeling can be used to analyze the effects of project level emissions for a variety of pollutants at a variety of receptor locations. The applicant conducted AERMOD dispersion modeling using the peak year emission levels to predict the NAAQS and PSD pollutant concentrations at receptors that extended in all directions away from the proposed project area boundary to form a 60 km × 60 km [37.2 mi × 37.2 mi] modeling domain (i.e., the modeling domain does not include the proposed project area, except for the receptors around U.S. Highway 387 that bisects the proposed project area). Two analyses (or runs) were conducted within the modeling domain: the initial modeling run and the final modeling run. The initial modeling run used the EPAs regulatory default settings for AERMOD and predicted pollutant concentrations at all of the receptor locations within the modeling domain. The final modeling run used the AERMOD dry depletion option and predicted particulate matter PM_{10} pollutant concentrations at the 21 receptor locations with the highest concentrations of that pollutant from the initial modeling run. Particulate matter PM_{10} is defined as particles which are 10 micrometers in diameter or smaller. In this SEIS, the NRC staff bases the proposed project impact magnitude determination (i.e., SMALL, MODERATE, or LARGE) in part on the particulate matter PM_{10} modeling results that implement the dry depletion option[1]. This is because the majority of the proposed project's particulate matter PM_{10} emissions are from vehicle travel on unpaved roads. The dry depletion option accounts for the fact that heavier particles (i.e., the particulate matter PM_{10}) from these types of fugitive emissions tends to settle out of the air relatively quickly as the dust plume disperses from the source (Countess, 2001).

[1]In addition, Section C-6.1 of SEIS Appendix C describes the results of the initial modeling run for the proposed project, which does not consider the results from the final modeling run that implements the dry depletion option.

SEIS Appendix C contains additional detailed information about the SEIS site-specific air dispersion modeling including:

- The proposed project emission inventory associated with the site-specific air dispersion modeling categorized in the following classifications: the peak year emissions (see SEIS Appendix C, Section C–3.1.4), the individual phase emissions at the 100 percent activity level (see SEIS Appendix C, Section C–3.1.5), the fugitive dust emissions (see SEIS Section C–3.1.1), the mobile source emissions (see SEIS Appendix C, Section C–3.1.2), and the stationary source emissions (see SEIS Appendix C, Section C–3.1.3).

- The modeling domain beyond the proposed project area (see SEIS Appendix C, Section C–4.1.1).

- The dry depletion option including the rationale for using these results for the SEIS impact magnitude determination (see SEIS Appendix C, Section C–4.1.2).

<u>Potential SEIS Impacts Analyzed Without Site-Specific Air Dispersion Modeling</u>

The NRC staff determined that for some analyses considered in this SEIS, the proposed project potential impacts could be determined without site-specific air dispersion modeling. Site-specific modeling was not conducted to assess impacts from the proposed Reno Creek ISR Project emissions to the nearest Class I and sensitive Class II areas because these areas are distant from proposed Reno Creek ISR Project area and the proposed project area would produce relatively low emission levels from combined stationary, mobile, and fugitive sources. The PSD analysis at the highway receptors was not conducted because the analysis in this SEIS is for providing a context for understanding the magnitude of the potential effects of the proposed project rather than making a regulatory determination associated with air permitting by WDEQ. The results without the PSD highway receptor analysis (see SEIS Table 4-10) already reveal that the greatest effect from project emissions can be attributed to short term (i.e., 24-hour time frame) particulate matter emissions. Site-specific modeling of hazardous air pollutants was not conducted because of the low magnitude of the estimated emissions. SEIS Appendix C, Section C-4.2 contains additional details concerning the basis for assessing these impacts without site-specific modeling.

4.7.1.1 Peak Year Analysis

The NRC staff reported in the GEIS that ISR Projects are not major air emission sources and the impacts would be classified as SMALL if the following conditions are met: (i) the air quality of the proposed project area's region of influence was in compliance with the NAAQS, (ii) the facility was not classified as a major source under EPA's New Source Review Program or operating permit programs under the Clean Air Act, and (iii) gaseous emissions were within regulatory limits and requirements. These conditions reflect the consideration that ISR project impacts on air quality depend on the emission levels of the proposed project, the existing air quality at the proposed project area, and the local affected environment (e.g., proximity to sensitive locations such as Class I areas). (NRC, 2009)

The GEIS emission levels and associated air dispersion modeling provides the basis for the conclusion in the GEIS that ISRs generally meet the conditions specified in the GEIS for a SMALL impact classification. The NRC staff conclude that the emission levels for the proposed

Reno Creek ISR Project would not be bounded by the emission levels described in the GEIS for air quality. The pollutant with the highest emission level for the proposed project is particulate matter PM_{10}, and the estimated emission levels for this pollutant described in SEIS Section 2.1.1.1.6 are larger than those cited in GEIS Table 2.7-2 (NRC, 2009). The proposed project generates an estimated 104.57 metric tons [115.27 short tons] of particulate matter PM_{10} during the peak year (see SEIS Table 2-4). The GEIS estimated an annual construction phase fugitive dust level of 10.0 metric tons [11.0 short tons] (NRC, 2009). The GEIS estimate did not categorize the fugitive dust as particulate matter PM_{10} or $PM_{2.5}$ (particles 2.5 micrometers in diameter and smaller) or provide a peak year emission estimate. For the other pollutants, the discrepancy between the emission levels for the proposed project and the GEIS is much smaller. The NRC staff relied on the site-specific emissions and associated air dispersion modeling to determine impact magnitude for the proposed Reno Creek ISR Project rather than the GEIS analysis because the proposed project emission level for the primary pollutant, particulate matter PM_{10}, is much greater for this ISR project than the emission level for this pollutant specified in the GEIS. In addition, the NRC staff relied on the Reno Creek modeling results rather than the GEIS analysis for the other pollutants because the Reno Creek modeling used site-specific information.

<u>Mitigation</u>

The air emission inventory used in this SEIS incorporates the following applicant-committed mitigation measures:

- Tier 1 engines for drill rigs,
- Tier 3 engines for construction equipment,
- Dust suppression for unpaved roads,
- Carpooling, and
- Reclamation of disturbed land.

The applicant has committed to utilizing engines with specific tier factors for equipment. The various tiers refer to a federal program that requires newly manufactured engines to generate lower pollutant emission levels. Higher tier numbers correlate with stricter emission standards and lower pollutant levels. SEIS Appendix C, Section C–3.1.6 describes in greater detail how this is incorporated into the emission inventory. SEIS Appendix C, Table C–12 describes the effectiveness (i.e., the percentage of emissions reduction) of using engines with various tier levels. The emission inventory also incorporates two different dust suppression methods for travel on unpaved roads. The applicant has committed to treating the CPP facility access road with water and a semiannual application of a chemical dust suppressant. In addition, the applicant has committed to treating the other unpaved project roads with water. An 85 percent reduction in the fugitive dust emissions is incorporated into the emission inventory for the treatment that includes chemical dust suppressants, while 50 percent control efficiency is incorporated into the emission inventory for the use of water alone as a dust suppressant. SEIS Appendix C, Section C–3.1.6 describes the basis for these control efficiencies and describes in greater detail how they are incorporated into the emission inventory. The applicant has also committed to carpooling, thereby reducing the number of vehicles commuters use, which results in fewer emissions and lower pollutant levels. SEIS Appendix C, Table C–13 describes the effectiveness of carpooling committed to by the applicant. Also, the applicant has committed to reclaiming disturbed land during the project lifespan. The amount of fugitive emissions from wind erosion is a function of the amount of disturbed land. Reclaiming land results in fewer particulate matter emissions and lower pollutant levels. SEIS Appendix C, Section C–3.1.6

describes in greater detail how land reclamation is incorporated into the emission inventory as well as the effectiveness of this mitigation measure.

The applicant identified other mitigation measures (see SEIS Table 6-1); however, these other measures are not credited in the calculation of the emission inventory (i.e., the estimated pollutant levels were not reduced because of the implementation of this mitigation).

Peak Year Analysis

SEIS Table 4-8 presents the pollutant concentrations associated with the proposed Reno Creek ISR Project with respect to the NAAQS. SEIS Table 4-9 presents these concentrations with respect to the PSD increments. The NAAQS and PSD thresholds are described in SEIS Section 3.7.2. The forms in SEIS Table 4-8 and SEIS Table 4-9 are the same as the forms for the NAAQS and PSD regulations. The forms express both the statistical (e.g., maximum, average, 98^{th} percentile) and temporal (e.g., once per year, over 1 year, over 3 years) nature of the value. As described in the footnotes for SEIS Table 4-8, some of the modeling result forms are not the same as the NAAQS forms. Similarly, the footnotes for SEIS Table 4-9 identify when the modeling result forms are not the same as the PSD increment forms. In cases where the modeling form does not match the NAAQS and PSD increment form, a value was derived from the modeling result that matched the NAAQS and PSD increment form. The lack of continuity between the model result forms and the NAAQS and PSD increment forms, as well as the values used to represent project level concentrations in SEIS Table 4-8 and SEIS Table 4-9, are described in SEIS Appendix C, Section C–4.3.1. In cases where the modeling form matches the NAAQS or PSD increment form, no adjustments were necessary.

The values in SEIS Table 4-8 are design values. Design values are mathematically determined pollutant concentrations used by EPA to determine whether an area is in compliance with the NAAQS. In some cases, a design value does not represent the highest estimated pollutant concentration. For example, the design value for particulate matter $PM_{2.5}$ is an annual mean averaged over 3 years. Unless the annual mean for all 3 years was the same, at least one of the annual means for a single year would be larger than the design value (i.e., the average of the annual means over a 3-year period). In such cases, individual year estimates may provide a more precise statistical representation for predicting impacts than do design values. However, the NRC staff consider the use of design values an appropriate metric for the SEIS analysis because the purpose of the site-specific air dispersion modeling in this SEIS is to provide a general characterization of the magnitude of air effluents from the proposed project.

The proposed project's site-specific air dispersion modeling indicates that peak year pollution concentration levels are generally low. The peak year concentrations for all pollutants are below the NAAQS (see SEIS Table 4-8). Pollutant concentrations ranged between 3.4 and 87.2 percent of the applicable NAAQS. The 87.2 percent value is associated with the nitrogen dioxide NAAQS over the 1-hour time frame.

While the NAAQS primarily relate to an area's attainment classification (see SEIS Section 3.7.2), the PSD increments primarily relate to pollution levels generated by individual projects. The peak year concentrations for all pollutants are below the allowable PSD increments (see SEIS Table 4-9). Pollutant concentrations ranged between 1.5 and 74.3 percent of the applicable PSD increment. The 74.3 percent value is associated with the particulate matter PM_{10} increment for the 24-hour time frame. Fugitive dust sources account for about 98 percent of the peak year particulate matter PM_{10} emissions (see SEIS Appendix C,

Table 4-8. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)							
Pollutant	**Average Time**	**NAAQS Form***	**Value ($\mu g/m^3$)**	**Back-ground Concentration ($\mu g/m^3$)**	**Total Concentration ($\mu g/m^3$)**	**NAAQS Limit ($\mu g/m^3$)**	**Percent of NAAQS Limit**
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	682.5†	680	1,362.5	40,000	3.4
	8 hour	Not to be exceeded more than once per year	88.4†	378	466.4	10,000	4.7
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	1055.1†	680	1,735.1	40,000	4.3
	8 hour	Not to be exceeded more than once per year	156.3†	378	534.3	10,000	5.3
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	62.9	21	83.9	188	44.6
	Annual	Annual mean	2.4†	6	8.4	100	8.4
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	142.9	21	163.9	188	87.2
	Annual	Annual mean	7.5†	6	13.5	100	13.5
Particulate Matter $PM_{2.5}$‡	24 hour	98th percentile, averaged over 3 years	1.7	8	9.7	35	27.7
	Annual	Annual mean, averaged over 3 years	0.2	3.4	3.6	12§	30.0
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	3.3	8	11.3	35	32.3
	Annual	Annual mean, averaged over 3 years	0.7	3.4	4.1	12§	34.2
Particulate Matter PM_{10} Final Run‖	24 hour	Not to be exceeded more than once per year on average over 3 years	18.8	40	58.8	150	39.2
	Annual	Annual mean	3.9†	15	18.9	50¶	37.8
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	54.6	40	94.6	150	63.1
	Annual	Annual mean	15.6†	15	30.6	50¶	61.2
Sulfur Dioxide	1 hour	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	22.9	43.2	66.1	200	33.0
	3 hour	Not to be exceeded more than once per year	37.6†	124.7	162.3	1,300	12.5

Table 4-8. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)							
Pollutant	Average Time	NAAQS Form*	Value ($\mu g/m^3$)	Back-ground Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS Limit ($\mu g/m^3$)	Percent of NAAQS Limit
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	49.2	43.2	92.4	200	46.2
	3 hour	Not to be exceeded more than once per year	72.0†	124.7	196.7	1,300	15.1

Source: Modified from AUC (2014)
*The form expresses both the statistical (e.g., maximum, average, or 98th percentile) and temporal (e.g., once per year, over 1 year, or over 3 years) nature of the values.
†The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Appendix C, Section C–4.3.1.
‡Particulate matter $PM_{2.5}$ is defined as particles which are 2.5 micrometers in diameter or smaller.
§This table identifies the primary NAAQS limit. The secondary limit is larger (i.e.,15 $\mu g/m^3$). Results that meet the primary standard would automatically meet the secondary standard.
‖Final modeling run conducted with dry depletion option for the top 21 receptor locations. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.
¶There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

Table 4-9. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the Prevention of Significant Deterioration (PSD) Increments					
Pollutant	Averaging Time	PSD Increment Form*	Value ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Percentage of PSD Increment
Nitrogen Dioxide	Annual	Not to be exceeded over the year	2.4†	25	9.6
Particulate Matter $PM_{2.5}$‡	24 hour	Not to be exceeded more than once per year	5.5†	9	61.1
	Annual	Not to be exceeded over the year	0.6†	4	15
Particulate Matter PM_{10} Final Run§	24 hour	Not to be exceeded more than once per year	22.4†	30	74.3
	Annual	Not to be exceeded over the year	3.9†	17	22.9
Sulfur Dioxide	3 hour	Not to be exceeded more than once per year	37.6†	512	7.3
	24 hour	Not to be exceeded more than once per year	6.3†	91	6.9
	Annual	Not to be exceeded over the year	0.3†	20	1.5

Table 4-9.	Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the Prevention of Significant Deterioration (PSD) Increments (Continued)				
Pollutant	**Averaging Time**	**PSD Increment Form***	**Value ($\mu g/m^3$)**	**PSD Class II Increment ($\mu g/m^3$)**	**Percentage of PSD Increment**

Source: Modified from AUC (2014)
*The form expresses both the statistical (e.g., maximum, average, or 98th percentile) and temporal (e.g., once per year, over 1 year, or over 3 years) nature of the values.
†The modeling result form is not the same as the PSD increment form. The value in this table has a form that matches the PSD increment form and was derived from the modeling results as described in Appendix C, Section C–4.3.1.
‡Particulate matter $PM_{2.5}$ is defined as particles which are 2.5 micrometers in diameter or smaller.
§Final modeling run conducted with dry depletion option for the top 21 receptor locations. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller, and $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.

Table C–5) and travel on unpaved roads accounts for about 95 percent of the peak year fugitive dust emissions (see SEIS Appendix C, Table C–1). The fact that the highest percentages relative to the PSD increments occur for the 24-hour threshold rather than the annual threshold indicates that potential particulate matter impacts from the proposed project are associated with short-term temporal spikes in emissions; mainly, particulate matter PM_{10} emissions from fugitive dust. For purposes of this air quality analysis, the short term is specified as 24 hours based on the timeframe for the particulate matter standards in the NAAQS.

All phases of the proposed Reno Creek ISR Project would produce greenhouse gas emissions. SEIS Table 2-5 presents the peak year carbon dioxide emission estimates for the proposed project. Except for electricity consumption, the only greenhouse gas included in the emission estimates is carbon dioxide. The NRC staff find the exclusion of other greenhouse gases from the inventory acceptable because carbon dioxide is the primary greenhouse gas emitted by the proposed project (AUC, 2014c), and the analysis in this SEIS provides a context for understanding the magnitude of the potential effects of the proposed project rather than a formal regulatory determination associated with air permitting by WDEQ. The Ambient Air Quality Modeling Protocol and Results (AUC, 2014c) in Section 2.7 and Appendix A contain additional information on the greenhouse gas emission estimates presented in SEIS Table 2-5. The estimated carbon dioxide emission level for the stationary sources is lower than the current EPA permitting threshold, as described in SEIS Section 3.7.2. In fact, the peak year emission level for all of the sources (i.e., stationary, mobile, and electric consumption) is below this threshold. As described in the “Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews” (CEQ, 2016), climate change effects are considered the result of overall greenhouse gas emissions from numerous sources rather than an individual source. In addition, there is not a strong cause and effect relationship between where the greenhouse gases are emitted and where the impacts occur. Because of these two factors, the NRC staff address the contribution of carbon dioxide from the proposed project to the overall atmospheric greenhouse gas levels and the relevant climate change effects in SEIS Section 5.7 on air quality cumulative effects rather than in this section, which addresses the air quality effects specifically attributed to the proposed project).

Peak year pollutant concentrations from the proposed project would all be below the NAAQS and the allowable PSD increments. The NRC staff conclude that the peak year emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds. The NRC staff conclude that the peak year emissions would result in a SMALL impact on air quality for Class I areas because the emission levels would be relatively low and the proposed project area is distant from Class I areas. Therefore, the NRC staff conclude that the overall impact to air quality for the peak year for the proposed project would be SMALL.

Peak Year Analysis in Relation to Individual Phase Analysis

This SEIS also considers impacts associated with individual phases of the Reno Creek ISR Project. The AERMOD air dispersion modeling was conducted for the peak year emission levels, which accounts for the time when activities associated with all four phases occur simultaneously and represents the maximum emissions the proposed project would generate in any single project year. Emissions from a single phase can vary in any given project year and the 100 percent activity level refers to the largest amount of emissions attributed to that particular phase for a single project year. Identification of the 100 percent activity level for each phase was obtained from the detailed information in the Ambient Air Quality Modeling Protocol and Results (AUC, 2014c), which provided emission data for individual project years as well as each phase's contribution to the overall emissions for each project year. Pollutant concentrations for individual phases were derived from the peak year modeling results (for concentration) based on the relative emission level of the 100 percent activity level for each individual phase when compared to the emission level for the peak year. SEIS Table 4-10 presents the estimated annual mass flow rates for the 100 percent activity levels for the individual phases, which included fugitive (see SEIS Table 2-1), mobile (see SEIS Table 2-2), and stationary (see SEIS Table 2-3) sources. SEIS Appendix C, Section C–3.1.6 provides additional details concerning the calculation of the emission inventory. SEIS Table 4-11 compares the 100 percent activity level emissions for the various phases to the peak year emissions. Peak year emissions are greater than any of the individual phase emissions when functioning at the 100 percent activity level. Therefore, the potential air quality impacts for the individual phases would not be greater than the potential impacts for the peak year. Pollutant concentration estimates from all sources for the various phases at the 100 percent activity level are compared to NAAQS in SEIS Table 4-12 and to PSD increments in SEIS Table 4-13. SEIS Appendix C, Section C–4.3.2 provides additional details concerning the information associated with the comparison of individual phase concentrations to NAAQS and PSD increments.

4.7.1.2 Construction Impacts

As discussed in GEIS Sections 4.3.6.1 (i.e., the Wyoming East Uranium Milling Region) and 4.4.6.1 (the Nebraska-South Dakota-Wyoming Uranium Milling Region), fugitive dust and combustion emissions during land-disturbing activities associated with construction would be expected to be short term (for purposes of this air quality analysis, the short term is specified as 24 hours based on the timeframe for the particulate matter standards in the NAAQS) and reduced through BMPs (e.g., wetting of roads and reclaiming cleared land areas to reduce dust emissions). The proposed project area is located in the Wyoming East Uranium Milling Region, as defined in the GEIS. However the GEIS sections on the Wyoming East Uranium Milling Region do not analyze PSD impacts to Class I areas. Because the analysis in this SEIS considers PSD impacts to Class I areas, this SEIS also cites the Nebraska-South Dakota-Wyoming Uranium Milling Region sections of the GEIS, which discuss PSD impacts to Class I areas (specifically Wind Cave National Park). In that analysis, the GEIS estimated ISR-construction-phase particulate matter, sulfur dioxide (SO_2), and nitrogen dioxide (NO_x) annual concentrations to be below the NAAQS (between about 1 and 2 percent), the PSD

Table 4-10. Estimated Mass Flow Rates (Metric Tons* Per Year) for the 100 Percent Activity Levels for Individual Phases From All Emission Sources for the Proposed Reno Creek ISR Project

Phase	Project Year	Pollutant†	Mass Flow Rates (Metric Tons* per Year) for Emission Source			Total Mass Flow Rate (Metric Tons* Per Year) for the 100 Percent Activity Level
			Mobile Combustion	Fugitive‡	Stationary Combustion§	
Construction – Facility	1	CO	7.56	0	0.73	8.29
		NO_x	7.93	0	1.26	9.19
		$PM_{2.5}$	0.46	2.10	0.06	2.62
		PM_{10}	0.47	19.05	0.06	19.58
		SO_2	1.22	0	0.00	1.22
Construction – Wellfield	5	CO	35.17	0	0.73	35.90
		NO_x	34.52	0	1.26	35.78
		$PM_{2.5}$	1.99	9.18	0.06	11.23
		PM_{10}	2.05	89.49	0.06	91.6
		SO_2	5.46	0	0.00	5.46
Operations	3	CO	3.14	0	0.73	3.87
		NO_x	4.87	0	1.26	6.13
		$PM_{2.5}$	0.28	1.83	0.06	2.17
		PM_{10}	0.29	16.22	0.06	16.57
		SO_2	0.71	0	0.00	0.71
Groundwater Restoration	13	CO	1.47	0	0.73	2.20
		NO_x	2.00	0	1.26	3.26
		$PM_{2.5}$	0.12	2.17	0.06	2.35
		PM_{10}	0.12	18.45	0.06	18.63
		SO_2	0.34	0	0.00	0.34
Decommissioning/ Reclamation	14	CO	2.68	0	0.73	3.41
		NO_x	5.03	0	1.26	6.29
		$PM_{2.5}$	0.31	3.44	0.06	3.81
		PM_{10}	0.32	34.36	0.06	34.74
		SO_2	0.63	0	0.00	0.63

Source: Modified from AUC (2014)
*To convert metric tons to short tons, multiply by 1.10231.
†CO = Carbon Monoxide, NO_x = Nitrogen Oxides, $PM_{2.5}$ = Particulate Matter 2.5 micrometers or less in diameter, PM_{10} = Refers to particles which are 10 micrometers in diameter or smaller, and SO_2 = Sulfur Dioxide.
‡Fugitive emissions are limited to particulate matter.
§Stationary sources emissions are not broken down by phase. The assumption is made that the entire stationary combustion emission estimates for the associated individual project year are generated by the one phase rather than a combination of several phases. For project year one, the estimated values are lower but unspecified. Therefore, the Construction – Facility phase estimate, with the 100 percent activity level occurring in project year one, is considered conservative. The mass flow rates of 0.00 short tons per year for sulfur dioxide (SO_2) mean that emissions were not greater than this level and do not necessarily mean that none of the pollutant was emitted.

Table 4-11. Percentage of Emission Levels From the 100 Percent Activity Levels for the Various Phases for the Proposed Project Compared to the Peak Year Emission Levels

Phase	Percentage of 100 Percent Activity Level Emissions Relative to the Peak Year Emissions				
	Carbon Monoxide	Nitrogen Dioxides	Particulate Matter $PM_{2.5}$*	Particulate Matter PM_{10}†	Sulfur Dioxide
Construction – Facility	21.2	22.6	20.5	18.7	19.7
Construction – Wellfield	91.9	88.0	87.7	87.6	88.5
Operations	9.9	15.1	17.0	15.8	11.5
Aquifer restoration	5.6	8.0	18.3	17.8	5.4
Decommissioning	8.7	15.5	29.7	33.2	10.3

Source: Modified from AUC (2014)
*Particulate matter $PM_{2.5}$ refers to particles which are 2.5 micrometers in diameter or smaller.
†Particulate matter PM_{10} refers to particles which are 10 micrometers in diameter or smaller.

Table 4-12. Nonradiological Concentration Estimates from Stationary, Mobile, and Fugitive Sources for Various Phases for the Proposed Project Compared to the NAAQS

Pollutant	Averaging Time	Percentage of NAAQS Limit				
		Construction Facilities	Construction Wellfield	Operations	Groundwater Restoration	Decommissioning/ Reclamation
Carbon Monoxide	1 hour	2.1	3.3	1.9	1.8	1.8
	8 hour	4.0	4.6	3.9	3.8	3.9
Carbon Monoxide Highway Run	1 hour	2.3	4.1	2.0	1.8	1.9
	8 hour	4.1	5.2	3.9	3.9	3.9
Nitrogen Dioxide	1 hour	18.7	40.6	16.2	13.8	16.3
	Annual	6.5	8.1	6.4	6.2	6.4
Nitrogen Dioxide Highway Run	1 hour	28.3	78.0	22.7	17.2	22.9
	Annual	7.7	12.6	7.1	6.6	7.2
Particulate Matter $PM_{2.5}$*	24 hour	23.9	27.1	23.7	23.7	24.3
	Annual†	28.7	29.7	28.6	28.6	28.8
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	24.8	31.1	24.4	24.6	25.7
	Annual†	29.5	33.4	29.3	29.4	30.1
Particulate Matter PM_{10} Final Run‡	24 hour	29.0	37.7	28.7	28.9	30.8
	Annual§	31.5	36.8	31.2	31.4	32.6
Particulate Matter PM_{10} Highway Run	24 hour	33.5	58.5	32.4	33.1	38.7
	Annual§	35.8	57.4	35.0	35.6	40.4
Sulfur Dioxide	1 hour	26.1	31.7	22.9	22.2	22.8
	3 hour	10.2	12.1	9.9	9.7	9.9

Table 4-12.	**Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for Various Phases for the Proposed Project Compared to the NAAQS (Continued)**					
		Percentage of NAAQS Limit				
Pollutant	**Averaging Time**	**Construction Facilities**	**Construction Wellfield**	**Operations**	**Groundwater Restoration**	**Decommissioning/ Reclamation**
Sulfur Dioxide Highway Run	1 hour	26.4	43.3	24.4	22.9	24.1
	3 hour	10.7	14.5	10.2	9.9	10.2

Source: Modified from AUC (2014)
* Particulate matter $PM_{2.5}$ is defined as particles which are 2.5 micrometers in diameter or smaller.
†This table identifies the primary NAAQS limit. The secondary limit is larger (i.e.,15 µg/m^3). Results that meet the primary standard would automatically meet the secondary standard.
‡Final modeling run conducted with dry depletion option for the top 21 receptor locations. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller .
§There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

Table 4-13.	**Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for Various Phases for the Proposed Project Compared to the PSD Increments**					
		Percentage of PSD Class II Increment				
Pollutant	**Averaging Time**	**Construction Facilities**	**Construction Wellfield**	**Operations**	**Groundwater Restoration**	**Decommissioning and Reclamation**
Nitrogen Dioxide	Annual	2.2	8.4	1.4	0.8	1.5
Particulate Matter $PM_{2.5}$*	24 hour	12.2	53.3	10.3	11.1	17.8
	Annual	3.0	13.2	2.5	2.7	4.5
Particulate Matter PM_{10} Final Run†	24 hour	14.0	65.3	11.7	13.3	24.7
	Annual	4.3	20.0	3.6	4.1	7.6
Sulfur Dioxide	3 hour	1.4	6.5	0.8	0.4	0.8
	24 hour	1.3	6.1	0.8	0.4	0.7
	Annual	0.3	1.3	0.2	0.1	0.1

Source: modified from AUC(2014)
*Particulate matter $PM_{2.5}$ is defined as particles which are 2.5 micrometers in diameter or smaller.
†Final modeling run conducted with dry depletion option for the top 21 receptor locations. Particulate matter $(PM)_{10}$ refers to particles which are 10 micrometers in diameter or smaller.

Class II allowable increments (between about 1 and 9 percent), and the stricter Class I increments (between 7 and 84 percent). The NRC staff concluded in the GEIS that for NAAQS attainment areas, nonradiological impacts would be SMALL (NRC, 2009).

As described in SEIS Section 4.7.1.1, the NRC staff relied primarily on the site-specific emissions and associated air dispersion modeling to determine impact magnitude for the proposed Reno Creek ISR Project because the proposed project emission level for the primary pollutant, particulate matter PM_{10}, is greater than the emission level for this pollutant specified in the GEIS. In addition, the NRC staff relied on the Reno Creek modeling results rather than the GEIS analysis for the other pollutants because the Reno Creek modeling used site-specific information.

To help characterize the magnitude of the proposed project's air effluents, the emission levels were compared to regulatory thresholds. The New Source Review Program requires stationary air pollution sources to obtain permits prior to construction should the source be classified as a major source. The estimated emission level of NAAQS pollutants for stationary sources for the proposed Reno Creek ISR Project are listed in SEIS Table 2-3. The emission estimates in this table are well below the New Source Review Program threshold of 227 metric tons [250 short tons] for classification as a major source as described in SEIS Appendix C, Section C–2.2. The pollutant with the highest stationary source emission level is nitrogen oxides (NO_x), which is 1.26 metric tons [1.39 short tons] (see SEIS Table 2-3). The NRC staff also compared the combined stationary, mobile, and fugitive emissions from the proposed Reno Creek ISR Project to the New Source Review Program thresholds rather than only the stationary sources because mobile and fugitive sources make up the majority of the proposed project emissions (see SEIS Table 2-4). SEIS Table 4-10 presents the emissions for the 100 percent activity level for the various phases from all sources (i.e., stationary, mobile, and fugitive). For the construction phase, the combination of stationary, mobile, and fugitive annual emissions levels are still lower than the New Source Review Program threshold. The pollutant with the highest total emission level is the wellfield construction phase particulate matter PM_{10} at 91.60 metric tons [100.98 short tons] (see SEIS Table 4-10).

Air emissions during the construction phase of the proposed project would consist primarily of fugitive dust and combustion emissions. For this air quality analysis, the construction phase was divided into two categories: CPP (i.e., facilities) construction and wellfield construction. The wellfield construction phase would generate more emissions than the facilities construction phase (see SEIS Table 4-10). Therefore, the analysis focused primarily on the wellfield construction phase. The wellfield construction phase would generate the highest levels of fugitive dust relative to the other phases (see SEIS Table 4-10). Travel on unpaved roads would generate about 94 percent of the particulate matter PM_{10} emissions and 92 percent of the particulate matter $PM_{2.5}$ emissions with wind erosion accounting for the remaining emissions (see SEIS Appendix C, Table C–10). For the mobile combustion emissions, the wellfield construction phase would generate the highest levels of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon monoxide when compared with the other phases (see SEIS Table 4-10). The mitigation credited into the peak year emission inventory and the associated air dispersion modeling as described in SEIS Section 4.7.1.1 also applies to the construction phase.

The pollution concentration levels for the construction phase functioning at the 100 percent activity level are generally low based on values derived from the proposed project's site-specific air dispersion modeling. As described in SEIS Table 4-11, the wellfield construction phase emission levels vary between 87.6 and 91.9 percent of the peak year emission levels depending on the particular pollutant. For the wellfield construction phase, the pollutant concentrations are below the NAAQS, ranging between 3.3 and 78.0 percent of the applicable standard (see SEIS Table 4-12). The facilities construction phase emission levels for all pollutants are much lower than those for the wellfield construction phase. The facilities construction phase emission levels vary between 18.7 and 22.6 percent of the peak year emission levels depending on the particular pollutant (see SEIS Table 4-11). For the facilities construction phase, the pollutant concentrations are below the NAAQS, ranging between 2.1 and 35.8 percent of the applicable standard (see SEIS Table 4-12).

The wellfield construction phase pollutant concentrations are all below the applicable PSD increments, ranging between 1.3 and 65.3 percent of the applicable threshold (see SEIS Table 4-13). For the facilities construction phase, all of the pollutant concentrations are below the PSD increments, ranging between 0.3 and 14.0 percent of the applicable threshold (see SEIS Table 4-13).

In the SEIS, the greenhouse gas emissions were not calculated for individual phases, but rather they were calculated for the peak year. The same combustion sources that would generate the non-greenhouse gas emissions also would generate the greenhouse gas emissions. Peak year emissions for non-greenhouse gas emissions would be greater than any of the individual phase emissions when functioning at the 100 percent activity level (see SEIS Table 4-11), and therefore, because the activities generating all combustion gas emissions are the same, peak year greenhouse gas emissions would also be greater than any of the 100 percent activity levels for the individual phases. The greenhouse gas emissions associated with the construction phase would represent a fraction of the peak year emissions, which are below the regulatory thresholds described in SEIS Section 3.7.2. Therefore the NRC staff conclude that construction phase emissions would also be below those thresholds. The NRC staff conclusion regarding potential greenhouse gas effects is addressed in SEIS Section 5.7 on air quality effects.

Both the facility and wellfield construction phase pollutant concentrations would be below the NAAQS and allowable PSD increments. The NRC staff conclude that both facility and wellfield construction phase emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds. The NRC staff conclude that both the facility and wellfield construction phase emissions would result in a SMALL impact on air quality for Class I areas because the emission levels would be relatively low and the proposed project area is distant from Class I areas. Therefore, the NRC staff conclude that the overall impact to air quality for both the facility and wellfield construction phases for the proposed project would be SMALL.

4.7.1.3 Operations Impacts

GEIS Section 4.3.6.2 stated that operating ISR facilities are not major point source emitters and are not expected to be classified as major sources under the operation (Title V) permitting program. Furthermore, the GEIS stated that the primary nonradiological emissions during operations include fugitive dust and combustion products from equipment, maintenance, transport trucks, and other vehicles. Additionally, the NRC staff concluded in the GEIS that any nonradiological emissions from pipeline system venting, resin transfer, and elution would be expected to be at such low levels that they would be negligible and were not considered in the analysis. For NAAQS attainment areas, the NRC staff concluded in the GEIS that nonradiological air quality impacts would be SMALL (NRC, 2009).

As described in SEIS Section 4.7.1.1, the NRC staff relied primarily on the site-specific emissions and associated air dispersion modeling to determine impact magnitude for the proposed Reno Creek ISR Project because the proposed projects emission level for the primary pollutant, particulate matter PM_{10}, would be greater than the emission level for this pollutant specified in the GEIS. In addition, the NRC staff relied on the Reno Creek modeling results rather than the GEIS analysis for the other pollutants because the Reno Creek modeling used site-specific information.

The estimated emission levels of NAAQS pollutants for stationary sources for the proposed project are listed in SEIS Table 2-3. The emission estimates in this table are well below the Title V or operating permit threshold of 90.7 metric tons [100 short tons] for classification as a major source in an attainment area, as described in Section C–2.2 of SEIS Appendix C. The pollutant with the highest stationary source emission level is nitrogen oxide at 1.26 metric tons [1.39 short tons]. The NRC staff also compared the combined stationary, mobile, and fugitive emissions from the proposed Reno Creek ISR Project to the Title V permit thresholds rather than only the stationary sources. The NRC staff opted to do this because mobile and fugitive sources account for the majority of the proposed project emissions (see SEIS Table 2-4). For the operations phase, combined stationary, mobile, and fugitive annual emissions levels are, lower than the Title V threshold. The pollutant with the highest total emission level is the particulate matter PM_{10} at 16.57 metric tons [18.27 short tons] (see SEIS Table 4-10).

Air emissions during the operations phase of the proposed project would consist primarily of fugitive dust and combustion emissions. Of the four phases, the operations phase would generate the lowest levels of particulate matter (see SEIS Table 4-10). Combustion emissions would be low, with estimated values similar to those for the facility construction, aquifer restoration, and decommissioning phases (see SEIS Table 4-10). The mitigation credited into the peak year emission inventory and the associated air dispersion modeling as described in SEIS Section 4.7.1.1, also applies to the operations phase.

The pollution-concentration levels for the operations phase functioning at the 100 percent activity level would be low based on values derived from the proposed project's site-specific air dispersion modelling. As described in SEIS Table 4-11, the operations phase emission levels vary between 9.9 and 17.0 percent of the peak year emission levels depending on the particular pollutant. For the operations phase, the pollutant concentrations are below the NAAQS, ranging between 1.9 and 35.0 percent of the applicable standard (see SEIS Table 4-12). For the PSD analysis, the operations phase pollutant concentrations are below the PSD increments, ranging between 0.2 and 11.7 percent of the applicable threshold (see SEIS Table 4-13).

In the SEIS, the greenhouse gas emissions were not calculated for individual phases, but rather they were calculated for the peak year. The same combustion sources that would generate the non-greenhouse gas emissions also would generate the greenhouse gas emissions. Since peak year emissions for non-greenhouse gas emissions would be greater than any of the individual phase emissions when functioning at the 100 percent activity level (see SEIS Table 4-11), and therefore, because the activities generating all combustion emissions are the same, peak year greenhouse gas emissions would also be greater than any of the 100 percent activity level for the individual phases. The greenhouse gas emissions associated with the operations phase would represent a fraction of the peak year emissions, which are below the regulatory thresholds described in SEIS Section 3.7.2. Therefore, the NRC staff conclude that operations phase emissions would also be below those thresholds.

Similar to the construction phase, the operations phase pollutant concentrations would all be below the NAAQS and the allowable PSD increments. The NRC staff conclude that the operations phase emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds. The NRC staff conclude that the operations phase emissions would result in a SMALL impact on air quality for Class I areas because the emission levels are relatively low and the proposed project area is distant from Class I areas. Therefore, the NRC staff conclude that the overall impact to air quality for the operations phase for the proposed project would be SMALL.

4.7.1.4 Aquifer Restoration Impacts

As described in GEIS Section 4.3.6.3, the aquifer restoration phase would employ the same infrastructure that was used during operations; therefore, air quality impacts from aquifer restoration would be similar to, or less than, those during operations. Additionally, fugitive dust and combustion emissions from vehicles and equipment during aquifer restoration would be similar to, or less than, the dust and combustion emissions during operations. For NAAQS attainment areas, the NRC staff concluded in the GEIS that nonradiological air quality impacts would be SMALL (NRC, 2009).

As described in SEIS Section 4.7.1.1, the NRC staff relied primarily on the site-specific emissions and associated air dispersion modeling to determine impact magnitude for the proposed Reno Creek ISR Project because the proposed projects emission level for the primary pollutant, particulate matter PM_{10}, would be greater than the emission level for this pollutant specified in the GEIS. In addition, the NRC staff relied on the Reno Creek modeling results rather than the GEIS analysis for the other pollutants because the Reno Creek modeling used site-specific information.

Air emissions during the aquifer restoration phase of the proposed project would consist primarily of fugitive dust and combustion emissions. The aquifer restoration phase would generate the lowest levels of carbon monoxide, nitrogen oxides, and sulfur dioxide (SO_2) relative to the other phases (see SEIS Table 4-10). Particulate matter emissions from the aquifer restoration phase would be low. In fact they would be very similar to the operations phase values, which are the lowest levels among all the phases (see SEIS Table 4-10). The mitigation credited into the peak year emission inventory and the associated air dispersion modeling as described in SEIS Section 4.7.1.1 also applies to the aquifer restoration phase.

The pollution concentration levels for the aquifer restoration phase functioning at the 100 percent activity level would be low based on values derived from the proposed project's site-specific air dispersion modelling. As described in SEIS Table 4-11, the aquifer restoration phase emission levels vary between 5.4 and 18.3 percent of the peak year emission levels depending on the particular pollutant. For the aquifer restoration phase, the pollutant concentrations are below the NAAQS, ranging between 1.8 and 35.6 percent of the applicable standard (see SEIS Table 4-12). For the PSD analysis, the aquifer restoration phase pollutant concentrations are below the PSD increments, ranging between 0.1 and 13.3 percent of the applicable threshold (see SEIS Table 4-13).

In the SEIS, the greenhouse gas emissions were not calculated for individual phases, but rather they were calculated for the peak year. The same combustion sources that would generate the non-greenhouse gas emissions also would generate the greenhouse gas emissions. Peak year emissions for non-greenhouse gas emissions would be greater than any of the individual phase emissions when functioning at the 100 percent activity level (see SEIS Table 4-11), and therefore, because the activities generating all combustion emissions are the same, peak year greenhouse gas emissions would also be greater than any of the 100 percent activity levels for the individual phases. The greenhouse gas emissions associated with the aquifer restoration phase would represent a fraction of the peak year emissions, which are below the regulatory thresholds described in SEIS Section 3.7.2. Therefore, the NRC staff conclude that aquifer restoration phase emissions would also be below those thresholds.

Similar to the construction phase, the aquifer restoration phase pollutant concentrations would all be below the NAAQS and the allowable PSD increments. The NRC staff conclude that the aquifer restoration phase emissions would have a SMALL impact on air quality because the pollutant concentrations are low compared to the NAAQS and PSD thresholds. The NRC staff conclude that the aquifer restoration phase emissions would result in a SMALL impact on air quality for Class I areas because the emission levels would be relatively low and the proposed project area is distant from Class I areas. Therefore, the NRC staff conclude that the overall impact to air quality for the aquifer restoration phase for the proposed project would be SMALL.

4.7.1.5 Decommissioning Impacts

As discussed in GEIS Section 4.3.6.4, fugitive dust and combustion emissions during land-disturbing activities from the decommissioning phase would come from many of the same sources as the construction phase. In the short term (i.e., 24 hours), emission levels could increase given the types and intensities of activity (i.e., demolishing of process and administrative buildings, excavating and removing contaminated soils, and grading of disturbed areas). However, such emissions would be expected to decrease as decommissioning progresses; and therefore, overall, impacts would be similar to, or less than, those associated with construction. In addition, impacts would be of short duration (i.e., 24 hours); and would be reduced through BMPs (e.g., wetting of roads and reclaiming cleared land areas to reduce dust emissions). The NRC staff concluded in the GEIS that for NAAQS attainment areas, nonradiological impacts would be SMALL (NRC, 2009).

As described in SEIS Section 4.7.1.1, the NRC staff relied primarily on the site-specific emissions and associated air dispersion modeling to determine impact magnitude for the proposed Reno Creek ISR Project because the proposed projects emission level for the primary pollutant, particulate matter PM_{10}, would be greater than the emission level for this pollutant specified in the GEIS. In addition, the NRC staff relied on the Reno Creek modeling results rather than the GEIS analysis for the other pollutants because the Reno Creek modeling used site-specific information.

Air emissions during the decommissioning phase of the proposed project would consist primarily of fugitive dust and combustion emissions. The decommissioning phase would generate more particulate matter than any other phase except for wellfield construction (see SEIS Table 4-10). Carbon monoxide, nitrogen oxides, and sulfur dioxide (SO_2) emissions for the decommissioning phase would be similar to the operations phase emissions and would not be that much greater than the aquifer restoration phases, which would have the lowest levels (see SEIS Table 4-10). The mitigation credited into the peak year emission inventory and the associated air dispersion modeling as described in SEIS Section 4.7.1.1 also applies to the decommissioning phase.

The pollution concentration levels for the decommissioning phase functioning at the 100 percent activity level would be low based on values derived from the proposed project's site-specific air dispersion modeling. As described in SEIS Table 4-11, the decommissioning phase emission levels vary between 8.7 and 33.2 percent of the peak year emission levels depending on the particular pollutant. For the decommissioning phase, the pollutant concentrations are below the NAAQS, ranging between 1.8 and 40.4 percent of the applicable standard (see SEIS Table 4-12). For the PSD analysis, the decommissioning phase pollutant concentrations are below the PSD increments, ranging between 0.1 and 24.7 percent of the applicable threshold (see SEIS Table 4-13).

In the SEIS, the greenhouse gas emissions were not calculated for individual phases, but rather they were calculated for the peak year. The same combustion sources that would generate the non-greenhouse gas emissions also would generate the greenhouse gas emissions. Peak year emissions for nongreenhouse gas emissions are greater than any of the individual phase emissions when functioning at the 100 percent activity level (see SEIS Table 4-11), and therefore, because the activities generating all combustion emissions are the same, peak year greenhouse gas emissions would also be greater than any of the 100 percent activity levels for the individual phases. The greenhouse gas emissions associated with the decommissioning phase would represent a fraction of the peak year emissions, which are below the regulatory thresholds described in SEIS Section 3.7.2. Therefore, the NRC staff conclude that decommissioning phase emissions would also be below those thresholds.

Similar to the construction phase, the decommissioning phase pollutant concentrations would all be below the NAAQS and the allowable PSD increments. The NRC staff conclude that the decommissioning phase emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds. The NRC staff conclude that the decommissioning/restoration phase emissions would result in a SMALL impact on air quality for Class I areas because the emission levels would be relatively low and the proposed project area is distant from Class I areas. Therefore, the NRC staff conclude that the overall impact to air quality for the decommissioning phase for the proposed project would be SMALL.

4.7.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the NRC would not license the proposed Reno Creek ISR Project. Uranium ISR activities would not occur, and the pollutants associated with these activities would not be generated. The No-Action Alternative eliminates a source of gaseous and particulate emissions that would contribute to the ambient pollutant concentrations. Therefore, the NRC staff conclude that there would be no impact to air quality for the No-Action Alternative.

4.8 Noise Impacts

The NRC staff concluded in the GEIS that the noise impacts at an ISR facility may range from SMALL to MODERATE during all four phases of an ISR project, depending on the distance between the nearest resident and the activities occurring at the ISR facility (NRC, 2009). Noise may also impact wildlife in the vicinity of the ISR facility. These impacts would be from the operation of equipment such as trucks, bulldozers, and compressors; from either commuting worker traffic or material and waste shipments; and from operation of the wellfields, the CPP, and associated equipment. For workers at an ISR facility, administrative and engineering controls would be used to maintain noise levels in work areas below Occupational Safety and Health Administration (OSHA) regulatory limits (29 CFR 1910.95) and would be further mitigated by use of personal hearing protection.

The potential environmental impacts from noise during construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project are described in the following sections.

4.8.1 Proposed Action (Alternative 1)

As described in SEIS Section 3.8, the majority of existing ambient noise (i.e., background noise) within the proposed Reno Creek ISR Project area is generated by traffic from State Highway 387, which traverses the project area (see SEIS Figure 3-1) and by CBM operations (AUC, 2012a). County Road 22 (Clarkelen/Turnercrest Road) and County Road 25 (Cosner Road) also traverse parts of the proposed project area and contribute to ambient noise.

Dwellings within and in the vicinity of the proposed area that may be impacted by noise generated by ISR activities are shown in SEIS Figure 3-1. The closest occupied offsite residence is approximately 2.0 km [1.25 mi] southeast of the proposed project boundary (see SEIS Figure 3-1). Wright, Wyoming (population 1,807), is the closest community to the proposed project, approximately 13 km [8 mi] to the northeast (see SEIS Figure 3-1). Other towns within 80 km [50 mi] of the proposed project area include Gillette, Kaycee, Midwest, and Edgerton (see SEIS Figure 3-5).

Recreational activities on land within and surrounding the proposed project area could be sensitive to noise impacts. As described in SEIS Section 3.2, recreational activities (primarily hunting) on privately-owned land within the proposed project area is limited and not allowed without permission of the landowner. In addition, hunting on privately-owned land would be restricted over the life of the project (AUC, 2012a). A parcel of state-owned land in the western portion of the project area offers limited potential for recreational activities (primarily hunting) that could be sensitive to noise impacts (see SEIS Figure 3-2). The applicant has committed to submitting a written request to the BLC to restrict hunting on this parcel of state-owned land (AUC, 2014a). Other nearby recreational attractions that could be sensitive to noise impacts include: the Thunder Basin National Grassland, Fort Reno historic site, and the Bozeman Trail. Although the Thunder Basin National Grassland exists within the proposed project area, lands encompassed by the Grassland within and surrounding the proposed project area are privately owned. As with other privately-owned land within and surrounding the proposed project area, recreational activities on the Grassland within or near the project area are limited and not allowed without permission of the landowner. The Fort Reno site and the Bozeman Trail are quite distant from the Reno Creek site and are not expected to be affected by noise levels from the proposed project. The Fort Reno site is 61 km [38 mi] northwest of the proposed project area, and the Bozeman Trail passes 19 km [12 mi] west of the project area.

As summarized in SEIS Table 1-1, the NRC staff concluded in the GEIS that depending on the phase of the facility life cycle, potential impacts on noise in the Wyoming East Uranium Milling Region could range from SMALL to MODERATE (NRC, 2009). The impact conclusions that contributed to a greater than SMALL impact in the GEIS finding addressed potential elevated noise levels that could affect wildlife behavior. In this SEIS, the potential impacts of noise on wildlife (e.g., raptors and Greater sage-grouse) are presented in SEIS Section 4.6. Therefore, the following discussion assesses noise impacts at the proposed Reno Creek ISR Project considering offsite and onsite human receptors (i.e., local residents and workers).

4.8.1.1 Construction Impacts

The NRC staff stated in the GEIS that potential noise impacts would be greatest during construction of an ISR facility. The use of drill rigs, heavy trucks, bulldozers, and other equipment used to construct and operate wellfields, drill wells, construct access roads, and build the processing facilities would generate noise exceeding undisturbed background levels. Noise levels are expected to be higher during daylight hours when construction is more likely to occur and more noticeable in proximity to the operating equipment. For individuals living in the vicinity of the site, ambient noise levels would return to background at distances more than 305 m [1,000 ft] from the construction activities. Overall, these types of noise impacts would be SMALL, given the use of hearing controls for workers and the expected distance of nearest residents to the site. Traffic noise during construction (e.g., commuting workers; truck shipments to and from the facility; and construction equipment such as trucks, bulldozers, and compressors) is expected to be localized and limited to highways in the vicinity of the site, access roads within the site, and roads in the wellfields. The relative increase in noise levels from passing traffic would be SMALL for the larger roads, but could be MODERATE for lightly traveled rural roads through smaller communities (NRC, 2009).

As described in SEIS Section 2.1.1.1.2, the construction phase of the proposed Reno Creek ISR Project would involve the use of heavy equipment to create and improve road surfaces, transport supplies, excavate foundations, erect buildings, and install wells and pipelines in the wellfields. Equipment such as bulldozers, graders, tractor trailers, excavators, cranes, and drill rigs would create noise that would be audible above background noise levels. Construction of processing facilities, pipelines, access roads, deep disposal wells, and the initial production unit is expected to be completed within 1 year (see SEIS Figure 2-1), followed by phased construction of additional production units during the estimated 11-year operations phase (AUC, 2012a).

Expected noise levels generated during construction activities at the proposed Reno Creek ISR Project would be most noticeable in proximity to operating equipment, such as drill rigs, heavy trucks, bulldozers, excavators, and front-end loaders, which can reach noise levels well above 85 decibels (dBA). The applicant has committed to the following mitigation measures to minimize noise impacts during construction: (i) implementing speed limits on access roads within the proposed project area; (ii) enforcing speed limits on county roads within the proposed project area (e.g., Clarkelen Road); (iii) restricting access road construction during nighttime hours; (iv) restricting drilling to daytime hours (7 a.m. to 8 p.m.) in areas where increased noise levels could impact nearby residences; and (v) requiring employees working at drilling or construction sites to wear hearing protection (AUC, 2012a). In addition, the applicant has committed to implementing a hearing conservation program to ensure that proper personal protective equipment (PPE) and engineering controls (e.g., sound abatement controls on operating equipment) are in place to protect workers from potentially damaging noise (AUC, 2012a). Implementation of these mitigation measures would ensure that noise levels remain below guidelines for offsite receptors [e.g., 55-dBA daytime guideline to protect against interference and annoyance (EPA, 1974)] and below OSHA regulatory limits for workers in 29 CFR 1910.95 (exposure limit for workplace noise of 85 dBA for a duration of 8 hours per day).

As described previously, the closest occupied offsite residence is approximately 2.0 km [1.25 mi] southeast of the proposed project boundary and is within 3.2 km [2.0 mi] of Production Units 5 and 7 as depicted in SEIS Figure 2-2 and Figure 3-1. These distances exceed the 305-m [1,000-ft] radius for noise from construction activities to return to background ambient noise levels (NRC, 2009). In addition, because of decreasing noise levels with distance, construction activities are not expected to have noise impacts on nearby communities (e.g., Wright, Gillette, Kaycee, Midwest, and Edgerton). As described previously, recreational activities on privately- and state-owned land within and surrounding the proposed project area are limited and hunting would be restricted on land within the proposed project area over the life of the project.

Truck transport of construction materials would be the primary noise source that may potentially affect the public. As described in SEIS Section 3.8, State Highway 387 traverses the proposed project area and Clarkelen Road provides access to proposed project facilities. Traffic noise along State Highway 387 and Clarkelen Road would increase during construction activities due to workers commuting to and from the job site and truck shipments to and from the facilities during daylight hours. State Highway 387 and Clarkelen Road are line sources of noise. As described in SEIS Section 3.8, the maximum sound levels from heavy trucks (70 dBA) traveling along State Highway 387 or Clarkelen Road would diminish to approximately 57 dBA at a distance of approximately 480 m [1,575 ft] from the source. At distances beyond 480 m [1,575 ft], it is assumed that sound levels generated by heavy trucks would be approximately 40 dBA. Based on typical land uses within and surrounding the project area (e.g., rangeland for livestock grazing), sound levels ranging from 40 to 57 dBA are within Federal Highway Administration (FHWA) noise abatement criteria established in 23 CFR Part 772. These criteria are described in SEIS Table 3-20. In addition, few residences are located within an 8-km [5-mi] radius of the proposed project, and increases in noise levels associated with passing heavy truck traffic during the construction phase would be short term (1 year; see SEIS Figure 2-1).

In summary, noise levels associated with project-related construction activities would not adversely impact onsite and offsite human receptors. Implementation of mitigation measures, such as using sound abatement controls on equipment and using personal hearing protection for workers in high noise areas, would ensure that noise levels remain within guidelines for offsite human receptors and workers. Recreational activities on privately- and state-owned land within and surrounding the proposed project area are limited and hunting would be restricted on land within the proposed project area over the life of the project. During the construction phase, noise levels associated with project-related transportation activities on State Highway 387 and Clarkelen Road would be within FHWA noise-abatement criteria at a distance of 480 m [1,575 ft] or greater and would be temporary (1 year). Therefore, the NRC staff conclude that the overall site-specific impacts from noise during construction would be SMALL.

4.8.1.2 Operations Impacts

As stated in the GEIS, during ISR operations, noise-generating activities would occur mainly indoors within the central uranium processing facilities; therefore, offsite sound levels would be reduced during the operations phase. Wellfield equipment (e.g., pumps, and compressors) would be contained within structures (e.g., header houses or satellite facilities), thus limiting the propagation of noise to offsite individuals. Traffic noise from commuting workers, truck shipments to and from the facility, and facility equipment would be localized and limited to highways in the vicinity of the site, access roads within the proposed license area, and wellfield roads. Relative increases in noise levels from traffic would be SMALL for the larger roads, but could be MODERATE for lightly traveled rural roads through smaller communities. Thus, the NRC staff concluded in the GEIS that potential impacts from noise during the operations phase may range from SMALL to MODERATE. (NRC, 2009)

The potential impact from onsite-generated noise during the operations phase of the proposed Reno Creek ISR project would be less than during the construction phase because fewer pieces of heavy equipment would be used. However, a variety of mechanical equipment (e.g., generators, pumps, air compressors, and ventilation systems) at the CPP and in the production units would generate noise during operations. The applicant has committed to the following mitigation measures to minimize noise impacts during operations: (i) implementing speed limits on access roads within the proposed project area; (ii) locating process machinery, such as pumps, dryers, and generators, within the fully enclosed CPP; and (iii) keeping all overhead CPP doors closed as much as possible to minimize the propagation of noise to onsite and offsite receptors (AUC, 2012a). In wellfields, pumps and compressors used for injection, production, and transfer of lixiviant would be contained within header houses. Likewise, pumps and compressors used to inject liquid wastes into deep disposal wells would be contained within buildings constructed around the wells (AUC, 2012b). Mitigation measures, such as the use of sound-abatement controls on operating equipment in the CPP and wellfields, would further reduce the propagation of noise to onsite and offsite human receptors. Although potential noise generation during operations of individual production units is expected to be of short duration (i.e., 2 to 3 years), operations activities would continue over much of the life of the project as operations are completed in sequentially developed production units (see SEIS Figure 2-1). Noise impacts to workers during operations would be mitigated by implementation of a hearing conservation program to ensure that OSHA exposure limits in 29 CFR 1910.95 are not exceeded (AUC, 2012a). This program would include fitting workers with proper PPE and implementing engineering controls (e.g., protective enclosures around equipment) to protect workers from potentially damaging noise.

Heavy truck traffic associated with shipments of yellowcake would result in temporary noise. Shipments of yellowcake would be infrequent (see SEIS Section 2.1.1.1.7) and would have only a SMALL impact on noise levels on Clarkelen Road and State Highway 387. Traffic noise from commuting workers on highways in the vicinity of the site and on Clarkelen Road leading to and from the site would increase during operations when facilities are experiencing peak employment. However, because of the remote location of the site and lack of human receptors within and surrounding the project site, noise impacts from passing traffic during operations would be SMALL.

In summary, much of the noise generated during the operations phase of the proposed project would be contained within buildings and structures (e.g., the CPP and header houses). Because of decreasing noise levels with distance, noise from operations activities would have no impact on residents, communities, or recreational areas that are located more than 305 m [1,000 ft] from specific noise-generating activities (NRC, 2009). As noted previously, the closest occupied offsite residence is approximately 2.0 km [1.5 mi] southeast of the proposed project boundary and approximately 3.2 km [2.0 mi] from the nearest production unit. Noise levels to workers would be mitigated by use of sound-abatement controls on operating equipment, adherence to OSHA regulatory limits, and use of personal hearing protection. Heavy truck traffic associated with yellowcake shipments would be infrequent and result in only short-term noise on local county roads and state highways. Therefore, the NRC staff conclude that the overall site-specific impacts from noise during operations would be SMALL.

4.8.1.3 Aquifer Restoration Impacts

The GEIS notes that general noise levels during aquifer restoration would be expected to be similar to, or less than, noise levels during operations. The noise from pumps and other wellfield equipment contained within buildings would reduce sound levels to offsite receptors. The existing operational infrastructure would be used, and traffic volume would be less than during the construction and operations phases. The NRC staff concluded in the GEIS that the potential impact from noise during aquifer restoration would range from SMALL to MODERATE, depending on the location of the nearest resident (NRC, 2009).

The NRC staff conclude that, for the proposed Reno Creek ISR Project, noise generated during the aquifer restoration phase of the proposed project would either be similar to, or less than, noise generated during the operations phase. Like the operations phase, mechanical equipment (e.g., generators, pumps, air compressors, and ventilation systems) at the CPP and in the production units would generate noise during aquifer restoration. Noise from traffic associated with aquifer restoration would be limited to delivery of supplies and workers traveling to and from the site; therefore, there would be fewer vehicular trips than during the operations phase. Mitigation measures that the applicant would implement to minimize noise impacts during aquifer restoration would be similar to operations and include (i) implementing speed limits on access roads within the proposed project area; (ii) locating process machinery, such as pumps, dryers, and generators, within the fully enclosed CPP; and (iii) keeping all overhead CPP doors closed as much as possible to minimize the propagation of noise to onsite and offsite receptors. In wellfields, pumps and compressors used for aquifer restoration activities, such as groundwater transfer and groundwater sweep, would be contained within header houses. Likewise, pumps and compressors used to inject liquid wastes generated by aquifer restoration activities into deep disposal wells would be contained within buildings constructed around the wells (AUC, 2012b). Although potential noise generation during aquifer restoration of individual production units is expected to be of short duration (e.g., 3 to 4 years), aquifer restoration activities would continue over much of the life of the project as operations are completed in sequentially developed production units (see SEIS Figure 2-1).

Because the amount of equipment used and the volume of traffic would be less than during the operations phase, noise impacts during aquifer restoration would remain SMALL. As described previously, the closest offsite residence is approximately 2.0 km [1.25 mi] southeast of the proposed project and approximately 3.2 km [2.0 mi] from the nearest production unit. Because of decreasing noise levels with distance, aquifer restoration activities and associated traffic would be expected to have only SMALL noise impacts for residences, communities, and sensitive areas that are located more than 305 m [1,000 ft] from specific noise-generating activities (NRC, 2009). Mitigation measures, such as the use of sound abatement controls on operating equipment in the CPP and production units, would further reduce the propagation of noise to onsite and offsite human receptors. Noise impacts to workers during aquifer restoration would continue to be mitigated by fitting workers with proper PPE and implementing engineering controls (e.g., protective enclosures around equipment) to ensure that OSHA exposure limits in 29 CFR 1910.95 are not exceeded (AUC, 2012a). Therefore, the NRC staff conclude that the potential impact from noise during aquifer restoration would be SMALL.

4.8.1.4 Decommissioning Impacts

As stated in the GEIS, general noise levels generated during decommissioning and reclamation would be similar to the noise generated during construction. Equipment used to dismantle buildings and milling equipment, remove potentially contaminated soils, or grade the surface as part of reclamation activities would generate audible noise at above-background levels. This noise would be temporary, and when decommissioning and reclamation activities are completed, noise levels would return to baseline, with occasional noise from longer term monitoring activities. Like the construction phase, the noise level would be greater during daylight hours when decommissioning and reclamation are more likely to occur and most noticeable in proximity to the operating equipment. Given the likely distance to nearby residents {i.e., greater than 305 m [1,000 ft]}, the NRC staff concluded in the GEIS that noise would not be discernible to offsite residents or communities. Therefore, the NRC staff concluded in the GEIS that the impact from noise generated during decommissioning could range from SMALL to MODERATE (NRC, 2009).

The noise generated during decommissioning of the proposed Reno Creek ISR Project would be similar to or less than that generated during the construction phase. Sources of noise would include the use of heavy equipment for earthmoving, excavation, and building demolition activities. In wellfields, the greatest source of noise would be from equipment used during plugging and abandonment of production, injection, and monitoring wells. Cement mixers, compressors, and pumps would be the largest contributors to noise. Fewer shipments to and from the proposed project area would occur as decommissioning progresses, resulting in less noise from traffic. Because of decreasing noise levels with distance, decommissioning activities and associated traffic would be expected to have only SMALL noise impacts for residences, communities, and sensitive areas that are located more than 305 m [1,000 ft] from specific noise-generating activities (NRC, 2009). As noted previously, the closest offsite residence is approximately 2.0 km [1.25 mi] southeast of the proposed project and approximately 3.2 km [2.0 mi] from the nearest production unit. Noise impacts to workers during decommissioning would be mitigated by adherence to OSHA noise regulations implemented through the applicant's hearing conservation program (AUC, 2012a). Therefore, the NRC staff conclude that the potential impact from noise on human receptors during decommissioning would be SMALL.

4.8.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, there would be no change to sound levels either within the proposed project area or to surrounding human receptors. Ambient noise levels would continue to be primarily generated by highway traffic from State Highway 387 and ongoing CBM operations.

4.9 Historical and Cultural Impacts

As described in GEIS Section 4.3.8, ISR facility construction, operations, aquifer restoration, and decommissioning phases have the potential to adversely impact historic and cultural resources (NRC, 2009). Historic and cultural resources can be affected by land disturbances or be adversely impacted by visual or auditory sensory alterations resulting from the lifespan of an ISR facility. (NRC, 2009)

The potential environmental impacts on historic and cultural resources from construction, operations, aquifer restoration, and decommissioning for the proposed Reno Creek ISR Project are detailed in the following sections.

4.9.1 Proposed Action (Alternative 1)

The proposed project encompasses a total area of 2,451 ha [6,057 ac]. The Area of Potential Effect (APE) for the review of historic and cultural resources at the proposed Reno Creek ISR Project is defined as the area that will be directly or indirectly impacted by construction, operations, aquifer restoration, and decommissioning activities.

The direct APE for all phases of the facility would total of 651 ha [1,609 ac] and would coincide with the footprint of ground disturbance relating to facilities and infrastructure (e.g., pipelines, access roads, header houses, the CPP, and wellfields) (AUC, 2012a). The space between the edges of the wellfields and monitoring well rings is also included in the direct impact area for the proposed project. The indirect APE for the proposed Reno Creek ISR Project would consist of the viewshed analysis for an area extending 3.2 km [2 mi] from the proposed project boundary, and the general local area from which the proposed CPP could be viewed, since the structure would be the tallest structure for the proposed project (AUC, 2012a).

As previously noted, ISR facility construction, operations, aquifer restoration, and decommissioning phases have the potential to adversely impact historic properties (i.e., properties that are listed in, or are eligible for listing in, the National Register of Historic Places (NRHP) and other historic and cultural resources. The NRC staff are also complying with NHPA requirements through this SEIS. The NRC staff have consulted with the WY SHPO, interested tribes and the applicant when making preliminary determinations on the identification of historic properties that could be impacted by the proposed project. SEIS Section 3.9.3 discusses the NRC staff's preliminary determinations regarding whether a historic or cultural resource meets the eligibility criteria to be considered a historic property in accordance with 36 CFR 60.4(a)-(d). As discussed in SEIS Section 3.9, after reviewing recommendations and considering any comments received from other consulting parties, the NRC staff made preliminary determinations that all the sites, isolates and historic structures identified in the surveys are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations.

4.9.1.1 Construction Impacts

GEIS Section 4.3.8.1 described ISR facility construction-related impacts, both direct and indirect, to historical and cultural resources associated with land-disturbing activities. According to the GEIS, these impacts may range from SMALL to LARGE and are dependent on the identification of historic and cultural sites in a proposed project area. In addition, GEIS Section 4.3.8 notes that, as needed, the NRC license applicant would be required, under conditions in its NRC license, to adhere to procedures regarding the discovery of previously undocumented cultural resources during all phases of a proposed project. These procedures typically entail the stoppage of work and the notification of appropriate parties (federal, tribal, and state agencies) (NRC, 2009).

As described in SEIS Section 2.1.1.1.2, the applicant's proposed project includes construction of the CPP and associated infrastructure, such as wellfields, pipelines, power lines, header houses, ponds, and access roads, and ancillary buildings. Consistent with the GEIS, construction phase activities that may disturb historic and cultural impacts would include earth moving activities, trenching, land clearing, etc. Potential impacts on historic and cultural resources from construction of the proposed project are discussed next.

The NRC staff have evaluated the results of historic and cultural resource surveys conducted for the proposed Reno Creek ISR Project and consulted with interested tribes, other interest parties and the WY SHPO as part of the environmental review (see SEIS Section 3.9.3). The surveys included a Class I and Class III cultural resource investigation and a tribal cultural survey. SEIS Section 3.9 discusses the NRC's staff preliminary determinations that the historic and cultural resources identified were not eligible for listing on the NRHP. The following section discusses the impact analysis for the historic and cultural resources identified in the tribal cultural survey and tribal recommendations regarding those resources.

<u>Tribal Cultural Survey</u>

Tribal surveyors conducted a systematic pedestrian reconnaissance of the entire 1,609-acre direct APE for the Reno Creek ISR project from June 16–20, 2014 and July 7–18, 2014. During the survey, the tribes recorded data at four previously recorded precontact sites, and one precontact isolate. Six new sites of religious and cultural significance to Native American Tribes were identified. The surveyors also recorded 22 new isolated cultural localities.

SEIS Section 3.9.3.2.2 presents the results of tribal cultural surveys and NRHP eligibility recommendations for previously recorded archaeological sites, as well as newly discovered tribal sites identified by representatives of the Crow Creek Sioux, Flandreau Santee Sioux, Yankton Sioux, Turtle Mountain Band of Chippewa, Fort Peck Assiniboine and Sioux, Northern Cheyenne Tribe, Northern Arapaho Tribe, Crow Tribe (Apsaalooke), Santee Sioux Nation, Fort Belknap Tribe, Chippewa Cree Tribe, and Cheyenne River Sioux Tribe.
Previously Recorded

Revisitation of Previously Recorded Sites

As discussed in SEIS Section 3.9, of the 74 cultural localities identified in the proposed project area by Class III intensive surveys, none were eligible for listing in the NRHP. While participating in the tribal cultural survey, some surveyors chose to revisit some of these previously recorded archaeological sites and isolate locations. In total, tribal representatives investigated four such sites and revisited one isolated find (48CA7084, 48CA2765, 48CA4267, 48CA7087 and IF 7063-11). As a result, the survey teams recorded 13 cultural artifacts. All of the newly recorded locations consist of individual artifacts. No new cultural features were recorded during these revisits. None of the surveying tribes recommended previously recorded archaeological sites or isolates as eligible for listing in the NRHP. The NRC staff reviewed these recommendations and concluded the recorded individual artifacts do not change the ineligible status of these previously inventoried sites and isolates. Therefore, the NRC staff made a preliminary determination that Sites 48CA7084, 48CA2765, 48CA4267, 48CA7087 and IF 7063-11 are ineligible for listing in the NRHP. The NRC staff submitted its preliminary determinations to WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations.

The NRC staff's assessments of the significance of impacts for known archaeological sites revisited during the tribal cultural surveys are summarized in SEIS Table 4-14. In assessing the significance of impacts to these sites, the NRC staff considered its preliminary NRHP-eligibility determinations as discussed in SEIS Section 3.9 and the locations of eligible sites within the APE affected by facility construction.

Tribal Sites: New Discoveries

Tribal representatives identified six new sites/feature areas (48CA7249, 48CA7250, 48CA7251, 48CA7252, 48CA7253, and 48CA7254) during the tribal cultural survey. A total of 55 cultural artifacts and 5 cultural features were recorded. The NRC staff's NRHP eligibility determinations, assessment of the significance of impacts, and recommendations for new sites identified during the tribal cultural survey are summarized in SEIS Table 4-19 and discussed in the following section. In assessing the significance of impacts to these sites, the NRC staff considered its NRHP eligibility determinations and the location of the sites with respect to the direct APE for facility construction.

Two of the six newly discovered cultural sites were identified within the proposed Reno Creek ISR Project area but outside the proposed Reno Creek ISR direct APE. Both of these sites (48CA7249 and 48CA7250) are located on property owned by the State of Wyoming. Four of the sites were located within the proposed Reno Creek ISR Project direct APE. One of these sites (48CA7252) is located on property owned by the State of Wyoming, while the remaining three sites (48CA7251, 48CA7253, and 48CA7254) are located on privately owned property.

Table 4-14. U.S. Nuclear Regulatory Commission (NRC) Determination of National Register of Historic Places (NRHP) Eligibility and Impact Analysis for Previously Recorded Archaeological Sites and Isolates, and Newly Recorded Tribal Sites and Isolates Identified During the Tribal Cultural Survey

State Site Number	Associated Tribal Resource Number	Site Description	NRC's NRHP Determination*	Location Relative to the Direct APE	Significance of Impact*	Mitigation Recommendations*
48CA2765	TR-002; TR-018, TR-019, TR-033, and TR-034	Precontact campsite historic trash	Not eligible	Inside APE	SMALL	None
48CA4267	TR-010, TR-036, TR-037; TR-011 and TR-038; TR-012	Precontact lithic scatter	Not eligible	Inside APE	SMALL	None
48CA7084	TR-001 and TR-014	Precontact campsite	Not eligible	Inside APE	SMALL	None
48CA7087	No assigned TR # (precontact artifacts recorded by Northern Arapaho Tribe)	Historic artifacts (potential homestead)	Not eligible	Inside APE	SMALL	None
48CA7249	N/A	Precontact lithic scatter	Not eligible	Outside APE	SMALL	None†
48CA7250	N/A	Precontact lithic scatter	Not eligible	Outside APE	SMALL	None†
48CA7251	TR-044	Cultural feature and Precontact lithic scatter	Not eligible	Inside APE	SMALL	Avoidance
48CA7252	TR-045	Cultural features and Precontact lithic scatter	Not eligible	Inside APE	SMALL	Construction Monitoring and/or Avoidance
48CA7253	Stone Circle - Partial Tipi Ring	Cultural feature	Not eligible	Inside APE	SMALL	None
48CA7254	Stone Circle Feature	Cultural feature	Not eligible	Inside APE	SMALL	None

*There would be no impact to historic properties in the proposed Reno Creek ISR Project area based on NRC's NHRP eligibility determinations. See SEIS Section 3.9.3.1.

†These sites would not be affected because they are outside of the direct APE.

Of the 12 tribes that participated in the survey, the Santee Sioux Tribe and the Northern Arapaho Tribe provided written recommendations regarding sites of religious or cultural significance (SEIS Section 3.9.3.1.4). The Santee Sioux offered a recommendation of no adverse effect for the proposed project. The Northern Arapaho Tribe provided recommendations for 48CA7251 and 48CA7252 as well as for three isolated resource areas.

The NRC staff and WY SHPO do not consider isolated cultural resource areas eligible for listing in the NRHP. Where discoveries are not considered to be eligible, the NRC staff expect that construction activities will have no significant impact on any of the sites or isolates located within the direct APE. The two tribal cultural sites (48CA7249 and 48CA7250) located outside of the direct APE would not be impacted by the current design plans for the proposed Reno Creek ISR Project. The NRC staff conclude that two sites (48CA7251 and 48CA7252) may be affected by the proposed project due to their location within the direct APE as a result of facility construction. Avoidance of the sites would reduce impacts. However, as recommended by the Northern Arapaho Tribe and the NRC staff, AUC could implement a voluntary avoidance and construction monitoring plan to mitigate potential effects to 48CA7252. Formalized mitigation strategies for 48CA7251 and 48CA7252 could be developed with the applicant in accordance with
36 CFR 800.14(b)(2). The NRC staff's eligibility determinations and mitigation strategies were submitted to the WY SHPO for concurrence. The WY SHPO is currently evaluating these preliminary determinations and recommendations.

Visual Impacts Assessment

The CPP would be the tallest building constructed at the proposed Reno Creek ISR Project area and is slated to stand approximately 15.2 m [50 ft] tall. A viewshed study conducted for the environmental review indicates that the CPP structure will be visible from many elevated areas within the direct and indirect APE (AUC, 2012a). The NRC staff used Geographic Information Systems (GIS) analysis to determine if the proposed CPP would be visible at any known historic properties (eligible properties or properties listed in the NRHP and other historic and cultural sites.

This assessment reviewed the potential for indirect impacts on new and previously inventoried cultural sites in an 8 km [5 mi] radius of the proposed CPP location. Previously inventoried site data was accessed through the WY SHPO. There are no NRHP-listed sites in the proposed Reno Creek ISR Project area. However, there are nine NRHP eligible sites mapped within 8 km [5 mi] of the proposed project boundary (SEIS Table 4-15). The Pumpkin Buttes TCP is beyond 8 km [5 mi] from the proposed project boundary.

Of the 11 eligible properties, 3 are multi-component sites, with both historic and prehistoric components, 2 are historic sites, 4 are prehistoric sites, and 2 are Native American sites of religious and cultural significance. Historic properties considered eligible for the NRHP under Criterion D alone were not evaluated for potential visual impacts because integrity of setting is not often considered a contributing characteristic for properties considered eligible on the basis of their historic information content. Therefore, the NRC staff assessed Site 48CA1559 (Historic Homestead and Ranch), and Site 48CA2520 (Historic Dance/Recreation Hall) (SEIS Table 4-15). The 2 historic sites (Site 48CA1559 and 48CA2520) still had extant historic buildings at the time of their recording.

Table 4-15. U.S. Nuclear Regulatory Commission (NRC) Determination of National Register of Historic Places (NRHP) Eligibility and Impact Analysis for Historic Properties Included in the Visual Impacts Analysis

Site Number	Site Type	Significance of Impact	Temporal Period	Distance to CPP	CPP Visible	NRHP Eligibility Criteria
48CA1559	Historic Homestead and Ranch	Small, no visual impact	1890-Present	10.4 km [6.5 mi]	No	Recorder: Criterion A, C, and D (SHPO Concurrence)
48CA2520	Historic Dance/Recreation Hall	Small, no visual impact	1940-1945	11.2 km [7 mi]	No	Recorder: Significant (Unknown Criterion) (SHPO Concurrence)

Source: WYCRO Database

The closest site to the proposed CPP location is Site 48CA1559, located 10.4 km [6.5 mi] away. Site 48CA2520 is the greatest distance from the proposed CPP location at 11.2 km [7 mi] away.

This 360 degree viewshed assessment determined that the proposed CPP location would not be visible at National Register Eligible (NRE) sites located outside of the proposed project area. This analysis does indicate that the proposed CPP location will be visible from the southeastern vantage of the Pumpkin Buttes, which is considered a TCP by BLM.

The NRC staff assessed the potential visual impact to the integrity of setting for the Pumpkin Buttes. The area between the Pumpkin Buttes and the proposed project currently contains intrusive modern elements (e.g., public roads and oil drilling stations). The presence of these intrusions may diminish the qualities of setting, feeling, and association of the Pumpkin Buttes with potential visual effects. The existence of small modern intrusions already obstruct the visual line between the proposed CPP location and the Pumpkin Buttes. Therefore, the addition of the proposed CPP location to this setting would not significantly change the setting of the Pumpkin Buttes or the qualities of setting and feeling associated with the Pumpkin Buttes based on the factors that the proposed CPP would not be seen from NRE sites and the presence of existing intrusive modern elements already obstructs the visual line to the Pumpkin Buttes. In addition, the applicant has committed to reduce any visual impact of the proposed project by using neutral paint colors for its proposed facilities (AUC, 2014). The NRC staff conclude that the impact to the visual setting of historic and cultural resources would be SMALL.

<u>Auditory Impacts Assessment</u>

The auditory impacts assessment of this SEIS evaluates the potential for new auditory changes that may impact historic properties or other historic and cultural sites within or outside the limits of proposed ground disturbance. GEIS Section 4.3.7.1 determined that activities associated with construction (and operations) of ISR facilities in the Wyoming East Uranium Milling Region would not introduce significant audible elements in light of sparse development and the distance to nearby communities. The GEIS stipulates that noise impacts related to activities occurring beyond 305 m [1,000 ft] are considered SMALL for residences, communities, and sensitive areas (NRC 2009).

As discussed in the GEIS, impacts to historic and cultural resources resulting from noise would be greatest during the construction (and potentially decommissioning) phase(s) of an ISR project due to noise generated by earthmoving, excavation, building construction, and demolition activities (NRC, 2009). The NRC staff's NRHP eligibility determinations identified no historic properties in the proposed Reno Creek ISR Project area (i.e., properties listed in or considered eligible for listing in the NRHP). An additional nine NRHP-eligible properties are located between 7.2 to 8 km [4.5 mi and 5 mi] of the proposed project area.

All historic properties and other historic and cultural sites identified by the NRC staff as eligible for listing in the NRHP are located more than 305 m [1,000 ft] from the proposed CPP location. Therefore, the NRC staff conclude that potential auditory impacts to historic and cultural sites during construction would be SMALL.

<u>Inadvertent Discovery Plan</u>

The applicant has agreed, under conditions in an NRC license, to adhere to procedures regarding the discovery of previously undocumented historic and cultural resources during the project lifetime. Therefore, in order to mitigate or avoid impacts to resources, the applicant has committed to use an inadvertent discovery plan to address the potential identification of previously unrecorded historic and cultural resources during ISR facility construction (AUC, 2012a). If an inadvertent discovery of historic or cultural resources is made, then work would cease and all appropriate state, tribal, and federal parties must be contacted. Any discovered artifacts will be inventoried and evaluated in accordance with 36 CFR Part 800.

<u>Construction Impacts Conclusion</u>

The NRC staff's evaluation of historic and cultural resources is based on analyses of the historic and cultural resource investigation (Greer Services, 2011), the NRC's Tribal Cultural Survey (NRC, 2015), and consultation with interested tribes, the applicant and the WY SHPO. As discussed in SEIS Section 3.9, the NRC's preliminary NRHP eligibility determinations identified no historic properties in the proposed Reno Creek ISR Project direct APE. There are nine known historic properties located approximately 8 km [5 mi] from the proposed project area in the indirect APE, but these historic properties will not be visible from the proposed CPP based on NRC's viewshed analysis. The Pumpkin Buttes TCP is also located outside the indirect APE. Based on these factors and applicant's agreement to use neutral colors and have an inadvertent discovery plan, the NRC staff conclude that the potential impacts to historic and cultural resources during the construction phase of the project would be SMALL.

4.9.1.2 Operations Impacts

In GEIS Section 4.3.8.2, the impact of the operations phase of the ISR facility life cycle is considered SMALL, primarily because activities during operations are generally limited to previously disturbed areas (e.g. access roads, the CPP, and wellfields). There would be the potential for impacts to previously undisturbed land areas due to any new construction, maintenance, and repair. However, in general fewer impacts on historic and cultural resources are anticipated during operations in comparison to the construction phase due to a reduction in ground disturbances (NRC, 2009). A key difference between the two phases with regard to historic and cultural resources is that during operations, access restrictions are present around active production units, new wells, header houses, and pipelines that limit inadvertent disturbance of cultural properties. As previously mentioned, the NRC staff's preliminary NRHP eligibility determinations for the proposed Reno Creek ISR Project found no sites eligible for listing in the NRHP in the direct APE and nine eligible sites in the indirect APE. The operations phase associated with the proposed project would have fewer visual or auditory impacts to other historic or cultural properties than construction phase. The applicant has also committed to the use of an inadvertent discovery plan to address the potential identification of previously unrecorded historic and cultural resources during ISR facility operations (AUC, 2012a). If an inadvertent discovery of historical or cultural resources is made, then work would cease and all appropriate state, tribal, and federal parties would be contacted. Any discovered artifacts will be inventoried and evaluated in accordance with 36 CFR Part 800. Based on these factors, the NRC staff conclude that the potential impacts to historic and cultural resources during the operations phase of the project would be SMALL.

4.9.1.3 Aquifer Restoration Impacts

In GEIS Section 4.3.8.3, the impact of the aquifer restoration phase of the ISR facility life cycle is considered SMALL. The anticipated impacts to historic and cultural resources associated with this phase would be equivalent to, or less than, those attributed to ISR facility operations (NRC, 2009). Moreover, potential ground-disturbing activities occurring in this phase will likely be confined to areas having been disturbed through construction as the impacts are generally limited to the existing infrastructure and previously disturbed areas (e.g., access roads, the CPP, and wellfields) (NRC, 2009).

The NRC's preliminary NRHP eligibility determinations for the proposed Reno Creek ISR Project found no sites in the direct APE and nine sites in the indirect APE that are eligible for listing in the NRHP. The aquifer restoration associated with the proposed project would have fewer visual or auditory impacts to other historic or cultural properties like the operations phase. The applicant has also committed to the use of an inadvertent discovery plan to address the potential identification of previously unrecorded historic and cultural resources during the aquifer restoration phase (AUC, 2012a). If an inadvertent discovery of historic or cultural resources is made, then work would cease and all appropriate state, tribal, and federal parties must be contacted. Any discovered artifacts would be inventoried and evaluated in accordance with 36 CFR Part 800. Therefore, the aquifer restoration phase of the proposed project would have a SMALL impact on historic and cultural properties.

4.9.1.4 Decommissioning Impacts

In GEIS Section 4.3.8.4, the impact of the decommissioning phase of the ISR facility life cycle is considered SMALL, primarily because decommissioning activities are generally limited to previously disturbed areas (e.g., access roads, the CPP, and wellfields) and because historic and cultural resources within the existing area of potential effect are known, potential impacts can be avoided or lessened by redesign of decommissioning project activities (NRC, 2009).

The GEIS states that decommissioning and reclamation activities would be limited to previously disturbed areas within an ISR facility (NRC, 2009). Consequently, it is expected that impacts to any known historic or cultural resources, or other historic or cultural resources inadvertently discovered during prior phases of the proposed project, would have been mitigated prior to the decommissioning phase. The NRC staff's NRHP eligibility determinations for the proposed Reno Creek ISR Project found no sites in the direct APE that are eligible for listing in the NRHP. Decommissioning and reclamation activities associated with the proposed project would also have few visual or auditory impacts to other historic and cultural properties. The applicant has also committed to the use of an inadvertent discovery plan to address the potential identification of previously unrecorded historic and cultural resources during ISR facility decommissioning (AUC, 2012a). If an inadvertent discovery of historical or cultural resources is made, then work would cease and all appropriate state, tribal, and federal parties must be contacted. Any discovered artifacts will be inventoried and evaluated in accordance with 36 CFR Part 800. Based on the above factors, the NRC staff concluded the impacts to historic or cultural resources would be SMALL during the decommissioning phase of the proposed Reno Creek ISR Project.

4.9.2 No-Action (Alternative 2)

Under the No-Action Alternative, the proposed Reno Creek ISR Project would not be constructed or operated. Therefore, no historic or cultural properties would be adversely affected by the No-Action Alternative. Ongoing light surficial impacts in the proposed project area, such as cattle grazing and vehicular traffic, are likely to continue.

4.10 Visual and Scenic Impacts

The NRC staff concluded in the GEIS that visual and scenic impacts at an ISR facility would be SMALL during all four phases of an ISR project. These impacts primarily come from use of equipment such as drill rigs, dust and other emissions from such equipment, construction of the CPP and storage structures, site and wellfield access roads, land clearing and grading activities, and lighting for nighttime operations. Such impacts may be mitigated by topography, the use of color considerations for structures, and dust suppression techniques (NRC, 2009).

Potential environmental impacts on visual and scenic resources from construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project are discussed in the following sections.

4.10.1 Proposed Action (Alternative 1)

As described in SEIS Section 3.10, the BLM Visual Resource Management (VRM) classification of landscapes (BLM, 1984, 1986) was considered in assessing the significance and management objectives of visual impacts. Additionally, according to GEIS Section 3.3.9, the Wyoming East Uranium Region (including the proposed project area) does not contain any VRM Class I resources. There are few VRM Class II resources listed within the Wyoming East Uranium Region (NRC, 2009); however, those sites are approximately 63 km [40 mi] away (AUC, 2012a). The majority of the Wyoming East Uranium Milling Region is categorized as VRM Class III and Class IV (NRC, 2009).

The Pumpkin Buttes are visible from the proposed project area, but range from 12 to 23 km [7.5 to 14 mi] away. There is a PA between the BLM and the WY SHPO regarding mitigation of adverse effects to the Pumpkin Buttes TCP. The proposed Reno Creek ISR Project would be located at least 8.6 km [5.5 mi] outside the PA boundary and outside the 3.2 km [2mi] Pumpkin Buttes TCP viewshed boundary (for more information on the Pumpkin Buttes, see SEIS Section 3.9 and 3.10). As described in SEIS Section 3.10, the applicant classified the project area and the 3.2-km [2-mi] buffer surrounding the project area as VRM Class III (AUC, 2012a). Per BLM (1984, 1986), the objective of VRM Class III is to partially retain the existing character of the landscape, and the level of change to the characteristic landscape should be moderate. Activities can contrast to basic elements of the characteristic landscape to a moderate extent in a VRM Class III area, and to a greater extent in a VRM Class IV area. .As previously discussed in SEIS Sections 3.7 and 4.7, PSD Class I areas require more stringent air quality standards that can affect visual impacts. The nearest PSD Class I area is located at Wind Cave National Park, approximately 181.9 km [113 mi] from the proposed Reno Creek ISR Project.

4.10.1.1 Construction Impacts

Visual impacts during construction of ISR facilities can result from the presence of equipment (e.g., drill rig masts or cranes), dust and diesel emissions from construction equipment, and hillside and roadside cuts. Depending on the location of an ISR facility relative to viewpoints, such as highways, facility construction and drill rigs may be visible. For nighttime operations, the drill rigs would be lighted, thus creating a visual impact on elevated areas. Most impacts would be temporary as equipment is moved and would be mitigated by BMPs (e.g., dust suppression). Additionally, because these sites would be located in sparsely populated areas with rolling topography, most visual impacts during construction would not be visible from more than about 1 km [0.6 mi] away. Therefore, the NRC staff concluded in GEIS Section 4.3.9.1 that visual and scenic impacts from construction would be SMALL (NRC, 2009).

Visual impacts related to facilities construction at the proposed Reno Creek ISR Project would include access roads, overhead electrical lines, CPP facility, storage ponds, wellhead covers, header houses, piping, and ancillary buildings (AUC, 2012a). Additional visual impacts would be related to construction associated with the four Class I deep disposal wells. The tallest structure would be the CPP. However, the CPP would be constructed at a location already occupied by a structure. The CPP and associated structures would be painted a neutral color (AUC, 2012a).

During construction, most impacts to visual resources at the proposed project area would result from well development, when drilling rig masts contrast with the general topography. Multiple drill rigs would likely be operating during wellfield construction. Visual impacts from drilling activities would be temporary (e.g. time for drilling would be less than two years per wellfield). Once a well is completed and conditioned for use, the drill rig would be moved to a new location to drill the next hole. In the wellfields, wellheads would be covered to prevent freezing and protect the wells. These covers would be low structures {approximately 0.9 m [3 ft] high} and would present only a slight contrast to the existing landscape. Unless the topography is extremely flat and void of vegetation, these structures would not be visible from distances of 1 km [0.6 mi] or more.

Visual and scenic impacts from land disturbance associated with facilities construction at the proposed project area would be short term (see SEIS Figure 2-1). The applicant has stated that temporarily impacted areas would be reclaimed after construction is complete and debris created during construction would be removed as soon as possible (AUC, 2012a). Roads and structures would be more long lasting, but would be removed and reclaimed after operations cease or retained at the request of the land owner. Additionally, roads would be aligned to the topography, thereby reducing straight line roads as well as cut and fill requirements (AUC, 2012a). Standard dust control measures (e.g., water application, speed limits, and coordinating dust-producing activities) would be implemented to reduce visual impacts from fugitive dust (AUC, 2012a).

As discussed previously, the proposed project would be located more than 181.9 km [113 mi] from the PSD Class I area at Wind Cave National Park and 63 km [40 mi] away from the nearest VRM Class II area. The VRM Class III designation for the proposed project area allows for moderate effects to the landscape characteristics. The temporary timeframe (e.g. less than two years) of construction activities, the applicant's commitment to clearing and reclaiming the land, placement of roads, dust suppression methods, speed controls, and neutral paint schemes would be consistent with the VRM Class III objectives. Based on the remote location of the proposed project area, the nature of construction activities, and the mitigation measures that would be used to reduce potential visual and scenic impacts, the NRC staff conclude that visual and scenic impacts from the proposed project during construction would be SMALL.

4.10.1.2 Operations Impact

Visual impacts during operations at ISR facilities would be less than those from construction because the wellfield surface infrastructure would have a low profile, and most piping and cables would be buried. The tallest structures would be expected to include the CPP and power lines. Because ISR sites are typically located in sparsely populated areas with generally rolling topography, most visual impacts during operations would be limited to a distance of about 1 km [0.6 mi] or less. The irregular layout of wellfield surface structures, such as wellhead protection and header houses, would further reduce visual contrast. BMPs, design (e.g., painting buildings), and landscaping techniques would be used to mitigate potential visual impacts. Therefore, the NRC staff concluded in the GEIS Section 4.3.9.2 that visual and scenic impacts from operations would be SMALL (NRC, 2009).

Most of the pipes and cables associated with wellfield operations at the proposed Reno Creek ISR Project would be buried to protect them from freezing, and therefore they would not be visible during operations (AUC, 2012a). The applicant would sequentially phase in wellfields as the uranium reserves are defined (AUC, 2012a); therefore, there would not be a large expanse of land undergoing development at one time. Because wellhead covers would typically be low structures and there is no active drilling in operating wellfields, the overall visual impact of an operating wellfield would be the same as or less than impacts from construction.

The CPP, header houses, Class I deep disposal wells, access roads, and overhead power lines at the project would be the main operational facilities and infrastructure affecting the visual landscape. The visibility of aboveground facilities and infrastructure would depend on the location of the observer, intervening topography, and distance. The CPP, associated structures, and wellheads would be painted a neutral color. Also, the applicant would limit nighttime activities to minimize the need for lighting. As discussed previously and in SEIS Section 4.7, the applicant has committed to implementing standard dust control measures (e.g., water application and speed limits), which would reduce visual impacts from fugitive dust during operations activities (AUC, 2012a).

As stated previously, there are no Class I areas in the proposed project area, the closest Class II area would be 63 km [40 mi] away, and the area is designated a VRM Class III region. The VRM Class III designation for the proposed project area allows for moderate effects to the landscape characteristics. Because the CPP, associated structures, and wellheads would be painted a neutral color, there would be limited nighttime activities, and dust control measures would be implemented, the NRC staff conclude that the visual and scenic impacts from operations for the proposed project would be SMALL.

4.10.1.3 Aquifer Restoration Impacts

Aquifer restoration activities at ISR facilities would be expected to take place some years after the facility has been in operation, and restoration activities would use in-place infrastructure. As a result, potential visual impacts would be similar to those experienced during operations. Mitigation measures (e.g., dust suppression) may be used to further reduce visual and scenic impacts. Therefore, potential impacts from aquifer restoration would be SMALL (NRC, 2009).

Much of the same equipment and infrastructure used during the operational period of the proposed project would be employed during aquifer restoration, so impacts to the visual landscape would be similar to those during operations. As with construction and operations, the visual impacts associated with aquifer restoration would be consistent with the predominant VRM Classes III for the region. No modifications to either scenery or topography would occur during restoration. Standard dust control measures (e.g., water application and speed limits) would be implemented to further reduce the overall visual and scenic impacts of aquifer restoration (AUC, 2012a). Therefore, the NRC staff conclude that the visual and scenic impacts from aquifer restoration for the proposed project would be SMALL.

4.10.1.4 Decommissioning Impacts

Because similar equipment would be used and similar activities conducted, potential visual impacts during decommissioning of ISR facilities would be similar to those impacts experienced during construction. The greatest potential visual impacts during decommissioning would be temporary (i.e., 1 to 2 years) as equipment is moved from place to place and mitigated by BMPs (e.g., dust suppression). Additionally, visual impacts would be minimal, because these sites are expected to be located in sparsely populated areas of the Wyoming East Uranium Milling Region, and the impacts would diminish as decommissioning activities decrease and disturbed surfaces become revegetated. NRC licensees are required to conduct final site decommissioning and reclamation under an approved site decommissioning plan, with the goal of returning the landscape to preconstruction conditions. While some roads and slope modifications may persist beyond decommissioning and reclamation, the NRC staff concluded in the GEIS that visual and scenic impacts from decommissioning would be SMALL (NRC, 2009a).

When project operations and aquifer restoration are complete at the proposed Reno Creek ISR Project, the applicant would return all lands disturbed by the ISR facility to their preoperational land use of livestock grazing and wildlife habitat unless the state justifies and approves an alternative use (e.g., the landowner may request to retain structures and roads for further use) (AUC, 2012a). Reclamation would return the landscape to baseline contours and would reduce the visual impact by removing buildings and associated infrastructure. After reclamation activities are completed, there would be no restrictions on surface use. Prior to final site decommissioning, the applicant would submit a decommissioning plan to the NRC, in accordance with 10 CFR Part 40.

During decommissioning and reclamation activities, temporary impacts to the visual environment would be similar to or less than those from the construction phase. Equipment used to dismantle buildings and milling equipment, remove any contaminated soils, or grade the surface as part of reclamation activities would generate temporary (i.e., one year) visual contrasts. In the wellfields, the greatest source of visual contrast would be from equipment used when production and monitoring wells are plugged and abandoned. Temporary visual contrasts associated with the Class I deep disposal wells would include the dismantling of well housings and the plugging and abandonment of the wells. Visual and scenic resources may be affected by fugitive dust emissions from decommissioning activities. The applicant has committed to implementing dust suppression measures (e.g., water application and speed limits) to reduce dust emissions (AUC, 2012a). Once decommissioning and reclamation activities are complete, the visual landscape would be returned to baseline conditions, with the potential exception of equipment related to longer term monitoring activities. Therefore, the NRC staff conclude that the visual and scenic impacts from decommissioning for the proposed project would be SMALL.

4.10.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the proposed project would not be constructed and there would be no change to the existing visual and scenic resources. The existing pipelines, wellfields, and utility lines within the proposed project area from CBM and gas extraction activities would remain. No additional structures or uses associated with the proposed Reno Creek ISR Project would be introduced to affect the existing viewscapes, and the existing scenic quality would remain unchanged.

4.11 Socioeconomic Impacts

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by a proposed project could affect regional employment, income, and expenditures. Job creation is characterized by two types: (i) construction-related jobs, which are transient, short in duration (1 to 2 years), and less likely to have a long-term socioeconomic impact on the region and (ii) operations-related jobs in support of facility operations, which have a greater potential for permanent, long-term socioeconomic impacts in a region.

GEIS Section 4.3.10 describes the socioeconomic impacts expected during an ISR facility life cycle (NRC, 2009). Potential environmental impacts to socioeconomics could occur during all phases of the facility's life cycle. The GEIS socioeconomic analysis for the Wyoming East Uranium Milling Region was based on 2000 U.S. Census Bureau (USCB) data. The socioeconomic analysis presented in this SEIS for the proposed Reno Creek ISR Project socioeconomic region of influence (ROI) is based on 2010 and more recent USCB data accessed via American FactFinder, USCB 2008-2012 American Community Survey 5-Year Estimates, and USCB State and County QuickFacts (USCB, 2014). Though specific numbers will differ between the 2000, 2010, and more recent USCB data, the NRC analysis of socioeconomics presented in GEIS Section 4.3.10 remains valid for the proposed Reno Creek ISR Project as explained in the following sections, and expected impacts would be similar in scale to NRC staff conclusions in the GEIS.

Potential socioeconomic impacts from construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project are discussed in the following sections.

4.11.1 Proposed Action (Alternative 1)

The socioeconomic analysis for the proposed project focuses on the impacts of constructing, operating, restoring the aquifer, and decommissioning the proposed ISR facility in Campbell County, Wyoming. The applicant expects to directly employ an estimated 80 workers during the construction phase of the proposed project (AUC, 2014). During the operations phase, the applicant expects to employ an estimated 92 workers (AUC, 2014). The applicant expects the workforce to be reduced to an estimated 52 workers during aquifer restoration and further reduced to an estimated 22 workers during decommissioning (AUC, 2014). Most workers are expected to come from communities within an 80-km [50-mi] radius of the proposed project area. These communities include Wright and Gillette in Campbell County, Kaycee in Johnson County, and Midwest and Edgerton in Natrona County. These communities make up the socioeconomic ROI for the proposed project, which is defined as the area where employees and their families would reside, spend their income, and use their benefits, thereby affecting the economic conditions in the region. Casper in Natrona County, the largest city in the region, is expected to be an important source of equipment, supplies, services, and workers (AUC, 2012a).

4.11.1.1 Construction Impacts

In GEIS Section 4.3.10.1, the NRC staff discussed the potential impacts to socioeconomics from construction of an ISR facility. These impacts would result predominantly from employment at an ISR facility and demands on the existing public and social services, tourism/recreation, housing, infrastructure (schools, utilities), and the local workforce. In the GEIS, the NRC staff estimated total peak construction employment at an ISR facility to be about 200 people, including company employees and local contractors. During surface facility and wellfield construction, local contractors would generally be used (e.g., drillers, and construction workers), as available, and local building materials and building supplies would be used to the extent practical. The NRC staff also estimated an additional 140 indirect jobs may be created to support the construction of an ISR facility. Indirect jobs represent employees hired by producers of materials, equipment, and services that are used on the project. (NRC, 2009)

In the GEIS, the NRC staff assumed that most construction workers would choose to live in larger communities with access to more services. However, the NRC staff expected that some construction workers would commute from outside the county to the construction site and that skilled employees (e.g., engineers, accountants, and managers) would come from outside the local workforce. The potential also exists that some of these employees would temporarily relocate closer to the project area and contribute to the local economy through purchasing goods and services and through paying taxes. Depending on where the workforce and supplies come from, the GEIS determined that potential impacts to towns and communities, in terms of housing and employment structure, may be SMALL to MODERATE. Given the expected short duration of construction activities (12 to 18 months), families are not expected to relocate closer to the project area. For this reason, potential impacts to education and use of local services was determined to be SMALL. (NRC, 2009)

Construction of the CPP facilities, deep disposal wells, and the initial production unit at the proposed Reno Creek ISR Project is expected to directly employ 80 people (AUC, 2014). Based on the smaller number of required construction workers for the proposed project (80 workers) when compared to the ISR construction workforce estimated in the GEIS (200 workers) and the nearby proximity of communities that workers would be expected to come from, the NRC staff conclude that the site-specific impacts of constructing the proposed project would be smaller than the impacts described in the GEIS.

Because of the small relative size of the ISR construction workforce, the overall potential impact to socioeconomics from construction of the proposed Reno Creek ISR Project would be expected to be SMALL. The following subsections describe the construction impacts related to demographics, income, housing, employment rate, local finance, education, and health and social services for the proposed project.

4.11.1.1.1 Demographics

Construction of the CPP facilities, initial production unit, and deep disposal wells for the proposed project would be anticipated to take 2 years (see SEIS Figure 2-1). A workforce of 80 employees engaged directly in construction activities is expected (AUC, 2014). An additional 24 indirect jobs are expected to be created to support construction activities (AUC, 2012a). Construction workers from outside the ROI are likely to locate in nearby communities such as Wright and Gillette in Campbell County, Kaycee in Johnson County, and Midwest and Edgerton in Natrona County.

Increases in population would have the greatest impact on small communities close to the proposed project area, such as Kaycee (population 263), Midwest (population 404), and Edgerton (population 195). Based on housing data presented in SEIS Table 3-27, all of the surrounding communities have available housing to manage increases in population. Likewise, based on school enrollment and student–teacher ratio data presented in SEIS Section 3.11.6, schools have available capacities to manage increases in population. Furthermore, as described in SEIS Section 3.11.7, surrounding communities have adequate health care and social services to serve increases in population. Due to the short duration of construction (2 years), the expected construction workforce and supporting personnel would have a short-term impact on public services and community infrastructure in surrounding communities.

The construction workforce would be made up predominantly of skilled trades (e.g., carpenters, electricians, welders, plumbers) and unskilled workers sourced from nearby communities and counties. The applicant plans to source the labor force for construction from within the surrounding region to mitigate any burden on public services and community infrastructure in the nearby towns (AUC, 2012a). Further, due to the short duration of construction (2 years), construction workers with families would be less likely to relocate their entire families to the region, thus minimizing impacts from an outside workforce. Therefore, the NRC staff conclude that the impacts to demographics on nearby communities during the construction phase would be SMALL.

4.11.1.1.2 Income

The applicant has estimated a construction workforce of 80 employees (AUC, 2014). Construction of the proposed project would preferentially draw upon the labor force within the region before going outside the region (AUC, 2012a). Construction workers would likely come from nearby communities such as Wright, Gillette, Kaycee, and Midwest. As noted previously, the construction workforce would be made up predominantly of skilled trades and unskilled workers. It is expected that the construction workforce would be paid at rates typical of the region. Income information, including median household income and per capita income for Campbell, Johnson, and Natrona Counties, is presented in SEIS Section 3.11.2. Because the construction workforce would be paid at rates typical of the region, the NRC staff conclude that the overall impacts to income during the construction phase of the proposed project would be SMALL.

4.11.1.1.3 Housing

The number of construction workers would cause a short-term increase in the demand of temporary (rental) housing units in communities within the ROI. Based on 2010 USCB housing information, the vacancy rate is approximately 10 percent (1,500 vacant units) in the seven communities within the ROI with most of the vacant units in Gillette (1,178 vacant units) and Wright (128 vacant units) (see SEIS Section 3.11.3). Hence, any changes in employment would have little to no noticeable effect on the availability of housing in communities surrounding the proposed project. Due to the short duration of construction activities (2 years), the number of construction workers (80 workers), and the availability of housing in the region, there would be little or no employment-related housing impacts. Therefore, the impact of the proposed project on housing availability would be SMALL.

4.11.1.1.4 Employment Structure

Construction of the proposed project would create employment opportunities for 80 construction workers. In addition, the project has the potential to create 24 indirect jobs. As described in SEIS Section 3.11.4, total 2010 county labor forces were estimated to be 32,824 for Campbell County; 5,937 for Johnson County; and 52,286 for Natrona County (WDAI, 2012). Unemployment rates in 2011 were 4.6, 7.1, and 5.9 percent in Campbell, Johnson, and Natrona Counties, respectively (WDAI, 2012). Because of the short duration of construction (2 years) and small size of the construction workforce (80 workers), the effect on employment in the region is expected to be SMALL.

4.11.1.1.5 Local Finance

Construction of the proposed Reno Creek ISR facility would generate some tax revenue in the local economy through the purchase of goods and services and would contribute to increased county and state tax revenues through an increased tax base. As described in SEIS Section 3.11.5, the majority of state revenue in Wyoming is generated from a 4 percent statewide sales tax (WDOR, 2013). Counties may impose two optional taxes, either for general or specific uses. Each optional tax is limited to a maximum of 1 percent. As described in SEIS Section 3.11.5, 2013 sales and use tax revenues in Campbell, Johnson, and Natrona Counties totaled approximately $183 million, $14 million, and $127.5 million, respectively (WDOR, 2013). In addition, Wyoming law allows counties to impose a local option lodging tax of not more than 4 percent. In 2013, lodging tax collections in Campbell, Johnson, and Natrona Counties totaled approximately $432,000, $163,000, and $1.3 million, respectively (WDOR, 2013). Because of the short duration of construction (2 years) and small size of the construction workforce (80 workers) in relation to the total labor forces in Campbell, Johnson, and Natrona Counties (see previous section), construction of the proposed Reno Creek ISR project would have a SMALL impact on local finances.

4.11.1.1.6 Education

If the construction workforce for the proposed Reno Creek ISR Project and their families secure local housing, an increased demand for schools would occur. However, construction workers are less likely to relocate their entire families to the region, especially given the relatively short duration (2 years) of construction activities. Based on school enrollment and student–teacher ratio data presented in SEIS Section 3.11.6, school districts have available capacities to manage increases in school-aged children relocating to the area. The NRC staff conclude that the overall impact on educational services during the construction phase of the proposed project would be SMALL**.**

4.11.1.1.7 Health and Social Services

The construction workforce is expected to cause only a small, short-term increase in the demand for doctors, hospitals, social services, and police during the construction phase of the proposed project. Because of the short duration of construction (2 years), construction workers with families would be less likely to relocate their entire families to the region, thus minimizing impacts on health care and social services. As presented in SEIS Section 3.11.7, towns surrounding the proposed project have adequate medical facilities; social services; and police, fire, and emergency medical services to accommodate workers and their families. Local governments are expected to have the capacity to effectively plan for and manage any increased demands on health and social services because population increases would be small (80 construction workers). Therefore, impacts to health and social services during the construction phase of the proposed project would be SMALL.

4.11.1.2 Operations Impacts

GEIS Section 4.3.10.2 describes employment levels during ISR facility operations and assumes 50 to 80 workers would support this phase of the ISR life cycle. Use of local contract workers and local building materials would diminish, because drilling and facility construction would diminish. Revenues would be generated from federal, state, and local taxes on the facility and the uranium produced. Employment types are expected to be more technical during operations, and as a result, the majority of the operational workforce is expected to be staffed from outside the region, particularly during initial operations. According to the GEIS, effects on community services (e.g., education, health care, utilities, shopping, and recreation) during facility operations would be similar to effects experienced during construction, except fewer people would be employed for a longer duration. Overall, NRC staff concluded in the GEIS that potential impacts to socioeconomics from operations would be SMALL to MODERATE (NRC, 2009).

The operations phase of the proposed Reno Creek ISR Project is expected to last for 11 years and employ 92 workers (AUC, 2014). In addition, eight to nine indirect jobs are expected to be created to support operations of the proposed project (AUC, 2012a). The operations phase would impact the local economy through creating jobs, purchasing local goods and services, and increasing county and state tax revenues. Severance tax on the extracted uranium would also be collected at the state level and would contribute to the State of Wyoming general fund. The anticipated size of the ISR operations workforce (92 payroll employees) is greater than the 50 to 80 employees analyzed in the GEIS. The following subsections describe the operations impacts related to demographics, income, housing, employment rate, local finance, education, and health and social services.

4.11.1.2.1 Demographics

A workforce of 92 employees is expected to be required for the operations phase of the proposed project (AUC, 2012a). The operations workforce is expected to stay in the area longer (approximately 11 years) and so workers would be more likely to secure permanent or semi-permanent housing in the area than the construction workforce. The operations phase would require a number of specialized workers, such as plant managers, technical professionals, and skilled tradesmen. As described in GEIS Section 4.3.10.2, because of the highly technical nature of ISR operations (requiring professionals in the areas of health physics, chemistry, laboratory analysis, geology and hydrogeology, and engineering), the majority (approximately 70 percent) of the workforce during operations is expected to be staffed from outside the region (NRC, 2009). Therefore, approximately 64 personnel (92 employees × 0.7) for the operations phase of the proposed project could be sourced from outside the local area. The remaining workforce would most likely come from the local labor pool. The increase in population during the operations phase would spur additional job creation to serve the larger population. The applicant estimated that eight to nine indirect jobs are expected during the operations phase of the project (AUC, 2012a).

Based on the size of the operations workforce (92 workers) and the potential addition of eight to nine (indirect) workers in support of facility operations, demographic conditions in Campbell, Johnson, and Natrona Counties are not likely to change. The combined effect of approximately 100 new jobs in the region (assuming that all of the direct and indirect workers would relocate to the ROI) constitutes less than 1 percent of the current combined civilian labor force in Campbell, Johnson, and Natrona Counties (see SEIS Section 3.11.4). Therefore, the impact on demographic conditions would be SMALL.

4.11.1.2.2 Income

Operations at the proposed project would create skilled positions such as project managers, plant operators, lab technicians, and drilling contractors. These skilled workers would likely command salaries that provide income levels equal to or higher than the average local and statewide income levels. The 2008 to 2012 Wyoming median household income was $56,573 (see SEIS Table 3-28). The statewide median household income is less than the Campbell County median household income of $77,090 and comparable to median household incomes in Johnson and Natrona Counties ($57,175 and $55,786, respectively) (see SEIS Table 3-28). Therefore, the proposed project would have a positive effect on local average annual incomes during ISR facility operations. However, because the operations workforce is small (92 workers) in comparison to the combined labor force in Campbell, Johnson, and Natrona Counties (see SEIS Section 3.11.4), overall impacts to local income during ISR facility operations would be SMALL.

4.11.1.2.3 Housing

Housing demand is anticipated to increase during operations. The operations workforce is expected to stay in the area longer, approximately 11 years (see SEIS Figure 2-1), and so would be more likely to secure permanent or semi-permanent housing in the area compared to the construction workforce. Most workers moving into the area are expected to relocate to the surrounding towns and communities of Wright, Gillette, Sleepy Hollow, Antelope Valley, Kaycee, Midwest, and Edgerton. Vacancy rates are currently high (9.4 to 16.9 percent) in Campbell, Johnson, and Natrona Counties (see SEIS Table 3-29). In 2010, there were approximately 1,500 vacant housing units in the 7 communities within the ROI for the proposed project (see SEIS Section 3.11.3). Therefore, the estimated operations workforce (92 workers) would have little impact on the housing inventory. Because of the small size of the operations workforce (92 workers) and the workforce indirectly supporting facility operations (8 to 9 workers), impacts to housing during ISR operations at the proposed project would be SMALL.

4.11.1.2.4 Employment Structure

As previously discussed, ISR facility operations at the proposed project would generate 92 new jobs, such as project managers, plant operators, lab technicians, and drill contractors. Most skilled positions are likely to be filled by people moving into the area rather than providing employment opportunities for people living in nearby communities. As described in GEIS Section 4.3.10.2, because of the highly technical nature of ISR operations (requiring professionals in the areas of health physics, chemistry, laboratory analysis, geology and hydrogeology, and engineering), the majority (approximately 70 percent) of the workforce during operations is expected to be staffed from outside the region (NRC, 2009). The proposed project would provide some jobs to the local labor pool to support ISR facility operations. However, because the number of skilled workers drawn from areas outside of the ROI would be relatively small (e.g., 92 workers × 0.7 = 64 workers), ISR facility operations at the proposed project would not noticeably affect employment rates in Campbell, Johnson, and Natrona Counties. Therefore, the impact on the employment structure would be SMALL.

4.11.1.2.5 Local Finance

Tax revenue would primarily profit Campbell County through the projected 11-year operations phase. Property taxes would be applied to the value of all equipment the project uses. The counties and municipalities within the ROI would indirectly benefit from increased sales tax revenue from the increased population and resultant demand for goods and services. In addition, the State of Wyoming levies taxes on the value of mineral production (a severance tax). Wyoming levies a 4 percent uranium mineral severance tax on the taxable value of the current year's production. The Wyoming Department of Revenue (Mineral Tax Division) administers and collects the severance tax. A county gross products tax for mineral production contributes to local government revenue. The county gross products tax is an *ad valorem* property tax based on the taxable value of the previous year's mineral production. The taxable value of the previous year's production is assessed by the Wyoming Department of Revenue (Mineral Tax Division) and certified to county and tax districts. Counties bill and collect this *ad valorem* property tax directly from mineral taxpayers based on the state-certified taxable value and applicable county and tax district mill levies. As described in SEIS Section 8.2.1, the proposed project would generate an estimated $41.5 million in total uranium production taxes over the 16-year life of the proposed project. Of this estimated total, the State of Wyoming would receive $16.4 million in severance taxes and Campbell County would receive $25.1 million in gross product taxes (AUC, 2012a). In addition, an additional $26.75 million in other state and local taxes (e.g., property and sales taxes) would be generated over the 16-year life of the project (AUC, 2012a). As further described in SEIS Section 3.11.5, sales and use tax revenues in Campbell County totaled approximately $183 million in 2013 and the approximate 2013 taxable valuation for all state and locally assessed property in Campbell County was $5.8 billion. On an annual basis, the increased tax revenue generated by the proposed project would be small in comparison to total property, sales, and mineral production taxes in Campbell County. Therefore, NRC staff conclude that the tax-revenue impact from ISR facility operations on local taxing jurisdictions in Campbell County would be positive and SMALL.

4.11.1.2.6 Education

The added population associated with the additional 92 workers and their families relocating during operations may have an impact on local public schools and education-related services. The average family size in Wyoming is 2.96 (USCB, 2014). Assuming a 2-parent family, a conservative upper estimate for the number of school-aged children that may relocate to the ROI would be 88 children of various ages. The potential increase in school-aged children would likely be split between the three county school districts in the ROI (see SEIS Section 3.11.6). Comprising various ages and spread across schools and classrooms in the surrounding communities (kindergarten and grades 1 through 12), the number of children (88) would not likely have a noticeable effect on student–teacher ratios. Based on student–teacher ratios, each of the schools within the ROI has some capacity for additional students. Current student–teacher ratios in Campbell, Johnson, and Natrona counties are 13.5 to 1, 10.8 to 1, and 14.1 to 1, respectively (see SEIS Table 3-30). However, Campbell County is experiencing significant growth in student numbers due to ongoing energy development activities. Campbell County school district officials are working to accommodate current and anticipated growth in student populations (AUC, 2012a). For example, in 2015, the Campbell County School District Board of Trustees approved building a new high school in Gillette to accommodate the growing student population. The NRC staff conclude that the impact on schools and education-related services during the ISR facility operations phase would be SMALL.

4.11.1.2.7 Health and Social Services

A small increase in demand would be expected for health care and social services during the operations phase of the proposed project from workers and their families relocating to the ROI. The estimated size of the operations workforce (92 workers) is only slightly greater than the estimated size of the construction workforce (80 workers). Therefore, the demand for health and social services during operations is not expected to differ significantly from those during the construction phase of the proposed project. The small additional increase in demand that would occur for the operations phase would likely already have been met during the construction phase. As described in SEIS Section 3.11.7, towns surrounding the proposed project have adequate medical facilities; social services; and police, fire, and emergency medical services to accommodate workers and their families. Impacts to health care and social services during operations would remain SMALL.

4.11.1.3 Aquifer Restoration Impacts

The NRC staff concluded in GEIS Section 4.3.10.3 that the socioeconomic impact from aquifer restoration would be similar to impacts experienced during ISR facility operations. This is because the level of employment and demand on services would not change. The NRC staff concluded in the GEIS the potential impacts to socioeconomics would be SMALL (NRC, 2009).

Socioeconomic impacts from the aquifer restoration process at the proposed project area would be similar to those experienced during ISR facility operations. Initial aquifer restoration of wellfields would be conducted in conjunction with the operations phase and would not require additional workers with specialized skills (AUC, 2012a). Restoration of the first wellfields would commence in year 6 and continue until year 14 or 15. The workforce for aquifer restoration is estimated to be 52 employees (AUC, 2014). Workers performing aquifer restoration activities would likely be sourced from the operations phase workforce, and any additional workers would likely be drawn from the local area. Impacts on demographics; income; housing; employment; tax revenue; and health, social, and educational services would remain unchanged because it is likely that workers taken from the operations workforce would have already relocated their families to the area and temporary workers would not relocate their families to the area. Therefore, the overall socioeconomic impact of aquifer restoration would be SMALL.

4.11.1.4 Decommissioning Impacts

GEIS Section 4.3.10.4 discusses the potential socioeconomic impacts of decommissioning. Decommissioning and reclamation activities (e.g., dismantling surface structures, removing pumps, plugging and abandoning wells, and reclaiming and recontouring the ground surface) would likely draw on a skill set similar to the ISR facility construction workforce. Decommissioning activities would be expected to be short in duration (24 to 30 months), and so employment would be temporary. Impacts to employment structure and housing are expected to be similar to those for construction, due to similar employment levels. The NRC staff concluded in the GEIS that overall potential impacts to socioeconomics from decommissioning would be SMALL to MODERATE (NRC, 2009).

Final decommissioning of the CPP facilities, production unit infrastructure, access roads, and Class I deep disposal wells at the proposed project is expected to take 1 year (AUC, 2012a). A workforce of 22 employees engaged directly in these activities has been estimated (AUC, 2014). Decommissioning activities for the proposed project could impact the demand for housing and local infrastructure, as well as health, social, and educational services, if new workers relocate their families to the local area. However, due to the size of the expected workforce needed for decommissioning (22 direct employees) and short duration of the decommissioning phase (1 year), these impacts would be SMALL and further reduced if a number of the ISR facility operations and aquifer restoration employees remain to assist in the decommissioning activities.

4.11.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the proposed Reno Creek ISR Project would not be constructed or operated. Socioeconomic conditions in Campbell, Johnson, and Natrona Counties would not change under the No-Action Alternative

4.12 <u>Environmental Justice</u>

As required by Title VI of the Civil Rights Act of 1964, federal agencies must consider whether their actions may cause disproportionately negative impacts on minority or low-income populations. Executive Order 12898 (59 FR 7629 (1994), “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” requires similar analysis.

In response to Executive Order 12898, the Commission issued a “Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions” (69 FR 52040). The Policy Statement explains that “[T]he Commission is committed to the general goals set forth in Executive Order 12898, and strives to meet those goals as part of its NEPA review process.”

In 1997, the CEQ provided the following guidance relevant to determining when an agency’s actions may disproportionately affect certain populations (CEQ, 1997):

<u>Disproportionately High and Adverse Human Health Effects</u>. Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health

effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group.

Disproportionately High and Adverse Environmental Effects. A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered.

The following environmental justice analysis assesses whether issuing a license for the proposed Reno Creek ISR project might cause disproportionately high and adverse human health or environmental effects on minority and low-income populations. In assessing the effects, the following CEQ (1997) definitions of minority individuals, minority populations, and low-income populations were used:

Minority individuals. Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, Hispanic and Asian.

Minority populations. Minority populations are identified when (i) the minority population of an affected area exceeds 50 percent or (ii) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-income population. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau’s Current Population Reports, Series PB60, on Income and Poverty.

4.12.1 Analysis of Impacts

Methodology

The NRC addresses environmental justice matters for license reviews through (i) identifying minority and low-income populations that may be affected by the proposed construction and operations of the proposed Reno Creek ISR Project and (ii) examining any potential human health or environmental effects on these populations to determine whether these effects may be disproportionately high and adverse. Consistent with guidance in NRC NUREG–1748 (NRC, 2003a) Appendix C (Environmental Justice Procedures), if a facility is located outside the city limits or in a rural area, a radius of approximately 6.4 km [4 mi] should be used for the environmental justice analysis. For the analysis in this SEIS, because the proposed Reno Creek ISR Project would be located in an area that is not considered an urban area, potentially affected populations who reside within a 6.4-km [4-mi] radius of the proposed project area are considered. Data on low-income and minority individuals were collected and analyzed at the census block group level within this study area. A block group is the smallest geographical area used by the U.S. Census Bureau to which census data is collected.

The proposed Reno Creek ISR Project and a 6.4-km [4-mi] perimeter around the proposed project area are contained within one block group (Census Tract 1, Block Group 2) within Campbell County. The U.S. Census Bureau provides race and poverty characteristics for Census Tract 1, Block Group 2, which is the block group potentially affected by the proposed project. SEIS Table 4-16 compares the percentage of people living in poverty and minority populations in the United States, in Wyoming, in Campbell County, and Census Tract 1, Block Group 2. The NRC environmental justice guidance in NUREG–1748 states, "[i]f the percentage in the block groups significantly exceeds that of the state or county percentage for either minority or low-income population, environmental justice will have to be considered in greater detail. As a general matter, and where appropriate, staff may consider differences greater than 20 percentage points to be significant. Additionally, if either the minority or low-income population percentage exceeds 50 percent, environmental justice will have to be considered in greater detail" (NRC, 2003a). As further described in the following paragraphs, no minority or low-income populations in the block group analyzed exceed 50 percent of the population or are greater than 20 percentage points more than that of the state or county. Because the minority and low-income populations in the block group analyzed do not significantly exceed that of the state or county, and the minority and low-income population does not exceed 50 percent of the block group, a detailed environmental justice analysis is not required.

According to the U.S. Census Bureau, between 2000 and 2010 the population of Campbell County increased to 46,133 from 33,698 (or about 36.9 percent) (SEIS Section 3.11.1). Minority populations are estimated to have increased by approximately 1,800 persons for a total approximate minority total of 3,200 persons (approximately a 129 percent increase). The estimated minority population increase in Campbell County may be due to an estimated influx of persons of Hispanic or Latino ethnicity, which accounts for more than 2,400 individuals, or an increase in population of about 200 percent from 2000 (USCB, 2016).

According to the most recent 5-year estimate from the US Census Bureau, the population living below the poverty level was 15.6 percent in the United States and 11.6 percent in Wyoming (the 2014 federal poverty threshold was $23,850 for a family of four). The percentage of people living below the poverty level within Campbell County is 6.8. This is a decrease from the 2000 Census Data in which 7.6 percent of the persons living in Campbell County were living below the poverty level (USCB, 2014).

The median household income estimate for Wyoming for the years 2010 to 2014 was $58,252. Campbell County had a much higher estimated median household income average ($78,609) and a lower percentage of individuals (6.8 percent) living below the poverty level than the state averages (USCB, 2016).

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operations of the proposed Reno Creek ISR Project. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. A disproportionately high environmental effect refers to

Table 4-16. Percentage of Population Living in Poverty and Percentage Minority Population 2010 to 2014 5-Year Estimate		
Geographic Unit	**Percent Living in Poverty**	**Percent Minority**
U.S.	15.6	37.2
Wyoming	11.6	14.3
Campbell County, Wyoming	6.8	11.7
Campbell County, Wyoming Census Tract 1, Block Group 2	7.3	15
Source: USCB, 2016		

an impact or risk of impact on the natural or physical environment in a low-income or minority community that is significant and appreciably exceeds the environmental impact on the larger community. These effects may include ecological, cultural, human health, economic, or social impacts (CEQ, 1997). Some of these potential effects have been identified in resource areas described in this chapter. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. Minority and low-income populations are subsets of the general public residing around the proposed Reno Creek ISR Project area, and all populations would be exposed to the same health and environmental effects generated from construction, operations, aquifer restoration, and decommissioning activities.

4.12.2 Proposed Action (Alternative 1)

GEIS Section 6.1.2 identified no minority populations in the Wyoming East Uranium Milling Region using 2000 census data (NRC, 2009a). Albany County was the only county in the Wyoming East Uranium Milling Region that was identified as having a low income population. As explained in GEIS Section 6.3, the NRC staff anticipated that because the nearest ISR facility to Albany County would be about 8 km [5 mi] from the county border, that no environmental justice concerns would be expected for ISR facilities in the Wyoming East Uranium Milling Region. The NRC staff concluded that no minority and low-income population located in the Wyoming East Uranium Milling Region would experience a disproportionately high and adverse impact from ISR facilities.

Potential impacts to minority and low-income populations due to the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be limited to onsite activities. Minority and low-income populations residing along site access roads could experience increased commuter vehicle traffic during construction and operational shift changes. As construction and operations employment increases at the proposed Reno Creek ISR Project, employment opportunities for minority and low-income populations may also increase. Increased demand for rental housing during peak construction could disproportionately affect low-income populations. However, according to the 2010 census information, there were more than 1,700 vacant housing units in Campbell County (SEIS Table 3-29), therefore the NRC staff do not anticipate a disproportionate effect on low-income populations due to lack of availability or inflated rental prices.

The percentage of minority and low-income populations living in the affected block group is similar to the percentage of minority and low-income populations recorded at the state and county level and well below the national level. Demographic information for Campbell County and Wyoming, including race and ethnicity, using 2010 census data is provided in SEIS Table 3-27. No minority or low-income populations were identified in the block group where the proposed Reno Creek ISR Project would be located and encompasses a 6.4-km [4-mi] perimeter around the proposed project area. Based on this information and the analysis of human health and environmental impacts presented throughout this chapter, there would be no disproportionately high and adverse impacts on minority and low-income populations from the construction, operations, aquifer restoration and decommissioning of the proposed Reno Creek ISR Project.

Subsistence Consumption of Fish and Wildlife

As part of addressing environmental justice associated with license reviews, the NRC also analyzed the risk of radiological exposure through the consumption patterns of special pathway receptors, including subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of plant materials. The special pathway receptors analysis is important to the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area.

EO 12898 (59 FR 7629) Section 4-4 directs federal agencies, whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations that principally rely on fish and wildlife for subsistence and to communicate the risks of these consumption patterns to the public. The land within the proposed project area is private and state-owned, used primarily for agricultural purposes (i.e. cattle grazing), and provides recreational activities, such as hunting with permission of the land owner (see SEIS Section 3.2). The applicant has stated that they would submit a written request to the BLC to request hunting restrictions. This request would specifically request full restrictive access to both recreational hunters and shooters (AUC, 2014a) for the small parcel of state-owned land. Hunting on private property would be allowed at the discretion of the land owner, but restricted within all proposed wellfields (AUC, 2012a). No commercial crop production takes place within the proposed project area. Also, as stated in SEIS Section 3.6.2, there is no adequate habitat within the proposed project area to support fish populations; therefore, no analysis was performed for subsistence consumption of fish. Because land access restrictions would limit hunting, and no fish or crops on the land are available for consumption, the NRC staff conclude that there is minimal, if any, risk of radiological exposure through subsistence consumption pathways, as further described next.

As is the case for the general public, the potential impacts to minority and low-income populations would be radiological effects. Radiation doses for the general public are described in SEIS Section 4.13 and would be expected to be below regulatory limits. Background radiological monitoring of soils and sediments, surface water, livestock, fish, and vegetation at the proposed Reno Creek ISR Project are described in SEIS Sections 3.12.1, 3.6.2, and 7.4. Large game animals have extensive ranges and are not confined to the proposed project area. Therefore, the potential for bioaccumulation of radionuclides in these animals would be limited because they would likely derive only a small fraction of total sustenance from the flora or fauna in the proposed Reno Creek ISR Project area. The NRC staff have therefore considered special pathways that took into account the potential levels of contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals on or near the proposed Reno Creek ISR Project area. However, as previously stated in this section, no minority or low-income populations were identified in the block group where the proposed Reno Creek ISR

Project would be located or in the 6.4-km [4-mi] perimeter around the proposed project area. Because (i) there are no minority or low-income populations identified, (ii) the land within and surrounding the proposed project area is privately owned, (iii) the radiation dose for the general public would be below regulatory limits, (iv) there is no adequate habitat for fish populations, (v) the applicant would request a full restriction on hunting for the state-owned land, and (vi) consumption of large game from hunting, as allowed by land owners, would result in minimal, if any, risk of radiological exposure, the proposed construction, operations, aquifer restoration, and decommissioning of the proposed ISR project would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the proposed Reno Creek project area.

4.12.3 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the ISR facility would not be constructed and operated at the proposed Reno Creek ISR Project area. The relative conditions affecting minority and low-income populations in the vicinity of the proposed project site would remain unchanged. Therefore, there would be no disproportionately high or adverse impacts to minority and low-income populations from this alternative.

4.13 Public and Occupational Health

As described in GEIS Section 4.3.11,[2] potential radiological and nonradiological effects from ISR activities may occur during all phases of the ISR facility's life cycle (NRC, 2009). These effects may occur during normal operations where proposed activities are executed as planned or during potential accident conditions when unplanned events can generate additional hazards. Additionally, the potential hazards and associated effects can be either radiological or nonradiological. Therefore, the analysis in this section evaluates the radiological and nonradiological potential public and occupational health and safety effects for normal and accident conditions in each phase of the ISR facility life cycle.

4.13.1 Proposed Action (Alternative 1)

The environmental impacts on public and occupational health and safety for the proposed project are described in the following sections.

4.13.1.1 Construction Impacts

Construction impacts on public and occupational health and safety were evaluated in GEIS Section 4.3.11.1. During facility construction, standard construction safety practices would address nonradiological worker safety. Construction emissions would be primarily from fugitive dust and diesel-powered construction equipment exhaust. Fugitive dust generated from construction activities and vehicle traffic would be limited by the duration of activities, and because the average natural levels of radioactivity in soils are low, it would not result in a radiological dose to workers and the public. Diesel emissions from construction equipment

[2]The GEIS concluded that potential public and occupational health and safety impacts from ISR activities would not significantly vary by region and therefore referred to the in-depth analysis in GEIS section 4.2.11 rather than repeating the same discussion for each region. Similarly, in this SEIS, the analysis refers to both the region-specific discussion and the more in-depth discussion in GEIS Section 4.2.11, as appropriate.

would also be limited by the duration of activities and be readily dispersed into the atmosphere. For these reasons, the NRC staff concluded in the GEIS that potential impacts to public and occupational health and safety from construction would be SMALL. (NRC, 2009)

As described in SEIS Section 2.1.1.1.2, construction activities at the proposed Reno Creek ISR Project would include clearing and grading for roads, building foundations and a surface impoundment, drilling wells, trenching, laying pipelines, and assembling buildings. Construction activities for the proposed project would also involve the installation of four Class I deep disposal wells (see SEIS Section 2.1.1.1.2). Workers could be exposed to low levels of background radiation during the construction phase by direct exposure, inhalation or ingestion of radionuclides during well construction, construction activities that disturbed soils, and fugitive dust from vehicular traffic. These activities are equivalent to the activities analyzed in GEIS Section 4.3.11.

The proposed Reno Creek ISR Project involves drilling wells using a common technique known as mud rotary drilling (see SEIS Section 2.1.1.1.2). This technique uses fluid moving through a drill stem, out the drill bit, and back to the surface between the drill stem and host rock. When the fluid returns to the surface, it passes through a trough to a mud pit, where the cuttings settle out and the fluid is recycled down the borehole. The applicant would temporarily hold residual cuttings and drilling fluids in mud pits after drilling and construction activities are completed. Because the cuttings are taken from very near and within the ore deposits, they have the potential to be more contaminated than soil samples at the surface. Shortly after completion of drilling (approximately 30 days), the applicant would backfill with the excavated soil and grade the mud pits in accordance with WDEQ regulations (AUC, 2012a).

As described in SEIS Section 3.12.1.1, the average concentration of radionuclides measured in the soil within the proposed Reno Creek ISR Project area is low. The mean radium (Ra-226) concentration of surface soils was 0.037 Bq/g [1.0 pCi/g] and comparable to expected natural background radioactivity. Fugitive dust generated from facility construction activities would be of short duration (i.e., 1 year) (see SEIS Figure 2-1), and because the average levels of radioactivity in soils are low, inhalation of fugitive dust would not result in an increased radiological dose to workers and the public. In addition, the applicant has proposed implementing standard dust control measures, such as water application, speed limits, or chemical dust suppression compounds, to reduce and control fugitive dust emissions (AUC, 2012a). Therefore, the NRC staff estimate that the direct exposure, inhalation, or ingestion of fugitive dust would not result in an increased radiological dose to workers and the general public during the construction phase of the proposed project.

Radon gas would also be emitted during well development activities. The applicant calculated the amount of radon released from wellfield development for a single production unit (AUC, 2012b) based on methods described in NUREG–1569 (NRC, 2003b). Using conservative estimates, the applicant calculated an annual release of 0.56 GBq [0.015 Ci] (AUC, 2012b). This represents a negligible fraction (0.004 percent) of the applicant's estimated single production unit radon release from all phases at full production (as described in SEIS Section 2.1.1.1.6 and evaluated in SEIS Section 4.13.1.2.1) and therefore would not impact worker or public health and safety. Based on the low average concentration of radionuclides in soils at the proposed site, the proposed mitigation measures that would be implemented to control fugitive dust, and the negligible amount of radon that would be released during wellfield development, the NRC staff conclude that the radiological impacts to workers and the general public from the construction phase for the proposed project would be SMALL.

The potential nonradiological air quality impacts from fugitive dust and diesel emissions including comparisons with health-based standards are evaluated in SEIS Section 4.7.1.2. Fugitive dust emissions would occur primarily from travel on unpaved roads and wind erosion. Construction equipment would be diesel powered and would emit diesel exhaust, which includes small particles (PM_{10}) and a variety of gases (SEIS Table 4-13). In SEIS Section 4.7.1.2, the NRC staff concluded that construction phase air emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds. Additionally, the applicant's compliance with federal and state occupational safety regulations would limit the potential nonradiological effects of fugitive dust and diesel emissions to levels acceptable for workers. Based on the foregoing analysis, the NRC staff concludes that overall nonradiological impacts on workers and the general public from the construction phase for the proposed project would be SMALL.

4.13.1.2 Operations Impacts

Operations impacts on public and occupational health and safety were evaluated in Section 4.3.11.2 of the GEIS. Potential public and occupational radiological effects from normal operations may result from (i) exposure to radon gas from the wellfields, (ii) ion-exchange resin transfer operations, and (iii) venting during processing activities. Workers may also be exposed to airborne uranium particulates from dryer operations and maintenance activities. Potential public exposures to radiation may occur from the same radon releases and uranium particulate releases (i.e., from facilities without vacuum dryer technology). Both worker and public radiological exposures are addressed in NRC regulations at 10 CFR Part 20, which requires licensees to implement an NRC-approved radiation protection program. The NRC periodically inspects those programs to ensure compliance. Measured and calculated doses for workers and the public are typically only a fraction of regulatory limits. For these reasons, the NRC staff concluded in the GEIS that potential radiological impacts to workers and the public from normal operations would be SMALL. Radiological accident risks could involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. Consequences of accidents to workers and the public would be generally low, with the exception of an unmitigated dryer explosion, which could result in a worker dose above NRC limits. The likelihood of such an accident would be low; therefore, the risk would also be low. Based on compliance with the required radiological safety program that includes monitoring and emergency response procedures, the radiological health and safety impacts from a potential unmitigated accident would be SMALL for the public and, at most, MODERATE for workers. (NRC, 2009)

Nonradiological worker safety at ISR facilities would be addressed through occupational health and safety regulations and practices. The potential effect from nonradiological accidents includes high consequence chemical release events (e.g., of ammonia) that may expose workers and nearby populations. However, the NRC staff concluded that the likelihood of such a release would be low, based on historical operating experience at NRC-licensed facilities, primarily because operators follow chemical safety and handling protocols. Therefore, the NRC staff concluded in the GEIS that nonradiological impacts from accidents during operations would be SMALL for the public and, at most, MODERATE for workers. (NRC, 2009)

4.13.1.2.1 Radiological Impacts From Normal Operations

The radiological impacts from normal operations involve radiation doses to workers and members of the public. Operational worker doses occur as a result of the close proximity of workers to processing solutions, to radon gas released during operations, and to the refined yellowcake product. Public radiation doses from normal operations occur from radon gas that is vented from processing facilities and wellfields. Both occupational and public radiation exposures are monitored and controlled following a radiation protection program that addresses the NRC safety requirements in 10 CFR Part 20. The following detailed evaluation of the radiological effects to workers and the public from normal operations at the proposed Reno Creek ISR Project is based on the NRC staff's consideration of the generic analyses and conclusions documented in the GEIS and the NRC staff's additional site-specific review.

GEIS Section 4.2.11.2.1 provides a summary of doses to occupationally exposed workers at ISR facilities. As stated, doses would be similar regardless of the facility's location and are well within the 10 CFR Part 20 annual occupational dose limit of 0.05 Sv [5 rem]. The largest annual average dose to a worker at a uranium recovery facility over a 10-year period [1994–2006] was 0.007 Sv [0.7 rem]. More recently, the maximum total dose equivalents reported for 2005 and 2006 were 0.00675 and 0.00713 Sv [0.675 and 0.713 rem]. Similarly, the average and maximum worker exposure to radon and radon daughter products ranged from 2.5 to 16 percent of the occupational exposure limit of 4 working-level months. The NRC staff concluded in the GEIS that the radiological impacts to workers during normal operations at ISR facilities would be SMALL.

For the proposed Reno Creek ISR Project, the planned ISR facility design and operations are consistent with the projects analyzed in the GEIS. To mitigate radiological exposure to workers, the applicant would (i) provide radiation dosimetry badges to all employees with significant potential for exposure; (ii) install ventilation designed to limit worker exposure to radon; (iii) install gamma exposure rate monitors, air particulate monitors, and radon daughter product monitors to verify that radiation levels are ALARA and in compliance with NRC regulations; and (iv) conduct work area radiation and contamination surveys to help prevent and limit the spread of contamination (AUC, 2012b). The applicant's airborne radiation monitoring program is further described in SEIS Section 7.2.1. Because the applicant's proposed operations and radiation safety measures are consistent with the facilities evaluated in the GEIS, the NRC staff concludes that the radiological impacts to workers would be SMALL.

GEIS Section 4.2.11.2.1 noted that radon gas is emitted from ISR wellfields and processing facilities during operations and is the only radiological airborne effluent during normal operations for facilities using vacuum dryer technology (NRC, 2009). The applicant plans to dry yellowcake using a rotary vacuum dryer (SEIS Section 2.1.1.1.6.). Therefore, during normal operations, emissions other than radon are not expected.

As discussed in GEIS Section 4.2.11.2.1, the potential radiological impacts from radon gas releases can be evaluated by the MILDOS-AREA computer code (MILDOS), which Argonne National Laboratory developed for calculating offsite facility radiation doses to individuals and populations. MILDOS uses a multi-pathway analysis for determining external dose; inhalation dose; and dose from ingestion of soil, plants, meat, milk, aquatic foods, and water. MILDOS uses a sector-average Gaussian plume dispersion model to estimate downwind concentrations. This model typically assumes minimal dilution and provides conservative estimates of downwind air concentrations and doses to human receptors. GEIS Section 4.2.11.2.1 presented historical data for ISR operations, providing a range of estimated offsite doses associated with six current or former ISR facilities. For these operations, doses to potential offsite exposure (human receptor) locations range between 0.004 mSv [0.4 mrem] per year for the Crow Butte facility in Nebraska and 0.32 mSv [32 mrem] per year for the Irigaray facility in Johnson County, Wyoming. Each value is well below the 10 CFR Part 20 annual radiation public dose limit of 1 mSv [100 mrem] (NRC, 2009).

In its environmental report, the applicant evaluated the potential consequences of radiological emissions at the proposed Reno Creek ISR Project (AUC, 2012a). Sources of radon emanation the applicant identified and modeled included wellfield development during the construction phase and CPP and wellfield operations during the operational and aquifer restoration phases (AUC, 2012b). The applicant described its implementation of the computer code MILDOS that was used to model radiological impacts on human and environmental receptors (e.g., air and soil) using site-specific data that included radon (Rn-222) release estimates, meteorological and population data, and other parameters. The estimated radiological impacts from routine site activities were compared to applicable public dose limits in 10 CFR Part 20 {1 mSv/yr [100 mrem/yr]}, as well as to baseline radiological conditions (see SEIS Section 3.12.1).

The NRC staff review of the applicant's radiological impact modeling independently verified that appropriate receptor locations and exposure pathways were modeled, and reasonable input parameters were used. The applicant also listed the origin of the input parameters and provided justification for their use. The applicant described the source terms, and the NRC staff review concluded that the source terms represented scheduled operations at the planned capacities. The source terms included emissions from wellfield development, CPP and wellfield operations, and aquifer restoration (AUC, 2012b; 2014a,c). The applicant's estimated single production unit maximum annual radon release includes contributions from construction (0.004 percent), operations (72 percent), and aquifer restoration (29 percent) (SEIS Section 2.1.1.1.6). Considering the annual radon releases from the combination of concurrent proposed activities, the applicant calculated the annual total effective dose equivalents (TEDEs) at the site boundary at 29 locations surrounding the central plant, 5 residences, 1 site downwind of the CPP, and 1 at an onsite CBM processing station (a total of 36 locations).

Results of the applicant's modeling (AUC, 2012b) indicated that the maximum offsite TEDE of 0.023 mSv/yr [2.3 mrem/yr] is located at the proposed project boundary east of the CPP and Production Unit 8. This calculated dose is 2.3 percent of the 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr]. Thus, the modeling results show that the calculated doses at any proposed project boundary or at any receptor locations beyond the proposed project area boundary are below the 10 CFR Part 20 public dose limit. The maximum TEDE at a residence was 0.0031 mSv/yr [0.31 mrem/yr] at the former Taffner residence (currently vacated) located 3.4 km [2.1 mi] north of the proposed CPP at a location beyond the proposed project boundary and downwind of venting production units. This is 0.31 percent of the 10 CFR Part 20 public dose limit of 1 mSv/yr [100 mrem/yr]. Hence, the modeling results show the calculated TEDEs at nearby receptor locations are well below the public dose limit.

In summary, the potential radiation doses to occupationally exposed workers and members of the public during normal operations would be SMALL. The applicant is required to implement an NRC-approved radiation protection program to protect workers and the public and ensure that radiological doses are ALARA. The applicant's radiation protection program includes commitments for implementing management controls, engineering controls, radiation safety training, radon monitoring and sampling, and audit programs (AUC, 2012b). Calculated public radiation doses from the releases of radioactive materials to the environment are small fractions of the limit in 10 CFR Part 20 that has been established for the protection of public health and safety.

4.13.1.2.2 Radiological Impacts From Accidents

GEIS Section 4.2.11.2.2 describes and evaluates numerous accident scenarios that may result in effects to worker and public health and safety and identifies mitigation measures for each accident scenario. Radiological accident risks may involve processing equipment failures leading to yellowcake slurry spills, or radon gas or uranium particulate releases. The NRC staff state in the GEIS that the consequences of these accidents to workers and the public are generally low, with the exception of a dryer explosion, which may result in a worker dose exceeding the NRC limits (NRC, 1980). However, the likelihood of such an accident is low, due to design considerations and operational monitoring; therefore, the NRC staff considered the risk also to be low.

GEIS Section 4.2.11.2.2 also noted that in addition to accident mitigation measures, other measures would be in place to protect workers and members of the public. Employee personnel dosimetry programs are required. As part of worker protection, respiratory protection programs would be in place, as well as bioassay programs that detect uranium intake in employees. Contamination control programs would be in place, which involve surveying personnel, clothing, and equipment prior to their removal to an unrestricted area.

As described in GEIS Section 4.2.11.2.2, a radiological hazard assessment (Mackin et al., 2001) considered three types of accidents, representing the sources containing the higher levels of radioactivity for all aspects of operations: (i) thickener failure or spill, (ii) pregnant lixiviant and loaded resin spills (radon release), and (iii) yellowcake dryer accident release.

The following discussion presents an overview of the accident scenarios, as evaluated in the GEIS, along with site-specific application to the proposed Reno Creek ISR Project. SEIS Table 4-17 summarizes the potential dose to workers and the public from the accident scenarios using data adapted from the GEIS.

Thickener Failure and Spill. Thickeners are used to concentrate the yellowcake (U_3O_8) slurry before it is transferred to the dryer or packaged for offsite shipment. Yellowcake may be inadvertently released to the atmosphere through a thickener failure or spill. The accident scenario evaluated in GEIS Section 4.2.11.2.2 assumed a tank or pipe leak that releases 20 percent of the thickener inside and outside of the processing building. The estimated doses to unprotected workers inside the facility from a thickener failure or spill have the potential to exceed the annual dose limit of 0.05 mSv [5 mrem] if timely corrective measures are not taken.

In addition, the applicant is required to implement an NRC-approved radiation protection program to protect occupational workers and ensure that radiological doses are ALARA. The applicant's radiation protection program includes commitments for implementing management controls, radiation safety training, radon monitoring and sampling, incident response plans including the use of personal protective equipment, and audit programs (AUC, 2012b). These protection measures, along with engineering controls such as concrete curbs and sumps to contain process spills at the CPP, would reduce worker exposures and the resulting doses to a small fraction of those evaluated.

The analysis of offsite public doses from the thickener failure scenario included a variety of wind speeds, stability classes, release durations, and receptor distances. A minimum receptor distance of 500 m [1,640 ft] was selected because it was found to be the shortest distance between a processing facility and an urban development for current operating ISR facilities.

Table 4-17. Generic Accident Dose Analysis for ISR Operations		
Accident Scenario	**Maximum Dose to Workers**	**Maximum Dose to Public**
Thickener spill	>50 mSv [5,000 mrem]	<0.25 mSv [25 mrem]
Pregnant lixiviant, resin spill	13 mSv [1,300 mrem]	<0.13 mSv [13 mrem]
Yellowcake dryer release	0.088 Sv [8.8 rem] Generic <0.01 Sv [1 rem]	<1 mSv [100 mrem]
Data adapted from the GEIS (NRC, 2009)		

Offsite, unrestricted doses from such a U_3O_8 spill could result in a dose below 0.25 mSv [25 mrem], or 25 percent of the annual public dose limit of 1 mSv [100 mrem], with negligible external doses based on sufficient distance between the facility and receptor (NRC, 2009). Because the nearest residence is located approximately 2.0 km [1.25 mi] to the southeast (see SEIS Figure 3-1) beyond the boundary of the proposed project area, the potential dose from a similar accident scenario involving a thickener failure or spill at the proposed project would be even lower.

Pregnant Lixiviant and Loaded Resin Spills. Process equipment (ion-exchange columns, drying and packing facilities) would be located on curbed concrete pads to prevent any liquids from exiting the building via spills or leaks and contaminating the outside environment (NRC, 2009). The primary radiation source for liquid releases within the facility would be the resulting airborne radon (Rn-222) released from the liquid or resin tank spill. The applicant also described an accident involving a process tank failure (AUC, 2012b). The applicant stated that the CPP at the proposed project would be designed to control and confine liquid spills from tanks should they occur. The central plant building structure would be designed with a 30-cm [12-in] surrounding concrete foundation wall to provide broad containment for the facility (AUC, 2012b). Additional curbing in specific areas designed to contain liquid spills from the leakage or rupture of a process vessel would direct any spilled solution to a floor sump (see SEIS Section 2.1.1.1.2). The total containment capacity of curbs and sumps at the proposed project in high risk areas would exceed 110 percent of the largest liquid-containing tank or vessel in that area of CPP (AUC, 2012b). The floor sump system would be designed to direct any spilled solutions back into the plant process circuit or to the waste disposal system. Bermed areas, tank containments, and/or double-walled tanks are designed to perform a similar function for any process chemical vessels located outside the central plant building (AUC, 2012b).

The radon accident release scenario assumes that a pipe or valve of the ion-exchange system, containing pregnant lixiviant, develops a leak and releases (almost instantaneously) all present Rn-222 at a high activity level {2.96×10^7 Bq/m^3 [8×10^5 pCi/L]}. For a 30-minute exposure, the dose to a worker located inside the central plant performing light activities without respiratory protection was calculated to be 13 mSv [1,300 mrem], which is below the 10 CFR Part 20 occupational annual dose limit of 0.05 Sv [5 rem]. The applicant's radiation protection program's controls and monitoring measures would be expected to minimize the magnitude of any such release and further reduce the consequences of this type of accident. Typical control and monitoring measures would include radiation and occupational monitoring, respiratory protection, engineering controls, standard operating procedures for spill response and cleanup, and worker training in radiological health and emergency response (AUC, 2012b). The analysis did not evaluate public dose; however, because atmospheric transport offsite would reduce the airborne levels by several orders of magnitude, any dose to a member of the public would be less than the 1 mSv [100 mrem] public dose limit of 10 CFR Part 20.

Yellowcake Dryer Accident Release. Dryers used to produce yellowcake powder from yellowcake slurry are another potential source of accidental release of radionuclides. A multiple-hearth dryer is capable of releasing yellowcake powder inside the processing building as a result of an explosion. This scenario was evaluated in GEIS Section 4.2.11.2.2 to establish a bounding condition for other accident scenarios involving dryers. The analysis in the GEIS assumed that about 4,309 kg [9,500 lb] of uranium yellowcake was released within the building area housing the dryer and that 1 kg [2.2 lb] was subsequently released as an airborne effluent to the outside atmosphere as a 100 percent respirable powder. Due to the nature of the material, most of the yellowcake would rapidly fall out of airborne suspension. For the occupationally exposed worker using respiratory protection, which is typical during dryer access and drum-filling operations, the dose was calculated to be 0.088 Sv [8.8 rem], which exceeds the annual occupational dose limit of 0.05 Sv [5 rem] established in 10 CFR Part 20. The amount assumed to remain airborne and to be transported outside the building for atmospheric dispersion to an offsite location was 1 kg [2.2 lb] of yellowcake. The rapid fallout within the building and the atmospheric dispersion significantly reduced the calculated exposure to members of the public to about 6.5×10^{-4} Sv [65 mrem] (NRC, 1980), which is less than the 10 CFR Part 20 public dose limit of 1 mSv [100 mrem].

The applicant would use two rotary vacuum dryers with heat-transfer fluid that circulates through the dryer shell (SEIS Section 2.1.1.1.6). This configuration separates the heater combustion source from the dryer itself, thereby substantially reducing the possibility of an explosion, which is the initiating event for the assumed catastrophic failure and significant release of yellowcake from the dryer. The combined operational capacity of the proposed dryers of 1,680 kg [3,700 lb] of yellowcake (AUC, 2012b) is less than half of the dryer capacities assumed for the preceding explosion accident analysis. This lower capacity would proportionately reduce the calculated accident dose. Additionally, the size of the proposed dryer room (AUC, 2012b) is approximately 68 percent of the room size used to calculate the airborne uranium concentration in the accident analysis. This smaller dryer room would proportionately increase uranium air concentrations and dose in the accident analysis. Based on these differences, the NRC staff consider a similar analysis for the proposed project would lead to lower dose results (but still above the worker dose limit) and therefore would be bounded by the calculations in Mackin et al. (2001). Accordingly, the applicant has committed to implement the recommendations described in Mackin et al. (2001) to lower the likelihood and consequences of a dryer explosion and fire. Additionally, the NRC would require the applicant to have emergency response procedures in place to mitigate worker exposures. Emergency training drills, dosimetry, respiratory protection, contamination control, and decontamination would all be required elements of the applicant's radiation protection program that would further reduce the consequences of a dryer accident.

Accident Analysis Conclusions. In the unlikely event of an unmitigated accident, and depending on the type of accident, potential doses to workers may result in a MODERATE impact to occupational health and safety. Typical protection measures, such as radiation and occupational monitoring, respiratory protection, standard operating procedures for spill response and cleanup, and worker training in radiological health and emergency response, would be required as a part of the applicant's NRC-approved radiation protection program (AUC, 2012b). These procedures and plans would reduce the radiological consequences to workers from accidents. Additionally, all accident analyses concluded that there would be a SMALL impact to public health and safety based primarily on the mitigating effects of distance from the facility on the radiation dose estimates. Therefore, the NRC staff conclude that the overall radiological impacts from accidents for the proposed project would be SMALL.

4.13.1.2.3 Nonradiological Impacts From Normal Operations

GEIS Section 4.2.11.2.4 identifies the various chemicals, hazardous and nonhazardous, that are typically used at ISR facilities. The GEIS also identifies the typical quantities of these chemicals that are used. The use of hazardous chemicals at ISR facilities is controlled under several regulations that are designed to provide adequate protection to workers and the public. The primary regulations applicable to use and storage include the following:

- 40 CFR Part 68, Chemical Accident Prevention Provisions. This regulation lists regulated toxic substances and threshold quantities for accidental release prevention.

- 29 CFR 1910.119, OSHA Standards (which includes Process Safety Management). This regulation lists highly hazardous chemicals, including toxic and reactive materials that have the potential for a catastrophic event at or above the threshold quantity.

- 40 CFR Part 355, Emergency Planning and Notification. This regulation lists extremely hazardous substances and their threshold planning quantities for the development and implementation of emergency response procedures. A list of reportable quantity values is also provided for reporting releases.

- 40 CFR 302.4, Designation, Reportable Quantities, and Notification—Designation of Hazardous Substances. This regulation lists Comprehensive Environmental Response, Compensation, and Liability Act hazardous substances compiled from the Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act, and the Toxic Substances and Control Act.

Chemicals would be utilized at the proposed Reno Creek ISR Project during the operations and aquifer restoration (see SEIS Section 2.1.1.1.3). The hazardous chemicals and their associated protective provisions expected to be used at the proposed project are as follows:

- Sodium chloride (NaCl), sodium carbonate (Na_2CO_3), and sodium bicarbonate ($NaHCO_3$)—Systems utilizing these chemicals would be designed to industry standards. These chemicals would be stored in tanks inside or outside the CPP.

- Hydrochloric acid (HCl), sulfuric acid (H_2SO_4), or nitric acid (HNO_3)—Due to the quantities that would be used, reporting would be required under 40 CFR 302.4. The acid storage tanks and distribution systems would be monitored closely and located in a secondary containment area separate from other process tanks to prevent accidental mixing with other chemicals.

- Hydrogen peroxide [50 percent (H_2O_2)]—Because the concentration would be <52 percent, no additional regulatory protective measures would be required. Bulk storage tanks for the hydrogen peroxide would be located outside the CPP in a secondary containment basin designed to contain at least 110 percent of the tank volume. This secondary containment basin would be separate from the containment basins for other chemical systems. The storage tank would be placarded and located a safe distance away from flammable sources, organic materials, and incompatible chemicals to avoid potential adverse chemical reactions (AUC, 2012b).

- Carbon dioxide (CO_2)—Carbon dioxide would be stored adjacent to the plant facilities. Floor-level ventilation and low-point carbon dioxide monitors would be installed to prevent a buildup of carbon dioxide in occupied areas (AUC, 2012b).

- Oxygen (O_2)—Oxygen would be stored near, but a safe distance from, plant facilities or within wellfield areas. Each vessel would be equipped with safety relief devices and would be located at least 7.6 m [25 ft] from buildings or as required by applicable National Fire Protection Association (NFPA) and OSHA standards. The storage facility would be designed to meet industry standards in NFPA-502F and OSHA standards for the installation of bulk oxygen systems on industrial premises (29 CFR 1910.104) (AUC, 2012b).

- Sodium hydroxide (NaOH)—Systems utilizing NaOH would be designed to industry standards and stored in tanks inside the CPP in a secondary containment basin designed to contain at least 110 percent of the tank volume. This secondary containment basin would be separate from the containment basins for other chemical systems (AUC, 2012b).

- Diesel, gasoline, and bottled gases—All bulk quantities of these chemicals would be stored outside of process areas and away from hazardous material storage areas (AUC, 2012b). All gasoline and diesel storage tanks would be above ground and within secondary containment structures. If the hydrocarbon storage capacity exceeds 5,000 L [1,320 gal], the applicant would prepare a Spill Prevention, Control, and Countermeasure (SPCC) plan in accordance with EPA requirements in 40 CFR Part 112 (AUC, 2012b). In addition, gasoline and diesel storage tanks must comply with WDEQ requirements.

The typical onsite quantities for some of these chemicals may exceed the regulated minimum reporting quantities and trigger an increased level of regulatory oversight regarding possession (type and quantities), storage, use, and disposal practices (NRC, 2009). Storage of these chemicals must comply with EPA-administered Superfund Amendments and Reauthorization Act (SARA) Title III reporting requirements. Compliance with applicable regulations reduces the likelihood of a release, which may result in injury or illness to an exposed worker. Because chemicals used in the ISR process are stored and used in or near plant facilities and wellfields, offsite impacts of a chemical spill would be SMALL and do not typically pose a significant risk to the public. Workers involved in a response and cleanup to a chemical spill may experience MODERATE impacts if the proper emergency and cleanup procedures and worker training were not available or were inadequate.

In general, the handling and storage of chemicals at the proposed project would follow standard industrial safety practices. The applicant has committed to developing and implementing standard operating procedures regarding receiving, storing, handling, and disposing of chemicals (AUC, 2012b). The applicant is also required to comply with EPA, WDEQ, and OSHA regulations regarding inspections and the industrial and environmental safety aspects associated with the use of chemicals. The Wyoming Department of Workforce Services regulates the industrial safety aspects associated with the use of hazardous chemicals. At the proposed project, most of the bulk chemicals would be stored in areas at a distance from the processing facilities, which would minimize the risk to public and worker health and safety (AUC, 2012b). As described in SEIS Section 2.1.1.1.2, bulk storage tanks for process chemicals, such as strong mineral acids, sodium hydroxide, and hydrogen peroxide, would be outside the CPP in concrete secondary containment basins designed to contain 110 percent of the tank volume plus withstand a 25-year, 24-hour flood event (AUC, 2012b). The secondary containment basins would be separate from the containment basins for other chemical systems. The types and quantities of chemicals (hazardous and nonhazardous) identified for use at the proposed project are consistent with those evaluated in the GEIS. The information the applicant provided regarding chemicals agrees with the GEIS evaluations and conclusions regarding potential effects to public or occupational health and safety. Therefore, the NRC staff conclude that the nonradiological impacts during normal operations for the proposed project would be SMALL.

4.13.1.2.4 Nonradiological Impacts From Accidents

The risks from accidents associated with the use of the typical hazardous and nonhazardous chemicals for ISR operations are not different from those for other typical industrial applications. Potential nonradiological accident impacts include high consequence chemical release events (e.g., of ammonia) involving both workers and nearby populations. In GEIS Section 4.2.11.2.2, the NRC staff state that the likelihood of such release events would be low based on historical operating experience at NRC-licensed facilities, primarily due to operators following commonly applied chemical safety and handling protocols. The NRC staff concluded in the GEIS that nonradiological impacts due to accidents would be SMALL offsite and potentially MODERATE for workers involved in accident response and cleanup.

GEIS Appendix E, Hazardous Chemicals, provides an accident analysis for the more hazardous chemicals. This accident analysis indicates that chemicals commonly used at ISR facilities can pose a serious safety hazard if not properly handled. The GEIS does not evaluate potential hazards to workers or the public due to specific types of high consequence, low probability accidents (e.g., a fire or large magnitude sudden release of chemicals from a major tank rupture or piping system rupture). The application of common safety practices for handling and use of chemicals is expected to limit the likelihood of these high consequence events to very low levels. The spills of reportable quantities from chemical bulk storage areas must be reported to WDEQ in accordance with the Water Quality Division rules and regulations (WDEQ, 2012) and to EPA in accordance with 40 CFR Part 302 (Comprehensive Environmental Response, Compensation, and Liability Act). These procedures and reporting requirements would mitigate the effects of an accident involving hazardous and nonhazardous chemicals.

The types and quantities of chemicals (hazardous and nonhazardous) to be used at the proposed project do not differ from those evaluated in the GEIS, nor is there any new or significant information that conflicts with the conclusions drawn in the GEIS regarding the potential nonradiological impacts on public and occupational health and safety from chemical accidents. Offsite impacts involving hazardous and nonhazardous chemicals would be SMALL and do not typically pose a significant risk to the public. Workers involved in a response and cleanup could experience MODERATE impacts, but training requirements and adherence to established procedures would reduce the impact to SMALL. Based on the foregoing analysis and the GEIS conclusions, at the proposed Reno Creek ISR Project, the impacts from potential accidents for both occupationally exposed workers and members of the public would be SMALL during operations.

4.13.1.3 Aquifer Restoration Impacts

Aquifer restoration impacts on public and occupational health and safety were evaluated in GEIS Section 4.3.11.3. Activities occurring during aquifer restoration would overlap similar activities occurring during operations (e.g., operation of wellfields, wastewater treatment and disposal). Therefore, the potential impact on public and occupational health and safety would be similar to the operational impacts. In the GEIS, the NRC staff also stated that the reduction of some operational activities (e.g., yellowcake production and drying, remote ion-exchange) as aquifer restoration proceeded would be expected to limit the relative magnitude of potential worker and public health and safety hazards. The NRC staff concluded in the GEIS that the overall impacts to workers and the public from aquifer restoration would be SMALL (NRC, 2009).

The proposed aquifer restoration activities are similar to activities that would take place during operations (e.g., operation of wellfields, wastewater treatment and disposal). Therefore, the potential effect on public and occupational health and safety would be similar to the operational effects. The reduction or elimination of some operational activities (e.g., yellowcake production and drying) would further limit potential worker and public health and safety hazards. The radiation doses associated with restoration are included in the operations assessment in SEIS Section 4.13.1.2. Similarly, nonradiological hazards during aquifer restoration are assessed in SEIS Section 4.13.1.2.3. Accident consequences would be smaller than those evaluated in SEIS Sections 4.13.1.2.2 and 4.13.1.2.4. Therefore, for the proposed project, aquifer restoration would have a localized SMALL occupational impact on workers (primarily from radon gas) and to the general public.

4.13.1.4 Decommissioning Impacts

Decommissioning impacts on public and occupational health and safety were evaluated in GEIS Section 4.3.11.4. During decommissioning, the degree of potential impact decreases as hazards are reduced or removed, soils and facility structures are decontaminated, and lands are restored to preoperational conditions. To ensure the safety of workers and the public during decommissioning, the NRC requires ISR licensees to submit a decommissioning plan for review and approval. The NRC would then periodically inspect the facility to ensure that the decommissioning plan is implemented properly. The plan includes details of the radiation safety program that is implemented during decommissioning activities. The plan is developed to minimize health and safety hazards and to be compliant with worker and public dose limits in 10 CFR Part 20, Subparts C and D limits. An approved plan would also provide “as low as reasonably achievable” (ALARA) provisions under 10 CFR Part 20, Subpart B to further ensure best safety practices are being used to minimize radiation exposures. Adequate protection of workers and the public during decommissioning would therefore be ensured through NRC review and approval of the applicant’s decommissioning plan, license conditions, inspection, and enforcement. Based on the NRC review and approval of the applicant’s decommissioning plan, the NRC application of any site-specific license conditions, and the NRC inspection and enforcement actions to ensure compliance with NRC radiation safety requirements, the NRC staff concluded in the GEIS the potential public and occupational health and safety impacts for decommissioning would be SMALL (NRC, 2009).

Prior to decommissioning, the applicant would have to submit a decommissioning plan for NRC review and approval at least 12 months before any decommissioning activities begin. The plan would need to include the types of safety information described in the GEIS. The applicant would also be required to comply with any site-specific, NRC-established license conditions. Additionally, the applicant would be subjected to NRC safety inspections during the course of decommissioning activities.

The applicant's proposal does not contain any new or significant information that changes the conclusions in the GEIS regarding potential effects to public and occupational health and safety from decommissioning. The majority of safety issues that are addressed during decommissioning involve radiological hazards at the facility (NRC, 2009). Removal of nonradiological hazardous chemicals would be conducted in accordance with applicable state and federal hazardous waste disposal and occupational health and safety requirements. Decommissioning permits the proposed project area to be released for unrestricted use in conformance with NRC license conditions and the dose criteria in 10 CFR Part 40, Appendix A. The criteria in 10 CFR Part 40, Appendix A, limit the dose from radiological contamination that may exist at the proposed project area after decommissioning is completed to levels that are sufficiently low to protect public health and safety.

Assuming the NRC review and approval of the applicant's decommissioning plan, the applicant's compliance with any applicable license conditions, and regular NRC inspection and enforcement activities, the anticipated impact from decommissioning for the proposed project for the duration of decommissioning activities would be SMALL.

4.13.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the proposed Reno Creek ISR Project would not be developed and there would be no occupational exposure. There would be no additional radiological exposures to the general public from project-related effluent releases, and there would be no impact on long-term environmental radiological conditions. Radiation exposure and risk to the general public would continue to be determined by exposure from natural background, medical-related exposures, and exposures from existing residual contamination.

4.14 Waste Management

As described in GEIS Section 4.3.12, environmental impacts on waste management could occur during all phases of the ISR life cycle. The proposed project would generate radiological and nonradiological liquid and solid materials that must be handled and disposed of properly. The primary radiological materials that must be disposed of are process-related liquids and process-contaminated structures, equipment, and soils, all of which are classified as byproduct material.

Before operations could begin, the NRC requires an ISR facility to have an agreement in place with a licensed disposal facility to accept byproduct material. The NRC would require by license condition that the disposal agreement be in place before the initiation of operations and be maintained for the duration of the license. Premature expiration or termination of the disposal agreement without timely replacement would be grounds for cessation of operations until a new agreement is in place.

Environmental impacts on waste management resources during the construction, operations, aquifer restoration, and decommissioning phases of the proposed Reno Creek ISR Project are discussed next. The environmental impacts of the proposed waste management actions on other resources are evaluated within the applicable subsections of each impact analysis in this chapter.

4.14.1 Proposed Action (Alternative 1

The types of waste streams that could be generated by the proposed Reno Creek ISR Project are discussed in SEIS Section 2.1.1.1.6. The primary radiological materials that could be generated by the proposed project are process-related liquid wastewater and process-contaminated structures, equipment, and soils, all of which are classified as byproduct material. As described in SEIS Section 2.1.1.1.6, the applicant has identified the Pathfinder Mines Shirley Basin, Energy Fuels Inc., White Mesa, and EnergySolutions Clive facilities as possible options for disposal of solid byproduct material. The applicant's preferred method for disposal of liquid byproduct material is by Class I deep disposal well. The impacts on waste management from the proposed project with Class I deep disposal wells are described in SEIS Section 4.14.1.1. The impacts of additional wastewater disposal options that have been used previously by other ISR facilities but were not proposed by the applicant, including evaporation ponds, land application, surface water discharge, and Class V deep well disposal are described in SEIS Section 4.14.1.3.

4.14.1.1 Disposal Via Class l Deep Disposal Wells

As described in SEIS Section 2.1.1.1.2, the applicant's preferred option for disposal of liquid byproduct material is via Class I deep disposal wells. Potential environmental effects on waste management from construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project using deep Class I deep disposal wells are discussed in the following sections.

4.14.1.1.1 Construction Impacts

Construction impacts on waste management resources were evaluated in GEIS Section 4.3.12.1. In the GEIS, the NRC staff concluded that waste management impacts from the construction phase of an ISR facility would be SMALL. Because construction activities would be on a relatively small scale, and sequential wellfield development would generate a low volume of construction waste (NRC, 2009).

The primary waste produced in this phase of the ISR facility life cycle would be nonhazardous solid waste. Examples of nonhazardous construction waste include building materials and piping. As discussed in SEIS Sections 2.1.1.1.6 and 3.13.2, the applicant has proposed to dispose of nonhazardous solid waste at the Campbell County landfill located at Gillette, Wyoming, approximately 80 km [50 mi] northeast of the proposed Reno Creek ISR Project area. An alternate regional landfill is the Casper, Wyoming, landfill, approximately 135 km [84 mi] southwest of the proposed project area, if additional capacity is needed. As described in SEIS Section 3.13.2, these landfills have available projected capacity over the duration of the proposed Reno Creek ISR Project.

The proposed activities to manage construction waste generated by the proposed project are discussed in SEIS Section 2.1.1.1.6. The proposed project would annually generate a volume of 1,590 m^3 [2,080 yd^3] of nonhazardous solid waste during the construction phase (SEIS Section 2.1.1.1.6), which is 2 percent or less of the annual volume of waste disposed at either the Campbell County landfill 106,280 m^3 [138,900 yd^3] or the Casper landfill 191,280 m^3 [250,000 yd^3] (SEIS Section 3.13.2). The total nonhazardous solid waste generated by the proposed Reno Creek ISR Project for the duration of the construction phase (9 years) (14,310 m^3 [18,720 yd^3]) would account for less than 2 percent of the capacity of the Campbell County landfill (764,500 m^3 [1,000,000 yd^3], which is based on multiplying the annual volume of waste disposed at the landfill by the 18-year landfill capacity projection provided by the operator) and less than 0.01 percent of the available capacity of the Casper landfill (317,000,000 m^3 [414,000,000 yd^3]). Additional details about landfills can be found in SEIS Section 3.13.2. As described in SEIS Sections 2.1.1.1.6 and 3.13.1, the applicant would dispose of drilling fluids in mud pits adjacent to drilling pads consistent with typical practices and anticipates obtaining WDEQ WYPDES permits to discharge well development water into mud pits adjacent to drilling pads (AUC, 2012b). The permit would require reporting of flow, pH, radium (Ra-226), uranium, TDS, and total suspended solids (TSS) to the WDEQ. The applicant expects to be classified as a Conditionally Exempt Small Quantity Generator (CESQG) based on the volume of hazardous waste they would generate (SEIS Section 2.1.1.1.6). The applicant would transport its hazardous waste to a permitted hazardous waste facility for disposal (AUC, 2012a). Because all drilling fluids and well development water would be managed onsite using permitted practices, the small quantities of hazardous waste that would be generated would be stored and disposed in accordance with applicable regulations, and there is available capacity for offsite disposal of nonhazardous solid waste, the NRC staff conclude that the impact on waste management from the proposed Reno Creek ISR Project would be SMALL.

4.14.1.1.2 Operations Impacts

Operations impacts on waste management resources were evaluated in GEIS Section 2.7. The GEIS stated that byproduct material generated during the operations phase at an ISR facility would primarily be liquid consisting of process bleed (1 to 3 percent of the process flow rate). The NRC staff also noted in the GEIS that byproduct material would be generated from flushing of eluant to limit impurities, resin transfer wash, filter washing, uranium precipitation (brine), and plant washdown. Treatment and disposal methods described in the GEIS for liquid byproduct material at ISR facilities were characterized as effective at reducing the volume of material prior to disposal at an approved facility. Solid byproduct material would be decontaminated and released for other use or disposed of at approved waste disposal facilities. The NRC staff concluded in GEIS Section 4.3.12.2 that the waste management impact from disposal of byproduct material would be SMALL based on the required preoperational disposal agreement between an applicant and a licensed byproduct material disposal site, regulatory controls including applicable permitting, license conditions, inspection practices, facility design specifications, and management practices including waste treatment, volume reduction, pond leak detection, and routine monitoring. The impact from hazardous and municipal waste (nonhazardous solid waste) disposal was expected to be SMALL because of the small volume of waste generated. The impact from disposal of nonhazardous solid waste was expected to be SMALL based on the available disposal capacity of municipal solid waste facilities (NRC, 2009).

Liquid byproduct material generated during operations at the proposed Reno Creek ISR Project would be composed of production bleed, waste brine streams from elution and precipitation, resin transfer wash, filter backwash water, and plant washdown water (SEIS Section 2.1.1.1.6). The applicant estimates the maximum production of liquid byproduct material at any time considering concurrent uranium recovery operations and aquifer restoration activities to be 545 Lpm [144 gal/min] for the proposed Class I deep disposal well (SEIS Section 2.1.1.1.6). The applicant would treat the liquid byproduct material stream onsite to remove uranium by ion exchange (SEIS Section 2.1.1.1.6). As stated in SEIS Section 2.1.1.1.6, the applicant would have to meet applicable EPA, State of Wyoming, and NRC requirements before injection in a Class I deep disposal well begins. When evaluating permit applications for Class I deep disposal wells, WDEQ considers the characteristics of the operation, the material proposed to be injected, and the surrounding environment, and determines whether the proposed injection would satisfy state regulations (WDEQ, 2015b,c). A WDEQ permit for the four proposed Class I deep disposal wells was granted in June 2015 (WDEQ, 2015a). This permit approves injection of defined radionuclide-bearing materials and prohibits hazardous waste [as defined by Resource Conservation Recovery Act (RCRA) and state regulations] from being injected. Before the permitted wells can be operated, an aquifer exemption determination must be made by the EPA for the aquifer (or portion thereof) that is the discharge zone for the injection well. In this regard, EPA would evaluate the aquifer and determine whether it meets criteria in 40 CFR 146.4 for exemption as an underground source of drinking water (currently pending). The NRC would require disposal systems to be approved, constructed, operated, and monitored to ensure dose limits and waste disposal standards in 10 CFR Part 20, Subparts D and K are met. The applicant would have 4 Class I deep disposal wells with a capacity of 606 Lpm [160 gal/min] (AUC, 2012b), sufficient to accommodate the applicant’s estimated 545 Lpm [144 gal/min] (AUC, 2012b) liquid byproduct material production from the proposed operation. Based on the applicant’s proposal to obtain adequate disposal capacity, as well as requirements to comply with EPA regulations and WDEQ Class I deep disposal well permit conditions, and NRC regulations, the NRC staff conclude that the waste management impacts from the disposal of liquid byproduct material via deep Class I deep disposal wells during the ISR operations phase would be SMALL.

Solid byproduct material generated during operations could include spent resin, empty chemical containers and packaging, pipes and fittings, tank or storage pond sediments, contaminated soil from leaks and spills, and contaminated construction and demolition debris. As discussed in SEIS Section 2.1.1.1.6, the applicant estimates, during the operational period and assuming combined operations and aquifer restoration, that the proposed Reno Creek ISR Project would produce 76 m^3 [100 yd^3] of solid byproduct material annually (AUC, 2012a). Solid byproduct material would be stored onsite within a restricted area until sufficient volume is generated for disposal. Based on the disposal options currently available and the disposal agreement that the NRC requires prior to operations (SEIS Section 2.1.1.1.6), the NRC staff conclude that the impacts on waste management from the disposal of solid byproduct material during the ISR operations phase would be SMALL.

Nonhazardous solid waste generated during operations could include facility trash, septic solids, and other uncontaminated solid materials (for example, piping, valves, instrumentation, and equipment). Because the proposed generation rate of nonhazardous solid waste (SEIS Section 2.1.1.1.6) is less than what was evaluated for the construction phase (SEIS Section 4.14.1.1.1), the waste from operating the proposed project would be small percentages of the annual waste disposed and remaining capacities at either landfill (SEIS Section 3.13.2), therefore, the NRC staff conclude that the impact on waste management would be SMALL.

As discussed in SEIS Section 2.1.1.1.6, the applicant has stated it expects to be classified as a CESQG based on the volume of hazardous waste they expect to generate during operations. The applicant would transport its hazardous waste to a permitted hazardous waste facility for disposal (AUC, 2012a).

Based on the type and quantity of byproduct material and waste expected to be generated and the available capacity for disposal, the NRC staff conclude that the waste management activities during the ISR operations phase of the proposed Reno Creek ISR Project would have a SMALL impact on waste management resources.

4.14.1.1.3 Aquifer Restoration Impacts

Aquifer restoration impacts on waste management resources were evaluated in GEIS Section 4.3.12.3. The GEIS described waste management activities that would occur during the aquifer restoration phase of an ISR project and noted that the same treatment and disposal options would be implemented as those used during operations. Therefore, the waste management effects would be similar to those during the operations phase of an ISR project. Some increase in wastewater volumes could occur, but the increase in volume would be offset by the decrease in production capacity from the removal of wellfields from production activities. The NRC staff concluded in the GEIS that the impact on waste management from aquifer restoration would be similar to the impacts from operations and therefore be SMALL (NRC, 2009).

For the proposed Reno Creek ISR Project, the applicant would use the same waste management systems for aquifer restoration as used during ISR operations with the exception of additional RO units, as discussed in SEIS Section 2.1.1.1.6.

Liquid byproduct material generated during aquifer restoration is composed of RO brine and aquifer restoration bleed (SEIS Section 2.1.1.1.6). The applicant would manage aquifer restoration wastewater (i.e., liquid byproduct material) by treating the wastewater by reverse osmosis and reinjecting the treated water (i.e., permeate) back into the aquifer production zone undergoing restoration (see SEIS Section 2.1.1.1.4). This treatment is done to both restore the water quality in the aquifer and limit the consumptive use of groundwater. As stated in SEIS Sections 2.1.1.1.6 and 4.14.1.1.2 for operations, the applicant would have to meet applicable WDEQ and NRC requirements before injecting the liquid byproduct material into a Class I deep disposal well. The applicant would have four Class I deep disposal wells with a capacity of 606 Lpm [160 gal/min] (AUC, 2012b), sufficient to accommodate the applicant's estimated maximum 545 Lpm [144 gal/min] (AUC, 2012b) liquid byproduct material production from the proposed concurrent operations and aquifer restoration activities. Based on the applicant's proposal to obtain adequate disposal capacity, as well requirements to comply with WDEQ Class I deep disposal well permit conditions, EPA and NRC regulations, the NRC staff conclude that the waste management impacts from the disposal of liquid byproduct material via Class I deep disposal wells during the ISR aquifer restoration phase would be SMALL.

Solid byproduct material generated during aquifer restoration could include spent resin, empty chemical containers and packaging, pipes and fittings, tank or storage pond sediments, and contaminated soil from leaks and spills. As discussed in SEIS Section 2.1.1.1.6, the applicant estimates, during the operational period and assuming combined operations and aquifer restoration, that the proposed Reno Creek ISR Project would produce 76 m^3 [100 yd^3] of solid byproduct material annually from the Class I deep disposal well (AUC, 2012a). Solid byproduct material would be stored onsite within a restricted area until sufficient volume is generated for disposal. Based on the proposed capacity to dispose of liquid byproduct material in four Class I deep disposal wells and the disposal agreement that the NRC requires prior to operations (SEIS Section 2.1.1.1.6), the NRC staff conclude that the waste management impacts from the generation of byproduct material during the ISR aquifer restoration phase would be SMALL.

Nonhazardous solid waste generated during aquifer restoration could include facility trash, septic solids, and other uncontaminated solid materials (for example, piping, valves, instrumentation, and equipment). Because the proposed generation rate of nonhazardous solid waste (SEIS Section 2.1.1.1.6) would be a small percentage of the annual landfill disposal volume and available capacity (SEIS Section 3.13.2), the NRC staff conclude that the impact on waste management would be SMALL.

As discussed in SEIS Section 2.1.1.1.6, the applicant has stated it expects to be classified as a CESQG based on the volume of hazardous waste they expect to generate during aquifer restoration. The applicant would transport its hazardous waste to a permitted hazardous waste facility for disposal.

Based on the type and quantity of waste expected to be generated and the available capacity for disposal, and the disposal agreement for solid byproduct material that the NRC requires prior to operations (SEIS Section 2.1.1.1.6), the NRC staff conclude that the waste management activities during the ISR aquifer restoration phase of the proposed project would have a SMALL impact on waste management resources.

4.14.1.1.4 Decommissioning Impacts

Decommissioning impacts on waste management resources were evaluated in GEIS Section 2.6. The GEIS stated that wastes generated from decommissioning an ISR facility would be predominantly byproduct material and nonhazardous solid waste. GEIS Section 4.3.12.4 stated that decommissioning byproduct material (including contaminated facility demolition materials, process and wellfield equipment, excavated soil, and pond bottoms) would be disposed of at a licensed facility. As stated previously, to ensure that sufficient disposal capacity is available for byproduct material (including that generated by decommissioning activities), the NRC requires a preoperational agreement with a licensed disposal facility to accept byproduct material for disposal. The NRC staff concluded that the required preoperational agreement for disposal of byproduct material, the NRC review and approval of a decommissioning plan and radiation safety program, and the small volume of solid waste generated for offsite disposal suggest the waste management impacts of an ISR facility would be SMALL (NRC, 2009).

The anticipated decommissioning activities occurring at the proposed Reno Creek ISR Project would be comparable to those described in GEIS Section 2.6 and would be conducted in accordance with an NRC-approved decommissioning plan. The applicant proposed to conduct radiological surveys of decommissioned facilities and equipment and classify materials in accordance with the applicable disposition of the materials (AUC, 2012b), including decontamination, recycling and reuse, disposal as byproduct material at a licensed facility, or disposal as nonhazardous solid waste at a municipal solid waste landfill (AUC, 2012b).

As discussed in SEIS Section 2.1.1.1.6, the applicant's estimate for solid byproduct material generated from decommissioning the plant facilities and all wellfields (over a planned 1-year decommissioning period) is 3,060 m^3 [4,000 yd^3] (AUC, 2012a). As discussed in SEIS Section 2.1.1.1.6, the applicant does not have a disposal agreement in place with a licensed site to accept solid byproduct material, and as discussed in SEIS Section 4.14.1.1.2, the NRC would require that the applicant enter into a written agreement with a disposal site to ensure adequate capacity for byproduct material disposal prior to beginning operations at the site. The applicant has evaluated the following facilities as potential sites for disposal of byproduct material: the Pathfinder Mines Corporation facility in Shirley Basin, Wyoming; the White Mesa site in Blanding, Utah; and the EnergySolutions site in Clive, Utah (SEIS Section 3.13.2). Based on the disposal agreement that the NRC would require by license condition prior to operations, the NRC staff conclude that the impact on waste management from the generation of byproduct material during decommissioning would be SMALL.

The applicant estimated that the proposed project would generate 1,530 m^3 [2,000 yd^3] of nonhazardous solid waste from decommissioning over the planned 1-year period (AUC, 2012a). This estimated solid waste volume is greater than what was analyzed in the GEIS {715 m^3 [935 yd^3]} and thus not bounded by the impact assessment described in the GEIS; therefore, the NRC staff considered additional site-specific information to evaluate effects. Considering the permitted landfill disposal capacities of the Campbell County landfill in Gillette, Wyoming, the Casper landfill (SEIS Section 3.13.2), the proposed project duration (SEIS Figure 2.1), and the capacity analysis in SEIS Section 4.14.1.1.1 that demonstrates construction waste at approximately the same annual volume for 9 years would be a small fraction of available capacity, the NRC staff conclude that there would be sufficient landfill capacity at the time of decommissioning for an additional year of disposal. Based on this capacity analysis, the NRC staff conclude that the potential impacts of the proposed Reno Creek ISR Project on nonhazardous solid waste management resources would be SMALL.

The applicant estimates that the volume of hazardous waste generated from decommissioning activities would allow the operation to meet the WDEQ definition of a CESQG (SEIS Section 2.1.1.1.6). The hazardous waste streams from decommissioning would be similar to the waste streams generated during the ISR construction phase and could include used oil, batteries, and cleaning solvents. The applicant would have in place a hazardous material program that complies with applicable EPA and WDEQ requirements for its handling, storage, and disposal at approved facilities. Because the volume of hazardous waste generated by the proposed project would be small and the waste would be handled, stored, and disposed of in accordance with applicable regulations, the NRC staff conclude that the impacts on waste management would be SMALL.

In summary, the NRC staff conclude that the impacts to waste management resources during the decommissioning phase of the proposed project would be SMALL for all materials based on the type and quantity of waste expected to be generated and the available capacity for disposal.

4.14.1.2 Alternative Wastewater Disposal Options

Although the applicant has proposed operation of permitted Class I deep disposal wells, the NRC staff have identified additional waste disposal options. Because these options are hypothetical and not proposed by the applicant, this section broadly evaluates the environmental effects on any resource area that would be affected by implementing the alternate wastewater disposal options identified in SEIS Section 2.1.1.2. All of these alternative wastewater disposal options would involve treatment of the wastewater resulting in the generation of solid waste, which also must be managed.

In the alternative wastewater disposal options considered in the following sections, the footprint of the disposal system would increase relative to disposal by Class I deep disposal wells (the applicant’s proposed waste disposal option) (SEIS Section 4.14.1.1). Increasing the size of the proposed facility would lead to more land disturbance and would increase the use of construction equipment, with an anticipated increase in potential effects to resource areas, such as ecological and wetland systems, cultural and historical resources, and nonradiological air quality. Because the license application currently relies on Class I deep disposal wells for disposal of liquid byproduct material, the applicant would have to amend its license application to select one of these alternative wastewater disposal options. The NRC staff would perform an additional environmental and safety review before deciding whether to grant or deny the license amendment request for the new wastewater disposal option. The applicant would survey the areas to be affected prior to construction, and the applicant and the NRC staff would consult with agencies such as the WY SHPO, WGFD, and FWS, as appropriate. Mitigation measures, such as avoidance of sensitive areas or documentation of cultural resources, would be discussed and implemented, as appropriate, as part of these consultations. If mitigation measures were implemented, the estimated impacts would be SMALL.

4.14.1.2.1 Evaporation Ponds

Evaporation ponds are an alternate wastewater disposal method. The types of waste streams and the infrastructure necessary for the use of evaporation ponds as a wastewater disposal option are described in SEIS Section 2.1.1.2.1. The type and volume of wastewater that would be disposed in an evaporation pond would be the same as described in SEIS Section 4.14.1.1 for disposal by injection into a Class I deep disposal well. Before the applicant could begin disposing wastewater into an evaporation pond system, the NRC staff would review the design and construction of the ponds and monitoring system against the criteria in 10 CFR Part 40, Appendix A (NRC, 2003b, 2008) taking into consideration EPA criteria in 40 CFR Part 61, Subpart W. The applicant would be required to demonstrate that the evaporation ponds could be designed, operated, and decommissioned to prevent migration of wastewater to subsurface soil, surface water, or groundwater. The applicant would also be required to demonstrate that monitoring requirements would be established to detect migration of contaminants to groundwater. The NRC staff would establish needed license conditions to ensure that the applicant met the necessary requirements.

Individual evaporation ponds could have a surface area of up to 16.2 ha [40 ac], and the total pond system could be as much as 270 ha [670 ac]]. During the ISR operations period for the proposed Reno Creek ISR Project, this area would be fenced to exclude wildlife and livestock. A 270 ha [670 ac] footprint would be 11 percent of the total permitted area {2,452 ha [6,057 ac]} for the proposed Reno Creek ISR Project, but it would be much larger than the footprint for a CPP without evaporation ponds {0.652 ha [1.61 ac] as described in AUC, 2012a}. The additional land disturbance required to install an evaporation pond system for wastewater disposal would be similar in scale for the proposed Reno Creek ISR Project. It is also anticipated that the applicant would need to have at least one other wastewater disposal option or additional storage capacity during the winter months in Wyoming because of the low evaporation rates during that season.

Although a wastewater disposal option that uses an evaporation pond system would increase the facility footprint relative to Class I deep disposal wells, the total amount of disturbed and fenced land would be small compared to the permitted area and comparable to the generic conditions evaluated in the GEIS with respect to land use. For these reasons, the overall impact on land use associated with an evaporation pond system would be SMALL.

Construction of an evaporation pond system would require earthmoving equipment, such as bulldozers, backhoes, and trucks, to prepare the site and construct the impoundment. The equipment would produce diesel emissions and fugitive dust emissions during construction that could have a temporary effect on nonradiological air quality. Depending on how the applicant elected to phase in the pond system, these effects could extend into the operational phase of the facility as well. Mitigation measures, such as wetting unpaved roads, would minimize fugitive dust, and the anticipated impacts to nonradiological air quality would be SMALL. The applicant may also need to obtain a National Emission Standards for Hazardous Air Pollutants (NESHAP) review to evaluate whether the anticipated radiological releases to air from the evaporation ponds would meet the criteria in 40 CFR Part 61, Subpart W. The applicant would also be required to have an NRC-approved air monitoring system for the wastewater disposal system. Keeping the pond wet to reduce dust and radon emissions would effectively reduce potential air emissions. Therefore, the estimated impacts on radiological air quality would be SMALL.

Evaporation ponds designed and constructed following NRC guidance (NRC, 2008) would utilize clay or geotextile liners to reduce the potential for infiltration into the subsurface. An NRC-approved monitoring system would be installed to detect leaks from the ponds, and the applicant would also implement an NRC-approved inspection plan for the ponds (NRC, 2008). Based on these measures, the estimated impacts on surface water and groundwater resources would be SMALL.

The evaporation ponds would be constructed at the same time and with the same mitigation measures described in SEIS Section 4.6 (Ecological Resources) for the construction of the rest of the facility. For these reasons, the estimated impact on ecological resources from an evaporation pond disposal system would be the same as identified in SEIS Section 4.6 and could be reduced to SMALL.

At the conclusion of proposed operations, the NRC requires the licensee to submit a decommissioning plan (SEIS Section 2.1.1.1.5) for NRC review (NRC, 2003b). The NRC staff would conduct detailed technical and environmental reviews of the proposed decommissioning plan. Decommissioning evaporation ponds would produce additional solid byproduct material for disposal relative to the proposed project. All of the pond liners and berms, as well as accumulated precipitates and sludge, would be classified as solid byproduct material. These solids would need to be transported to a licensed facility for disposal as part of the decommissioning program. This would increase the total amount of decommissioning byproduct material, increasing the number of truck trips needed to transport the materials to a disposal facility. The NRC staff expects the required pre-operational disposal agreement would ensure disposal capacity would be available for solid byproduct material. Based on this analysis, the potential impacts on waste management from decommissioning evaporation ponds would be SMALL.

4.14.1.2.2 Land Application

Under the land application alternate wastewater disposal option, the liquid effluent would need to be treated to meet NRC dose limits, waste disposal standards, and effluent limits in 10 CFR Part 20, Subparts D and K and Appendix B as well as WDEQ requirements imposed by a WYPDES permit (NRC, 2003b). The waste streams and infrastructure necessary for land application are described in SEIS Section 2.1.1.2.3. The NRC would establish license conditions to ensure land application activities were conducted safely and would verify compliance with the conditions by inspection. The applicant would need to implement an NRC and WDEQ-approved program for monitoring land application effluent, and potentially affected environmental media including groundwater, surface water, soil, vegetation, and livestock. The monitoring program would report the radiological and chemical constituent levels and trends to the NRC and WDEQ. Within their respective oversight roles, the NRC and WDEQ would evaluate the results against applicable license or permit conditions and regulatory requirements to protect public health and safety and the environment. At the time of decommissioning, the applicant would need to demonstrate that the soils in land application areas meet the criteria in 10 CFR Part 40 Appendix A before the NRC would terminate the license and allow unrestricted use of the site.

Land application areas can vary in size depending on the site-specific conditions such as wastewater flow rates and climate. Large areas may be needed to provide sufficient capacity to accommodate flow rates and maintain soil concentrations below regulatory levels while avoiding ponding, runoff, and infiltration to shallow groundwater. The wastewater may require additional treatment to meet NRC and WYPDES regulations, and this would include facilities such as an ion-exchange circuit, reverse osmosis, radium-settling basins, storage ponds, and backup ponds.

For a facility the size of the proposed Reno Creek ISR Project, the NRC staff estimated land application areas of approximately 894 ha [2,209 ac] with an additional 116 ha [286 ac] of ponds for wastewater treatment and storage (SEIS Section 2.1.1.2.2). Under these conditions, land application would have the largest surface disturbance footprint of the wastewater disposal options evaluated in this SEIS (SEIS Table 2-7). This footprint would account for 41 percent of the proposed Reno Creek ISR Project area of 2,451 ha [6,057 ac] (SEIS Section 2.1.1.1.2), and would be much larger than the land disturbed by the proposed project involving four Class I deep disposal wells {62.4 ha [154.3 ac]} (SEIS Section 4.2.1.1). During operations the NRC staff assumes land application areas would be fenced to exclude wildlife and livestock. Additionally, if additional storage capacity is not provided (included in the NRC staff's facility footprint estimates) the applicant may need to have at least one other wastewater disposal option during the winter months in Wyoming when evaporation rates would be low and the ground would be frozen or covered by snow. The estimated amount of disturbed and fenced land is larger than what was considered in the GEIS and is a greater proportion of the total project area than what was considered in GEIS. Based on the large restricted area, the NRC staff concludes that the overall impacts on land use associated with wastewater disposal by land application would be MODERATE.

Constructing the land application areas would require limited use of earthmoving equipment to install pipelines, small berms, access roads, and fencing. Constructing related treatment facilities, basins, and storage reservoirs would require more earthmoving equipment, such as bulldozers, scrapers, backhoes, and trucks to prepare the site and construct the impoundments, but this would occur over a smaller parcel of land. Because the NRC staff assumes the land application areas would be fenced, the restricted access would have a MODERATE impact on land use, whereas the potential construction impacts on soils and ecology would be SMALL. The construction equipment would produce diesel emissions and fugitive dust emissions that could affect nonradiological air quality. As described in SEIS Section 4.7.1, construction phase air emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds.

During operations, there is the potential for radiological releases to air and both radiological and nonradiological wastewater constituent accumulation in soils at land application areas. Treated wastewater would have low levels of radioactivity and radon fluxes would be low based on estimates for similar land application areas (NRC, 1997; 2003b). An NRC-approved radiation protection program and required operational monitoring to demonstrate compliance with 10 CFR Part 20 effluent and dose limits would limit the potential radiological impacts to the public and workers to SMALL. Monitoring and oversight of nonradiological constituents by WDEQ associated with the required WYPDES permit would mitigate the potential impacts to public and occupational health, soils, water resources, and ecology. As described in SEIS Section 4.6.1.1.2, the proposed Reno Creek ISR Project with the associated wastewater storage ponds supporting four Class I deep disposal wells would have a SMALL impact on avian species of concern. The land application wastewater disposal option would have increased potential for avian impacts (MODERATE) because there would be additional wastewater storage and treatment ponds that could attract birds, and effects to individual birds are possible if unmitigated direct exposure to undiluted wastewater solutions occurs (SEIS Section 4.6.1.1.2). If avian mitigation measures and regulatory controls effectively eliminate or reduce exposures to undiluted wastewater solutions to a small number of individual animals, the impacts could be reduced to SMALL.

At the conclusion of proposed operations, the NRC requires the licensee to submit a decommissioning plan (SEIS Section 2.1.1.1.5) for NRC review (NRC, 2003b). The NRC staff would conduct detailed technical and environmental reviews of the proposed decommissioning plan. Decommissioning the land application facilities would produce additional solid byproduct material and nonhazardous solid waste for disposal relative to the proposed project. This would include the removal of additional wastewater treatment facilities, pond liners and berms associated with radium-settling basin(s), and accumulated pond sediments. The NRC staff expects the required pre-operational disposal agreement would ensure disposal capacity would be available for solid byproduct material and the increased nonhazardous solid waste could be accommodated by available landfill capacity. Based on this analysis, the potential impacts on waste management from decommissioning the radium-settling basin(s) and other storage facilities associated with treating wastewater for disposal by land application would be SMALL.

4.14.1.2.3 Surface Water Discharge

For surface discharge of wastewater to be used as an alternate wastewater disposal option, the applicant would be required to meet the dose limits, waste disposal standards, and effluent limits in 10 CFR Part 20, Subparts D and K and Appendix B. The applicant would also be required to obtain a surface water discharge permit from WDEQ. In accordance with EPA regulations, the applicant would not be allowed to discharge process wastewater to navigable waters of the United States (NRC, 2003b). The applicant would need to develop storage capabilities prior to treatment to 10 CFR Part 20 standards. In addition, the applicant would need to characterize and remediate any residual radioactivity at the discharge point or from storage facilities (tanks, impoundments), radium settling basins, and related liners and sludge above NRC limits as part of the decommissioning of the facility (NRC, 2003b; Sanford Cohen and Associates, 2008).

Establishing the discharge point for the treated effluent would likely require short-term (during construction) use of earthmoving equipment to install pipelines, small berms, access roads, and fencing to exclude livestock and wildlife. The amount of land to be fenced for the discharge point alone would be limited, and the estimated impact on land use would likely be SMALL. As is the case with both land application and a deep Class V disposal well, the wastewater would likely require treatment to meet state surface water discharge permit requirements. This would require use of treatment facilities to provide an ion-exchange circuit, reverse osmosis, and additional impoundments, including radium-settling basins, storage ponds, backup ponds, and possibly additional storage facilities, to maintain separate waste streams for process wastewater {64 ha [158 ac]} (Table 2-7). These treatment facilities would also be fenced to exclude wildlife and livestock and limit public access. The amount of land needed for the wastewater treatment facilities would be less than that needed for land application (see SEIS section 2.1.1.2) and greater than what would be needed for deep Class V disposal wells. As with evaporation ponds, land application, and Class V disposal wells, the increased footprint for the additional wastewater treatment facilities needed to meet state surface water discharge requirements would be small relative to the entire project area {2,452 ha [6,057 ac]}, but large relative to the footprint of the CPP {0.652 ha [1.61 ac]} (AUC, 2012a). Overall, the disturbed area needed to accommodate the addition of wastewater treatment would be about 3 percent of the project area and would have a SMALL impact on land use.

Constructing the wastewater treatment facilities (e.g., radium-settling basins) would require earthmoving equipment, such as bulldozers, backhoes, and trucks, to prepare the site and construct the impoundment(s). This would be similar to the proposed project (with deep Class I disposal well) because wastewater treatment facilities are included in the plans for the proposed Reno Creek ISR Project. The equipment would produce diesel emissions and fugitive dust emissions during construction that could temporarily affect nonradiological air quality. As described in SEIS Section 4.7.1, construction phase air emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds. The applicant may also need to consider emissions of radionuclides such as radon from the surface discharge points. Because the NRC regulations and WDEQ permit would require the applicant to monitor and maintain low radionuclide concentrations for the treated wastewater, the estimated impacts on radiological air quality would be SMALL.

The proposed Reno Creek ISR facility and wellfields would be developed in the Upper Belle Fourche drainage basin (AUC, 2012b). Intermittent ephemeral gullies at the site that are located in this drainage basin would likely be used if surface water discharge were pursued. Surface discharge into these gullies could result in increased erosion and suspended sediments in the existing stream channel. Sediment loads would likely taper off quickly both in time and distance; therefore, the long-term impact would be SMALL.

As noted previously, the applicant would not be allowed to discharge treated wastewater into navigable waters of the United States. A recent wetlands delineation survey identified 17.13 ha [42.31 ac] of potential wetlands in the Reno Creek ISR Project (AUC, 2012a) area. These wetlands primarily include tributaries of the Belle Fourche River. A permit under Section 404 of the Clean Water Act would be required for discharges of dredged or fill material into a wetland or water of the U.S. exceeding 0.2 ha [0.5 ac]. The NRC staff assumes that, if the applicant pursued surface discharge of treated effluent, the proposed Reno Creek ISR Project would avoid surface discharge points that might disturb any of these wetlands areas, and potential impacts to these wetlands from surface discharge of treated wastewater would be SMALL.

During operations, the applicant would be required to routinely monitor the soils and discharged water to ensure that the applicable limits are met. Therefore, it is not anticipated that decommissioning the surface discharge point would identify elevated areas of radioactivity that would require remediation and thereby result in additional solid byproduct material for disposal. At the conclusion of proposed operations, the NRC requires the licensee to submit a decommissioning plan (SEIS Section 2.1.1.1.5) for NRC review (NRC, 2003b). The NRC staff would conduct detailed technical and environmental reviews of the proposed decommissioning plan. As with the Class V disposal well, land application, and evaporation pond disposal options, decommissioning the wastewater treatment facilities for the surface discharge disposal option would produce additional solid byproduct material and nonhazardous solid waste for disposal relative to the proposed project. This would include the removal of additional wastewater treatment facilities, pond liners and berms associated with radium-settling basin(s), and accumulated pond sediments. The NRC staff expects that the required pre-operational disposal agreement would ensure disposal capacity would be available for solid byproduct material, and the increased nonhazardous solid waste could be accommodated by available landfill capacity. Based on this analysis, the potential impacts on waste management from decommissioning the radium-settling basin(s) and other storage facilities associated with treating wastewater for disposal by surface discharge would be SMALL.

4.14.1.2.4 Class V Disposal Well

The potential impacts associated with wastewater disposal through a Class V disposal well would be similar to those associated with the proposed project (disposal via a Class I deep disposal well). Under the terms of a Class V disposal well permit issued by WDEQ, however, the wastewater would require additional treatment to meet class of use or federal drinking water standards (whichever is more stringent) prior to injection because disposal would be in an aquifer that lies above or below an aquifer that is a supply of drinking water.

The potential impacts associated with constructing, operating, and decommissioning the necessary wastewater treatment facilities would be similar to those described in the previous section for discharge to surface water (SEIS Section 4.14.1.2.2) but the land needed for the treatment facilities would be less. Although the footprint of a set of four Class V wells alone would be small {2.0 ha [5.0 ac], (SEIS Table 2-7)}, the wastewater would likely require additional treatment to meet the necessary discharge requirements (Class of Use or federal drinking water standards). This treatment would require facilities providing an ion-exchange circuit, reverse osmosis, and additional impoundments including radium settling basins, storage ponds, and backup ponds {28 ha [69 ac]}. These treatment facilities would be fenced to exclude wildlife and livestock and would limit public access. The amount of land needed for the wastewater treatment facilities would be similar to that for surface discharge or land application, although disposal wells would require less storage capacity due to their continuous operation throughout the year relative to the other options. The increased footprint of the additional wastewater treatment facilities would be small relative to the entire project area {2,452 ha [6,057 ac]}, but large relative to the footprint of the CPP {0.652 ha [1.61 ac]} (AUC, 2012a). The current proposed project identifies as much as 62.3 ha [154 ac] of disturbed land for the proposed Reno Creek ISR Project. Overall, the amount of disturbed land to accommodate addition of a wastewater treatment facility would be smaller than the disturbed land estimated for the proposed project (approximately half), and would be small relative to the project area, and therefore would have a SMALL impact on land use.

Constructing the wastewater treatment facilities (e.g., radium-settling basins) would require earthmoving equipment, such as bulldozers, backhoes, and trucks, to prepare the site and construct the impoundment(s). The equipment would produce diesel emissions and fugitive dust emissions during construction that could have an adverse effect on nonradiological air quality. As described in SEIS Section 4.7.1, construction phase air emissions would have a SMALL impact on air quality because the pollutant concentrations would be low compared to the NAAQS and PSD thresholds.

The applicant would also need to consider emissions of radionuclides such as radon during the wastewater treatment process. These emissions would be included as part of the NRC-approved monitoring plan for the facility, and the anticipated impacts to occupational and public health and safety would be SMALL.

At the conclusion of proposed operations, the NRC requires the licensee to submit a decommissioning plan (SEIS Section 2.1.1.1.5) for review (NRC, 2003b). The NRC staff would conduct detailed technical and environmental reviews of the proposed decommissioning plan. As with the surface discharge, land application, and evaporation pond disposal options, decommissioning the wastewater treatment facilities for the Class V disposal well option would produce additional solid byproduct material and nonhazardous solid waste for disposal relative to the proposed project. This would include the removal of additional wastewater treatment facilities, pond liners and berms associated with radium-settling basin(s), and accumulated pond sediments. The NRC staff expects the required pre-operational disposal agreement would ensure disposal capacity would be available for solid byproduct material and the increased nonhazardous solid waste could be accommodated by available landfill capacity. Based on this analysis, the potential impacts on waste management from decommissioning the radium-settling basin(s) and other storage facilities associated with treating wastewater for disposal by Class V deep disposal well would be SMALL.

4.14.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the Reno Creek ISR project would not be developed, and therefore there would be no waste generated from the construction, operations, aquifer restoration, or decommissioning of the project. There would be neither Class I deep disposal well injection of liquid byproduct material nor disposal of solid byproduct material, hazardous waste, or nonhazardous solid waste onsite or offsite. Therefore, there would be no effect on waste management from the No-Action Alternative.

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5 CUMULATIVE EFFECTS

5.1 Introduction

The Council on Environmental Quality's (CEQ's) National Environmental Policy Act (NEPA) defines cumulative effects as "the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" [Title 40 of the *Code of Federal Regulations* (CFR) 1508.7]. Cumulative effects or impacts[1] can result from individually minor but collectively significant actions taking place over a period of time. A proposed project could contribute to cumulative effects when its environmental impacts overlap with those of other past, present, or reasonably foreseeable future actions. For this supplemental environmental impact statement (SEIS), other past, present, and future actions considered in the analysis for the proposed Reno Creek ISR Project area include (but are not limited to) coal mining, coalbed methane (CBM) development, oil and gas production, other in situ uranium recovery (ISR) operations, conventional uranium mining and milling, wind farms, and cattle and sheep grazing.

The analysis of the cumulative impacts of the proposed project was based on publicly available information on existing and proposed projects, information in the Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (GEIS) (NRC, 2009), general knowledge of the conditions in Wyoming and in the nearby communities, and reasonably foreseeable future actions that could occur. The primary activity in the area is mineral mining and oil and gas development, although interest in these developments has not necessarily been realized into active projects due to fluctuation in market prices for these products. There are also several ISR and conventional uranium projects within the vicinity {24 kilometers (km) [15 miles (mi)]} of the proposed Reno Creek ISR Project that are in various stages of prelicensing, licensing, operations, or decommissioning.

The GEIS (NRC, 2009) provides an example methodology for conducting a cumulative impacts assessment. SEIS Section 5.1.1 describes other past, present, and reasonably foreseeable future actions considered in the cumulative impacts analysis. The methodology used to conduct the cumulative impacts analysis in this SEIS is provided in SEIS Section 5.1.2.

Preconstruction Activities

On September 15, 2011, the U.S. Nuclear Regulatory Commission (NRC) published a final rule in the *Federal Register* (76 FR 56951) to clarify the definitions of "commencement of construction" and "construction" with respect to materials licensing actions conducted under the NRC's regulations. This final rule became effective on November 14, 2011. The parts of the final rule that are applicable to the NRC's licensing action for the proposed Reno Creek ISR project are in 10 CFR 40.4 (Definitions) [repeated in 10 CFR 51.4 (Definitions)] and 10 CFR 51.45 (Environmental Report). The applicable definitions in 10 CFR 40.4 follow.

Commencement of construction means taking any action defined as ''construction'' or any other activity at the site of a facility subject to the regulations in this part (i.e., 10 CFR Part 40) that

[1]For the purposes of this analysis, "cumulative impacts" is deemed to be synonymous with "cumulative effects."

has a reasonable nexus to (i) radiological health and safety or (ii) common defense and security. Construction means the installation of wells associated with radiological operations (e.g., production, injection, or monitoring well networks associated with ISR or other facilities); the installation of foundations; or in-place assembly, erection, fabrication, or testing for any structure, system, or component of a facility or activity subject to the regulations in this part that are related to radiological safety or security.

The activities defined below are not considered part of “construction,” and are alternately referred to by the NRC staff as “site preparation” or “preconstruction” activities. The listed activities also are not considered by the NRC to be part of the proposed action. All preconstruction activities are addressed under each resource area as part of the cumulative impacts analyses. Note that activities included under the definition of construction are considered to be part of the proposed action for the purposes of evaluating the environmental impacts of a proposed project. The term “construction” does not include any of the following:

- Changes for temporary use of the land for public recreational purposes

- Site exploration, including necessary borings to determine foundation conditions or other preconstruction monitoring to establish background information related to the suitability of the site, the environmental impacts of construction or operations, or the protection of environmental values

- Preparation of the site for construction of the facility, including clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas

- Erection of fences and other access control measures that are not related to the safe use of, or security of, radiological materials subject to this part

- Excavation

- Erection of support buildings (e.g., construction equipment storage sheds, warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and office buildings) for use in connection with the construction of the facility

- Building of service facilities (e.g., paved roads, parking lots, railroad spurs, exterior utility and lighting systems, potable water systems, sanitary sewerage treatment facilities, and transmission lines)

- Procurement or fabrication of components or portions of the proposed facility occurring at other than the final, in-place location at the facility

- Taking any other action that has no reasonable nexus to

  (i) Radiological health and safety
  (ii) Common defense and security

5.1.1 Other Past, Present, and Reasonably Foreseeable Future Actions

The proposed Reno Creek ISR Project would be located in the Wyoming East Uranium Milling Region as defined by the GEIS (NRC, 2009). This region encompasses large portions of northeastern Wyoming including the Powder River Basin (PRB). The PRB covers approximately 26,000 km^2 [10,000 mi^2] of land and holds the largest deposits of coal in the United States, as well as significant reserves of uranium and other natural resources (i.e., oil and gas). As such, there has been, and continues to be, substantial extraction activities throughout the PRB. While CBM extraction was a dominant activity in the region for many years, the region has recently experienced a decline in CBM activity and an increase in oil and gas production as the result of evolving oil and gas drilling extraction techniques.

Federal agencies have completed several environmental impact statements (EISs) related to activities within the PRB Region. Most of these EISs are related to resource management actions on federal lands administered by the U.S. Bureau of Land Management (BLM) or U.S. Forest Service (USFS) and are focused on improving natural resource conditions and reducing adverse impacts from various human-related activities. The various past, present, and reasonably foreseeable future actions in the vicinity of the proposed Reno Creek ISR Project are discussed in the next sections.

5.1.1.1 Uranium Recovery Sites

Uranium was discovered in the Wyoming PRB region in 1952 (Love, 1952). Since that time, numerous uranium recovery sites have been located in the region; however, after exploratory activities, many were not considered economically viable. Using the ISR method, approximately 20,412 metric tons [45 million lb] of uranium have been mined in the PRB region to date (BLM, 2011). In response to the regional availability of uranium, several uranium mines are proposed in the PRB, but due to the fluctuating price, they have not become operational. The number of projected uranium mines that may become operational would depend on several factors, including changes to the market price of uranium, NRC licensing, and state approval of permits. According to the BLM PRB Coal Review (2011), uranium production through 2020 is estimated to be 7,200 metric tons [15.9 million lb] per year as proposed developments, primarily in the Pumpkin Buttes District in southwestern Campbell County, become operational.

SEIS Table 5-1 lists potential and existing uranium recovery sites within 80 km [50 mi] of the proposed Reno Creek ISR project area. There are five potential ISR projects (in prelicensing, licensing, or operational phases) within 24 km [15 mi] of the proposed Reno Creek ISR Project area (see SEIS Table 5-1). Within the larger area of approximately 80 km [50 mi], there are 14 potential and existing uranium recovery or disposal sites (see SEIS Figure 5-1).

As indicated in SEIS Table 5-1, there are two conventional uranium mining sites that are undergoing decommissioning: Bear Creek Uranium Recovery Project (Bear Creek) and Highlands Uranium Recovery Facility (Highlands). Bear Creek is owned by Bear Creek Uranium Company and is located approximately 39.3 km [24.4 mi] south of the proposed project area. Highlands is owned by Exxon Mobil Corporation and is located in Converse County, Wyoming, approximately 62.5 km [39.3 mi] south of the proposed project area. Both the Bear Creek and Highlands decommissioning activities are being performed under NRC license (licenses SUA–1310 and SUA–1139, respectively).

Table 5-1. Potential and Existing Uranium Recovery Sites Within 80 km [50 mi] of the Proposed Reno Creek ISR Project

Site Name	Company/Owner	Type	County, State	Status	Approx. Distance km [mi]	Direction
Bear Creek	Bear Creek Uranium Co.	Conventional	Converse, WY	Decommissioning	39.3 [24.4]	S
Highland	Exxon Mobil	Conventional	Converse, WY	Decommissioning	62.5 [38.8]	S
Ludeman	Uranium One	ISR-Expansion	Converse, WY	Acceptance Review of applicant submitted responses to Requests for Additional Information	79.6 [49.5]	S
Moore Ranch	Uranium One	ISR-Expansion	Campbell, WY	Licensed, Not Operating	13.3 [8.3]	SW
Nichols Ranch and Nichols Hank Unit	Uranerz	ISR-New	Johnson and Campbell, WY	Licensed, Operating	20 [12.4]	NW
Jane Dough	Uranerz	ISR-Expansion	Johnson and Campbell, WY	Technical Review Ongoing	20 [12.4]	NW
North Butte	Cameco	ISR-Expansion	Campbell, WY	Licensed, Operating	14.1 [22.7]	NW and WSW
Brown Ranch	Cameco	ISR-Expansion	Campbell, WY	Letter of Intent 5/6/2015	14.1 [22.7]	NW and WSW
Ruth	Cameco	ISR-Expansion	Johnson, WY	Nonoperational	14.1 [22.7]	NW and WSW
Reynolds Ranch	Cameco	ISR-Expansion	Converse, WY	Nonoperational	55.8 [34.7]	S
Ruby Ranch	Cameco	ISR-Expansion	Campbell, WY	Letter of Intent 6/24/2013, Application Expected FY16	9.3 [5.8]	NW
Smith Ranch-Highland	Cameco	ISR-Expansion	Converse, WY	Technical Review Ongoing-License Renewal	62.5 [38.8]	S
Spook	DOE	Conventional	Johnson, WY	UMTRCA Title 1 Disposal Site	43.4 [27]	S

Table 5-1. Past, Existing, and Potential Uranium Recovery Sites Within 80 km [50 mi] of the Proposed Reno Creek ISR Project (Continued)

Site Name	Company/Owner	Type	County, State	Status	Approx. Distance km [mi]	Direction
Willow Creek-Irigaray and Christiansen Ranch	Uranium One	ISR-restart	Johnson and Campbell, WY	Licensed, Operating	30.8 [19.1]	NW

Sources: EPA, 2016; NRC, 2015a,b, 2016

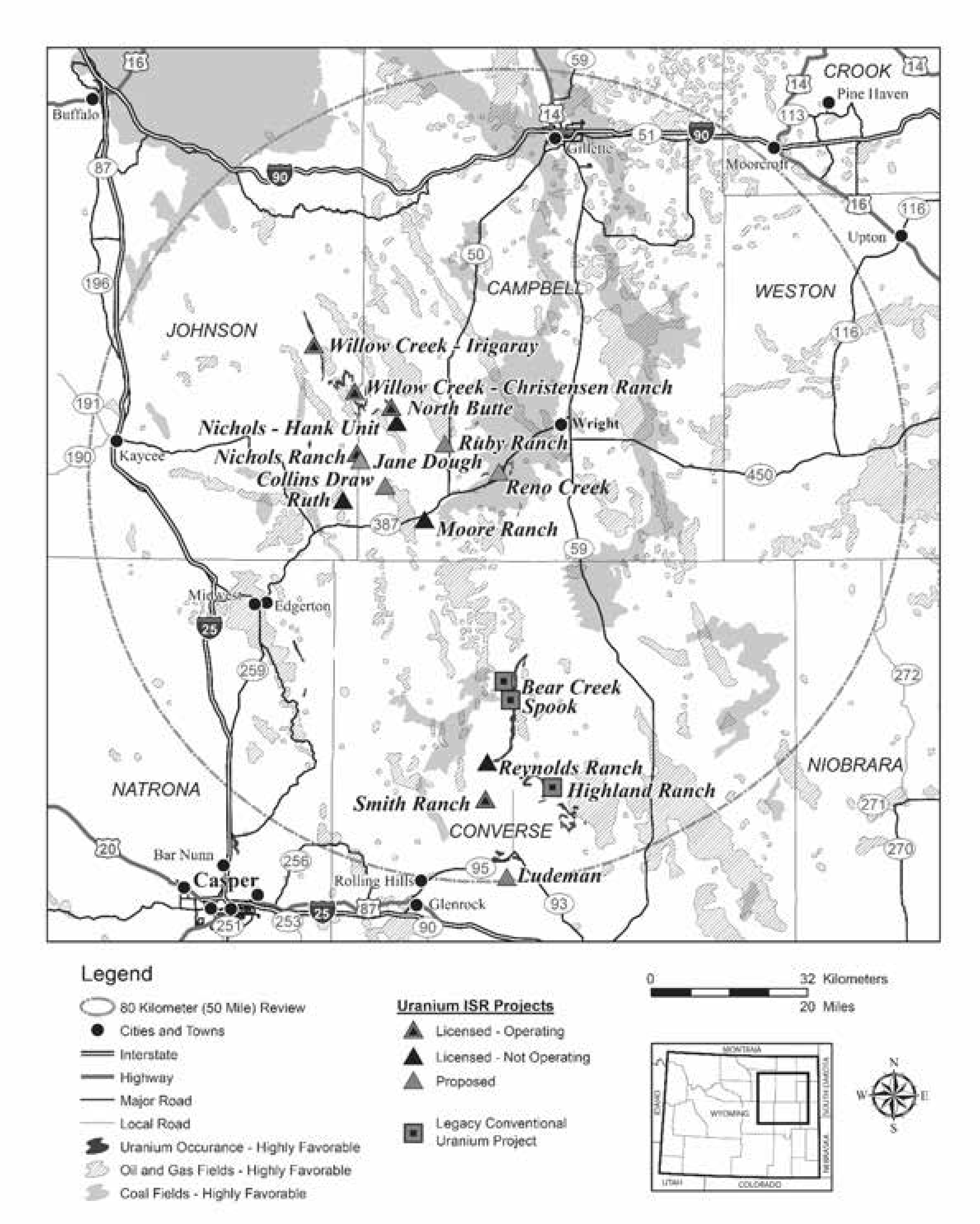

Figure 5-1. Potential and Existing Uranium Milling and Mining Sites Within 80 km [50 mi] of the Proposed Reno Creek ISR Project (AUC, 2012a)

Additionally, the Spook facility is a Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I site located in Johnson County, Wyoming, which is approximately 43.4 km [27 mi] south of the proposed Reno Creek ISR Project area. The UMTRCA Title I program established a joint federally and state-funded program for remedial action at abandoned mill tailings sites where tailings resulted largely from production of uranium for the U.S. weapons program. Under Title I, the U.S. Department of Energy (DOE) is responsible for cleanup and remediation of these abandoned sites. The NRC is required to evaluate DOE's design and implementation for remediation and, after remediation is complete, concur that the sites meet U.S. Environmental Protection Agency (EPA) standards. In 1993, DOE became a licensee of the NRC under the general license provisions of 10 CFR 40.28. This occurred after the NRC concurred in the completion of construction and surface cleanup at the inactive tailings site and accepted DOE's plan for long-term surveillance and maintenance at the Spook site.

As noted in GEIS Section 5.1 uncertainties exist related to the cumulative effects of mineral production (which includes ISR) due to varying extraction technologies, design of long-term monitoring programs, and the effectiveness of predictive models. However, the likelihood of mining projects, milling projects or both being collocated has the potential to impact the surrounding environment. The various activities associated with uranium production would likely impact multiple resources areas (e.g. land use, ecology, and groundwater) (NRC, 2009).

5.1.1.2 Coal Mining

In the 1970s and 1980s, the PRB emerged as a major coal-producing region, and comprises over 90 percent federally owned land (BLM, 2011). The Powder River Regional Coal Team decertified the Powder River Federal Coal Region as a federal coal production region in 1990, which allowed leasing to occur in the region on an application basis. Because of this decertification, U.S. coal production increased 11 percent, from 1.03 billion tons [1.14 billion T] produced in 1990 to 1.15 billion tons [1.27 billion T] produced in 2007 (BLM, 2009a). Between 1990 and 2008, the BLM Wyoming State Office held 25 competitive lease sales and issued 19 new federal coal leases containing more than 5.17 billion tons [5.7 billion T] of coal using the "lease by application" process (BLM, 2005a, 2011, 2013a). In 2009, PRB coal mines produced 444 million metric tons [489 million short tons] of coal (BLM, 2011). As of 2008, there were 13 operating coal mines in the Wyoming PRB area. These mines make up more than 96 percent of the coal produced in Wyoming each year (BLM, 2005a, 2011, 2013a). Prior to 2008, there had been several annual production declines but with an overall trend of increasing production (BLM, 2011). In the years since 2008, coal production in Wyoming has decreased compared to pre-2008 years (Center for Energy Economics and Public Policy, 2015) but with an overall trend of year-on-year increases. Although difficult to accurately predict, existing coal mining operations are expected to continue.

In 2003, the cumulative disturbed land area of the PRB attributable to coal mines totaled nearly 90,070 hectares (ha) [222,568 acres (ac)] (BLM, 2010). This area is projected to increase to 174,785 ha [434,374 ac] by 2020 if the upper coal production estimates are met (BLM, 2010). The 2020 estimates take into account other developments related to coal, which include railroads, coal-fired power plants, major (230 kV) transmission lines, and coal technology projects. Specific coal mining activities would account for approximately 35 percent of the total disturbed area (BLM, 2010). Surface mining of coal can cause adverse impacts to land use, geology and soils, water resources, ecology, air quality, noise, historic and cultural resources, visual and scenic resources, socioeconomics, and waste management. SEIS Table 5-2

Table 5-2. Coal Mines Within 80 km [50 mi] of the Proposed Reno Creek ISR Project					
Site Name	**Company Owner**	**Type**	**County, State**	**Approximate Distance km [mi]***	**Direction**
Antelope	Cloud Peak Energy, LLC	Surface	Converse, WY	23.3 [14.5]	SE
Belle Ayr	Alpha Coal West Inc.	Surface	Campbell, WY	44 [27.4]	NNE
Black Thunder	Thunder Basin Coal Co. LLC	Surface	Campbell, WY	17.7 [11]	ENE
Caballo	Peabody Caballo Mining, LLC	Surface	Campbell, WY	48.3 [30]	NNE
Coal Creek	Thunder Basin Coal Co. LLC	Surface	Campbell, WY	34.5 [21.4]	NE
Cordero Rojo Complex	Cloud Peak Energy, LLC	Surface	Campbell, WY	36.8 [22.9]	NNE
Dave Johnston	Glenrock Coal Co	Surface	Campbell, WY	64.2 [39.9]	SSW
Dry Fork	Western Fuels of Wyoming, Inc.	Surface	Campbell, WY	72.1 [44.8]	NNE
Eagle Butte	Alpha Coal West Inc.	Surface	Campbell, WY	73.2 [45.5]	NNE
North Antelope Rochelle	Peabody Energy	Surface	Campbell, WY	19.0 [11.8]	E
Rawhide	Peabody Energy	Surface	Campbell, WY	77.7 [48.3]	NNE
Wyodak	Wyodak Resources Develop. Corp.	Surface	Campbell, WY	68.1 [42.3]	NNE
Source: WMA, 2015a *distances from the proposed Reno Creek project area have been updated to reflect distances to site permit boundaries					

lists 12 surface coal mines within 80 km [50 mi] of the proposed Reno Creek ISR site. No underground coal mines are located within this area.

There are five coal-fired power plants in operation (Dry Fork Station, Neil Simpson Unit 2, and Black Hills Corporation's WYGEN I, II, and III) located between 69 and 79 km [43 and 49 mi] north-northeast of the proposed project (WDEQ, 2016a,b,c,d). The five coal-fired power plants are capable of generating a combined total of 770 MW of electrical power. The Neil Simpson Unit 1 coal-fired power plant was retired in 2014. In addition, Basin Electric's proposed Two Elk coal-fired power plant project is proposed approximately 29.8 km [18.5 mi] east-northeast of the proposed Reno Creek ISR Project (WDEQ, 2016e). If constructed, the Two Elk plant would add an additional 250 MW of electrical power generation capacity to the PRB. However, WDEQ requested that the Two Elk permit be revoked in July 2016 due to delayed construction.

5.1.1.3 Oil and Gas Production

The application of improved technology and the emergence of unconventional plays (i.e., oil fields) led to an oil production increase of 19 percent from 2013 through the first three quarters of 2014 in the Wyoming PRB (WSGS, 2015). Directional and horizontal drilling, as well as hydraulic fracturing in unconventional plays, resulted in a nationwide surge in production between 2012 and 2014; however, U.S. oil production outpaced demand and is being adversely affected by low oil prices (EIA, 2015). U.S. natural gas production increased 35 percent between 2005 and 2013 and is expected to continue to increase through 2040 (EIA, 2015).

There are approximately 5,854 oil and gas production wells in Campbell County, Wyoming, with a total of 32,967 oil and gas wells on file in the state. These wells account for approximately 1,729,174 barrels of oil in a high-yielding production month. In 2013, Campbell County was the state's leading producer of crude oil with 13 million barrels. Wyoming is projected to have produced 75 million barrels of oil in 2014, compared to the 63 million barrels of oil produced in 2013 (WSGS, 2015). In 2013, the number of horizontal oil well permit applications in Campbell County doubled to 416, and Converse County experienced a 42 percent increase to 464 (WSGS, 2015). Wyoming's natural gas production decreased 9 percent from 2012 to 2013 (WSGS, 2015). In 2003, the cumulative disturbed land area in the PRB from oil and gas, CBM, and related development was nearly 76,081 ha [188,000 ac]. Prior to 2015, increased development associated with extraction of these energy resources resulted in a total of 123,429 ha [305,000 ac]. Two proposed oil and gas projects (the Greater Crossbow Oil and Gas Project and the Converse County Oil and Gas Project) are located south of the Reno Creek ISR Project within 80 km [50 mi] (BLM, 2016a,b). These two projects would include drilling approximately 5,000 oil and gas wells. The depth to producing gas and oil-bearing horizons generally ranges from 1,219 to 4,115 m [4,000 to 13,500 ft], but some wells are as shallow as 76.2 m [250 ft] (BLM, 2005a, 2011, 2013a).

Regional oil and gas exploration, production, disposal, and pipeline construction could potentially generate cumulative impacts. Construction of wells (production and disposal) necessitates the building of temporary access roads to reach and construct 1.2-ha [3-ac] drill pads for each drill site (BLM, 2009a). At that time, there would be a temporary increase in fugitive dust emissions due to the use of heavy machinery. During oil well production, the region would have an increase in traffic on county-maintained paved roads from oil trucks moving product to a refinery. For more information on the effects on land use and transportation from oil and gas exploration, see SEIS Sections 5.2 and 5.3, and for information on induced seismicity associated with waste water associated with oil and gas production, see SEIS Section 5.4.

5.1.1.4 Coalbed Methane Development

The CBM gas extraction removes natural gas from coal beds. Since 2008 this form of mining is common in the PRB, but has been in decline (WMA, 2015a). Currently CBM activities account for 18 percent of Wyoming's natural gas production. The decline is due to (i) the drop in natural gas prices worldwide, (ii) the depletion of reservoirs, and (iii) competition from unconventional gas resources. Most of the remaining reserves in the PRB are currently not economically viable for development. The Wyoming Oil and Gas Conservation Commission (WOGCC) is in the process of reviewing options for the "orphaned" CBM wells that were abandoned but still remain in the PRB region (WSGS, 2015). For active CBM mining, recovery and infrastructure involves the installation of facilities that include access roads; pipelines for gathering gas and produced water; electrical utilities; facilities for measuring and compressing recovered gas; facilities for treating, discharging, disposing of, containing, or injecting produced water; and pipelines to transport gas (high-pressure transmission pipelines). The wells are collocated on a well pad installed in a 32-ha [80-ac] spacing pattern {8 pads per 259 ha [1 mi^2]}. The overall life of each well is approximately 7 to 10 years, after which pipes are abandoned in place and well sites are reclaimed (NRC, 2009).

There are 324 permitted or completed CBM wells within 3.2 km [2 mi] of the proposed Reno Creek ISR Project. The target coal seams occur approximately 192 and 434 m [631 and 1,424 ft] below ground surface. The CBM formation is separated vertically from the uranium production zone that would be used for ISR activities at the proposed Reno Creek ISR Project by 61 m [200 ft]. (AUC, 2012a)

Wind Power

The southern portion of Wyoming has the greatest potential for wind energy. However, Campbell and Converse Counties also offer potential to support commercial-scale wind generation projects. There are five projects in the PRB within 80 km [50 mi] of the proposed Reno Creek ISR Project:

- PacifiCorp's Glenrock, Glenrock III, and Rolling Hills Wind Projects provide power in the Wyoming PRB. Construction was completed on Glenrock's 66 1.5-MW turbines in 2008, on another 26 1.5-MW turbines for Glenrock III in 2009, and for 66 1.5-MW turbines for Rolling Hills in 2009. The wind farm cluster is located on 121 ha [300 ac] of the reclaimed Dave Johnston Coal Mine. Turbines associated with this cluster stretch from approximately 56.3 [35 mi] to 68.4 km [42.5 mi] south of the proposed Reno Creek ISR Project area, generating up to 237 MW of energy (PacifiCorp, 2011a,b).

- Duke Energy (doing business as Three Buttes Windpower, LLC) completed the Campbell Hill Windpower Project and began commercial operations in December 2009. The Campbell Hill Windpower Project is located approximately 72 km [45 mi] southwest of the proposed Reno Creek ISR project in Converse County and consists of 66 wind turbines generating 99 MW (PacifiCorp, 2015).

- Duke Energy built the Top of the World Wind Energy Project, a 200-MW wind farm consisting of 110 turbines. Turbines associated with this project stretch from approximately 68.1 [42.3mi] to 81 km [50.3 mi] south of the proposed Reno Creek ISR Project area. The project began commercial operation in 2010 (Duke Energy, 2015).

Additionally, Third Planet Windpower has proposed a 150-MW wind project with 100 1.5-MW turbines. This proposed project, the Reno Junction Wind Project, would straddle an 18.5-km [11.5-mi] north-south stretch of Wyoming State Highway (SH) 50 approximately 6.4 km [4 mi] west of the proposed Reno Creek ISR project area. The company received a construction and operations permit from the Wyoming Industrial Siting Council in July 2010, but did not begin construction within three years of the date of the permit. Therefore, the permit was revoked in August 2013. No other proposed wind energy projects have been identified in the Wyoming PRB area (WDEQ, 2015).

Land disturbance for wind energy projects results from the development of access roads, the turbine assembly pad, and the foundation pad for each wind turbine tower. Additional land disturbances result from installation of transformers and substations, underground electric and fiber optic communications cables, one or more operations and maintenance facilities, meteorological towers, and transmission lines connecting the project to the regional grid. Much of the disturbance area is reclaimed immediately following construction, with long-term disturbance associated with permanent facilities (i.e., access roads, support facilities, and tower foundations). Wind-generating projects have an expected life of approximately 25 years, which could be extended based on market conditions and the overall condition of the infrastructure.

Some re-disturbance would occur at the time of decommissioning, followed by final reclamation (BLM, 2011).

5.1.1.5 Transportation Projects

Powder River Basin Expansion Project

The Dakota Minnesota and Eastern (DM&E) Railroad filed an application to construct the Powder River Basin Expansion Project with the federal Surface Transportation Board (STB) in February 1998. The project seeks approval to construct and operate a new rail line and associated facilities in east-central Wyoming and southwest South Dakota (STB, 2001). As noted in SEIS Section 5.3, the project would require the construction of temporary roads to access the rail line right-of-way (ROW), increasing project-related construction traffic and potential accidents along the new rail line corridor. Potential effects from construction of this project would be similar to effects from construction of roads evaluated for ISR facilities described throughout SEIS Chapter 4, including fugitive dust emissions, noise, incidental wildlife or livestock kills, increased sedimentation and degradation of surface water quality, and land surface and habitat disturbances. If approved and completed, the project will add coal-hauling rail capacity and establish a dedicated, direct route to transport coal from the PRB to Midwest markets. The extension will add 418 km [260 mi] of rail line and connect the northern DM&E line to operating coal mines located south of Gillette, Wyoming. At this time, Canadian Pacific—DM&E's parent company—has not yet decided whether to build the extension. The decision to build is contingent on several factors: (i) acquiring the necessary ROW to build the line, (ii) executing agreements with PRB mining companies for the right of DM&E to operate loading tracks and facilities, (iii) securing contractual commitments from prospective coal shippers to ensure that revenues from the proposed line are economical, and (iv) arranging financing for the project.

5.1.1.6 Other Mining

Sand and gravel, bentonite, and clinker (scoria) have been and are being mined in the PRB. Aggregate, which consists of sand, gravel, and stone, is used in the construction industry. In the PRB, the largest identified aggregate operation is located in northern Converse County. It has a total disturbance area of approximately 27 ha [67 ac], of which 1.6 ha [4 ac] have been reclaimed. Bentonite is weathered volcanic ash that is used in a variety of products, including drilling mud and cat litter, because of its absorbent properties. There are three major bentonite-producing districts in and around the PRB. Clinker is used as road surfacing material and is found in extensive areas in the Wyoming PRB. Clinker is also used as aggregate where alluvial terrace gravel or in-place granite or other igneous rock is not available. Clinker generally is mined in Converse and Campbell Counties in the PRB (BLM, 2005a, 2011, 2013a). Aggregate mines can vary in size and location depending on the need of the industries relying on the products. BLM did not evaluate effects of mining operations beyond surface disturbances (BLM, 2011). However, the NRC staff assume that other mining operations would use existing transportation corridors, but depending on project location, some access roads may be constructed. Examples of the potential effects of construction include increases in noise and fugitive dust. At the current mining rates within Wyoming, and more specifically the PRB, sand and gravel, bentonite, and clinker mining is expected to continue for the next 15 to 20 years (WMA, 2015b).

5.1.1.7 Environmental Impact Statements as Indicators of Past, Present, and Reasonably Foreseeable Future Actions

Draft and final EISs prepared by federal agencies, which cover a reasonable time period serve as indicators of present and reasonably foreseeable future actions. The NRC staff relied on information in GEIS Section 5.3.2 (NRC, 2009) and other publicly available information, including several EISs identified for projects within the Wyoming East Uranium Milling Region (see SEIS Table 5-3) to determine past, present, reasonably foreseeable future actions within an 80-km [50-mi] radius around the proposed Reno Creek ISR Project. These documents were prepared for mineral mining and energy activities and actions that focus on improving natural resource conditions and reducing adverse impacts from various human-related activities.

5.1.2 Methodology

In calculating and assessing potential cumulative impacts, the NRC staff developed a methodology that follows the Council on Environmental Quality (CEQ) guidance (NRC, 2009; CEQ, 1997).

1. Identify the potential environmental impacts of the federal action, and evaluate the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions for each resource area. Potential environmental impacts are discussed and analyzed in SEIS Chapter 4.

2. Identify the geographic scope for the analysis for each resource area. This scope will vary from resource area to resource area, depending on the geographic extent over which the potential impacts may occur.

3. Identify the timeframe for assessing cumulative impacts. The selected timeframe begins with NRC acceptance of the application for an NRC license to operate the proposed Reno Creek ISR Project in June 2013. The cumulative impacts analysis timeframe ends in 2030, the date estimated for license termination after completion of the decommissioning period (see SEIS Figure 2-1).

   NRC licenses for ISR facilities are typically granted for a 10-year period. The proposed Reno Creek ISR Project has an estimated 11-year production lifespan with a total timeframe of 16 years, including construction and decommissioning (see SEIS Figure 2-1). If NRC grants an NRC license, the applicant will have to apply for license renewal before the initial license period expires to continue operations.

4. Identify ongoing and prospective projects and activities that take place or may take place in the area surrounding the project site. These projects and activities are described in SEIS Section 5.1.1.

5. Assess the cumulative impacts for each resource area from the proposed project, and other past, present, and reasonably foreseeable future actions. This analysis would take into account the environmental impacts of concern identified in Step 1 and the resource-area-specific geographic scope identified in Step 2.

Table 5-3. Draft and Final National Environmental Policy Act Documents Related to the Wyoming East Uranium Milling Region

Date	Agency	Title
1/17/2003	BLM	Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project
6/24/2005	BLM	Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States
8/17/2007	USFS	Thunder Basin Analysis Area Vegetation Management, To Implement Best Management Grazing Practices and Activities, Douglas Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Campbell, Converse, and Weston Counties, WY
8/17/2009	BLM	South Gillette Area Coal Lease Applications, WYW172585, WYW173360, WYW172657,WYW161248, Proposal to Lease Four Tracts of Federal Coal Reserves, Belle Ayr, Coal Creek, Caballo, and Cordero Rojo Mines, Wyoming Powder River Basin, Campbell County, WY
10/16/2009	USFS	Thunder Basin National Grassland Prairie Dog Management Strategy, Land and Resource Management Plan Amendment #3, Proposes to Implement a Site-Specific Strategy to Manage Black-Tailed Prairie Dog, Douglas Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Campbell, Converse, Niobrara, and Weston Counties, WY
7/30/2010	BLM	Wright Area Coal Lease Project, Applications for Leasing Six Tracts of Federal Coal Reserves Adjacent to the Black Thunder, Jacob Ranch, and North Antelope Rochelle Mines, Wyoming Powder River Basin, Campbell County, WY
8/27/2010	NRC	Moore Ranch In-Situ Uranium Recovery (ISR) Project, Proposal to Construct, Operate, Conduct Aquifer Restoration, and Decommission an In-Situ Recovery (ISR) Facility, NUREG–1910, Campbell County, WY
1/27/2011	NRC	Nichols Ranch In-Situ Uranium Recovery (ISR) Project, Proposal to Construct, Operate, Conduct Aquifer Restoration, and Decommission and In-Situ Recovery Uranium Milling Facility, Campbell and Johnson Counties, WY
5/29/2015	BLM	Proposed Resource Management Plan and Final Environmental Impact Statement for the Buffalo Field Office Planning Area, WY

Source: EPA, 2016

The following terms describe the level of cumulative impact:

SMALL: The environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource considered.

MODERATE: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.

LARGE: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

The NRC staff recognize that many aspects of the activities associated with the proposed Reno Creek ISR Project would have SMALL impacts on the affected resources. It is possible, however, that an impact that may be SMALL by itself, but 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 NRC staff determined the appropriate level of analysis that was merited for each resource area potentially affected by the proposed project. The level of analysis was determined by considering the impact level to the specific resource, as well as the likelihood that the quality, quantity, and stability of the given resource could be affected.

SEIS Table 5-4 summarizes the potential cumulative impacts of the proposed Reno Creek ISR Project on environmental resources the NRC staff identified and analyzed for this SEIS, which are then detailed in the subsequent sections. The potential cumulative impacts take into account the other past, present, and reasonably foreseeable activities identified in SEIS Section 5.1.1.

5.2 Land Use

The NRC staff assessed cumulative impacts on land use within a 16-km [10-mi] radius of the proposed Reno Creek ISR Project area, comprising a land area of approximately 81,350 ha [201,000 ac]. The timeframe for the analysis of cumulative impacts is 2012 to 2030, as described in SEIS Section 5.1.2. Land use impacts result from (i) land disturbance; (ii) interruption, reduction, or impedance of livestock grazing and open wildlife areas; and (iii) land access. The cumulative impacts on land use were not assessed beyond 16 km [10 mi] from the project area because, at that distance, the impacts on land use from the proposed project would be expected to be minimal. The majority of land within a 16-km [10-mi] radius of the proposed project area is privately- or state-owned and is classified as agricultural land (see SEIS Figure 3-1). Land use within the land use cumulative impact assessment study area is predominantly rangeland used for livestock grazing. Within this study area, activities on both public and private lands (e.g., livestock grazing, uranium recovery, oil and gas production, and CBM development) are ongoing and projected to continue in the future.

Cumulative impacts from the loss of rangeland in the land use study area from existing and potential activities include a decrease in the area available for foraging, loss of forage or cropland productivity, loss of animal unit months (AUMs), and loss of water-related range improvements (e.g., improved springs, water pipelines, or stock ponds). Other than in un-reclaimed areas, these impacts would be reduced after portions of the proposed Reno Creek ISR Project area have been reclaimed. Another impact could be dispersal of noxious and invasive weed species both within and beyond areas where the surface had been disturbed, which reduces the area of desirable grazing by livestock.

Minimal surface disturbance would occur as a result of preconstruction activities associated with the proposed Reno Creek ISR Project. Preconstruction activities including topsoil stripping, excavation, backfilling, compacting, and grading to prepare a level site would disturb approximately 6.3 ha [15.5 ac] to accommodate the central processing plant (CPP) building, office/maintenance building, storage areas, backup pond, and parking area (AUC, 2014). These areas would be fenced to control access. Preconstruction activities would also include construction of access roads to access the initial production unit.

Table 5-4. Potential Cumulative Impacts on Environmental Resources		
Resource Category	Site Specific Impact	Comment and Cumulative Impact
Land Use	SMALL	The proposed project would have a SMALL incremental effect when added to the MODERATE cumulative impacts to land use.
Transportation	SMALL	The proposed project would have a SMALL incremental effect when added to the MODERATE cumulative impacts to transportation.
Geology and Soils	SMALL	The proposed project would have a SMALL incremental effect when added to the MODERATE cumulative impacts to geology and soils.
Water Resources		
Surface Water and Wetlands	SMALL	The proposed project would have a SMALL incremental effect when added to the MODERATE cumulative impacts to surface water and wetlands.
Groundwater	SMALL	The proposed project would have a SMALL incremental effect when added to the MODERATE cumulative impacts to groundwater.
Ecological Resources		
Terrestrial Ecology	SMALL to MODERATE	The proposed project would have a SMALL incremental effect when added to the SMALL to MODERATE cumulative impacts on terrestrial ecological resources. Note that Greater sage-grouse is the only species that has a MODERATE impact.
Aquatic Ecology	SMALL	The proposed project would have a SMALL incremental effect when added to the SMALL cumulative impacts on aquatic ecological resources.
Threatened and Endangered Species	SMALL	The proposed project would have no effect on federally listed, proposed, and candidate species, and a SMALL incremental effect on other species of concern when added to the SMALL cumulative impacts.
Air Quality		
Near-Field Air Quality	SMALL	The proposed project would have a SMALL impact when added to the MODERATE cumulative impacts on the near-field air quality.
Far-Field Air Quality	SMALL	The proposed project would have a SMALL impact when added to the MODERATE TO LARGE cumulative impacts on the far-field air quality. Impacts from past and present actions would be MODERATE. Because of uncertainty associated with impacts from reasonably foreseeable future actions, future impacts could be as much as LARGE.

Table 5-4. Potential Cumulative Impacts on Environmental Resources (Continued)		
Resource Category	**Site Specific Impact**	**Comment and Cumulative Impact**
Climate Change	SMALL	The proposed project, in terms of greenhouse gas emissions, would have a SMALL impact when added to the MODERATE cumulative impact from other greenhouse gas emissions. The overall effect of projected climate change on the proposed Reno Creek ISR Project (i.e., the overlap of environmental impacts from climate change and the proposed project) would be SMALL.
Noise	SMALL	The proposed project is likely to have a SMALL incremental effect when added to the MODERATE cumulative impacts to noise.
Historic and Cultural	SMALL	The proposed project is likely to have a SMALL incremental effect when added to the SMALL to MODERATE cumulative impacts to historic and cultural resources.
Visual and Scenic	SMALL	The proposed project is likely to have a SMALL incremental effect when added to the SMALL cumulative impacts to visual and scenic resources.
Socioeconomics	SMALL to MODERATE	The proposed project is likely to have a SMALL to MODERATE incremental effect when added to the SMALL to MODERATE cumulative impacts to socioeconomics. A MODERATE cumulative impact could occur if a disproportionate number of employees at the proposed Reno Creek ISR Project elect to relocate and reside in smaller communities close to the proposed project.
Environmental Justice	No disproportionately high and adverse impacts on minority and low-income populations	The proposed project would have no disproportionately high and adverse impacts on minority and low-income populations.
Public and Occupational Health and Safety	SMALL	The proposed project is likely to have a SMALL incremental effect when added to the SMALL cumulative impacts to public and occupational health and safety.
Waste Management	SMALL	The proposed project is likely to have a SMALL incremental effect when added to the SMALL cumulative impacts to waste management.

The estimated surface disturbance associated with access road construction is approximately 0.8 ha [2 ac] (AUC, 2014). As discussed in SEIS Section 4.2.1, potential land use impacts related to the proposed Reno Creek ISR Project would be SMALL for all stages of the ISR project lifecycle (i.e., construction, operations, aquifer restoration, and decommissioning). The proposed project would disturb 62.4 ha [154.3 ac] during the project lifecycle. This amount of land would also be fenced from grazing at different times over the project lifecycle. Over the life of the proposed project (including preconstruction), the amount of land that would be disturbed and fenced would be small in comparison to the available grazing land within the land use study area {i.e., land within a 16-km [10-mi] radius of the proposed project area}.

Past, ongoing, and future conventional uranium mines and ISR facilities within the land use study area and within the broader regional area are described in SEIS Section 5.1.1.1. The Nichols Ranch ISR facility lies 20 km [12.4 mi] to the northwest and is the closest operational ISR facility to the proposed Reno Creek ISR Project. However, the Nichols Ranch facility lies outside the land use study area. Two potential ISR facilities, Moore Ranch and Ruby Ranch, are located within the land use study area (see SEIS Table 5-1 and SEIS Figure 5-1). Moore Ranch, which is 13.3 km [8.3 mi] to the southwest, has an NRC license but is not currently operating. Ruby Ranch is 9.3 km [5.8 mi] to the northwest and is expected to submit an NRC license application for an ISR facility in 2016. If developed and operated, these two potential facilities would have impacts on land use (i.e., surface disturbances) within the land use study area. An estimated 61 ha [150 ac] was estimated to be potentially disturbed during development of the potential Moore Ranch ISR Project (NRC, 2010). To assess the projected land area that would be affected by development of the potential Ruby Ranch project, the NRC staff assumed that approximately the same area affected by the proposed project {62.4 ha [154.3 ac]} would also apply. Similar to the proposed Reno Creek ISR Project, the amount of land area affected is small in comparison to the land use study area of 80,400 ha [199,000 ac].

As described in SEIS Section 3.2.3, extensive oil and gas production activities surround the proposed project area. Locations of oil and gas fields and associated wells in the land use study area are shown in SEIS Figure 3-4. Producing oil and gas fields within 8 km [5 mi] of the proposed project area are listed in SEIS Table 3-5. Two producing oils wells and two permanently abandoned wells are located within the proposed Reno Creek ISR Project area (see SEIS Figure 3-4). The producing wells are in the northeast part of the proposed project area in the K-Bar Field. Impacts on land use from continued oil and gas development in the land use study area would include construction of temporary access roads and 1.2-ha [3-ac] drill pads for each drill site (BLM, 2009a).

As further described in SEIS Section 3.2.3, there is extensive CBM production within and surrounding the proposed project area (see SEIS Figure 3-3). For example, there are 324 wells used for CBM production within 3.2 km [2 mi] of the proposed project area. Of these 324 wells, 46 are within the proposed Reno Creek ISR Project area. Impacts on land use from continued CBM development in the land use study area would include land disturbance and access restrictions associated with CBM infrastructure and facilities. CBM facilities and infrastructure include access roads; well pads; pipelines for gathering gas and produced water; electrical utilities; facilities for measuring and compressing recovered gas; facilities for treating, discharging, disposing of, containing, or injecting produced water; and pipelines to transport gas.

Existing wind energy operations in the region are located in the PRB south and southwest of the land use study area (see SEIS Section 5.1.1.5). The nearest wind energy projects to the land use study area are located in Converse County approximately 64 to 72 km [40 to 45 mi] from the proposed project area. The proposed Reno Junction Wind Project would be located approximately 5 km [3 mi] west of the proposed Reno Creek ISR Project area. Development of wind energy projects is generally compatible with other land uses, including livestock grazing, recreation, and oil and gas production activities (BLM, 2005b). Much of the disturbance area associated with development of wind energy projects is reclaimed immediately following construction, with long-term disturbance associated with permanent facilities (i.e., access roads, support facilities, and tower foundations) (BLM, 2011).

Proposed transportation projects, such as the proposed DM&E PRB Expansion Project, would have an impact on the use of privately-owned agricultural land and mineral and mining rights on federal lands in Wyoming. State-owned lands and utility corridors are also expected to have impacts. Construction of the rail extension would involve direct and indirect takings of privately held land and the potential destruction of wells, windmills, corrals, fencing, outbuildings, irrigation systems, and other capital improvements. Access roads, hauling roads, and borrow pits would be built. DM&E would be required to mitigate adverse environmental impacts to private agricultural and ranch lands, federal lands, state lands, and utility corridors. DM&E would negotiate these mitigation measures with landowners and federal and state agencies STB, 2001). DM&E would be required to restore all federal, state, and privately held agricultural lands disturbed by the project to preconstruction conditions as promptly and fully as possible (STB, 2001).

The NRC staff have determined that the cumulative impact on land use within the land use study area resulting from past, present, and reasonably foreseeable future actions would be MODERATE. This finding is based on the assessment of existing and potential impacts on land use within the land use study area from the following actions:

- Land disturbance and restrictions on livestock grazing from development of potential ISR projects;
- Land disturbance from existing and potential oil and gas production and development;
- Land disturbance and restrictions on livestock grazing from existing and potential CBM development; and
- Direct and indirect taking of privately held land for development of transportation projects, such as the DM&E PRB Expansion Project.

Other ongoing and reasonably foreseeable future actions are not expected to have a noticeable impact on land use within the land use study area. There are no coal mines within the land use study area. Potential wind energy projects, such as the Reno Junction Wind Project, are generally compatible with the primary land use in the study area (i.e., livestock grazing) (BLM, 2005b).

5.2.1 Summary

The estimated land disturbance of 62.4 ha [154.3 ac] for the proposed Reno Creek ISR Project is a small amount of land in comparison to the land use study area of 81,350 ha [201,000 ac]. About this same amount of land would be fenced over the life of the proposed project to restrict livestock grazing and big game and public access to the ISR facilities, infrastructure, and wellfields. As wellfield production ends, fencing would be removed and the land would be reclaimed. At the end of operations, the applicant would decommission the site and restore the land to its previous use (with the possible exception of access roads that land owners may request to remain) in accordance with an NRC-approved decommissioning plan (see SEIS Section 2.1.1.1.5). Therefore, the NRC staff conclude that the proposed Reno Creek ISR Project would add a SMALL incremental effect to the MODERATE impacts to land use from other past, present, and reasonably foreseeable future actions in the land use study area, resulting in an overall MODERATE cumulative impact in the land use study area.

5.3 Transportation

Cumulative impacts on transportation systems of Campbell, Johnson, and Converse Counties, Wyoming, were identified and evaluated. This geographic area was selected because major transportation routes within the region (both Interstate and U.S. Highways) occur within these three counties. Local highways, existing county roads, and access roads were the focus of this analysis over the 2012 to 2030 timeframe.

The major road network in the Wyoming PRB as a whole is sparse, which is consistent with the low population density. Primary access to the proposed Reno Creek ISR Project from nearby communities is from State Highway 387, which traverses the proposed project area. Two transportation routes (State Highways 50 and 59) are available to access the proposed project area from the city of Gillette, located approximately 66 km [41 mi] to the north. State Highway 50 runs south from Gillette and connects with State Highway 387, approximately 7.2 km [4.5 mi] west of the proposed project area. State Highway 59 also runs south from Gillette and connects with State Highway 387 at Wright, located approximately 12 km [7.5 mi] northeast of the proposed project area.

Potential environmental impacts from transportation associated with the proposed Reno Creek ISR Project are described in SEIS Section 4.3. As analyzed in that section, all phases (i.e., construction, operations, aquifer restoration, and decommissioning) of the proposed Reno Creek ISR Project would have a SMALL impact on transportation. Potential impacts would be from workers commuting to and from the site and from the shipment of materials and chemicals on and off the site. During preconstruction activities associated with the proposed Reno Creek ISR Project, the applicant estimated that 12 vehicles per day would travel to and from the proposed project area (AUC, 2014). Vehicle traffic would include passenger vehicles, light duty trucks, and commercial delivery and pickup vehicles. Given the relatively minor increase in traffic (12 vehicles per day), the potential environmental impacts on transportation during preconstruction are expected to be SMALL.

In the cumulative impacts transportation study area, transportation would be impacted by ongoing and reasonably foreseeable future activities. These activities include livestock grazing, uranium exploration and mining, and oil and gas exploration and development. The many unimproved, two-track dirt roads and one lane gravel roads in the cumulative impacts transportation study area were constructed to access livestock grazing lands, to facilitate natural resource exploration and extraction, to provide access to recreational areas, and for off-road vehicle recreational activities. County roads in the transportation study area have intermittently provided access for uranium exploration and mining, as well as oil and gas exploration activities, since the mid-1970s. Reasonably foreseeable future uranium, oil, and gas exploration would result in additional trucks and heavy equipment using existing county roads. For example, within approximately 80 km [50 mi] of the proposed Reno Creek ISR Project area, there are 14 past, existing, and potential uranium recovery or disposal sites (see SEIS Section 5.1.1.1). At each site, the transportation requirement and potential transportation impacts would be comparable to the proposed Reno Creek ISR Project (see SEIS Sections 3.3 and 4.3). In addition to potential traffic impacts, the existing or planned ISR facilities would require construction of new road surfaces or improvement of existing roads. Therefore, the number of roads and road networks in the transportation study area would grow concurrently with the natural resource exploration and extraction activities with a related increase in traffic and the potential for accidents involving yellowcake and byproduct transport.

The Campbell County Coal Belt Transportation Study evaluated the existing roadway network to develop a comprehensive transportation plan that services the primary coal, oil, and gas production areas within Campbell County (Kadrmas, Lee, and Jackson, Inc., 2010). Based on Wyoming Department of Transportation (WY DOT) automated daily traffic count information on state highways in Campbell County, the study estimated a rural 2-lane highway hourly capacity of 1,375 vehicles per hour. This estimate accounted for known roadway conditions such as terrain, grade, truck traffic, and peak hour volumes. The study concluded that present traffic volumes on roads in Campbell County are low when compared to existing capacity and that the existing roadway network has sufficient capacity to accommodate projected future increases in traffic levels (Kadrmas, Lee, and Jackson, Inc., 2010). Additionally, the study provided a series of recommendations for road system improvements in 5-year increments through 2020 and beyond.

Wind energy projects (see SEIS Section 5.1.1.5) and transportation projects (see SEIS Section 5.1.1.6) would also have an impact on transportation resources in the cumulative impacts study area. Wind energy projects would impact transportation on local roads; however, these impacts would be temporary. During the 1- to 2-year construction period for a wind energy project, the vehicles of 100 to 150 workers and vehicles used to transport construction equipment, blades, turbine components, and other materials to the site would cause a relatively short-term increase in the use of local roadways. Shipments of materials, such as gravel, concrete, and water, are not expected to significantly affect local primary and secondary road networks. Shipments of overweight and/or oversized loads are expected to cause temporary disruptions on primary and secondary roads used to access construction sites. It is possible that local roads could require fortification of bridges and removal of obstructions to accommodate overweight and oversized shipments. Once completed, wind energy projects would require a relatively low number of workers to operate and maintain. For example, the operation and maintenance of an 180-MWcapacity wind energy project with about 150 turbines would require 10 to 20 workers. Consequently, transportation activities would be limited to a small number of daily trips by pickup trucks, medium-duty vehicles, or personal vehicles. Shipments of large components required for equipment replacement in the event of major mechanical breakdowns are expected to be infrequent. Transportation activities during site decommissioning would be similar to those during construction but would involve a much smaller workforce. Heavy equipment would be required for dismantling turbines and towers, breaking up tower foundations, and regrading and recontouring the site (BLM, 2005).

Two major rail lines serve the Wyoming PRB area. The Burlington Northern and Santa Fe (BNSF) Railroad enters Sheridan County, Wyoming, from Montana, which runs south to Gillette in Campbell County, Wyoming, and proceeds southeasterly to South Dakota. A secondary route jointly operated by BNSF and Union Pacific Railroad (UPRR), primarily serving coal trains from PRB mines, heads south from Gillette into Converse County toward Douglas where it splits into southerly and easterly branches. The typical ROW corridor for the railroad in the Wyoming PRB area is 122 m [400 ft] wide (BLM, 2012a). Recent coal train traffic averages approximately 160 coal unit trains per day (total outbound and returning).

The proposed DM&E PRB Expansion Project would have impacts on transportation in Wyoming. The project would require the construction of temporary roads to access the rail line ROW. The extension would add 418 km [260 mi] of rail line and connect the northern DM&E

line in South Dakota to operating coal mines located south of Gillette in the cumulative impacts study area. DM&E has proposed mitigation measures as part of the proposed PRB Expansion Project to address potential adverse impacts to transportation. To the extent possible, DM&E would confine all project-related construction traffic to a temporary access road within the ROW or established public roads. Any temporary access roads constructed outside the rail line ROW would be removed and the land reclaimed upon completion of construction. As a result of road closures after construction and during operation of railyards, DM&E would provide or develop alternative access for the safe movement of farm and ranch equipment and livestock to fields and pastures (STB, 2001).

Regional and local highways in the transportation cumulative impacts study area have sufficient capacity to accommodate the traffic of ongoing actions and increases in traffic from other reasonably foreseeable future actions. However, county roads would be impacted. County roads have been used to access uranium exploration and mining and oil and gas exploration activities in the transportation study area since the mid-1970s. Reasonably foreseeable future uranium, oil, and gas exploration and development in the transportation study area would result in additional trucks and heavy equipment using existing county roads. Construction and operation of potential wind energy and transportation projects would also impact county roads in the transportation study area. Transportation impacts would be most significant during the construction phase of wind energy, oil and gas exploration, and transportation projects because construction activities involve more workers and deliveries of materials and equipment. The NRC staff conclude that the cumulative impact on transportation within the transportation study area resulting from all past, present, and reasonably foreseeable future actions would be MODERATE.

5.3.1 Summary

As described in SEIS Section 4.3.1, regional and local highways used to access the proposed Reno Creek ISR Project could accommodate the additional projected traffic from the proposed project. However, projected daily traffic on Clarkelen Road, the county road providing access to the proposed Reno Creek ISR Project, would experience a noticeable increase over existing traffic. The applicant has committed to mitigation measures to reduce impacts to the county road system potentially affected by the proposed project. Mitigation measures include (i) improving signage; (ii) enforcing speed limits; and (iii) performing routine assessments of road conditions (AUC, 2012a). The applicant has also committed to work with Campbell County to provide necessary upgrades to affected portions of the county road system (AUC, 2012a). Therefore, the NRC staff conclude that the proposed Reno Creek ISR Project will have a SMALL incremental effect on transportation when added to the MODERATRE impact from all the other past, present, and reasonably foreseeable future actions in the transportation study area.

5.4 Geology and Soils

Cumulative impacts on soils and geology were assessed within the Wyoming PRB region and the counties that border the southern portion of Campbell County. This area was chosen as the geographic boundary for the analysis of cumulative impacts on soils and geology because the proposed Reno Creek ISR Project would be located in the southern portion of Campbell County, with Converse County located directly to the south and Weston and Johnson Counties to the east and west, respectively. The timeframe for the analysis of cumulative impacts begins in 2012 and terminates in the year 2030.

Preconstruction activities (e.g., topsoil stripping, excavation, backfilling, compacting, and grading to prepare a level site) would disturb a minimal amount of soil (AUC, 2014). Topsoil would be stripped, stockpiled, and stabilized to accommodate any ancillary buildings or parking areas. In addition, topsoil stockpile stabilization would minimize erosion for later use in the decommissioning phase (AUC, 2014). As assessed in SEIS Section 4.4, all phases of the proposed Reno Creek ISR Project would have a SMALL impact on geology and soils. The primary impacts on geology and soils would result from earthmoving activities during the construction phase. Earthmoving activities that might affect soils include the clearing of ground and topsoil and preparing surfaces for the CPP, header houses, access roads, drilling sites, excavating and backfilling trenches and pipelines, and associated structures. Operations at the proposed project may produce spills of process fluids or chemical materials that may contaminate soils. Required monitoring and mitigation, such as spill prevention and cleanup programs, would reduce these potential soil impacts (see SEIS Chapters 6 and 7). Subsurface impacts, such as subsidence and activation of nearby faults, would not occur at the proposed project area, because of the relatively small net withdrawal of fluids from production zone aquifers and because of the low pressures during operations relative to those needed to produce small earthquakes. As described in SEIS Section 5.1.1.1, there are four potential ISR projects (in prelicensing, licensing, or operational phases) within 24 km [15 mi] of the proposed Reno Creek ISR Project area (see SEIS Table 5-1). Within the larger area of approximately 80 km [50 mi], there are 14 past, existing, and potential uranium recovery or disposal sites (see SEIS Figure 5-1). Development of future ISR projects in the geological and soil resources study area would have impacts on geology and soils due to increased vehicle traffic, clearing of vegetated areas, soil salvage and redistribution, discharge of ISR-produced groundwater, and construction and maintenance of project facilities and infrastructure (e.g., roads, well pads, pipelines, industrial sites, and associated ancillary facilities). The NRC staff assume that the development of future ISR projects within the cumulative impacts study area would be similar to the proposed Reno Creek ISR Project, with similar potential for surface impacts to geology and soils. The construction and operation of the infrastructure for these future projects, however, would be subject to the same monitoring, mitigation, and response programs required to limit potential surface impacts (e.g., erosion and contamination from spills) as those for the proposed Reno Creek ISR Project. Reclamation and restoration of disturbed areas would mitigate loss of soil and soil productivity associated with ISR activities.

Other historical, present, and future natural resource development activities that relate to geology and soils include stock grazing, coal mining, and oil and gas and CBM development. As described in SEIS Section 5.1.1.2, the Wyoming East Uranium Milling Region has 16 currently active surface coal mines. The closest coal mines to the proposed Reno Creek ISR Project area are the North Antelope, Rochelle, and Black Thunder coal mines, approximately 26 km [16 mi] to the east (see SEIS Table 5-2). These mines produce from the Anderson/Big George coal seams within the Fort Union Formation. Although there have been several annual production declines, existing coal mining operations are expected to continue over the timeframe for the analysis of cumulative effects (i.e., until 2030). Geologic formations hosting potential CBM reserves are present in the immediate vicinity of the proposed project (see SEIS Section 3.4.1.2). However, the region has experienced a decline in CBM activity and activities are anticipated to continue to decline through the 2030 timeframe.

Surface-disturbing activities related to livestock grazing, coal mining, oil and gas, and CBM exploration activities, such as construction of new access roads and drill pads and overburden stripping, would have direct effects on geological resources. Direct effects on geology from these activities would be limited to excavation and relocation of disturbed bedrock and unconsolidated surficial materials associated with surface disturbances. Impacts from these activities include loss of soil productivity due primarily to wind erosion, changes to soil structure from soil handling, sediment delivery to surface water resources (i.e., runoff), and compaction from equipment and livestock pressure. Reclamation and restoration of soils disturbed by historic livestock grazing and exploration activities would mitigate loss of soil and soil productivity, and salvaged and replaced soil would become viable soon after vegetation is established. However, indirect long-term effects, such as cross-contamination of aquifers, may occur if boreholes associated with oil and gas and CBM exploration are not properly abandoned (see SEIS Section 3.4.1).

Deep injection of wastewater into geologic strata beneath usable aquifers is one of the commonly used methods to dispose of wastewater from industrial activities such as hydraulic fracking, oil and gas production, and ISR operations. As noted in SEIS Sections 5.1.1.1 and 5.1.1.3, oil and gas production and ISR operations are common in the cumulative impact geology and soils study area. Recent studies in the central and eastern United States, especially Oklahoma and Texas (e.g., Ellsworth, 2013; Weingarten et al., 2015; Karanen et al., 2013) have shown that high-pressure and high-volume injection of wastewater may be responsible for a substantial increase in seismic (earthquake) activity. Many of the wastewater induced earthquakes in the central and eastern United States have been intense enough to cause noticeable ground shaking. Ellsworth (2013) noted that the number of M_W 3.0[2] and larger earthquakes in these areas have increased fivefold since about 2009, corresponding to the large increase in the number of Underground Injection Control (UIC) Class II wastewater injection wells (wells used exclusively to inject fluids associated with oil and natural gas production). This dramatic rise in seismicity correlates with the expansion of domestic oil and gas production from fracking and, and more directly from the use of deep well injection to dispose of wastewaters from oil and gas production. In addition, the increase in seismicity may be related to the increase in injection rates and volumes in these wells. A recent statistical analysis of the location and timing of earthquakes across the central and eastern United States and their relationship to the location and operational parameters (e.g., injection rates, injection volumes) of UIC Class II injection wells by Weingarten et al. (2015) concludes that the entire increase in earthquake rates since 2009 is associated with deep well injection.

Although the studies described above have focused on UIC Class II wells in the central and eastern United States, the cause and effect mechanisms of induced seismicity may also be possible near UIC Class I injection wells in the western United States, including the cumulative impacts study area for geology and soils in eastern Wyoming. Both UIC Class I and Class II wells are completed to similar depths, with an average depth of more than 4,000 ft [1,220 m] below ground surface, and both UIC Class I and Class II wells are capable of injecting similarly large volumes of wastewater at similar injection rates. For UIC Class I wells, EPA regulations include minimum criteria for siting hazardous waste injection wells, requiring that wells must be limited to areas that are geologically suitable [at 40 CFR § 146.62(b)]. According to these regulations, the UIC Director (i.e., the delegated state or EPA) is required to determine geologic suitability based upon an “analysis of the structural and stratigraphic geology, the hydrogeology, and the seismicity of the region.” In Wyoming, the Wyoming Department of Environmental Quality (WDEQ) implements the UIC program for Class I wells. The WOGCC has primacy on

[2]Magnitude in this SEIS is given as moment magnitude (abbreviated M_W), which measures the size of an earthquakes based on total energy released. The M_W scale was developed in the 1970s Hanks and Kanamori (1979) to succeed the 1930s-era Richter magnitude scale (M_L).

Class II wells and maintains a catalog on activities (e.g., dates, quantities of fluid injected, pressure, and targeted geologic formations) occurring at each well.

In 2014, the Wyoming State Geological Survey (WSGS) reviewed existing seismic data to quantify the potential relationship between earthquakes and injection and disposal well activity in Wyoming (Larsen and Wittke, 2014). The WSGS maintains a database of earthquake events and receives real-time notices from the United States Geological Survey (USGS) Advance National Seismic System (ANSS) Composite Earthquake Catalog. In this study, the ANSS earthquake data and WDEQ and WOGCC injection well information from 1984 to 2013 were evaluated. This time period contained the best and most reliable ANSS earthquake data available for Wyoming. The WSGS identified six disposal sites containing either UIC Class II wells or a combination of UIC Class I and II wells that warranted interpretation for potential induced seismicity. WSGS concluded that the earthquakes that occurred at five of the sites were most likely the result of natural causes (e.g., volcanic activity or movement along a fault) and unrelated to injection or disposal well activities (Larsen and Wittke, 2014). At the remaining site, near Bairoil, Wyoming in Sweetwater, County, WSGS concluded that further evaluation is necessary to determine if some induced seismicity has occurred, or if seismic events recorded at the site are triggered by natural phenomenon. As documented in Larsen and Wittke (2014), if in the future there are areas with high seismic activity and/or a significant seismic event occurs in the vicinity of active injection or disposal wells, the WSGS would report it to the WOGCC and WDEQ and conduct further investigations to determine if induced seismicity is a possible cause. Based on the results of the foregoing WSGS study, the NRC staff conclude that Class I disposal wells within the cumulative impact study area for geology and soils are unlikely to contribute to induced seismicity.

Impacts to geology and soils from wind energy projects, such as the potential Reno Junction Wind Project, include use of geologic resources (e.g., sand and gravel), activation of geologic hazards (e.g., landslides and rockfalls), and increased soil erosion. Sand and gravel and/or quarry stone would be needed for access roads. Concrete would be needed for buildings, substations, transformer pads, wind tower foundations, and other ancillary structures. These materials would be mined as close to the potential wind energy site as possible. Tower foundations would typically extend to depths of 12 m [40 ft] or less. The diameter of tower bases is generally 5 to 6 m [15 to 20 ft], depending on the turbine size. Construction activities can destabilize slopes if they are not conducted properly. Soil erosion would result from (i) ground surface disturbance to construct and install access roads, wind tower pads, staging areas, substations, underground cables, and other onsite structures; (ii) heavy equipment traffic; and (iii) surface runoff. Any impacts to geology and soils would be largely limited to the proposed project area. Erosion controls that comply with county, state, and federal standards would be applied. Operators would identify unstable slopes and local factors that can induce slope instability. Implementation of BMPs would limit the impacts from earthmoving activities. Foundations and trenches would be backfilled with originally excavated material, and excess excavation material would be stockpiled for use in reclamation activities (BLM, 2005). The proposed PRB Expansion Project would have a significant impact on the geology and soils of Wyoming (see SEIS Section 5.1.1.6). Along the route of the proposed rail line, geology and soils would be disturbed by increased traffic, clearing of vegetated areas, and soil salvage and redistribution. To limit the impacts, DM&E has proposed mitigation measures as part of the proposed PRB Expansion Project to address potential adverse impacts on geology and soils. DM&E would limit ground disturbance to only the areas necessary for project-related construction activities and would commence reclamation of disturbed areas as soon as practicable after project-related construction ends. During project-related earthmoving activities, DM&E would stockpile topsoil for application during reclamation to minimize erosion, and would implement appropriate erosion control measures at these stockpiles. DM&E would be required by state permitting agencies to restore and revegetate soils disturbed by the project to preconstruction conditions as promptly and fully as possible (STB, 2001).

Surface-disturbing activities associated with ongoing and reasonably foreseeable future energy resource exploration and development (i.e., uranium, oil and gas, coal, and CBM), wind energy, and transportation projects would have direct impacts on geology and soils. Therefore, the NRC staff determine that the cumulative impacts on geology and soils within the study area resulting from all past, present, and reasonably foreseeable future actions would be MODERATE. Direct impacts would result from increased traffic, clearing of vegetated areas, soil salvage and redistribution, and construction of project facilities and infrastructure. In addition, induced seismicity resulting from surface coal mining activities could have direct impacts on geology and soils. Indirect impacts, such as cross-contamination of aquifers, may also occur if boreholes associated with uranium and oil and gas and CBM exploration are not properly abandoned.

5.4.1 Summary

The NRC staff conclude that the proposed Reno Creek ISR Project would contribute a SMALL incremental effect on the MODERATE cumulative impacts to geology and soils resulting from past, present, and future actions, including ISR projects, CBM projects, oil and gas operations, surface coal mining activities, and development of wind energy and transportation projects, as identified in SEIS Section 5.1.1. Several factors contribute to the SMALL finding: (i) the limited land area the proposed project would disturb as described in SEIS Section 4.4.1; (ii) the systems and procedures that would be in place to monitor and clean up soil contamination resulting from spills and leaks (see SEIS Chapter 6); (iii) available information showing a low potential for injection of process-related wastewater in Class I deep disposal wells to induce seismicity (i.e., earthquakes) in Wyoming, as documented in Larsen and Wittke (2104); and (iv) the reclamation and decommissioning that would take place to return the proposed project area to preproduction conditions through return of topsoil, removal of contaminated soils, and reestablishment of vegetation.

5.5 Water Resources

The impact to surface and groundwater resources was evaluated within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project. The 80-km [50-mi] radius for the water resources study area encompasses the watersheds that would be potentially impacted by past, present, and reasonably foreseeable future actions (see SEIS Figure 3-12). The timeframe for the analysis is 2012 to 2030.

5.5.1 Surface Water and Wetlands

The proposed Reno Creek ISR Project area straddles the water divide between the Upper Belle Fourche River and the Antelope Creek drainage basins (see SEIS Figure 3-11). Approximately 80 percent of the proposed project area drains into the Upper Belle Fourche River, and the remaining portion, on the eastern edge, drains into the Antelope Creek basin. All drainage channels within the proposed project area are ephemeral in nature, flowing for short durations in response to snowmelt or local precipitation events. In SEIS Section 4.5.1, the NRC staff concluded that the environmental impacts to surface water resources during all phases (i.e., construction, operations, aquifer restoration, and decommissioning) of the proposed

Reno Creek ISR Project would be SMALL. This finding was based on features and measures that would minimize impacts to surface water and wetlands including: (i) limited surface disturbances; (ii) low regional precipitation and minimal average seasonal runoff; (iii) mitigation measures to control runoff such as installation of sediment control features (e.g., sediment logs, silt fences, and straw bales); and (iv) the applicant's adherence to Wyoming Pollution Discharge Elimination System (WYPDES) permit requirements, which would include implementation of a Storm Water Pollution Prevention Plan (SWPPP) permit. The WYPDES permit would protect surface water by limiting the discharge volume and prescribing concentration limits to discharged water.

In addition to the impacts from the proposed project, the applicant has also identified actions that would occur as part of the preconstruction activities (see SEIS Section 5.1). The primary impact to surface water and wetlands from preconstruction activities would be degradation of surface water quality from increasing suspended sediment concentrations in runoff due to vegetation removal and soil disturbance (AUC, 2014). During preconstruction, the applicant has committed to using sediment control features, such as sediment logs, silt fences, and straw bales, to reduce the sediment load in runoff from disturbed areas until vegetation can be reestablished (AUC, 2014). In addition, to minimize impacts to ephemeral stream channels, the applicant has committed to constructing access roads in a manner to avoid ephemeral stream channels where possible (AUC, 2014).

Numerous past, existing, and potential ISR facilities are present within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project (see SEIS Section 5.1.1.1). Potential future ISR projects would necessitate new roads, power lines, facilities construction, underground pipeline installation, and well drilling, all of which could have adverse effects on surface water and wetlands. Impacts to surface water and wetlands at existing and potential ISR projects would be subject to mitigation through BMPs, required WYPDES stormwater permits, and permits from the U.S. Army Corps of Engineers (USACE) for any activities that could potentially disturb jurisdictional wetlands. In addition, all NRC-licensed ISR projects (past, existing, and potential) would be subject to NRC and WDEQ decommissioning requirements to reclaim and restore affected areas and resources (e.g., land, groundwater, and surface water) to preoperational conditions.

Within this water resources study area, a principal contributor to potential surface water impacts is CBM dewatering activities, which results in ponding in manmade reservoirs or stock ponds and permitted discharge sites. There is extensive CBM production within and surrounding the proposed project area. As described in SEIS Section 5.1.1.4, there are 324 permitted or completed CBM wells within 3.2 km [2 mi] of the proposed Reno Creek ISR Project. The PRB Coal Review (BLM, 2008) provides a summary of the cumulative surface water resource effects in the Wyoming PRB area for future years 2020 and 2030 as a result of ongoing CBM development. BLM estimated that 9 to 52 percent of CBM-produced water would contribute to surface water flows, and perennial flows would be likely to develop in former ephemeral channels (BLM, 2008). CBM-produced water would increase the availability of surface waters for irrigation and other purposes for downstream users. BLM noted that noticeable changes in water quality would occur in the main channel drainages during periods of low flow and that sodic (high in sodium) soils and salinity are key water quality parameters because of their impact on water used for irrigation. BLM projected that the concentrations of suspended sediments in surface water would likely rise above baseline levels from increased flow and surface water runoff from disturbed areas. WDEQ adopted the Most Restrictive Proposed Limit for sodicity and salinity into its WYPDES permitting process to mitigate potential water quality impacts to downstream users. The BLM estimated in the PRB Coal Review that 20 percent of CBM discharges infiltrate the surface, indicating that 33 million L [8.6 million gal] infiltrated the surface in 2009 (BLM, 2011).

Surface water quality within the 80-km [50-mi] area of the proposed project area may be impacted by conventional oil and gas development, rangeland grazing, wind energy projects, and transportation projects. Cattle grazing is a source of nonpoint pollution to streams and wetlands. However, this potential impact to surface water quality in streams and wetlands would only occur during heavy rain events and would therefore be intermittent. In addition, poor management of livestock grazing (e.g., overgrazing) could restrict flow in ephemeral streams due to erosion and sedimentation from decreased vegetative cover in drainage areas.

Oil wells are located throughout Campbell, Converse, Johnson, and Weston Counties within the water resources study area; oil wells within 16 km [10 mi] of the proposed Reno Creek ISR Project area are shown in SEIS Figure 3-4. Impacts to surface waters and wetlands from oil and gas exploration activities would be from surface runoff as new access roads and drill pads are constructed. Runoff degrades surface water quality, causes erosion, and leads to siltation of streambeds and wetlands. Operators must obtain construction and industrial WYPDES permits from the WDEQ prior to conducting oil and gas exploration and production activities. WYPDES permits include plans and programs for spill prevention and cleanup, erosion control, and stormwater runoff control. These plans and programs significantly mitigate the potential impacts to surface sediment load and turbidity from exploration activities. In addition, USACE Clean Water Act Section 404 permits are also required for any disturbances in or near jurisdictional wetlands. Section 404 permits include provisions that must be followed to mitigate impacts when conducting activities in and near jurisdictional wetlands.

Impacts to surface waters and wetlands from potential wind energy projects in the western United States, such as the Reno Junction Wind Project, may include changes in water quality and alteration of natural flow systems. The quality of surface water could be degraded by soil erosion and stormwater runoff from construction activities that disturb the ground surface, and by heavy equipment traffic. Surface water flow could be diverted by access road systems or stormwater control systems. Operation of a wind energy project uses very small amounts of water and results in virtually no discharges to surface water. Operators of these facilities implement stormwater management plans to ensure compliance with applicable regulations and prevent offsite migration of contaminated stormwater or increased soil erosion (BLM, 2005).

The DM&E PRB Expansion Project would have a significant impact on surface water and wetlands, if completed. DM&E has proposed mitigation measures to address potential adverse impacts on surface waters and wetlands within the PRB Expansion Project area. Before project-related construction could begin, DM&E must obtain all federal permits, including Clean Water Act Section 404 permits and USACE permits required for project-related alteration or encroachment of wetlands, streams, and rivers. In addition, DM&E must obtain WYPDES permits for regulation of stormwater discharges to surface waters. DM&E would employ BMPs, such as silt screens and straw bale dikes, to minimize soil erosion, sedimentation, runoff, and surface instability during project-related construction. These mitigation measures would minimize sedimentation into streams and wetlands (STB, 2001).

Livestock grazing is expected to continue in the water resources study area (see SEIS Section 5.2) and as such will continue to have the potential to degrade water quality in streams and wetlands Construction activities associated with other ongoing and reasonably foreseeable future actions, including uranium and oil and gas exploration and development, CBM activities, wind energy projects, and transportation projects, would have potential impacts on surface water and wetland resources in cases where surface water features are present. All of these activities would necessitate construction of new roads, power lines, facilities, and infrastructure, which would have the potential to degrade water quality and alter natural surface water flow systems. Therefore, the NRC staff have determined that the cumulative impact on surface water and wetlands within the surface water study area resulting from past, present, and reasonably foreseeable future actions would be MODERATE.

5.5.1.1 Summary

In SEIS Section 4.5.1, the NRC staff concluded that the impacts on surface water resources during all phases of the proposed Reno Creek ISR Project would be SMALL. Potential impacts to surface waters at the proposed Reno Creek ISR Project would be mitigated through proper planning and design of facilities and infrastructure, the use of proper construction methods, and implementation of BMPs (see SEIS Section 4.5.1). Prior to construction of the proposed project, the applicant must also obtain a construction and industrial stormwater WYPDES permits from WDEQ. The WYDPES permit would include plans and programs for spill prevention and cleanup, erosion mitigation, surface water monitoring, and stormwater runoff control. Based on the foregoing analysis, the NRC staff conclude that the proposed Reno Creek ISR Project would contribute a SMALL incremental cumulative effect to the MODERATE cumulative impact on surface water and wetland resources from all other past, present, and reasonably foreseeable future actions in the surface water study area.

5.5.2 Groundwater

Assessments of the environmental impacts to groundwater resources from the proposed Reno Creek ISR Project are discussed in SEIS Section 4.5.2. The potential for groundwater impacts from the proposed Reno Creek ISR Project would occur during all phases of the ISR facility lifecycle but primarily during the operations and aquifer restoration phases.

Consumptive groundwater use during construction at the proposed Reno Creek ISR Project area would be generally limited to dust control, cement mixing, pump testing, and well drilling and completion. Likewise, consumptive groundwater use during decommissioning would be generally limited to dust control, well plugging, and revegetation and reclamation of disturbed areas. Potential groundwater quality impacts during well installation would be minimized by directing drilling fluids and muds into mud pits to control the spread of fluids. In addition, the quantities of drilling fluids would be minimized by using the minimum quantity of water that is technically practicable for well drilling and development. Poor well completion techniques, lack of well integrity, and improper well plugging and abandonment can result in the mixing of groundwater between the production zone and surrounding aquifers and thus affect the groundwater quality in overlying and underlying aquifers. Should this occur these effects would be mitigated by measures such as (i) implementing onsite geologic oversight during well drilling, installation, and abandonment phases; (ii) ensuring that injection, production, and monitoring wells pass mechanical integrity testing (MIT); and (iii) using well construction and plugging and abandonment techniques approved by WDEQ (AUC, 2012a).

Potential groundwater impacts during the operations and aquifer restoration phases of the proposed project would be mitigated and reduced through implementation of leak detection, spill prevention, and cleanup programs, groundwater monitoring programs, periodic MIT of wells, and adherence to WDEQ UIC permit requirements. The applicant has committed to monitoring all domestic and stock wells within 2 km [1.2 mi] of wellfields and providing replacement wells in the event of significant drawdown or degradation of water quality in these wells. The applicant's excursion monitoring program would ensure the protection of water quality in aquifers overlying the production zone aquifer. After uranium production and aquifer restoration are completed and groundwater withdrawals are terminated at the proposed project area, groundwater levels would recover with time. As described in SEIS Section 4.5.2.1.3, the applicant's groundwater model predicted 2.13 to 3.35 m [7 to 11 ft] of residual drawdown within the proposed project area 5 years after aquifer restoration is completed (AUC, 2012b). Groundwater restoration would restore impacted aquifers to acceptable water quality levels as specified in 10 CFR Part 40, Appendix A, Criterion 5B(5). In SEIS Section 4.5.2, the NRC staff concluded that because the applicant is required to install monitoring wells around and within the proposed wellfield locations and implement corrective actions or mitigative measures in the event that groundwater quantity and quality impacts are detected, the potential impacts on groundwater resources would be SMALL.

In addition to the impacts from the proposed project, the applicant has also identified actions that would occur as part of the preconstruction activities (see SEIS Section 5.1). An activity which could affect groundwater includes installing a potable water well system. Any well constructed would be permitted through the WDEQ permitting process. The applicant did not specify which subsurface aquifer unit the well would access. The applicant states that the hydrogeologic layers directly associated with the proposed project would not be affected by this preconstruction activity (AUC, 2014). The NRC staff conclude that because preconstruction activities associated with groundwater would include installation of a single well, and that well would be constructed and operated under WDEQ permitting criteria the impact to groundwater from preconstruction activities would be SMALL.

The applicant has been authorized by WDEQ to drill, complete, and operate four Class I deep disposal wells to dispose of treated liquid waste streams into the Upper Cretaceous Teckla and Teapot Sandstones at depths between approximately 2,130 and 2,400 m [7,000 and 7,860 ft] below ground surface (WDEQ, 2015). In SEIS Section 4.5.2, the NRC concluded that potential impacts to deep aquifers used for liquid waste disposal at the proposed Reno Creek ISR Project area would be SMALL because (i) the target aquifers for Class I deep well disposal (i.e., the Teckla and Teapot Sandstones) are confined above and below by sufficiently thick and continuous low-permeability layers, (ii) groundwater quality in the target aquifers is highly saline and thus not suitable for domestic, stock, or agricultural uses, and (iii) Class I deep well disposal operational monitoring requirements would ensure that the impact of deep disposal wells on surrounding formations is evaluated regularly and that appropriate measures are taken to correct failure of the disposal system.

Ongoing and Reasonably Foreseeable Future Actions

Population growth, ongoing and planned ISR facilities, oil and gas exploration, coal and CBM development, wind energy projects, and transportation projects activities may contribute to impacts on groundwater resources within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project area.

Population Growth

As discussed in SEIS Section 3.11.1, populations in counties and communities in the socioeconomic region of influence for the proposed project are projected to increase in the coming years. For example, between 2010 and 2030, the populations of Campbell, Johnson, and Natrona counties are projected to increase by approximately 43 percent, 22 percent, and 17 percent, respectively. These projected population increases would create an increased demand for groundwater for municipal and industrial use. Most population growth within 80 km [50 mi] of the proposed project would occur in larger communities such as Gillette and Wright in Campbell County. As discussed in SEIS Section 3.5.2.2, formations stratigraphically below the Wasatch Formation (the host for uranium mineralization at the proposed Reno Creek ISR Project area) are used for municipal and industrial water supply. These formations include:

- The Fort Union Formation, which is a source of municipal water supply for the cities of Gillette and Wright;
- The Lance Formation and Fox Hills Sandstone sequence, which is a source of industrial water supply at Rozet (east of Gillette) and the Hilight Field in southeastern Campbell County and a source of municipal water supply for the city of Gillette; and
- The Madison Formation, which is a source of municipal water supply for the city of Gillette. These Madison wells are located east of Gillette, more than 80 km [50 mi] northeast of the proposed Reno Creek ISR Project. Groundwater in the Madison wells east of Gillette is encountered at significantly shallower depths than at the proposed Reno Creek ISR Project.

As described in SEIS Section 3.5.2.3, the production zone within the Wasatch Formation at the proposed Reno Creek ISR Project area is separated from underlying aquifers (i.e., the Fort Union Formation and Lance and Fox Hills Sandstone sequence) by an approximately 46 to 76 m [150 to 250 ft] thick aquitard consisting of laterally continuous silt and mudstone. In addition, the target aquifers for Class I deep well disposal (i.e., the Teckla and Teapot Sandstones) are hydraulically confined above and below by thick and continuous low-permeability layers, which would minimize potential impacts to overlying aquifers, such as the Lance and Fox Hills Sandstone sequence, and underlying aquifers, such as the Madison Formation. As described in SEIS Section 4.5.2, the target aquifers for deep well disposal are overlain by the Lewis Shale (Pierre Shale), a low-permeability marine shale with an approximate thickness of 274 m [900 ft] in the proposed project area, and underlain by the Steele Shale, a low-permeability marine shale with an approximate thickness of 152 m [500 ft] in the proposed project area.

ISR Facilities

Numerous existing and potential ISR facilities are present within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project (see SEIS Figure 5-1). Confined sandstone beds in the Fort Union Formation are the uranium-bearing production aquifers at ISR facilities south of the proposed Reno Creek ISR Project area in Converse County. These facilities include Smith Ranch, Reynolds Ranch, and Ludeman. Impacts on groundwater resulting from interactions of ISR activities at these facilities and the proposed Reno Creek ISR Project are not likely because these activities would be conducted in stratigraphically separated aquifers. Confined sandstone units in the Wasatch Formation are the uranium-bearing production aquifers at ISR facilities in the Pumpkin Buttes Uranium District in southwestern Campbell County and southeastern Johnson County. In addition to the proposed Reno Creek ISR Project, these facilities include Moore Ranch, Nichols Ranch, Jane Dough, Willow Creek—Irigaray, and Willow Creek—Christensen Ranch. The production aquifer within the Wasatch Formation at the proposed Reno Creek ISR Project is known to be continuous for some kilometers within the proposed project area. However, it is unknown whether the Reno Creek production aquifer is stratigraphically connected to uranium-bearing production aquifers at other nearby ISR facilities in Campbell and Johnson counties. Because sandstone units in the Wasatch Formation were deposited in a fluvial depositional system (i.e., deposits produced by the action of a stream or river), it is unlikely that production aquifers are continuous over long distances (e.g., more than approximately 8 km [5 mi]). ISR licensees are required to implement excursion detection, control, mitigation, and remediation plans under NRC regulations to reduce the potential effect on groundwater quality.

Oil and Gas Exploration

The PRB has been extensively explored and developed for oil and gas. As noted in SEIS Section 5.1.1.3, there are approximately 5,854 oil and gas production wells in Campbell County. Oil and gas wells and associated oil and gas fields within a 16-km [10-mi] radius of the proposed Reno Creek ISR Project are shown in SEIS Figure 3-4. Impacts on groundwater resulting from interaction of ISR activities and oil and gas exploration and production are not likely because these activities are conducted in stratigraphically separated aquifers. ISR activities at the proposed Reno Creek ISR Project area would take place in sandstone aquifers in the Wasatch Formation at depths of 55 to 128 m [180 to 420 ft]. Within 8 km [5 mi] of the proposed Reno Creek ISR Project area, oil and gas production is from Cretaceous formations below the Lewis Shale (Pierre Shale) at depths ranging from approximately 2,350 to 3,850 m [7,710 to 12,630 ft] (see SEIS Table 3-5).

Coal Mining and CMB Development

There is extensive coal mining and CBM development within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project. As discussed in SEIS Section 3.4.1.2, coal mines are located approximately 12.9 km [8 mi] east of Wright, Wyoming, along the north-south trending outcrop of the Fort Union Formation. The closest coal mines to the proposed project area are the North Antelope, Rochelle, and Thunder Basin coal mines, approximately 26 km [16 mi] to the east. These coal mines produce from the Anderson/Big George coal seams, which are within the Fort Union Formation. In addition, there is extensive CBM production within and surrounding the proposed project area. As described in SEIS Section 5.1.1.4, there are 324 permitted or completed CBM wells within 3.2 km [2 mi] of the proposed Reno Creek ISR Project. The CBM production that is present within the proposed project area is from the Anderson/Big George Coal. The Anderson/Big George Coal seams are approximately 305 to 335 m [1,000 to 1,100 ft] below ground surface in the proposed project area and approximately 183 m [600 ft] below the base of the production aquifer.

The PRB Coal Review (BLM, 2008) provides a summary of the cumulative groundwater resource effects in the Wyoming PRB area for future years 2020 and 2030 as a result of ongoing coal mine dewatering and CBM development. The BLM estimated that CBM development would remove about 37 million ha-m [3 million acre-feet], less than 0.3 percent of the total recoverable groundwater {1.7 billion ha-m [nearly 1.4 billion acre-feet]} in the Wasatch and Fort Union Formations within the PRB. An estimated 15 to 33 percent of the removed groundwater would infiltrate the surface and recharge the shallow aquifers above the coal zones (BLM, 2008). BLM predicted that within the PRB, the redistribution of pressure within the coals after CBM water production ended would allow the hydraulic pressure head to recover within approximately 15 m [50 ft] or less of preproject levels within 25 years after project completion (BLM, 2003). The complete recovery of water levels would take tens to hundreds of years, depending on the specific location. BLM (2003) noted that the areal extent and magnitude of drawdown effects on coal zone aquifers and overlying or underlying sand units in the Wasatch Formation would be limited by the discontinuous nature of different coal zones within the Fort Union Formation and sandstone layers within the Wasatch Formation. This is consistent with a groundwater monitoring study conducted by the WSGS and the BLM (Clarey, 2009). One well cluster used in the study was the All Night Creek well cluster that is located within the proposed Reno Creek ISR Project area. The maximum reported drawdown in the Big George Coal Seam within the Fort Union Formation was approximately 183 m [600 ft]. However, zero to minimal drawdown was observed in the overlying sand aquifers, one of which is equivalent to the proposed Reno Creek ISR Project production zone aquifer (PZA) within the Wasatch Formation. Therefore, this study confirms that the PZA within the proposed Reno Creek ISR Project area is hydrologically separated from coal zones within the underlying Fort Union Formation.

Wind Energy Projects

Impacts to groundwater from existing and potential wind energy projects within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project area (see SEIS Section 5.1.1.5) would not be noticeable. During construction of wind energy projects, water would be required for mixing of concrete for tower foundations and support facilities and for dust control along access roads and other areas of disturbance around the turbines. Disturbed areas would be revegetated and reclaimed immediately following construction. Once a wind energy project is operating, minimal quantities of groundwater are needed (BLM, 2005b, 2011).

Transportation Projects

The proposed PRB Expansion Project (a railroad expansion project) would have an impact on groundwater. Groundwater would be used to suppress dust during rail and bridge construction activities. Once operational, the PRB Expansion Project would use negligible amounts of groundwater. Water demand during construction activities would be supplied by existing municipal and private wells. DM&E (the project proponent) would ensure that any wells that may be affected by project-related construction or preconstruction activities are appropriately protected or capped to prevent well and groundwater contamination. If wells are located on private land, DM&E would secure permission from the landowner before undertaking any actions (STB, 2001).

The NRC staff have determined that the cumulative impact on groundwater resources within the water resources study area resulting from past, present, and reasonably foreseeable future actions is MODERATE. This finding is based on ongoing and reasonably foreseeable future actions that would (i) increase demand on regional aquifers used for municipal and industrial purposes, such as the Fort Union Formation, the Lance Formation/Fox Hills Sandstone aquifer sequence, and the Madison aquifer; (ii) impact groundwater quality and quantity in the Wasatch Formation, which hosts uranium deposits in the Pumpkin Buttes Uranium District and is also a source of water supply for domestic and stock watering purposes in the study area; and (iii) potentially affect water quality in deep geologic formations that are used for disposal of liquid wastes. In addition, ongoing and reasonably foreseeable future actions, such as ISR, wind energy projects, and transportation projects, would use groundwater to construct concrete foundations and support facilities and for dust suppression during construction and operations activities, which would potentially impact water quantity in regional and local aquifers in the study area.

In SEIS Sections 4.5.2.1.1 and 4.5.2.1.2, the NRC staff concluded that the potential impacts on groundwater resources from constructing and operating the proposed Reno Creek ISR Project would be SMALL. The NRC staff determined that preconstruction impacts to groundwater are SMALL. ISR licensees are required to implement excursion detection, control, mitigation, and remediation plans under NRC regulations to reduce the potential impact on groundwater quality and quantity outside the exempted production zone. WDEQ permitting requirements would protect groundwater in aquifers used for deep well disposal of liquid byproduct from the proposed project. After uranium production and aquifer restoration are completed and groundwater withdrawals are terminated at the proposed Reno Creek ISR Project, groundwater levels would recover with time. Groundwater restoration would restore impacted aquifers at the proposed project to acceptable water quality levels.

5.5.2.1 Summary

In summary, based on the foregoing analysis, the potential impact of the proposed project on the existing and future use and quality of water would be minimal. Impacts to groundwater resulting from interaction between ISR activities at the proposed Reno Creek ISR Project area and CBM and oil and gas production are unlikely because the ISR production zone is separated from underlying coal and oil and gas bearing formations by hundreds to thousands of meters [hundreds to thousands of feet]. Impact to groundwater resulting from interaction between ISR activities at the proposed Reno Creek ISR Project area and other ISR facilities in the Pumpkin Buttes Uranium District is unlikely because the host formation for uranium mineralization (i.e., the Wasatch Formation) is unlikely to be continuous over long distances (e.g., more than approximately 8 km [5 mi]). Therefore, the NRC staff conclude that the proposed Reno Creek ISR Project would contribute a SMALL incremental effect to the MODERATE cumulative impacts to groundwater resources when added to all other past, present, and reasonably foreseeable future actions in the groundwater study area.

5.6 Ecological Resources

The geographic study area considered for the analysis of cumulative impacts to ecology is an 80-km [50-mi] radius from the center of the proposed project. Because the proposed project area is within the Wyoming PRB, the NRC staff summarize impacts that are occurring in the Wyoming PRB in SEIS Section 5.1.1. The Wyoming PRB is dominated by sagebrush shrubland and mixed-grass prairie (BLM, 2005a). The basin is currently experiencing rapid population and industry growth due to various types of energy development activities, and this trend is projected to continue in the future. As such, ecosystems and species within the Wyoming PRB are subject to varying levels of incremental impacts associated with this expansion. The timeframe selected for the analysis begins in 2012, when the applicant submitted a license application to the NRC for the proposed Reno Creek ISR Project, and ends in 2040, which represents the license termination at the end of the decommissioning period plus a 10-year restoration period for woody vegetation species (see SEIS Section 5.1.2 for the estimated operating life of the proposed Reno Creek ISR Project). No impacts to biota would be expected from the proposed project beyond 2040. Data sets prior to 2012 are utilized to demonstrate historical trends.

5.6.1 Terrestrial Ecology

Activities occurring in the PRB include livestock grazing (cattle and horses), wildlife herd management, hunting, uranium recovery, CBM production, wind energy, and oil and gas exploration. In addition, a regional transportation project is planned for transporting coal. As discussed in SEIS Section 4.6, potential effects to ecological resources, both flora and fauna, include reduction in wildlife habitat and forage productivity, modification of existing vegetative communities, degradation of water quality, and potential spread of invasive species and noxious-weed populations. Impacts to wildlife could involve loss, alteration, and incremental habitat fragmentation; displacement of and stresses on wildlife; and direct and indirect mortalities.

5.6.1.1 Vegetation

Most of the sagebrush lands in the region have been changed by land uses, such as livestock grazing, agriculture, or resource extraction. Habitat disturbance associated with these regional activities also affects vegetation by promoting the spread of noxious weeds and fragmenting vegetative communities. Grasses and noxious weeds tend to replace sagebrush after disturbances. Loss and degradation of native sagebrush shrubland habitats has imperiled much of this ecosystem type as well as sagebrush-obligate species, including the Greater sage-grouse (*Centrocercus urophasianus*) (Becker, et al., 2009; Taylor, et al., 2012). Due to the larger area that is disturbed for linear facilities (e.g., pipeline rights-of-way and oil- and gas-related road systems), the potential for spread of noxious weeds is higher when compared to the development of site facilities (e.g., ISR facilities, mines, or power plants) (BLM, 2013). Site reclamation requirements of WDEQ-approved permits would mitigate effects from projects occurring in the Wyoming PRB. In addition, WDEQ permit requirements for CBM discharge water to ephemeral drainages would mitigate potential water quality effects to riparian and wetland vegetation from projects occurring in the Wyoming PRB (BLM, 2013).

The known mineral- and energy-development activities (including wind energy projects, transportation projects, and coal, oil, and gas extraction developments) that occur within the Wyoming PRB are summarized in SEIS Section 5.1.1. Potential effects on vegetation from these activities are consistent with those potential effects discussed in SEIS Section 4.6. As noted in SEIS Section 5.1.1, BLM conducted a cumulative effects study for the Wyoming PRB through 2030. This study included a cumulative effects analysis for vegetation and wildlife. BLM estimated that approximately 171,471 ha [423,716 ac] (approximately 5.2 percent) of the vegetation in the Wyoming PRB Coal Review study area, including wetland and riparian vegetation, will have been disturbed by 2030 from all mineral, energy (excluding wind), and transportation projects (BLM, 2013). BLM estimated that 60 percent of these disturbances would occur in sagebrush shrubland communities. BLM also estimated that by 2030, approximately 58 percent of these disturbances would be reclaimed, and that the remaining disturbed area would be reclaimed incrementally or following a project’s completion, depending on the type of development activity and permit requirements (BLM, 2013).

To assess the extent of cumulative disturbed vegetation within the 80-km [50-mi] study area around the proposed Reno Creek ISR Project, the NRC staff assume the same percentage of vegetation disturbance (including wetland and riparian vegetation) as the BLM Wyoming PRB estimate for mineral, energy (excluding wind), and transportation projects. Using a conservative estimate of 1 ha [2.47 ac] of disturbance per megawatt (MW) of wind energy produced, an additional 0.2 percent {536 ha [1,325 ac]} of land could be disturbed from development of wind energy projects within 80-km [50-mi] of the proposed Reno Creek ISR Project (see SEIS Section 5.1.1.5) (Denholm et al., 2009). These disturbances would total approximately 106,313 ha [262,706 ac] of vegetation within the 80-km [50-mi] radius around the proposed Reno Creek ISR Project. Assuming 58 percent of these disturbances would be reclaimed by 2030 per BLM's estimates; the remaining 44,652 ha [110,337 ac], or about 2.2 percent of the study area, of vegetation would still be disturbed at the end of 2030. The NRC staff anticipate that the previously described requirements of WDEQ-approved permits (i.e., weed management, revegetation, and discharge water quality control) would ensure that vegetation and habitats support a stable ecosystem (BLM, 2012a; WDEQ, 2006). However, as described in SEIS Sections 4.6.1.1 and 4.6.1.4, reestablishing mature sagebrush vegetation communities to pre-disturbance productivity levels could take 10 or more years (Connelly et al., 2004; BLM, 2010; 2015a). Therefore, these past, present, and reasonably foreseeable future actions would have a SMALL to MODERATE cumulative impact on vegetation.

Vegetation within the proposed project area is primarily the big sagebrush shrubland plant community. SEIS Sections 3.6.1 and 4.6.1 describe and analyze the ecological conditions and impacts on ecology from the proposed Reno Creek ISR Project. As discussed in SEIS Section 4.6.1, the potential impact on vegetation, taking into account the applicant's proposed mitigation measures from the proposed Reno Creek ISR Project, would be SMALL. However, the potential impacts that may occur to vegetation during and following the decommissioning phase of the proposed project may be SMALL to MODERATE until such time as sagebrush shrubland vegetation has been reestablished equivalent to vegetative cover in reference areas (see SEIS Section 4.6.1.4). After reestablishment the impact would be SMALL.

The applicant stated that the entire amount of estimated vegetation disturbance over the life of the proposed project {approximately 59 ha [146 ac]} includes preconstruction activities (AUC, 2014). Of the disturbed vegetation, approximately 4.9 ha [12.2 ac] of big sagebrush shrubland would be disturbed during preconstruction activities, such as excavating the backup storage pond, erection of fences, installing a potable water well system, and building a sanitary sewerage treatment facility (AUC, 2014). The applicant also stated that disturbances from preconstruction activities would be reclaimed either during the phased construction or during decommissioning (AUC, 2014). As stated in SEIS Section 5.6, the NRC staff does not expect effects on biota beyond 2040. Because of the relatively small amount of vegetation that would be disturbed from the proposed project, including preconstruction, when added to the vegetation disturbances expected from all past, present, and reasonably foreseeable future actions from projects within the 80-km [50-mi] radius around the proposed project, the proposed Reno Creek ISR Project would contribute a SMALL incremental effect on vegetation impacts to the SMALL to MODERATE cumulative impact to vegetation.

5.6.1.2 Wildlife

In the 80-km [50-mi] radius surrounding the proposed Reno Creek ISR Project area, potential impacts from other ISR facilities to wildlife would be similar to those described in SEIS Sections 4.6.1.1 and 5.6.1, including loss, alteration, or incremental fragmentation of habitat; displacement of and stresses on wildlife; modification of prey and predator communities; and direct or indirect mortalities. Other similar potential effects in this area (e.g., habitat loss, habitat fragmentation, and noise disturbance) would also likely occur from conventional mining or oil and gas extraction activities. Wind energy projects have the potential to increase mortalities to birds and bats from collisions with wind turbine blades, particularly in bird migration routes. BLM reported that the number of bird and bat collisions at wind energy projects is generally relatively small, when compared with collisions from other human-made structures (BLM, 2005b). These past, present, and reasonably foreseeable future actions in the Wyoming PRB (discussed in SEIS Section 5.6.1) could result in the disturbance of tens of thousands of acres; nonetheless, reclamation of disturbed areas would proceed concurrently with operations during mining and drilling projects, which would mitigate these impacts.

The cumulative effects of these projects can influence habitats indirectly or directly, thereby affecting wildlife. For example, an indirect effect would be the alteration of the natural regime, which could change the frequency of land-clearing fires that can significantly reduce the growth of sagebrush shrubland vegetation, thus reducing the amount of habitat necessary to support sagebrush obligate species (Naugle et al., 2009). An example of a direct effect is a reduction in the long-term viability of the Greater sage-grouse due to loss of sagebrush habitat. Greater sage-grouse is a species that U.S. Fish and Wildlife Service (FWS) previously considered for listing on the Endangered Species Act (ESA), and which continues to be at risk because of population declines related to habitat loss and degradation. Because of its spatial extent, oil and gas development is regarded as playing a major role in the decline of the Greater sage-grouse species (BLM, 2015a; Taylor et al., 2012). As stated in SEIS Sections 3.6.1.2.3, 3.6.3, and 4.6.1.1, the proposed Reno Creek ISR Project area is not located within a designated core population area, or PHMA, for the Greater sage-grouse. However, core population areas, or PHMAs, are located within the 80-km [50-mi] radius surrounding the proposed project area, primarily to the east in Weston County and the west in Johnson County. Therefore, because oil and gas development activities are occurring in the 80-km [50-mi] radius surrounding the proposed project area, there are currently MODERATE cumulative impacts to the Greater sage-grouse.

BLM estimates that approximately 171,272 ha [423,716 ac] of the PRB Coal Review study area, or approximately 5.2 percent, is habitat for terrestrial species (e.g., big game, upland game birds, raptors, waterfowl and shorebirds, nongame and migratory birds, small- and medium-sized mammals, reptiles, and amphibians) that could be disturbed by 2030 (BLM, 2013). As noted in SEIS Section 5.6.1.1, the NRC staff assume that approximately 44,652 ha [110,337 ac], or about 2.2 percent, of habitat would be disturbed at the end of 2030 within the 80-km [50-mi] radius surrounding the proposed Reno Creek ISR Project. There are no crucial big game habitats or migration corridors located within 30.6 km [19 mi] of the proposed Reno Creek ISR Project area, although pronghorn, mule deer, elk, and white-tailed deer are residents of the Wyoming PRB. Big game have been observed occupying areas adjacent to and within active mining operations, suggesting that some animals may become habituated to such disturbances (BLM, 2010). Development activities in the Wyoming PRB could potentially reduce wildlife populations if habitats adjacent to land in the 80-km [50-mi] radius around the proposed project are at, or near, their carrying capacity (e.g., the maximum population an area will support) for a species, considering that there may be an unavoidable reduction or alteration of existing habitats (BLM, 2013). For some species that require specific conditions for their habitats (e.g., small mammals), future populations would be strongly influenced by the quality and composition of the remaining habitats. However, as stated in SEIS Section 5.6.1.1 for vegetation, the NRC staff assume that WDEQ-approved permit requirements would ensure that the reclamation goals of projects achieve revegetation and that habitats would support a stable ecosystem (e.g. BLM, 2012a; WDEQ, 2006). WDEQ may also enforce other mitigation measures for projects such as speed limits, fencing and overhead power line construction techniques that limit effects on wildlife, and timing and buffer stipulations. In addition, the NRC staff assume that project operators would comply with FWS requirements under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Therefore, the overall cumulative impact to big game, upland game birds, raptors, waterfowl and shorebirds, nongame and migratory birds, small- and medium-sized mammals, reptiles, and amphibians would be SMALL.

As discussed in SEIS Sections 4.6.1.1 through 4.6.1.4, the NRC staff determine that the potential impacts to wildlife that may occur during all phases of the proposed project are expected to be SMALL. This finding is based on (i) the total land disturbance during the life of the proposed project {approximately 62 ha [154 ac], or about 2.5 percent of the proposed project area (AUC, 2012a)}, (ii) the applicant's phased approach, which would reduce the amount of habitat affected at one time (see SEIS Chapter 2 for more information on a phased approach), (iii) the applicant's commitment to use mitigation measures that would reduce effects on wildlife (e.g., ensure speed limits, use designated roads, and construct overhead power lines in accordance with Avian Power Line Interaction Committee standards), and (iv) the applicant's commitments to reseed and revegetate disturbed areas and follow a WDEQ-approved reclamation plan. As stated in SEIS Section 5.6.1.1 for cumulative impacts on vegetation, preconstruction land disturbances are included in the 62 ha [154 ac] the NRC staff evaluated in SEIS Section 4.6. Therefore, preconstruction activities would not change the SMALL impact determination for the proposed project. Thus, the proposed Reno Creek ISR Project's incremental impacts to cumulative impacts would be SMALL when added to the SMALL cumulative impacts on terrestrial wildlife from all past, present, and reasonably foreseeable future actions in the cumulative impact study area. However, for the reasons detailed in this section, cumulative impacts to the Greater sage-grouse would continue to be MODERATE.

5.6.2 Aquatic Ecology

In the PRB, CBM and coal mining projects use or manage the majority of water resources as part of their operations (BLM, 2013). BLM estimated that the small remaining amounts of surface water flow from these projects would discharge into intermittent and ephemeral streams in four subwatersheds (Antelope Creek, Little Powder, Upper Belle Fourche, and Upper Cheyenne) but would have little or no effect on stream flows due to high evaporation and infiltration rates before the discharges reach the streams. As stated in SEIS Section 5.5.1, the proposed Reno Creek ISR Project area straddles the water divide between the Upper Belle Fourche River and the Antelope Creek drainage basins. BLM determined that the contribution of coal-related development under a high-production scenario in year 2030 would have low effects on fish in the Antelope Creek and Upper Belle Fourche River watersheds, and are not expected to significantly impact surface water quality (BLM, 2013). This finding is based on past surface water monitoring sampling conducted in receiving streams. Therefore, BLM expects that effects on fisheries from coal-related projects are expected to be low in perennial streams in the Upper Belle Fourche River and the Antelope Creek subwatersheds (BLM, 2013). BLM anticipate cumulative effects from sedimentation of other reasonably foreseeable future actions would be short-term (i.e. during surface disturbance activities) and localized. BLM expect sediment input into water bodies would stop and water quality would return to background concentrations after surface disturbance activities end (BLM, 2013). BLM also anticipates that construction and operation of reasonably foreseeable future activities within the PRB would not occur within stream channels and would not result in removal of ponds or reservoirs; thus, no direct loss or alteration of aquatic habitat would occur (BLM, 2013). To assess the extent of impacted aquatic resources as a result of the projects discussed in SEIS Section 5.1.1, the NRC staff assume that the effects from all projects including wind energy projects would also not result in direct loss or alteration of aquatic habitat. Because the majority of the water uses in the PRB are for coal-related projects which are not expected to significantly impact surface water quality, the NRC staff conclude that the cumulative impact on aquatic ecology resulting from all past, present, and reasonably foreseeable future actions in the 80-km [50-mi] radius surrounding the proposed project area would be SMALL. In addition, all proposed activities in the study area would be regulated by a WYPDES permit and would comply with federal and state water quality regulations, which would reduce impacts on aquatic ecology.

As described in SEIS Sections 4.6.1.1.1 and 4.6.1.1.2, because of the limited and ephemeral nature of surface water at the proposed Reno Creek ISR Project area, the occurrence of aquatic species is also limited. No loss of aquatic habitat would result from planned ISR activities during any phase of the proposed project. In addition, no surface water would be diverted, no process water would be discharged into an aquatic habitat, and stormwater runoff would be managed through the SWPPP and the WYPDES permit (as discussed in SEIS Section 4.6.1.1.1). Therefore, during all phases of the proposed Reno Creek ISR Project lifecycle, the potential impacts to aquatic species and habitats would be SMALL as described in SEIS Sections 4.6.1 through 4.6.4. As stated in SEIS Sections 5.6.1 and 5.6.2, no additional land disturbances beyond those evaluated and analyzed for the life of the proposed project in SEIS Section 4.6 {62 ha [154 ac]} would occur from preconstruction activities. Therefore, no additional potential impacts on aquatic resources, such as additional erosion and vegetation removal in riparian areas, would occur as a result of the proposed Reno Creek ISR Project from preconstruction activities.

The NRC staff conclude that the proposed Reno Creek ISR Project would have a SMALL incremental effect on aquatic ecology when added to the SMALL cumulative effects from all other past, present, and reasonably foreseeable future actions in the cumulative impacts study area. This conclusion is based on the limited and ephemeral nature of surface water features within the proposed project area as described in other sections of this SEIS, and because of the mitigation requirements associated with the required regulatory permits and licenses.

5.6.3 Protected Species and Species of Concern

A number of protected species and species of concern are or could be potentially present within the PRB and 80-km [50-mi] radius surrounding the proposed Reno Creek ISR Project area including the Ute ladies'-tresses orchid, Northern long-eared bat, Sprague's pipit, bald eagle, black-tailed prairie dog, and the mountain plover (BLM, 2009b; WGFD, 2010; see SEIS Section 3.6.3). For the purposes of this cumulative assessment, protected species and species of concern are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. This includes federally listed species that are protected under the ESA, or are considered candidates for such listing by the FWS, BLM, and WGFD species of greatest conservation need. SEIS Table 3-15 lists species of concern that could occur in Campbell County. Other species of concern could occur within the 80-km [50-mi] radius around the proposed Reno Creek ISR Project. Potential impacts to terrestrial protected species and species of concern from regional projects in the 80-km [50-mi] radius around the proposed Reno Creek ISR Project would be similar to those discussed in SEIS Section 5.6.2 for nongame wildlife (e.g., small mammals, birds, amphibians, and reptiles). Increased activity and noise from projects that occur within potential habitat for these species, especially during respective breeding seasons, could decrease a species' use of a habitat or the overall suitability of a habitat (BLM, 2009b). However, given the location of development activities compared with the geographical occurrence of many of these species, and with mitigating permit requirements and state policies and federal regulations in place (e.g., the ESA and MBTA), the cumulative impacts to all protected species would be SMALL.

5.6.4 Summary

As discussed in SEIS Sections 3.6.3 and 4.6.1.1, no federally listed threatened or endangered plant species or critical habitat are known to occur within the proposed project area. Although the Northern long-eared bat (NLEB), a federally threatened species, could potentially occur within the proposed project area, the proposed project area is not located within the white-nose syndrome zone and accidental take of the NLEB from otherwise lawful activities in areas not yet affected by white-nose syndrome is not prohibited under the ESA (FWS, 2016). Therefore, the proposed project would not result in an unacceptable take under Section 7 of the ESA. As discussed in SEIS Section 4.6.1.1, five FWS species of conservation concern and FWS management concern and one FWS species of management concern were observed during the applicant's baseline wildlife surveys within 1.6 km [1 mi] of the proposed Reno Creek ISR Project area. Several other species of concern, including FWS species of concern previously discussed (bald eagle, black-tailed prairie dog, and mountain plover) could potentially occur within the proposed project area (see SEIS Table 3-15). However, for reasons explained in SEIS Sections 4.6.1.1 through 4.6.1.4, due to applicant commitments and mitigation measures, federal regulations and state policies and permit requirements, the NRC staff conclude that the proposed Reno Creek ISR Project would have a SMALL impact on protected species and species of concern. As explained in SEIS Sections 5.6.1 and 5.6.2, no additional potential impacts on ecology beyond those that were evaluated for the proposed project would occur as a result of preconstruction activities. Therefore, incremental impacts would also be SMALL when added to the SMALL cumulative impacts to protected species and species of concern from all past, present, and reasonably foreseeable future actions in the 80-km [50-mi] radius surrounding the proposed project area.

5.7 Air Quality

The NRC staff assessed the cumulative impacts to air quality primarily within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project. Much of this area, hereafter called the region of influence, consists of land from Campbell, Converse, and Johnson Counties. The region of influence also includes smaller sections of land from Crook, Natrona, Niobrara, and Weston Counties (SEIS Figure 5-1). For purposes of this SEIS, the assessment of impacts within the region of influence will be called the near-field analysis, and the assessment of impacts beyond the region of influence (i.e., at the nearest Class I area) will be called the far-field analysis. The nearest Class I area to the proposed Reno Creek ISR Project is Wind Cave National Park, which is located in Custer County, South Dakota, about 181.9 km [113 mi] away (AUC, 2012a). The timeframe for the air quality cumulative impacts analysis runs from 2012 to 2030.

5.7.1 Non-Greenhouse Gas Emissions

As described in SEIS Section 5.1.1, past, present, and reasonably foreseeable future activities that may contribute to pollutant emissions include uranium exploration and extraction, oil and gas exploration and production, coal mining and CBM operations, wind energy projects, and transportation projects. Air pollutants emitted by these sources potentially have cumulative impacts within the region. Those potential impacts include, but are not limited to, particulate matter from travel on unpaved roads and disturbed land and carbon monoxide, nitrogen oxides, sulfur dioxide, particulates, and volatile organic compounds from various types of combustion emissions. Air pollutants can also be transported from emission sources outside the region.

This assessment first considers impacts for the near-field, followed by impacts for the far-field. The NRC staff based the cumulative impact determination in part on the site-specific project level modeling that implements the dry depletion option[3].

5.7.1.1 Near-Field Analysis

The effects of past and present activities on the air quality in the region of influence (i.e., the near-field) are represented in the National Ambient Air Quality Standards (NAAQS) compliance status and air monitoring results. EPA evaluates the NAAQS compliance status of an area on an ongoing basis. As described in SEIS Section 3.7.2, EPA currently designates the entire area within the region of influence as an attainment area for all pollutants. WDEQ operates and maintains a network of ambient air quality monitoring stations whose primary purpose is to evaluate compliance with the NAAQS. Results from these monitoring stations provide EPA information for determining the NAAQS compliance status. The region of influence for the proposed Reno Creek ISR Project contains six of these monitoring stations. The *Wyoming Ambient Air Monitoring Annual Network Plan 2014* reports that the monitoring results for these six monitors are in compliance with the NAAQS (WDEQ, 2014). The near-field analysis does not include air quality issues associated with Class I or sensitive Class II areas (e.g., visibility) because the region of influence contains no Class I or sensitive Class II areas.

The next part of the analysis considers the various reasonably foreseeable future actions within the region of influence, starting with other ISR facilities. According to information in SEIS Table 5-1, there are six ISR projects within the region of influence that are either in the prelicensing stage or are licensed and not operating. The analysis in this SEIS assumes that various stationary, mobile, and fugitive emissions from these ISRs would be managed and mitigated in a manner similar to the proposed Reno Creek ISR Project. Three ISRs would be located within 20 km [12.4 mi] of the proposed Reno Creek ISR Project. For the purposes of evaluating the cumulative effect of these projects, the NRC staff assumed that these other ISR projects would be developed in a phased approach (see SEIS Chapter 2 for more information) similar to that of the proposed Reno Creek ISR Project. The potential for the proposed Reno Creek ISR Project impacts to overlap with the other ISR projects is reduced by several factors, and any consideration of overlapping impacts between ISR projects needs to account for these factors:

- Preconstruction activities vary between 5.4 to 17.5 percent of the peak year emission levels depending on the particular pollutant (see SEIS Appendix C Table C–5).
- Mobile and fugitive sources generate the vast majority of ISR emissions (see SEIS Table 2-4), and these types of sources do not generate emissions continuously.
- Particulate matter PM_{10} (i.e., particles larger than 2.5 micrometers and smaller than 10 micrometers in diameter) is the primary pollutant generated by ISR activities (see SEIS Table 2-4). Based on the information in Tables C-1 and C-5 in SEIS

[3] In addition, Section C-6.2 of SEIS Appendix C includes the cumulative effect impact magnitude determination that relies only on the initial site-specific modeling run (i.e., does not consider the results from the final modeling run that implements the dry depletion option).

Appendix C, 93 percent of the proposed project's particulate matter PM_{10} emissions would be from mechanically-generated sources (i.e., fugitive emissions from travel on unpaved roads). Heavier particles (i.e., particulate matter PM_{10}) from mechanically generated fugitive emissions are the type of emission most likely to be removed from the air close to the generating source (Countess, 2001).

- ISR emissions vary over the lifetime of the project. As depicted in Table C–1 and Table C–3 of SEIS Appendix C, many of the project years generate much lower emission levels than the peak year.

SEIS Table 5-1 identifies 14 coal mines within the region of influence and provides the distance and direction from the proposed Reno Creek ISR Project. As described in SEIS Section 5.1.1.2, although it is difficult to predict, existing coal mining operations are expected to continue with some increases in production from 2009 levels.

The predominant wind direction is a major consideration when assessing potential overlapping impacts with coal mines. Thirteen of the coal mines are located to the east of the proposed Reno Creek ISR Project with the closest mine located 26.1 km [16.2 mi] away. Because of the predominant wind direction (see SEIS Table 3-27), pollutants would travel from the proposed project area to these coal mines rather than from these coals mines to the proposed project area. In terms of overlapping effects, the air quality at these coal mines would experience the additional emissions from the single proposed ISR project rather than the air quality at the proposed Reno Creek ISR Project experiencing the additional emissions from thirteen coal mines. There is one coal mine located 64.2 km [39.9 mi] to the south-southwest where the predominant wind direction would transport pollutants from the coal mine towards the proposed project area. In this one case, any overlapping effects would be experienced at the proposed project rather than at the coal mine. Because pollutants disperse as they travel, the distance between the proposed Reno Creek ISR Project and this one coal mine reduces the potential for overlapping impacts.

Oil and gas production, as well as CBM development, occurs in the region of influence. Extraction of these resources typically involves well installation and operation activities that generate combustion emissions from mobile sources and fugitive dust from travel on unpaved roads and disturbed land. The analysis in this SEIS assumes that various stationary, mobile, and fugitive emissions would be managed and mitigated in a manner similar to the proposed Reno Creek ISR Project. As depicted in SEIS Figure 5-1, highly favorable areas for oil and gas development occur about 8.0 km [5 mi] from the proposed Reno Creek ISR Project. Potential overlap between the proposed Reno Creek project and oil and gas resource projects can be characterized in a similar manner to interactions between the proposed Reno Creek ISR Project and other ISR projects described earlier. Although CBM development is common in the PRB, this form of mining has been declining since 2009.

The proposed DM&E PRB Expansion Project would affect air quality in eastern Wyoming and southwestern South Dakota. Mitigation measures have been recommended as part of the proposed DM&E PRB Expansion Project to address potential adverse effects on air quality (STB, 2001). DM&E would be required to meet EPA emission standards for diesel-electric locomotives. To the extent practicable, DM&E would adopt fuel-saving practices, such as throttle modulation, dynamic braking, increased use of coasting trains, and shutting down locomotives when not in use for more than an hour, to reduce overall emissions during project-related operations. To minimize fugitive dust emissions during project-related construction activities, DM&E would implement fugitive dust suppression controls, such as spraying water, tarp covers for haul vehicles, and installation of wind barriers. Again, potential overlap of impacts is reduced because

- Emissions from the DM&E PRB Expansion Project are spread out over a large area rather than localized at one location.
- Both the proposed project and the DM&E Expansion Project do not continuously generate emissions.
- The predominant wind direction would transport pollutants from the proposed Reno Creek ISR project to the expansion project area.

The NRC staff conclude that the cumulative impact on air quality within the region of influence resulting from other past, present, and reasonably foreseeable future actions is MODERATE because the ambient pollutant concentrations are noticeable but not destabilizing. As described in SEIS Section 3.7.2, EPA currently designates all of the area within the Reno Creek region of influence as attainment areas for all pollutants. Ambient air concentrations applicable to the proposed Reno Creek ISR Project area are below NAAQS (see SEIS Table 3-17). Based on the description of the reasonably foreseeable future actions in this section, the NRC staff expect this trend to continue within the region of influence for the proposed Reno Creek ISR Project.

Cumulative impacts on air quality for the near-field include incremental effects from the proposed Reno Creek ISR Project added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The NRC staff conclude in SEIS Section 4.7.1 that the proposed Reno Creek ISR Project would have a SMALL effect on air quality. As stated in the preceding paragraph, the NRC staff conclude that the impact on air quality within the region of influence for the proposed Reno Creek ISR Project resulting from past, present, and reasonably foreseeable future actions is MODERATE. When combining the incremental impacts from the proposed Reno Creek ISR Project with all other impacts from other past, present, and reasonably foreseeable future actions in the region of influence, the NRC staff conclude that the cumulative impact for the near-field would be MODERATE. SEIS Table 4-9 presents the impacts of the project combined with the current background ambient air pollutant concentrations (i.e., the impacts from past and present emissions). Based on the description in this section of the SEIS concerning the possible overlap of impacts between the proposed Reno Creek ISR Project and the reasonably foreseeable future actions, the NRC staff expect the existing ambient air quality conditions in the region of influence for the proposed Reno Creek ISR Project to continue in a similar manner. SEIS Appendix C Section C-5 contains additional information on the SEIS approach for the near-field analysis.

5.7.1.2 Far-Field Analysis

The collective emissions generated from all of the sources within the region of influence have the potential to affect receptors outside of the region of influence (i.e., the far-field). Analyses of the effects from regional emissions often focus on Class I areas since these areas have the greatest level of protection (i.e., the most stringent standards) under the PSD program (see SEIS Section 3.7.2.1). The nearest Class I area to the proposed Reno Creek ISR Project is Wind Cave National Park located in Custer County, South Dakota, about 181.9 km [113 mi] away (AUC, 2012a). Wind predominantly blows from the west-southwest and southwest which transports emissions from the proposed project towards Wind Cave National Park.

Wind Cave National Park, as well as the entire state of South Dakota, is in attainment (40 CFR 81.342). In 2005, a monitoring station was established at Wind Cave National Park to determine air pollution background levels and whether the site was affected by the long-range transport of air pollutants, such as pollution from increased oil and gas development in Colorado, Wyoming, and Montana (SDDENR, 2015). According to the South Dakota Ambient Air Monitoring Annual Network Plan (SDDENR, 2015), pollutant concentrations at the Wind Cave site are below the applicable NAAQS. In fact, the particulate matter PM_{10} and $PM_{2.5}$ concentrations are the lowest in the state.

In addition to attainment status, air quality at Class I areas also considers visibility impairment. Visibility impairment occurs when the pollution in the air either scatters or absorbs the light. Both natural and man-made sources contribute to air pollution, which may impair visibility. Natural sources include windblown dust and smoke from fires, while man-made sources include electric utilities (i.e., power plants), industrial fuel burning, and motor vehicles. The closest Class I area to the proposed project (i.e., Wind Cave National Park) has experienced visibility impacts. The South Dakota Department of Environment and Natural Resources Regional Haze State Implementation Plan (SDDENR, 2011) provided pollution emission inventories and modeling results and also identified the sources of the pollutants that affect visibility. This plan identified sulfate, nitrate, and organic carbon as the major contributors to visibility impairment at Wind Cave National Park. The modeling indicates that only about 3 percent of the sulfur dioxide pollution affecting visibility at Wind Cave National Park comes from sources within South Dakota and at most, about 10 percent of the nitrogen dioxide pollution comes from sources within South Dakota. The state that contributes the most sulfur dioxide and nitrogen dioxide pollution that affects visibility at this Class I area is Wyoming.

The preceding paragraph characterizes the current impacts at Wind Cave National Park. Future impacts are less well defined. In 2014, BLM published the most recent version of the PRB Coal Review (BLM, 2014a). BLM developed this document to provide a regional air emission inventory and associated modeling results for the PRB that could be used in NEPA assessments. The PRB Coal Review developed regional emission inventories for 2008 (the base year), 2020, and 2030 and conducted modeling based on these three inventories for several locations, including Wind Cave National Park. The information derived from the regional PRB modeling primarily relates to changes in pollution concentrations caused by variations in emissions levels over time from all of the emission sources within the region. The trend at the regional level is that both the 2020 and 2030 modeled concentrations for all pollutants remain unchanged or tend to decrease relative to the 2008 base year (BLM, 2014a). In the recently published final EIS for the Buffalo Regional Management Plan, which assessed impacts from emissions generated in Campbell, Johnson, and Sheridan Counties, BLM noted concerns about the quality of the emission inventory and modeling in the PRB Coal Review (BLM, 2015a). BLM stated in the final EIS that they would not be using the PRB Coal Review air quality analysis to inform planning decisions for the Buffalo Regional Management Plan or for future projects in the planning area (BLM, 2015a).

At this time, the NRC staff has not identified an appropriate information source to replace the PRB Coal Review air quality analysis. However, the NRC is aware of efforts currently underway that may provide additional relevant data. For example, BLM, in cooperation with the Forest Service, will develop an EIS for a large scale oil and gas project in Converse County proposing to drill approximately 5,000 oil and natural gas wells in Converse County in an area encompassing approximately 1.5 million acres over a 10-year period (BLM, 2014b). Also, efforts by BLM are underway in South Dakota to conduct regional modeling to assess impacts to air quality and air quality related values (BLM, 2015b). Should those documents become available prior to publication of the final SEIS, then the NRC staff would consider any relevant information.

The NRC staff conclude that current far-field impacts are MODERATE because of the visibility impacts experienced at Wind Cave National Park. Based on the currently available information, the NRC staff expect future impacts to continue at a similar level. However, based on known flaws in the currently available information (BLM, 2015a), the NRC staff acknowledge the possibility that future impacts to air quality could be LARGE. Therefore, the NRC staff determine that the far-field cumulative impacts on air quality resulting from other past, present, and reasonably foreseeable future actions could range from MODERATE to LARGE.

Although there is uncertainty concerning future impacts to the far-field, the contribution of the proposed Reno Creek ISR Project to the far-field impacts is better understood. Uranium extraction only contributes a small portion of the overall emissions in the southern portion of the PRB (i.e., Campbell, Johnson, and Sheridan Counties). As noted in figures in Section 4.1.1.3 of BLM (2015a), the only pollutants generated from uranium extraction activities that contribute more than one percent to the overall emission levels are nitrogen oxides at two percent. These percentages are based on all of the uranium extraction projects in the southern portion of the PRB. SEIS Table 5-1 identifies nine active projects within 80 km [50 mi] of the proposed Reno Creek project. Based on a comparison of the project and regional emission levels, the NRC staff conclude that the proposed Reno Creek ISR Project would have a SMALL effect on the far-field air quality. When combining the incremental impacts from the proposed Reno Creek ISR Project with all the impacts from other past, present, and reasonably foreseeable future actions in the region of influence, the NRC staff conclude that the cumulative impact for the far-field would be MODERATE to LARGE. Section C-5 of the SEIS Appendix C contains additional information on the SEIS approach for the far-field analysis.

5.7.2 Greenhouse Gas Emissions and Global Climate Change

5.7.2.1 Global Climate Change and Contribution to Atmospheric Greenhouse Gas Levels

The impact magnitude resulting from a single source or a combination of greenhouse gas emission sources over a larger region must be placed in geographic context for the following reasons:

- 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.
- The total number and variety of greenhouse gas emission sources is extremely large, and the sources are ubiquitous.

Consequently, the NRC staff determined that an appropriate approach to address the cumulative impacts of greenhouse gas emissions (including carbon dioxide) is to recognize that

- Greenhouse gas emissions contribute to climate change.

- Climate change is best characterized as the result of numerous and varied sources, each of which might seem to make a relatively small addition to global atmospheric greenhouse gas concentrations.

- The extent of the analyses should be commensurate with the quantity of greenhouse gas emissions generated by the proposed action.

- Carbon footprint and resilience to climate change are relevant factors in evaluating distinctions between the various alternatives.

- Analysis may include both the proposed project's contribution to atmospheric greenhouse gas levels and the potential effects of climate change on the proposed project.

These concepts are more fully developed in the "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews" (CEQ, 2016).

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The U.S. Global Change Research Program (GCRP) report (GCRP, 2014) provides a synthesis of the results of numerous climate modeling studies. The NRC staff conclude that the cumulative impacts of greenhouse emissions around the world as presented in the GCRP report are an appropriate basis for its evaluation of cumulative impacts. Based primarily on the scientific assessments of the GCRP and National Research Council, the EPA Administrator issued a determination in 2009 (74 FR 66496) that greenhouse gases in the atmosphere may reasonably be anticipated to endanger public health and welfare, based on observed and projected effects of greenhouse gases, their effect on climate change, and the public health and welfare risks and effects associated with such climate change. Based on the effects set forth in the GCRP report and the CO_2 emissions threshold criteria and general approach implemented in the final EPA "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule" (75 FR 31514), the NRC staff conclude that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing (i.e., MODERATE). As described in SEIS Section 3.7.2.2, the U.S. Supreme Court invalidated the portions of the Tailoring Rule stating that sources could be subject to EPA air permitting based solely on greenhouse gas emissions; however the Supreme Court did not invalidate the emission threshold criteria established in the Tailoring Rule or the general approach implemented by EPA.

<u>Proposed Reno Creek ISR Project</u>

The NRC staff consider that the proposed project generates low levels of greenhouse gases relative to other sources. SEIS Sections 2.1.1.1.6, 3.7.2.2, and 4.7 describe greenhouse gas emissions. The proposed Reno Creek ISR Project would generate an estimated total of 41,719 metric tons [45,987 short tons] of carbon dioxide (see Table 2-5). As described in SEIS Section 4.7.1.1, the total amount of greenhouse gases associated with the proposed project would be below the thresholds identified by EPA. For purpose of this SEIS, the total emissions of the proposed project would be from both direct and indirect sources. Direct sources are those directly associated with the proposed project (e.g., emissions from diesel engines onsite) and would contribute 5,956 metric tons [6,565 short tons] of carbon dioxide to the total peak year emission estimate (SEIS see Table 2-5). Indirect sources include only offsite production of electricity consumed by the proposed project and would contribute 35,763 metric tons [39,422 short tons] of carbon dioxide to the total peak year estimate (SEIS see Table 2-5). The vast majority of greenhouse gas emissions associated with the proposed project can be attributed to the one indirect source. Because emission estimates are below EPA thresholds, the NRC staff conclude that the proposed Reno Creek ISR Project would generate low levels of greenhouse gases relative to other sources (i.e., the project is not considered a large emitter or source of greenhouse gases) and would have a SMALL impact on air quality in terms of greenhouse gas emissions.

Mitigation is one response strategy for addressing climate change. The emission inventory for the proposed project described in the preceding paragraph includes mitigation (e.g., carpooling). As described in SEIS Table 2-5, combustion emissions from mobile sources would make up the majority of direct carbon dioxide emissions from the proposed project. The applicant has committed to implementing a carpooling program, which would reduce the amount of carbon dioxide emissions associated with workers traveling to and from the proposed project area. SEIS Appendix C Table C–13 specifies a 65.4 percent reduction in vehicle emissions from commuting as a result of carpooling. SEIS Table 6-2 identifies other potential mitigation measures identified by the NRC but not committed to by the applicant. These mitigation measures include minimizing unnecessary travel and minimizing vehicle and equipment idle time. The NRC staff acknowledge that any reduction of greenhouse gas emissions at the project level would be reflected in a reduction of the overall greenhouse gas levels. However, the need to implement mitigation for a given project should take into account the relative amount of greenhouse gases produced by that project. As described in the preceding paragraph, the NRC staff conclude that the proposed Reno Creek ISR Project would generate low levels of greenhouse gases relative to other sources.

Cumulative impacts include the incremental effects from the proposed project when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The NRC staff conclude that the proposed Reno Creek ISR Project would have a SMALL incremental impact on air quality in terms of greenhouse gas emissions when added to the MODERATE cumulative impacts anticipated from other greenhouse gas emissions from past, present, and reasonably foreseeable future actions. Because emission estimates are below EPA thresholds, the NRC staff conclude that the proposed Reno Creek ISR Project would generate low levels of greenhouse gases relative to other sources (i.e., the project is not considered a large emitter or source of greenhouse gases) and would have a SMALL impact on air quality in terms of greenhouse gas emissions. The NRC staff conclude that the national and worldwide impacts associated with greenhouse gas emissions are MODERATE because of the effects as described in the GCRP report and the general approach to addressing carbon dioxide emissions in the EPA Tailoring Rule, which established emission criteria thresholds and did not call for immediate action such as closure of greenhouse gas-emitting facilities (portions of the Tailoring Rule that were not invalidated by the U.S. Supreme Court). The NRC staff further conclude that the cumulative impacts would be noticeable but not destabilizing (i.e., MODERATE), with or without the greenhouse gas emissions of the proposed project.

As described earlier in this SEIS section, the carbon footprint of the various alternatives is a relevant factor when evaluating potential impacts for the various alternatives. The No-Action Alternative eliminates the proposed project as a source of gaseous emissions that would contribute to the ambient greenhouse gas levels. The elimination of all project-level greenhouse gas emission distinguishes the No-Action Alternative from the proposed action alternative which would generate low levels of greenhouse gases relative to other sources.

5.7.2.2 Potential Effect of Climate Change on the Proposed Reno Creek ISR Project

The NRC staff acknowledge that climate change may have impacts across a wide variety of resource areas, including air, water, ecological, and human health. The GCRP describes these potential impacts in the report *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment* (GCRP, 2014). In this section, the discussion of impacts from climate change on the environment focuses on those aspects of climate change that may affect the proposed Reno Creek ISR Project (i.e., areas where the impacts of climate change and the proposed Reno Creek ISR Project overlap).

While there is general agreement in the scientific community that some climate change is occurring, considerable uncertainty remains in the magnitude and direction of some of the changes, especially predicting trends in a specific geographic location. As described in SEIS Section 3.7.2, the recent report from the GCRP served as a source for climate change information (GCRP, 2014).

Based on the information in SEIS Section 3.7.2, the overall effect of projected climate change on the proposed Reno Creek ISR Project would be SMALL. The temperature and precipitation projections discussed in SEIS Section 3.7.2.2 extend to the latter part of this century. Any changes in temperature and precipitation over the much shorter project lifespan are expected to be smaller. Much of the activity associated with ISR occurs below ground, whereas temperature and precipitation are parameters primarily associated with the surficial and atmospheric environment. Changes to groundwater availability are another potential overlapping effect with climate change since the proposed project would utilize groundwater. For example, in SEIS Section 2.1.2, the NRC staff estimate that the annual aquifer restoration water use would be about 0.20 million m^3 [52 million gal]. However, potential changes to the proposed project area environment and resources, such as groundwater availability, are not expected to be altered over the lifespan of the project in a manner that would change the magnitude of the environmental impacts from what has already been evaluated in this SEIS.

Resilience to climate change impacts can be a factor that distinguishes alternatives. As described in the preceding paragraph, changes to groundwater availability are a potential overlapping effect with climate change since the proposed project would utilize groundwater. The No-Action Alternative eliminates the need to utilize groundwater to support ISR activities. Therefore, the No-Action Alternative is more resilient to climate change impacts in terms of water usage than the proposed project because the No-Action Alternative does not utilize any groundwater.

As described in SEIS Section 5.7.2.1, mitigation is one response strategy for addressing climate change. The other major response strategy is adaptation, which refers to actions to prepare for and adjust to new conditions created by climate change. As described previously in this section of the SEIS, the NRC staff consider the overall effect of projected climate change in relation to the proposed Reno Creek ISR Project to be SMALL. The NRC staff are not aware of any adaption measures for climate change impacts associated with the proposed Reno Creek ISR project.

5.8 <u>Noise</u>

The geographic boundary of the proposed Reno Creek ISR Project for the cumulative impacts assessment from noise was assessed within an 8-km [5-mi] radius. This boundary was chosen because noise dissipates quickly from the source. As stated in GEIS Section 4.3.7, sound levels as high as 132 dBA will taper off to the lower limit of human hearing (20 dBA) at a distance of 6 km [3.7 mi] in this region (NRC, 2009). The timeframe for the analysis is from 2012 to 2030.

Noise associated with the proposed Reno Creek ISR Project includes the operation of equipment such as trucks, bulldozers, and compressors; traffic due to commuting workers or material/waste shipments; and wellfield and the CPP operations. This SEIS has identified these noise impacts for all phases of the proposed Reno Creek ISR Project as SMALL (see SEIS Section 4.8). During preconstruction, noise impacts would be similar to those described for the construction phase (i.e., SMALL) (AUC, 2014).

The GEIS noted that noise would not be discernible to an offsite person at distances of greater than 300 m [1,000 ft] (NRC, 2009). There are currently six occupants living in four residences outside the proposed project area. The closest offsite residences are located approximately 2.0 km [1.25 mi] southeast and 2.7 km [1.7 mi] east of the proposed project area. Because the closest residents live beyond 300 m [1,000 ft] of the proposed Reno Creek ISR Project area, there would be no noise impact above background levels.

Present and reasonably foreseeable future noise-generating activities in the cumulative noise impacts study area would primarily be from operating heavy equipment and traffic noise associated with (i) oil and gas and CBM operations, (ii) ISR operations, and (iii) wind energy projects.

There are 324 CBM wells within 3.2 km [2 mi] and 46 oil and gas producing wells within 8 km [5 mi] of the proposed project area (see SEIS Section 3.2). Oil and gas and CBM operations generate noise during construction of drill pads, well drilling, and operation of compressor stations. Noise levels associated with operation of compressor stations would be expected to be below 55 dBA at distances of 488 m [1,600 ft] and beyond (BLM, 2003). Noise levels associated with drill pad construction and well drilling would be expected to decrease to 54 dBA at 610 m [2,000 ft] from the drill site (BLM, 2003). A noise level of 55 dBA is the level that protects human receptors against interference and annoyance with an adequate margin of safety (EPA, 1974).

At this time, no future ISR projects have been identified within the cumulative noise impacts study area {i.e., within an 8-km [5-mi] radius of the proposed Reno Creek ISR site}. However, there are five potential ISR projects (in prelicensing, licensing, or operational phases) within 24 km [15 mi] of the proposed Reno Creek ISR Project area (see SEIS Table 5-1). These operating and potential ISR projects could contribute to noise within the study area from additional traffic on State Highway 387 from commuting workers, construction and operations deliveries, and yellowcake and byproduct transport. State Highway 387 traverses the cumulative noise impacts study area and is a primary regional highway providing access to operating and potential ISR projects located south and southwest of Gillette and west of Wright (see SEIS Figure 5-1).

Construction of a wind energy project, such as the potential Reno Junction Wind Project, would produce noise from activities including access road construction, grading, drilling and blasting (for tower foundations), construction of ancillary structures, cleanup, and revegetation. In general, construction activities would last for a short period (e.g., 1 to 2 years) and would occur during the day; accordingly, potential noise impacts would be temporary and intermittent in nature. Noise generated by turbines, substations, transmission lines, and maintenance activities during the operational phase of a wind energy project would approach typical background levels for rural areas at distances of 610 m [2,000 ft] or less. Like construction activities, decommissioning activities would occur during the day and would last for a short period compared with wind turbine operation, and therefore the potential impacts would be temporary and intermittent in nature (BLM, 2005).

Noise may also have impacts on wildlife. For further information on the cumulative impacts on terrestrial ecology and applicant mitigation measures and monitoring, see SEIS Section 5.6 and Chapters 6 and 7 (Mitigation and Monitoring, respectively).

The NRC staff has concluded that the cumulative impact of noise within the study area resulting from all ongoing and reasonably foreseeable future actions would be MODERATE. There are extensive oil and gas and CMB operations in the cumulative impact study area that contribute to noise above background levels. Existing and potential ISR projects could contribute to traffic noise along State Highway 387, which traverses the proposed Reno Creek ISR Project area, from commuting workers, equipment and materials deliveries, and yellowcake and byproduct transport. During operation of potential wind energy projects, such as the Reno Junction Wind Project, noise generated by turbines, substations, transmission lines, and maintenance activities would approach typical background levels for rural areas at distances of 610 m [2,000 ft] or beyond (BLM, 2005).

5.8.1 Summary

In summary, there are few human noise receptors (e.g., residences or communities) in the cumulative impacts noise study area. As described in SEIS Sections 4.8.1 and 4.6.1, noise generated by construction and operations activities at the proposed Reno Creek ISR Project would dissipate or be reduced by mitigation measures before reaching onsite and offsite human receptors. Additionally, noise levels would be mitigated by administrative and engineering controls to maintain noise levels in work areas below Occupational Safety and Health Administration (OSHA) regulatory limits. The NRC staff has concluded that the proposed Reno Creek ISR Project would have a SMALL incremental effect on noise when added to the MODERATE cumulative impacts from all ongoing and reasonably foreseeable future actions in the noise study area.

5.9 Historic and Cultural Resources

Cumulative impacts on historic and cultural resources were assessed within a 16-km [10-mi] radius of the proposed Reno Creek ISR Project. This area delineates the geographic boundary utilized for the cumulative analysis of historic and cultural resources and will be referred to as the “historic and cultural resources study area.” The historic and cultural resource study area covers a larger spatial extent than either the direct or indirect Area of Potential Effect (APE) in order to evaluate activities outside of the proposed project area. The assessment of cumulative impacts on historic and cultural resources beyond 16 km [10 mi] was not undertaken because, at this distance, the impacts on historic and cultural resources from the proposed Reno Creek ISR Project on other past, present, and reasonably foreseeable future actions would be minimal. The timeframe for this analysis is 2012 to 2030, based on the estimated operating life of this proposed project.

Potential impacts to cultural and historic resources could result from energy development, erosion, and grazing activities. Additionally, activities on both public and private lands include oil, gas, CBM, and coal development. These activities are ongoing and are projected to expand in the future. Impacts from these activities would result primarily from the loss or damage to historical, cultural, and archaeological resources, but also from temporary restrictions on access to these resources. All applicants for ISR facilities would conduct appropriate historic and cultural resource surveys as part of prelicense application activities. Impacts to cultural resources can be minimized for proposed projects located on federal or tribal lands or that are part of a federal action, because such projects are subject to the National Historic Preservation Act (NHPA), the Section 106 consultation process, and other applicable statutes.

Past, present, and reasonably foreseeable future actions that have the potential for cumulative effects on historic and cultural resources identified in the cumulative impacts study area include uranium exploration and extraction, oil and gas exploration, coal mining, CBM, wind energy projects, transportation projects, and other aggregate mining (see SEIS Sections 5.1.1.1 through 5.1.1.7). Historic and cultural resources may be affected by the consequences of nearby projects, such as erosion, destabilization of land surfaces, increased area access, and increased vibration from locomotive and heavy truck traffic.

As new developments start, it is anticipated that activities associated with surface-disturbing activities would be surveyed for historic and cultural resources, as appropriate. Surveys by professional archaeologists and cultural specialists would identify and evaluate National Register of Historic Places (NRHP) eligibility prior to proposed project construction. In addition, identification of properties of importance to Native American tribes will also need to be undertaken as part of consultation. If NRHP-eligible sites are found, appropriate levels of evaluation and mitigation would be required prior to construction.

Within the historic and cultural resources study area there are four ISR facilities in various stages of prelicensing, are licensed, or are operating (proposed Jane Dough ISR Project, proposed Ruby Ranch ISR Project, Moore Ranch ISR Project, and Nichols Ranch ISR Project, see SEIS Table 5-1). The proposed Jane Dough ISR Project and proposed Ruby Ranch ISR Project are in prelicensing, Moore Ranch ISR Project was licensed but is not currently operating, and Nichols Ranch ISR Project is licensed and operating. Because both the proposed Jane Dough ISR Project and proposed Ruby Ranch ISR Project are not licensed at this time, there is no information available regarding the presence or absence of archeological sites eligible for the NRHP. However, any potential impacts to historic and cultural resources at these proposed sites would likely be minimized, since these projects would be subject to the NHPA, Section 106 consultation process, and applicable statutes. The historic and cultural resource analysis for the Moore Ranch ISR Project indicated that no sites in the direct APE were eligible for the NRHP (NRC, 2010). However, as noted, the Moore Ranch ISR Project has been licensed but is not currently operating. The operating Nichols Ranch ISR Project has one archaeological site at the Nichols Ranch Unit and seven archaeological sites at the Hank Unit eligible for listing on the NRHP. However, the licensee has committed to avoiding the site on the Nichols Ranch Unit. Of the seven NRHP-eligible sites at the Hank Unit, there would be an adverse effect to the visual setting of five traditional cultural properties (TCPs), which include the Pumpkin Buttes TCP. These sites would be marked, fenced, and avoided. Mitigation for the Pumpkin Buttes TCP would be conducted in accordance with a Programmatic Agreement (PA) between the BLM and the Wyoming State Historic Preservation Office (WY SHPO), which applies to BLM-administered lands and federal uranium leaseholders extracting uranium from federally owned subsurface minerals within 3.2-km [2-mi] of the Pumpkin Buttes TCP.

Archaeological and historic sites and artifacts are present near the proposed Reno Creek ISR Project area; therefore, any present and future projects could potentially cause adverse impacts to these sites and artifacts in the absence of appropriate mitigative strategies. However, with recommended strategies in place (e.g., avoidance or construction monitoring) the impact would be SMALL to MODERATE. Therefore, the NRC staff have determined that the cumulative impact on historic and cultural resources within the historic and cultural resources study area resulting from all past, present, and reasonably foreseeable future actions is SMALL to MODERATE.

The analysis of cumulative impacts on historic and cultural resources at the proposed project focused on identification of archeological sites and the assessment and implementation of mitigative measures to protect resources within both the direct and indirect APE. As described in SEIS Section 4.9.1, archaeological field investigations of the proposed project identified 74 cultural localities. None of these 74 cultural localities were recommended or determined eligible for listing on the NRHP. Tribal survey teams identified 6 new cultural sites and 22 isolated cultural artifact locations. As stated in SEIS Section 3.9.3.1.5, the NRC staff have determined that none of the sites are eligible for listing in the NRHP. However, following tribal government consultation, the NRC staff have recommended mitigation procedures for ineligible tribal resources (48CA7251 and 48CA7252) that would be subject to ground-disturbing activities from the proposed project (e.g., avoidance and construction monitoring). The NRC staff have determined that avoidance is possible for 48CA7251. However, avoidance may not be possible for 48CA7252 based on proposed project plans. As presented in SEIS Section 4.9.1, the Northern Arapaho Tribe has recommended that construction monitoring by a tribal member could serve to mitigate the possible adverse effect to 48CA7252. The applicant has also committed to the use of an inadvertent discovery plan to address the potential identification of previously unrecorded historic and cultural resources during all phases of the proposed project (AUC, 2012a). The inadvertent discovery plan typically entails the stoppage of work and the notification of appropriate parties (federal, tribal, and state agencies) (NRC, 2009).

Within the historic and cultural resources study area for this cumulative impacts analysis are the Pumpkin Buttes, located approximately 12 km [7.5 mi] from the proposed project area boundary. The Pumpkin Buttes have been identified as a TCP and have potential cultural affiliation with nine Tribes (SWCA, 2006). As previously stated, there is a PA between the BLM and the WY SHPO regarding mitigation of adverse effects to the Pumpkin Buttes TCP. The proposed Reno Creek ISR Project would be located at least 8.6 km [5.5 mi] outside of the PA boundary. While the TCP is outside of the PA boundary, the Pumpkin Buttes are visible from most of the Reno Creek ISR Project. Although not required by the PA, the applicant has committed to reduce the visual impact by using neutral paint colors for its proposed facilities and infrastructure (AUC, 2014).

The NRC staff assessed the potential visual impact to the integrity of setting for the Pumpkin Buttes. The area between the Pumpkin Buttes and the proposed project currently contains intrusive modern elements (e.g., public roads and oil drilling stations). The existence of small modern intrusions already obstructs the visual line between the proposed project and the Pumpkin Buttes. Therefore, the addition of the proposed project to this setting would not significantly change the setting of the Pumpkin Buttes or the qualities of setting and feeling associated with the Pumpkin Buttes. Due to the distance between the proposed project and the Pumpkin Buttes (outside the PA boundary), the current surface-disturbing activities in the area (e.g., oil and gas exploration, coal mining, and CBM exploration), and the presence of existing intrusive modern elements already obstructing the visual line to the Pumpkin Buttes, the NRC staff conclude that the impact to the visual setting of historic and cultural resources would be SMALL.

5.9.1 Summary

As discussed previously in SEIS Section 4.9.1, the NRC staff concluded that the project activities would have a SMALL impact because: (i) archaeological field investigations within the direct APE area identified no historic and cultural sites that are recommended as eligible for listing in the NRHP; (ii) impacts to eligible historic and cultural sites in the indirect APE would result in negligible effects due to the applicant's proposed mitigation measures; (iii) the applicant has committed to using neutral paint schemes for the proposed project facilities and infrastructure, and (iv) the applicant agreed to an inadvertent discovery plan that would mitigate the potential adverse effect on future sites. As a result, the NRC staff conclude that the proposed Reno Creek ISR Project would have a SMALL incremental impact on historic and cultural resources when added to the SMALL to MODERATE cumulative impact from all other past, present, and reasonably foreseeable future actions.

5.10 Visual and Scenic Resources

Cumulative impacts to visual and scenic resources were assessed within a 3.2-km [2-mi] radius of the proposed Reno Creek ISR Project. Beyond this distance, any changes to the landscape would be in the background distance zone for the purposes of Visual Resource Management (VRM) defined by BLM, and would be either unobtrusive or imperceptible to viewers (BLM, 1984, 1986). The timeframe for the analysis is 2012 to 2030.

At present, human-made features within and in the immediate vicinity of the proposed project area include roads, power lines, telephone and electric lines and poles, ranch residences, fence lines, a CBM compressor station, pumpjacks, and reservoirs. The primary visual features on the landscape (i.e., the background distance zone) are oil and gas production facilities, which are visible due to their vertical profile (i.e., they are taller than ISR wellheads). Energy development is expected to continue over the next 20 years within the PRB region. Past, present and reasonably foreseeable future projects could include construction of uranium recovery facilities, transportation infrastructure, a coal-fired power plant, major transmission lines, coal technology projects, oil and gas facilities, and CBM processing plants. Each of these activities could have an impact on visual and scenic resources, although these would be anticipated to be developed in the background distance zone {i.e., greater than 3.2-km [2-mi]} away. As described in SEIS Sections 5.1.1.1 through 5.1.1.7, the operating and proposed projects (i.e., uranium recovery, coal, oil and gas, CBM, wind, transportation, and aggregate mining) are not within the visual and scenic cumulative impacts study area. Therefore, the NRC staff conclude that the cumulative impact from past, present, and reasonably foreseeable future actions on visual and scenic resources in the study area would be SMALL.

With respect to potential cumulative effects, resource development in the vicinity of the proposed project may affect the visual and scenic resources associated with the Pumpkin Buttes TCP and any associated TCPs. The viewshed (from the location of the proposed CPP) for the general area is classified by BLM as a VRM Class III resource, with no VRM Class I areas nearby. As discussed in SEIS Section 4.10.1.1, the proposed project activities would have a SMALL impact because the most effect on visual and scenic resources would be temporary (e.g. less than 2 years construction per wellfield and removal of buildings and infrastructure during decommissioning). During operations all pipes and cables would be buried and therefore not visible. The applicant has also committed to implementing mitigation (e.g., reclaiming and reseeding areas, using dust suppression methods, and using neutral paint colors for structures), which would reduce the visual and scenic impacts associated with the proposed project and would be consistent with the VRM Class III objectives (AUC, 2012a). Furthermore, the proposed project would be located more than 181.9 km [113 mi] from the PSD Class I area at Wind Cave National Park and 63 km [40 mi] away from the nearest VRM Class II area. Therefore, the NRC staff conclude that visual and scenic impacts from the proposed project for all project phases would be SMALL.

5.10.1 Summary

Due to the structures and infrastructure currently present within the study area, the anticipated continuation of energy development activities and associated continued use of the current infrastructure, and the remote location of the proposed project in relation to other potential projects in the area, the NRC staff has concluded that the proposed Reno Creek ISR Project would have a SMALL incremental effect on visual and scenic resources when added to the SMALL cumulative impacts from all past, present and reasonably foreseeable future actions in the visual and scenic resources study area.

5.11 Socioeconomics

As described in SEIS Section 5.1.2, the timeframe for this cumulative impacts analysis for socioeconomics resources begins in 2013 and ends in 2030. The following socioeconomic indicators were evaluated as part of the analysis:

- Population
- Employment
- Housing
- School enrollment
- Public services
- Local Finance

The geographic boundary varies for the socioeconomic resource indicators listed above and is described as part of the analysis for each indicator. The potential socioeconomic impacts for the proposed Reno Creek ISR Project would be SMALL as described in SEIS Section 4.11.

5.11.1 Population

The geographic boundary, or study area, for the cumulative population analysis includes Campbell County and surrounding counties (Johnson, Natrona, Converse, and Weston). Population change over time is generally an excellent indicator of cumulative social and economic change in a given area. Population changes and projections for counties within the geographic boundary for the cumulative population analysis are shown in SEIS Table 5-5.

Population in all of the counties within the cumulative population analysis study area increased from 2000 to 2010. The greatest increases in population from 2000 to 2010 occurred in Campbell and Johnson counties, with percentage increases of 36.9 and 21.1, respectively. Population in all of the counties is projected to continue to increase in 2020 and 2030. The greatest percentage increase in population is projected for Campbell County, with projected increases of 23.3 percent from 2010 to 2020 and 16.1 percent from 2020 to 2030

Table 5-5. 2000–2010 Population Change and 2020/2030 Populations Projections for Counties Within the Geographic Boundary for the Cumulative Population Analysis

State/County	2000 Census	2010 Census	Percent Change 2000/2010	Population Projections	
				2020	2030
State of Wyoming	493,782	563,626	14.1	622,360	668,830
Campbell County	33,698	46,133	36.9	56,890	66,060
Johnson County	7,075	8,569	21.1	9,450	10,450
Natrona County	66,533	75,450	13.4	82,490	88,320
Converse County	12,052	13,833	14.8	15,950	17,270
Weston County	6,644	7,280	9.6	7,900	8,120

Sources: USCB, 2014; WDAI, 2011

If the reasonably foreseeable future actions described in SEIS Section 5.1.1 go forward and become functional within the boundary of the cumulative population analysis study area, workers would be needed to build and operate these facilities. These future actions include potential wind energy projects, such as the Reno Junction Wind Project, and proposed transportation projects, such as the DM&E PRB Expansion Project. Additional workers would also be needed to staff any expansion in uranium, oil and gas, coal, and CBM extraction projects. It is likely that any additional workers would desire to live closer to their places of employment and become active in their communities. The town of Wright (population 1,807) and the cities of Gillette (population 29,087) and Casper (population 55,318) may see population increases associated with these future actions in the population study area. Assuming that energy and transportation projects are developed and constructed, the addition of new workers in these communities would have a MODERATE cumulative impact on population. The relatively small pool of workers associated with the proposed Reno Creek ISR Project (80 short-term positions during construction, 92 positions during operations, 52 positions during aquifer restoration, and 22 positions during decommissioning) would have only a SMALL incremental impact on population. If a disproportionate number of workers associated with the proposed Reno Creek ISR Project elect to reside in small towns close to the proposed project, such as Wright, the incremental impact on population could be MODERATE.

5.11.2 Employment

The geographic boundary (study area) for the cumulative employment analysis includes Campbell County and surrounding counties (Johnson, Natrona, Converse, and Weston). While no individual county employment projections are available, the latest long-term occupational and industry projections from the Research and Planning Section of the Wyoming Department of Workforce Services (WDWS) indicate that Wyoming's job market will expand during the 10-year period from 2012 to 2022 (WDWS, 2014a,b). Long-term industry projections indicate that total employment across all industries is expected to increase by an estimated 35,842 jobs (12.9 percent) from 2012 to 2022 (WDWS, 2014a). However, over this 10-year period, total employment in the mining industry is expected to increase by only 1,114 jobs (4.0 percent). Employment in mining other than oil and gas extraction is expected to decline by an estimated 565 jobs (-5.7 percent) from 2012 to 2022. This decline in employment is due to current and expected contraction in CBM extraction and coal mining (see SEIS Section 5.1.1.2 and 5.1.1.4).

The cumulative employment analysis study area may experience an increased rate of employment from ongoing and reasonably foreseeable future actions that may occur (see SEIS Section 5.1.1). If the potential Reno Junction Wind Project and the proposed DM&E PRB Expansion Project are financed and developed, workers would be needed to build and operate these projects. Wind energy projects are expected to employ 100 to 150 workers during a 1- to 2-year construction period and 10 to 20 workers to operate and maintain the projects (BLM, 2005). The proposed DM&E project would employ more than 900 workers over the 2- to 3-year construction phase (STB, 2001). However, only a small portion of the overall workforce would be located in a single location at any one time. Once a particular phase of the DM&E project is complete, workers would relocate to other job locations (STB, 2001). Workers may also be required to staff potential ISR facilities in the study area (see SEIS Section 5.1.1.1). It is assumed that potential ISR facilities would employ the same number of workers as the proposed Reno Creek ISR Project (80 during construction, 92 during operations, 52 during aquifer restoration, and 22 during decommissioning). The projected job growth related to reasonably foreseeable future actions would result in SMALL to MODERATE cumulative impacts on employment in the study area. Based on the estimated number of workers expected for the proposed project, the proposed Reno Creek ISR Project would have a SMALL incremental impact on employment in the study area.

5.11.3 Housing

The geographic boundary (Study area) for the cumulative housing analysis includes Campbell County and surrounding counties (Johnson, Natrona, Converse, and Weston). Housing would be required to accommodate workers moving into the study area to staff ongoing and reasonably foreseeable future actions (e.g., oil and gas and CBM operations, ISR operations, and wind energy and transportation projects). Smaller communities in the study area, such as Wright, could experience housing impacts due to limited housing availability. Assuming, however, that new employees and their families relocate to one of the larger communities, such as Gillette, there would be adequate housing to absorb the influx of facility workers from ongoing and reasonably foreseeable future actions. Therefore, the cumulative impact on housing from ongoing and reasonably foreseeable future actions in the study area would be expected to be SMALL. Given the estimated number of potential Reno Creek ISR Project employees (80 during construction, 92 during operations, 52 during aquifer restoration, and 22 during decommissioning), there would be a SMALL incremental impact to housing markets, prices, and real estate development in larger communities such as Gillette. However, housing impacts may be MODERATE if a disproportionate number of employees at the proposed Reno Creek ISR Project elect to reside in smaller communities, such as Wright.

5.11.4 Education

Campbell County School District #1, Johnson County School District #1, and Natrona County School District #1 represent the geographic boundary (study area) for the school enrollment resource analysis. These school districts were selected because most permanent Reno Creek ISR Project employees would be likely to live in one of these school districts. Most of the construction workforce, however, in not expected to relocate entire families during the relatively brief construction phase (2 years). Student enrollment in these school districts totaled 22,742 students in 2014 with 8,705 students in Campbell County School District #1, 1,287 students in Johnson County School District #1, and 12,750 students in Natrona County School District #1 (see SEIS Table 3-30). The Wright public schools within the Campbell

County School District #1 are the closest schools to the proposed Reno Creek ISR Project and had a total enrollment of 506 students during the 2012–2013 school year (WDOE, 2014).

Most of the construction workforce for the ongoing and reasonably foreseeable future actions described in SEIS Section 5.1.1 is not expected to relocate entire families into the school enrollment study area. The construction phases of future actions, such as wind projects, ISR facilities, and transportation projects, are relatively brief, ranging from 1 to 3 years. During operations of ongoing and reasonably foreseeable future actions, new employees would be more likely to move their families and send their children to schools in the study area. The potential increase in school-aged children would likely be split between the school districts in the school enrollment study area. Based on the number of permanent employees needed to operate reasonably foreseeable future actions (e.g., 92 for ISR facilities, 10 to 20 for wind projects, and about 12 for transportation projects), cumulative impacts to school enrollment are expected to be SMALL. Based on the number or workers (92) estimated for the operations phase, the proposed project would have a SMALL incremental impact on school resources in the school enrollment study area. However, school enrollment impacts may be MODERATE if a disproportionate number of employees at the proposed Reno Creek ISR Project elect to reside in smaller communities close to the proposed project, such as Wright.

5.11.5 Public Services

The geographic boundary (study area) for the cumulative public services analysis includes Campbell County and surrounding counties (Johnson, Natrona, Converse, and Weston). There may be incremental impacts to local government facilities and public services as population increases in affected counties and communities, which generally result in across-the-board increases in the demand on services. Even small changes in population size may result in additional demand for health and human services, such as doctors, hospitals, police, and fire response. Additionally, the various reasonably foreseeable future actions described in SEIS Section 5.1.1 may result in increased demand for specific services (e.g., road maintenance). Operational impacts to public services and public infrastructure, as a result of the workers relocating with their families, would be area-specific, and may be long-term (10 years or longer). As described in SEIS Section 3.11.7, there are a number of existing medical and emergency facilities that would be capable of handling support for an increased population. Additionally, the State of Wyoming has numerous social services offices located throughout the state. The Wyoming Department of Health has a Public Health Nursing office in Gillette. This office provides primary and preventative health services, including family planning; immunizations; Supplemental Nutrition Program for Women, Infants, and Children (WIC); and maternal and family health. The Wyoming Department of Family Services has a local office in Gillette, which provides assistance for connecting with community resources; reporting child and adult abuse and neglect; and applying for programs, including Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), and Medicaid. The Wyoming Department of Family Services also has foster care coordinators located in all the counties in the cumulative public services study area. It is not anticipated that additional population from ongoing and reasonably foreseeable future actions would stress the current social services capabilities in the public services study area. Therefore, cumulative impacts to public services would be expected to be SMALL. Given the number of workers required for the proposed Reno Creek ISR Project (80 during construction, 92 during operations, 52 during aquifer restoration, and 22 during decommissioning), incremental impacts on public services from the proposed project would be SMALL.

5.11.6 Local Finance

The geographic boundary (study area) for the cumulative local finance analysis is Campbell County. Tax revenue would accrue mainly in Campbell County and to the State of Wyoming; and because of the structure of the tax system, taxes may not accrue or be distributed to the localities proportionate to the population/public service impacts experienced by those entities. The tax system in place helps capture tax revenue during construction, operations, and decommissioning of industrial facilities. Additionally, a county *ad valorem* tax from current and future mineral extraction operations would contribute to local government revenue. Indirectly, counties and municipalities would benefit from increased sales and property tax revenue from increases in population and resultant demand for goods, services, and housing. If reasonably foreseeable future actions, such as wind energy, ISR projects, and transportation projects, are constructed and operated, there would be a MODERATE cumulative impact on local finance. In SEIS Section 4.11.1.2.5, the NRC staff concluded that the tax revenue impact from the proposed Reno Creek ISR Project operations on taxing jurisdictions in Campbell County would be SMALL. Therefore, contributions from the proposed project are expected to have a SMALL incremental impact on local finance.

5.11.7 Summary

In summary, the NRC staff determined that the cumulative impact on socioeconomic resources resulting from past, present, and reasonably foreseeable future actions ranges from SMALL to MODERATE. Impacts to population and local finance would be MODERATE; impacts to employment would be SMALL to MODERATE, and impacts to housing, education, and public services would be SMALL.

The NRC staff conclude that the proposed Reno Creek ISR Project would have a SMALL to MODERATE incremental effect on socioeconomic resources when considered with other past, present, and reasonably foreseeable actions. Impacts to population, housing, and education would be SMALL to MODERATE, while impacts to employment, public services, and local finance would be SMALL.

5.12 Environmental Justice

Past, present, and reasonably foreseeable future actions described in SEIS Section 5.1.1 could potentially contribute to cumulative disproportionately high and adverse human health or environmental effects in the PRB. However, the geographic area considered in this cumulative environmental justice analysis includes a 6.4-km [4-mi] radius around the proposed Reno Creek ISR Project, consistent with the NRC guidance described in SEIS Section 4.12.1. Potential impacts to minority and low-income populations from the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project are discussed in SEIS Section 4.12.

No minority and low-income populations have been identified as residing near the proposed Reno Creek ISR Project. The percentage of minority and low-income populations living within a 6.4-km [4-mi] radius of the proposed project area are comparable to the percentage of those minority and low-income populations recorded at the county and state level, and less than half of the national level. The NRC staff concluded in SEIS Section 4.1.2 that there would be no disproportionately high and adverse impacts on minority and low-income populations from the construction, operations, aquifer restoration and decommissioning of the proposed Reno Creek

ISR Project. In addition, no special pathway receptors or traditional or cultural practices of minority and low-income populations were identified.

5.12.1 Summary

In summary, based on the finding that there are no minority or low-income populations within the a 6.4-km [4-mi] radius around the proposed Reno Creek ISR Project, and the findings of the analysis of human health and environmental impacts presented in Chapters 4 and 5 of this SEIS, the NRC staff conclude that any impacts from the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project when added to other past, present, and reasonably foreseeable future actions in the area, would not result in disproportionately high or adverse impacts to minority or low-income populations.

5.13 Public and Occupational Health and Safety

Cumulative effects on public and occupational health and safety were evaluated within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project. This distance was chosen to be inclusive of areas in the region where uranium milling has been practiced. The timeframe for the analysis is 2012 to 2030 (see SEIS Section 5.1.2 for the estimated operating life of the facility).

The public and occupational health and safety impacts from the proposed Reno Creek ISR Project would be SMALL and are discussed in detail in SEIS Section 4.13.1. During normal activities associated with all phases of the project lifecycle, radiological and nonradiological worker and public health and safety impacts would be SMALL. Annual radiological doses to the population within 80 km [50 mi] of the proposed project would be far below applicable NRC regulations. For accidents, radiological and nonradiological impacts to workers may be MODERATE if the appropriate mitigation measures and other procedures intended to ensure worker safety are not followed. Typical protection measures, such as radiation and occupational monitoring, respiratory protection, standard operating procedures for spill response and cleanup, and worker training in radiological health and emergency response, would be required as a part of the applicant's NRC-approved Radiation Protection Program (AUC, 2012b). These procedures and plans would reduce the overall radiological and nonradiological impacts to workers from accidents to SMALL.

Past, present, and reasonably foreseeable future uranium recovery facilities in the vicinity of the proposed Reno Creek ISR Project and within the broader regional area are described in SEIS Section 5.1.1 and Table 5-1. Within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project, there are several licensed ISR facilities (SEIS Section 3.12.2). Willow Creek–Irigaray and Christensen Ranch ISR facilities in Johnson County, Wyoming; the Smith Ranch ISR facility in Converse County, Wyoming; and Nichols Ranch ISR facility in Campbell County, Wyoming (including the Hank Unit), are licensed and operating. Moore Ranch ISR facility located in Campbell County, Wyoming, is licensed but currently nonoperational. The North Butte ISR satellite in Campbell County, Wyoming, is licensed and operating. The Ruth ISR satellite in Johnson County, Wyoming, and the Reynolds Ranch ISR satellite in Converse County, Wyoming, are licensed but are currently nonoperational. Additionally, several inactive and decommissioned conventional uranium mills are in the 80-km [50-mi] radius. However, because of their relative distances, none of these projects are considered to represent an appreciable additional source of radiation exposure in and around the proposed Reno Creek ISR Project area that would significantly increase the estimated radiation exposure from the proposed Reno

Creek ISR Project. Other than CBM activities, there are no major sources of nonradioactive, chemical releases to the atmosphere or water-receiving bodies in the immediate area surrounding the proposed project area. The potential effects from nonradiological releases to the atmosphere and water resources are described in SEIS Sections 5.7 and 5.5.

In addition, four ISR expansions are in the planning or licensing stages: Ludeman (Uranium One: Willow Creek), Jane Dough (Uranerz: Nichols Ranch), Allemand Ross (Uranium One: Willow Creek), and Ruby Ranch (Cameco: Smith Ranch-Highland). The applicant has also identified a potential ISR project, Collins Draw in Campbell County (in between Nichols Ranch and Moore Ranch sites); however, the NRC staff have not received a letter of intent to submit a proposal for this site. If constructed and operated, all of these facilities would have similar radiological and nonradiological impacts on public and occupational health and safety to those at the proposed Reno Creek ISR Project. These facilities would result in localized incremental increases in annual radiological doses to the nearby populations; however, these radiological doses are not expected to significantly overlap and increase those of other facilities and are not expected to affect the proposed Reno Creek ISR Project, as described in the following analysis.

As stated in SEIS Section 4.13.1.2.1, during normal operations, radon (Rn-222) would be the only significant radionuclide released at the proposed Reno Creek ISR Project. The primary sources of radon (Rn-222) would be wellfield venting and process operations at the CPP (predominantly via vent stacks on the ion-exchange columns and various tanks). As further described in SEIS Section 4.13.1.2.1, the applicant's maximum calculated dose to a member of the public is at the proposed Reno Creek ISR Project boundary at a location east of the CPP and Production Unit 8 and northeast of Production Unit 11. This maximum calculated dose is 0.023 mSv/yr [2.3 mrem/yr] and is within the range of results from similar calculations at other operating ISR facilities in the United States (NRC, 2009). Beyond the site boundary, the magnitude of the applicant's dose estimates for residences at various locations and distances is significantly reduced and consistent with the NRC staff expectations [the airborne radon (Rn-222) becomes more dispersed as the distance from release points increases]. The applicant's maximum calculated dose at a nearby residence is 0.0031 mSv/yr [0.31 mrem/yr]. This residence is located approximately 2.4 km [1.5 mi] downwind from venting production units. The low magnitude of these calculated doses and the significant attenuation of dose with distance support the NRC staff's conclusion that the combined exposures from the proposed Reno Creek ISR Project and other operating and potential ISR facilities in the study area would remain far below the 10 CFR Part 20 public dose limit of 1.0 mSv/yr [100 mrem/yr] and have a negligible contribution to the 6.2 mSv [620 mrem] average yearly dose received by a member of the public from all sources.

As described in SEIS Section 4.13.1.2.1, both worker and public radiological exposures are addressed in the NRC regulations at 10 CFR Part 20. These regulations apply to all licensed ISR facilities. Licensees are required to implement an NRC-approved radiation protection program to protect occupational workers and ensure that radiological doses are "as low as reasonably achievable" (ALARA). For example, the applicant's radiation protection program includes commitments for implementing management controls, engineering controls, radiation safety training, radon monitoring and sampling, and audit programs (AUC, 2012b). Measured and calculated doses for workers and the public are commonly only a fraction of regulated limits. GEIS analysis of three separate accident scenarios (thickener failure and spill, pregnant lixiviant and loaded resin spills, and yellowcake dryer accident release) would also result in hypothetical public doses that are less than the NRC regulatory limits and would produce

SMALL potential impacts (NRC, 2009) (see SEIS Section 4.13.1.2.2). The estimated worker dose resulting from an unmitigated accident exceeds the NRC limits; however, such accidents are unlikely and would be expected to be prevented by safety procedures and practices.

The types and quantities of chemicals (hazardous and nonhazardous) proposed for use at the proposed Reno Creek ISR Project do not differ from those evaluated in the GEIS. The use of hazardous chemicals at ISR facilities is controlled under several regulations (see SEIS Section 4.13.1.2.3 for a list of these regulations) that are designed to provide adequate protection to workers and the public. The handling and storage of chemicals at these facilities would follow standard industrial safety standards and practices. Industrial safety aspects associated with the use of hazardous chemicals are regulated by the WDEQ and Wyoming Department of Workforce Services. Nonradiological worker safety would be addressed through occupational health and safety regulations and practices.

Other past, present, and reasonably foreseeable future actions in the vicinity of the proposed Reno Creek ISR Project that could contribute to nonradiological public and occupational health and safety impacts include oil and gas exploration, coal mining, and other mineral extraction activities (SEIS Section 5.1.1). Increased hazards to human health and safety would occur during development and operation of these projects from the inherent hazards associated with construction, operations, and maintenance activities. However, these hazards would be minimized by implementation of various mitigations, including complying with industry standards, using proper equipment, implementing access controls, developing and implementing health and safety programs involving procedures and training for normal operations and emergencies, and complying with applicable federal and state occupational and public safety regulations (BLM, 2012, 2003). Hazardous materials that are likely to be used during these ongoing and reasonably foreseeable future projects include diesel fuel, gasoline, explosives, hydraulic fluids, motor oil/grease, solvents, water and well treatment chemicals, lead-acid batteries, biocides, herbicides, and compressed gasses used for welding (e.g., acetylene or propane) (BLM, 2012b). A large-scale release of diesel fuel or several of the other substances used at the projects may have implications for public health and safety. The location of the release would be the primary factor in determining its importance. Involved workers are the most likely to be affected by accidents involving hazardous materials; however, the risks of such incidents would be limited by the implementation of common safety practices and regulatory controls (BLM, 2012b, 2003). Based on the remote location of these other activities, the NRC staff concludes that the probability of a release within a populated area that could result in public injury or fatality would be low.

The potential impacts to public and occupational health and safety from preconstruction activities would include fugitive dust, combustion emissions, noise, and occupational hazards (SEIS Section 5.1). Based on the 10 CFR 40.4 definition of construction, the NRC considers prelicense construction activities with no nexus to radiological health and safety (or common defense and security) as preconstruction. Therefore, no radiological safety impacts from preconstruction are expected. Because preconstruction activities would be similar to the construction activities already evaluated for the proposed project and incorporated into the cumulative impact analysis, and the preconstruction effects would be short-term (limited to the duration of the activities) and similar or less than the effects from the proposed construction, the NRC staff consider these effects already addressed in the cumulative impact analysis. Based on the preceding analysis, the NRC staff have determined that the cumulative impact on public and occupational health and safety in the study area resulting from all past, present, and reasonably foreseeable future actions would be SMALL. As described in in the preceding analysis, the estimates of combined radiological exposures from currently operating and proposed future ISR facilities in the study area are far below the regulatory public dose limit of 1.0 mSv/yr [100 mrem/yr] and have a negligible contribution to the 6.2 mSv [620 mrem] average yearly dose for a member of the public from all sources. Nonradiological exposures to workers and the general public from hazardous chemicals and materials resulting from past, present, and reasonably foreseeable future actions would be minimized by the application of common safety practices and compliance with applicable federal and state occupational and public safety regulations.

5.13.1 Summary

In conclusion, the overall cumulative impacts are the incremental impacts from the proposed Reno Creek ISR Project when added to the impacts from past, present, and reasonably foreseeable future actions, such as other ISR facilities and CBM operations. As described in the preceding analysis, the incremental direct and indirect impacts of the proposed Reno Creek ISR Project would be SMALL and the impacts from all past, present, and reasonably foreseeable future actions would also be SMALL. Therefore, the NRC staff conclude that the proposed Reno Creek ISR Project would contribute a SMALL incremental impact on the SMALL cumulative impacts to public and occupational health when added to all other past, present, and reasonably foreseeable future actions in the study area, assuming all appropriate mitigations mentioned previously would be implemented.

5.14 Waste Management

The cumulative impacts on waste management resources are considered within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project ISR Project area. This distance was chosen to encompass nearby operating ISR facilities that could generate nonhazardous solid waste that would be destined for disposal at the same facility expected to be used by the proposed Reno Creek ISR project for disposal of similar waste. The timeframe for the analysis is 2012 to 2030 (see SEIS Section 5.1.2 for the estimated operating life of the facility).

Waste management impacts from the proposed Reno Creek ISR Project would be SMALL and are discussed in detail in SEIS Section 4.14.1. The proposed Reno Creek ISR Project would generate radiological and nonradiological liquid and solid wastes that must be handled and disposed of properly. Waste streams and the types and volumes of wastes to be disposed are described in SEIS Section 2.1.1.1.6. The primary radiological materials that must be disposed are process-related liquid and solid byproduct material (for example, waste treatment solids, process-contaminated structures and soils). As discussed in SEIS Section 4.14.1.1.2, liquid byproduct material generated during operations is composed of production bleed, waste brine streams from elution and precipitation, resin transfer wash, filter backwash water, plant washdown water, and aquifer restoration water. Liquid byproduct material would be treated onsite using ion exchange followed by deep disposal in Class I deep disposal wells. State- and federal-permitting actions, NRC license conditions, and NRC and state inspections ensure that proper waste disposal practices would be used to comply with safety and environmental requirements to protect workers, the public, and the environment.

As described in SEIS Section 4.14.1, the overall impacts from the disposal of process-related liquid byproduct material at the proposed Reno Creek ISR Project would be SMALL based on the applicant's commitment to provide adequate onsite disposal capacity in WDEQ-permitted Class I deep disposal wells and compliance with applicable permits and regulations. In addition, impacts associated with disposal of solid byproduct material would be SMALL based on the required preoperational disposal agreement made between the licensee and the licensed disposal facility that would ensure adequate disposal capacity is available for the duration of the project. Hazardous waste disposal impacts at the proposed Reno Creek ISR Project would be SMALL based on the low volumes of waste generated and disposal in accordance with applicable regulations. Impacts from disposal of nonhazardous solid waste would be SMALL during the construction, operations, aquifer restoration, and decommissioning phases of the proposed project based on estimated volumes and the available capacity of local municipal solid waste landfills.

Past, present and reasonably foreseeable uranium recovery facilities in the vicinity of the proposed Reno Creek ISR Project and within the broader regional area are described in SEIS Section 5.1.1. As noted previously, within an 80-km [50-mi] radius of the proposed Reno Creek ISR Project, there are three operating ISR facilities (Willow Creek, Smith Ranch, Nichols Ranch) and one ISR facility that is licensed but not operating (Moore Ranch). Additionally there are two operating ISR expansions (North Butte, Reynolds Ranch) and five other ISR expansions that are in the planning or licensing stages. These current and potential facilities would generate solid and liquid wastes similar to the proposed Reno Creek ISR Project, which could contribute to waste management effects within the cumulative impacts study area. The applicant has also identified a potential ISR project, Collins Draw in Campbell County (located in between Nichols Ranch and Moore Ranch sites); however, the NRC has not received a letter of intent to submit an application for this site.

Generation of nonhazardous solid waste at operating or planned ISR facilities and expansions could impact landfill resources in the cumulative impacts study area. Considering the analysis timeframe and study area, the NRC staff estimated the cumulative volume of nonhazardous waste generated by those licensed or planned ISR facilities and expansions expected to dispose of their waste at the Campbell County landfill in Gillette. The NRC staff identified four ISR projects (Willow Creek, Nichols Ranch, Moore Ranch, and Reno Creek) and six expansions (North Butte, Ruth, Ruby Ranch, Allemand-Ross, Ludeman, and Jane Dough) that met this analysis criterion. Estimates of total nonhazardous solid waste for the facility lifecycle were available for the following licensed or planned ISR Projects: Reno Creek {29,580 m^3 [38,660 yd^3]} (SEIS Section 2.2.1.1.6); Nichols Ranch {7,960 m^3 [10,400 yd^3]} (NRC, 2011); and Moore Ranch {21,470 m^3 [28,060 yd^3]) (NRC, 2010). The waste volumes for the remaining ISR facilities or expansions were estimated by the NRC staff from available information. The NRC staff estimated the nonhazardous waste volume for the Willow Creek ISR Project by calculating the average of the waste volumes for three previously mentioned ISR sites {19,670 m^3 [25,710 yd^3]}. Additionally, the NRC staff assumed the nonhazardous solid waste volume from ISR expansions (that is, adding wellfields and in some cases ion exchange facilities without a central processing plant) would produce half of the amount of waste as a full ISR project. This assumption is based on the relative decommissioning waste volumes documented in the GEIS (Table 2.6-1) (NRC, 2009) for processing plant facilities and wellfields. Thus, the NRC staff estimated the total nonhazardous waste volume for the six licensed or planned ISR expansions {59,010 m^3 [77,130 yd^3]} by calculating half of the previously described three facility average waste volume {of 19,670 m^3 [25,710 yd^3]} (assumed by the NRC staff to be a representative waste volume for a full ISR project) and multiplying by six expansions. Considering all the preceding estimates, the resulting cumulative nonhazardous waste volume from the applicable licensed or planned ISR facilities and expansions in the study area within the vicinity of the Gillette landfill is 137,700 m^3 [180,000 yd^3]. This volume is approximately 7 percent of the remaining capacity of the Gillette landfill of 1.9 million m^3 [2.5 million yd^3] {calculated as the product of 18 years of remaining capacity and the average annual disposal volume of 106,280 m^3 [138,900 yd^3] from SEIS Section 3.13.2}.

Because the total estimated volume of nonhazardous solid waste from the proposed Reno Creek ISR Project when added to other current and proposed ISR projects in the region is a small fraction of the remaining capacity of the Campbell County landfill in Gillette, Wyoming, the NRC staff conclude that the cumulative impact would be SMALL.

Generation of solid byproduct material at the planned and potential ISR facilities and expansions in the cumulative impacts study area could impact licensed disposal facility resources. Before ISR operations begin, the NRC requires ISR facilities to have an agreement in place with a licensed disposal facility to accept byproduct material, thereby ensuring adequate capacity is available. These agreements limit the impact on byproduct material waste management resources to SMALL for the proposed project and any other operating or planned ISR facilities.

Liquid byproduct material is typically managed at ISR facilities using onsite resources such as Class I deep disposal wells. The applicant has been granted a permit from WDEQ for four Class I deep disposal wells for disposal of liquid byproduct material (SEIS Section 2.1.1.1.6). Additional deep disposal well use in the region by other operating or planned ISR facilities is expected as additional ISR facilities are licensed. The WDEQ-permitting process for these wells evaluates the suitability of proposals to ensure that groundwater resources are protected and potential environmental effects are limited to acceptable levels. Based on the assumption that WDEQ would not permit deep injection wells that would have a significant potential to impact groundwater resources, the NRC staff conclude that the cumulative impacts of using Class I deep disposal wells for the proposed project, along with the potential impacts from present and reasonably foreseeable future actions, would be SMALL.

Other ongoing and reasonably foreseeable future activities in the vicinity of the proposed Reno Creek ISR Project area, such as oil and gas production (SEIS Sections 5.1.1.3 and 5.1.1.4) and coal mining (SEIS Section 5.1.1.2), would produce additional nonradiological waste materials. These projects would use and generate hazardous materials and would need to dispose of solid and hazardous wastes. Each project would also be responsible for complying with applicable federal and state regulations and site-specific permitting requirements or conditions that control management of generated wastes. A recent evaluation of past, present, and reasonably foreseeable future actions in the PRB (BLM, 2011) projected future development trends for conventional oil and natural gas, CBM, and coal mining to year 2030. Conventional oil and natural gas production was projected to increase from the present to year 2030 (BLM, 2011). CBM production is currently below levels that were previously projected (BLM, 2003) and were expected to decline between the current timeframe and 2030. Coal mining was noted as declining since 2009 and, while future uncertainties were noted, projected to increase by 2030 to at least the previous peak (2009) levels (low estimate) or increase by as much as 38 percent above 2009 production levels (high estimate). These projections suggest that the level of activity, and therefore combined waste generation from these activities, is unlikely to increase during the timeframe of the analysis. Additionally, coal mines are not large generators of hazardous waste (BLM, 2012b), and therefore hazardous waste generation and potential effects to disposal resources are not expected to change from these activities. Regarding the generation of nonhazardous solid waste, the annual volumes disposed at local landfills {106,280 m^3 [138,900 yd^3] at Campbell County landfill and 191,280 m^3 [250,000 yd^3] at the Casper landfill} reflect the current regional cumulative demand for disposal capacity, and the available landfills have projected capacity to operate beyond year 2030 (SEIS Section 3.13.2). Therefore, potential impacts from other ongoing and reasonably foreseeable future activities in the vicinity of the proposed Reno Creek ISR Project area on these resources would be SMALL.

The potential impacts on waste management resources from preconstruction activities would include generating wastes similar to the wastes produced during the construction phase that would require handling, storage, and disposal (AUC, 2014). These include normal construction debris that would be classified as nonhazardous solid waste, hazardous waste, used oil, and domestic sewage. Because preconstruction precedes operations, no byproduct material would be produced. Because preconstruction activities are similar to the construction activities already evaluated for the proposed project and incorporated into the cumulative impact analysis, and the preconstruction effects would be short-term (limited to the 26-week duration of the activities) with similar or lower waste generation than the proposed construction, the NRC staff consider these SMALL impacts are already adequately addressed in the cumulative impact analysis.

Based on the preceding analysis, the NRC staff have determined that the cumulative impact on waste management resources resulting from all past, present, and reasonably foreseeable future actions in the study area is SMALL. As described in the preceding analysis the required disposal agreements for byproduct material from NRC-licensed ISR facilities would ensure disposal capacity is available to all ISR facilities prior to operations. The projected volume of nonhazardous solid waste from the proposed Reno Creek ISR project, when combined with other current and potential future ISR facilities, is a small percentage of available disposal capacity over the duration of the proposed project. Projected trends for oil and gas, CBM, and coal mining indicate these other regional activities suggest declining production except for coal, which could grow modestly between the current timeframe and year 2030. Preconstruction activities at ISR facilities would generate wastes similar to construction at similar or lower rates for a limited time and would therefore not significantly change the waste management impacts.

5.14.1 Summary

The overall cumulative impacts are the incremental impacts from the proposed Reno Creek ISR Project when added to the impacts from past, present, and reasonably foreseeable future actions. As described in the preceding analysis, the incremental impacts of the proposed Reno Creek ISR Project would be SMALL and the impacts from all past, present, and reasonably foreseeable future actions would also be SMALL. Therefore, the NRC staff conclude that the proposed Reno Creek ISR Project would contribute a SMALL incremental impact on the SMALL impacts on waste management resources from other past, present, and reasonably foreseeable future actions in the study area (assuming all appropriate mitigations are followed) and, therefore, the overall cumulative impact on waste management resources would be SMALL.

5.15 References

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6 MITIGATION

6.1 Introduction

The Generic Environmental Impact Statement (GEIS) for In Situ Leach Uranium Milling Facilities (NRC, 2009) described potential mitigation measures that a licensee or facility operator might use to reduce potential adverse impacts associated with construction, operations, aquifer restoration, and decommissioning of an in situ recovery (ISR) milling facility. Under Title 40 of the *Code of Federal Regulations* (CFR) 40 CFR 1508.20, the Council on Environmental Quality defines mitigation to include activities that

- avoid the impact altogether by not taking a certain action or parts of a certain action;
- minimize impacts by limiting the degree or magnitude of the action and its implementation;
- rectify the impact by repairing, rehabilitating, or restoring the affected environment;
- reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action; and
- compensate for the impact by replacing or providing substitute resources or environments.

Mitigation measures are those actions or processes that would be implemented to control and minimize potential adverse impacts from construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project. Potential mitigation measures can include general best management practices (BMPs) and more site-specific management actions.

BMPs are processes, techniques, procedures, or considerations that can be used to effectively avoid or reduce potential environmental impacts. While BMPs are not regulatory requirements, they can overlap with and support such requirements. BMPs will not replace any U.S. Nuclear Regulatory Commission (NRC) requirements or other federal, state, or local regulations.

Management actions are active measures that a licensee or facility operator specifically implements to reduce potential adverse impacts to a specific resource area. These actions include compliance with applicable government agency stipulations or specific guidance, coordination with governmental agencies or interested parties, and monitoring of relevant ongoing and future activities. If appropriate, corrective actions could be implemented to limit the degree or magnitude of a specific action leading to an adverse impact (reducing or eliminating the impact over time by preservation and maintenance operations) and repairing, rehabilitating, or restoring the affected environment. The licensee may also minimize potential adverse impacts by implementing specific management actions, such as programs, procedures, and controls for monitoring, measuring, and documenting specific goals or targets and, if appropriate, instituting corrective actions. The management actions may be established through standard operating procedures that appropriate local, state, and federal agencies (including NRC) review and approve. The NRC may also establish requirements for management actions by identifying license conditions. These conditions are written specifically into the NRC license and then become commitments that are enforced through periodic NRC inspections.

The mitigation measures that AUC, LLC (AUC) proposed to reduce and minimize adverse environmental impacts at the proposed Reno Creek ISR Project are summarized in this Supplemental Environmental Impact Statement (SEIS) in Section 6.2. Based on the potential impacts identified in Chapter 4 of this SEIS, the NRC staff have identified additional potential mitigation measures for the proposed Reno Creek ISR Project. These mitigation measures are summarized in SEIS Section 6.3. The proposed mitigation measures provided in this chapter do not include environmental monitoring activities. Environmental monitoring activities are described in SEIS Chapter 7.

6.2 Mitigation Measures Proposed by AUC

The applicant identified mitigation measures in its license application (AUC, 2012a,b) as well as in response to the NRC staff's requests for additional information (RAIs) (AUC, 2014a–c). SEIS Table 6-1 lists the mitigation measures proposed for each resource area. Because many of the applicant's proposed mitigation measures would apply to all four phases of the ISR process, they are listed together in the table.

6.3 Potential Mitigation Measures Identified by the NRC

The NRC staff have reviewed the mitigation measures the applicant proposed and has identified additional mitigation measures that could potentially reduce impacts (SEIS Table 6-2). The NRC has the authority to address unique site-specific characteristics by identifying license conditions, based on conclusions reached in the safety and environmental reviews. These license conditions could include additional mitigation measures, such as modifications to required monitoring programs. While the NRC cannot impose mitigation outside its regulatory authority under the Atomic Energy Act, the NRC staff have identified mitigation measures in SEIS Table 6-2 that could potentially reduce the impacts of the proposed Reno Creek ISR Project. These additional mitigation measures are not requirements being imposed upon the applicant. For the purposes of the National Environmental Policy Act, and consistent with 10 CFR 51.71(d) and 51.80(a), the NRC is disclosing measures that could potentially reduce or avoid environmental impacts of the proposed project.

Table 6-1.	Summary of Mitigation Measures Proposed by AUC	
Resource Area	**Activity**	**Proposed Mitigation Measures**
Land Use	Land Disturbance	Restore and re-seed disturbed areas as soon as practicable with an approved seed mix designed to stabilize soils from erosion and reduce the potential for exotic invasive plants. Reclaim compacted soils and reestablish vegetation in areas disturbed by drilling, pipeline installation, road installation, and facility construction, as soon as construction activities are completed. Restrict normal vehicular traffic to designated roads, and keep traffic in wellfields to a minimum. Develop wellfields sequentially, and restore and reclaim wellfields in interim steps to minimize land area impacted at any one time. Use existing county roads and oil and gas development access roads, to the extent possible, to minimize construction of new access roads. Construct secondary and tertiary access roads to be as narrow as practicable to minimize disturbance. Construct roads using techniques that will minimize erosion, such as building stream crossings at right angles with adequate culvert installation and minimizing cut and fill during access road construction. Use common corridors when locating access roads, pipelines, and utilities.
	Access Restrictions	Construct fences around processing facilities, storage ponds, and deep disposal wells. Construct temporary fencing around production wellfields, and remove fencing after operations and reclamation of each wellfield is completed. Execute agreements with surface owners/lessees to provide mitigation or compensation for temporary loss of areas currently used for livestock grazing or crop production. Limit access to monitoring wells, Class I deep disposal wells, and header houses by (i) covering each monitoring well with a locking device, (ii) securing the well head and pumping equipment for Class I deep disposal wells within locked buildings, and (iii) securing header houses within the fenced area of the wellfield. Implement fencing construction techniques to minimize habitat alteration and impediments to large game migration. Work with the Office of State Lands and Investments (BLC), the Wyoming Game and Fish Division, and private landowners to limit recreational activities (primarily hunting) within the proposed project area, to the extent practicable.
	Mineral Rights	Develop working relationships with the oil and gas production companies operating within the proposed project area (currently Williams Production RMT Company, Yates Petroleum Corporation, Lance Oil and Gas Company, and Bill Barrett Corporation, Ballard Petroleum, True Oil, EOG, and Peak Powder River) to help minimize potential conflicts over infrastructure placement and utilization. Develop working relationships with other mineral production companies that become operational during the life of the project.

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Transportation	Transportation Safety	Maintain access roads, and impose speed limits to minimize or eliminate accidents and collisions. Improve signage on affected portions of Clarkelen/Turnercrest Road and Highway 387. Implement speed limits on access roads within the proposed project area. Enforcement of speed limits on county roads for applicant employees and contractors. Implement a carpooling plan for employees to the proposed project area to reduce wear on roads and reduce air quality emissions. Comply with all applicable U.S. Nuclear Regulatory Commission (NRC) and U.S. Department of Transportation packaging and transportation requirements for all shipments of yellowcake, process chemicals, ion-exchange resins, fuel, and radioactive materials to mitigate the potential impacts of a transportation accident. Use dedicated tanker trucks for transporting uranium-loaded or uranium-stripped resins between the central processing plant and satellite facilities. Survey the exterior and cab of the shipping truck for radiological contamination prior to each shipment of uranium-loaded or uranium-stripped resin or yellowcake. Equip both the transport vehicle and shipping facilities with communication devices that allow direct communication with the shipper or receiver.
	Emergency Response	Communicate with local and state authorities on transportation and emergency response training and procedures. Use standard operating procedures for transportation and emergency response. Train drivers on transportation accident response based on the specific material(s) shipped. The transport companies will also have standing contracts with environmental emergency response contractors for spill cleanup. Supply both shipping and receiving facilities with emergency response kits. Ensure each resin or yellowcake transport vehicle carries an emergency spill kit that would help contain material in the event of a spill. Maintain shipping records (bill of lading) to identify the characteristics and quantity of material shipped. Notify the NRC if a radiological accident occurs, pursuant to requirements of Title 10 of the *Code of Federal Regulations* (CFR) 10 Part 20.

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Geology and Soils	Soil Disturbance and Contamination	Salvage topsoil in stockpiles on the leeward side of hills, in accordance with the Wyoming Department of Environmental Quality (WDEQ) guidelines and conditions of the WDEQ Permit to Mine. Slope topsoil stockpiles with a 3:1 grade or flatter, and revegetate as soon as practicable using an approved seed mix to minimize wind and water erosion. Temporarily store subsoil from mud pit excavations separately from topsoil stockpiles, and redeposit subsoil as mud pit backfill when the use of the mud pit is complete. Reuse subsoil from facility construction activities in areas such as the backup storage pond and primary access road embankments. Reestablish temporary or permanent native vegetation as soon as possible after disturbance, typically within one construction season. Decrease runoff from disturbed areas by using structures to temporarily divert and/or dissipate surface runoff from undisturbed areas. Retain sediment within the disturbed areas by using silt fencing, sediment logs, and hay bale check dams. Fill pipeline and utility trenches with appropriate material, and regrade surfaces soon after completion. Design drainages to minimize the potential for erosion by routing stormwater away from disturbed areas. Use existing roads, limit secondary and tertiary road widths, and implement a single-direction-of-travel policy to access wellfield facilities to minimize soil compaction. Use a spill prevention and cleanup plan to minimize soil contamination from vehicle accidents and/or wellfield spills or leaks. Protect production wellfields and monitoring wells from flooding by installing cement seals around well casings and using watertight well caps. Collect and monitor soils and sediments for potential contamination, including areas treated for dust control with chemical dust suppression compounds used to transport routes for yellowcake and ion-exchange resins and wellfield areas where spills or leaks are possible. Remove and dispose of contaminated soil in accordance with NRC and state requirements. Obtain either the industrial or individual Wyoming Pollutant Discharge Elimination System (WYPDES) permit, in accordance with WDEQ regulations, and implement mitigation measures to control erosion, runoff, and sedimentation. Monitoring and maintaining injection pressures in Class I and Class III Underground Injection Control (UIC) wells at a level that does not exceed fracture pressures specified in its UIC permit.

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Surface Water Resources	Erosion, Runoff, and Sedimentation	Minimizing surface water crossings and avoid wetlands during road construction. Construct access roads perpendicular to the direction of surface water flow, and minimize cut and fill during access road construction. Follow U.S. Army Corps of Engineers (USACE) construction practices to reduce potential impacts to wetlands. Refrain from consuming or discharging to surface waters. Obtain USACE permits and authorization from WDEQ when filling and crossing jurisdictional waters. Obtain an industrial WYPDES permit, in accordance with WDEQ regulations, and implement mitigation measures to control erosion, runoff, and sedimentation. Construct the central processing plant and supporting buildings outside the 100-year floodplain, and install a flood control diversion channel designed to redirect runoff from a 100-year, 24-hour precipitation event. Design drainage structures to route stormwater runoff away from structures, roads, the backup storage pond, parking areas, and chemical storage areas. Construct a system of structures, such as straw bales, collector ditches, and engineered diversion structures or berms to protect facilities and infrastructures (e.g., storage ponds, access roads, plant-to-plant pipelines, wellfields) that will be located within the 100-year inundation boundary to protect them from flood damage. Recontour land surfaces to restore surface drainage to blend with the natural terrain after completion of the proposed in situ recovery (ISR) project.
	Spills and Leaks	Develop and implement spill-response procedures to correct and remediate accidental spills. Provide containment curbs around and collection sumps in containment areas designed to contain the largest liquid-containing vessel. Equip wellfield facilities with leak detection equipment, which will signal alarms at the central processing plant. Perform weekly inspections of wellfield facilities and well heads. Construct the backup storage pond to meet the requirements for lining systems under WDEQ Water Quality Rules and Regulations and for embankment retention systems under NRC Regulatory Guide 3.11. Place liners, underdrains, and leak-detection systems underneath ponds associated with water treatment or storage of untreated or partially treated water (i.e., storage ponds, spare ponds, and central plant pond), and place liners underneath ponds that contain treated water (i.e., storage ponds and spare storage ponds). Bury pipelines to avoid freezing, and monitor pipeline pressures to detect leaks. Report all regulated substance spills that occur at the proposed project to the WDEQ, in accordance with Administrative Rules of WDEQ, and remediate in accordance with state requirements.

Table 6-1.	Summary of Mitigation Measures Proposed by AUC (Continued)	
Resource Area	**Activity**	**Proposed Mitigation Measures**
Groundwater Resources	Water Use	Obtain Class III UIC permit and aquifer exemption. After obtaining a Class I UIC permit for deep well disposal of liquid byproduct material, construct. operate, and abandon Class I deep disposal wells to comply with WDEQ Class I disposal well permit conditions. Minimize consumptive use of groundwater during operations and groundwater restoration phases. Obtain water appropriation permits to utilize groundwater from the overlying aquifer. Monitor private domestic, livestock, and agricultural wells, as appropriate, during operations, and provide alternative sources of water to landowners in the event of significant drawdown to wells within and adjacent to the proposed project area.
	Spills and Leaks	Obtain construction and industrial WYPDES permits from the WDEQ, which require reporting of spills of petroleum products or hazardous chemicals. Develop and implement spill response procedures to correct and remediate accidental spills. Construct production and monitoring wells using methods approved by the WDEQ for construction requirements. Construct the backup storage pond lining system to meet the requirements of the WDEQ Water Quality Rules and Regulations, so that it is appropriate to the pond usage and contents to prevent potential infiltration of liquid waste into soil and shallow aquifers. Bury pipelines to avoid freezing, and monitor pipeline pressures to detect leaks. Report all regulated substance spills that occur at the site to the WDEQ, and remediate in accordance with state requirements. Install leak detection and warning systems in all wellfield facilities.

Table 6-1.	Summary of Mitigation Measures Proposed by AUC (Continued)	
Resource Area	**Activity**	**Proposed Mitigation Measures**
	Excursions	No new stock or drinking water wells will be located in the proposed ISR operation areas and none would be completed in the ore bearing aquifer where production will occur. Ensure that any future stock wells would be completed in either shallower or deeper sands that are not impacted by ISR operations, or provide another source of stock water. Conduct precise and periodic mechanical integrity testing of all production, injection, and monitoring wells prior to their use. All production and injection wells would be mechanical integrity tested during their use to limit the likelihood of well integrity failure during operations. Properly plug and abandon all boreholes in the project area and within proximity to well fields if leakage through old boreholes is a potential problem prior to the initiation of ISR operations. Collect detailed lithologic and hydrogeological data in each proposed wellfield prior to ISR operations to ensure hydraulic control of the production zone. Plug wells in accordance with WDEQ and Wyoming State Engineer's Office requirements. Plug and abandon or mitigate any of the following, should they pose a potential to impact the control and containment of wellfield solutions within the proposed project area: (i) historical wells and exploration holes, (ii) holes drilled by the applicant for delineation and exploration, and (iii) any well failing mechanical integrity testing. Adjust production bleed rate so that the inward flow gradient is maintained to prevent lixiviant excursions. Conduct ISR operations only in geologically confined portions of production aquifers.
	Restoration/ Reclamation	Install monitoring wells within and encircling the production zone for early detection of potential horizontal excursions. Install monitoring wells in aquifers above and below the production aquifer for early detection of potential vertical excursions. Implement corrective actions, and provide required notifications and reports to the NRC, in the event of an excursion. Submit the Production Unit Hydrologic Data Packages to the Wyoming Department of Environmental Quality (WDEQ) for review and approval before ISR operations commence. The applicant would submit the first Production Unit Hydrologic Data Package to the NRC staff for review and verification. The applicant would submit all subsequent Production Unit Hydrologic Data Packages to NRC staff for review. Return groundwater quality in the production zone to NRC-approved groundwater protection standards upon completion of ISR operations as required by 10 CFR Part 40, Appendix A, Criterion 5B(5). Plug and abandon all monitoring and production wells in accordance with applicable federal and state regulations, as part of decommissioning activities.

Table 6-1.	Summary of Mitigation Measures Proposed by AUC (Continued)	
Resource Area	**Activity**	**Proposed Mitigation Measures**
Ecology	Restoration/ Reclamation	Minimize disturbance of surface areas and vegetation, where possible (also benefits wildlife). Construct any new roads, power lines, and pipelines in the same above-ground and below-ground corridors, to the extent possible, to reduce overall vegetation and wildlife habitat disturbance and minimize new surface disturbance. Salvage topsoil to minimize erosion. Restore creek channels, wetland habitat, and sagebrush and other shrubs to reduce impacts to native species and their habitat. Restore diverse landforms and topsoil replacement, and construct brush piles, snags, and/or rock piles to enhance habitat for wildlife. Impose dust control measures, as described in SEIS Section 4.7 (Air Quality) to limit dust deposition on vegetation, both on and offsite, affecting the forage ability for obligate species. Implement weed control, as needed, to limit the spread of noxious, invasive, and nonnative species on disturbed areas. Reestablish temporary or permanent native vegetation as soon as possible after disturbance. Minimize the spread of undesirable, invasive, and nonnative species (weeds) in disturbed areas.
	Transmission Lines	Design any new power lines to follow the 2006 Avian Power Line Interaction Committee guidelines to reduce bird injuries and mortalities.
	Reduce Human Disturbances	Follow the land use mitigation measures for land disturbance activities and access restrictions, which will also minimize impacts to vegetation and wildlife. Enforce speed limits to minimize collisions with wildlife. Prepare a U.S. Fish and Wildlife Service (FWS)-approved migratory bird monitoring and mitigation plan to minimize conflicts between nest sites and project-related activities, if direct impacts to raptors and migratory birds occur. Prepare a FWS-approved raptor monitoring and mitigation plan prior to construction and operations. Employ operational practices to prevent birds from using the backup storage pond/surface impoundments

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Air Quality	Fugitive Dust and Combustion Emissions From Construction Equipment and Vehicles	Minimize land surface disturbance by constructing secondary and tertiary access roads as narrowly as practicable to reduce fugitive dust. Use drill rigs with engines no larger than 300 horsepower (except for the deep well drill rig) to limit combustion emissions. Use Tier 1 drill rig engines and Tier 3 construction equipment engines to limit combustion emissions. Use water or chemical dust suppression compounds to minimize fugitive dust generated from onsite unpaved roads. Impose speed limits to reduce vehicle emissions and dust generated by vehicles. Implement a single-direction-of-travel policy on roads that access wellfield facilities to limit dust generated by vehicles. Implement an employee carpooling policy. Restore or reseed disturbed areas promptly to limit the exposed/disturbed area at any given time. Coordinate construction and transportation activities to reduce maximum dust levels. Maintain vehicles to meet applicable EPA emission standards.
Noise	Exposure of Workers and Public to Noise	Avoid construction activities during the night. Impose speed limits to reduce vehicle noise. Use sound abatement controls on operating equipment and facilities, such as locating process machinery inside, and restrict drilling to daytime hours (7 a.m. to 8 p.m.) in areas where the annoyance noise threshold could be exceeded at nearby residences. Use personal hearing protection for workers in high noise areas. Adhere to regulatory timing and spatial restrictions with regard to construction activities near raptor nests. Locate all planned facilities outside of BLM-recommended buffer zones of raptor nests identified within the project area. Follow an FWS-approved raptor monitoring and mitigation plan to reduce conflicts between active raptor nests and project-related activities.
Cultural and Historic Resources	Disturbance of Prehistoric Archaeological Sites and Sites Eligible for Listing on the National Register of Historic Places (NRHP)	Prepare an inadvertent discovery plan to manage AUC's activities in the event of a discovery of cultural resources during any phase of the project. Prepare an internal cultural resources management plan, if cultural resources are identified in the area of potential effect or if areas with a high potential to contain cultural material are identified. Cease any work upon the inadvertent discovery of cultural resources during any phase of the project until the resources can be evaluated by a professional archaeologist. Use existing roads, to the maximum extent feasible, to avoid additional surface disturbance.

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Visual and Scenic	Potential Visual Intrusions in the Existing Landscape Character	Follow the land use mitigation measures for land disturbance activities, which will also minimize impacts to vegetation and wildlife. Cover wellheads with low structures that present low contrast with existing landscape. Reclaim disturbed areas, and remove debris after construction is complete. Remove and reclaim roads and structures after operations are complete. Select building materials and paint that complement the natural environment. Consider landscape topography to conceal wellheads, plant facilities, access roads, and other areas of disturbance from public vantage points. Use standard dust control measures, including water or chemical dust suppression compound application, speed limits, and coordinating dust-producing activities to reduce visible fugitive dust. Limit nighttime activities to reduce lighting needs. Consider using exterior lighting only where needed, limiting the height of exterior lighting units, and using shielded or directional lighting to limit lighting to where it is needed and without jeopardizing site security and/or worker safety.
Socioeconomics	Effects on Surrounding Communities	Preferentially source the labor force from the surrounding region to reduce any burden on public services and community infrastructure (e.g., housing, schools) in nearby towns.
Public and Occupational Health and Safety	Effects From Facility Construction	Implement standard dust control measures, such as water application and speed limits, to reduce and control fugitive dust emissions. Comply with federal and state occupational safety regulations to limit nonradiological impacts of fugitive dust and diesel emissions to acceptable levels.

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
	Effects From Facility Operation	Communicate with local and state authorities on transportation of material shipments and provide emergency response training and procedures for local emergency personnel. Design buildings and structures to the 2,500-year seismic probability standards in the International Building Code. Store hazardous chemicals away from incompatible chemicals and away from areas populated by workers to reduce the risk of injury during an accidental release. Reduce radiological exposure to workers by (i) installing ventilation designed to limit worker exposure to radon; (ii) installing gamma exposure rate monitors, air particulate monitors, and radon daughter product monitors to verify that expected radiation levels are not exceeded; and (iii) conducting work area radiation and contamination surveys. Use pressurized down-flow ion-exchange columns, pressure piping, and vacuum dryer technology during normal operations to limit radiological emissions other than radon gas. Comply with an NRC-approved Radiation Protection Program that would include routine radiation surveys, respiratory protection, standard operating procedures for spill response and cleanup, and worker training in radiological health and emergency response. Monitor radiation workers via use of dosimeters and area air sampling to ensure that radiological doses remain within regulatory limits and as low as reasonably achievable. Implement engineering controls, such as concrete curbs and sumps, to contain process spills resulting from accidents. Perform radiological surveys, soil sampling, and analysis during and following accidents from radioactive material shipments to confirm cleanup, and provide a report to the NRC to verify that contaminants have been removed, in accordance with 10 CFR 20.2202 and 20.2203. Comply with applicable EPA, Occupational Safety and Health Administration and WDEQ regulations concerning the use, inspection, and storage of hazardous and nonhazardous chemicals. Develop and implement standard operating procedures regarding receiving, storing, handling, and disposing of chemicals.
Waste Management	Disposal/Capacity	Establish a solid byproduct material disposal agreement with a licensed facility prior to the start of operations. Dispose of all soil contaminated by leaks or spills at an off-site licensed disposal facility. Dispose of all petroleum-contaminated soil potentially generated at a WDEQ licensed facility.

Table 6-1. Summary of Mitigation Measures Proposed by AUC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
	Waste Reduction	Recycle wastewater to reduce the amount of water needed for facilities and the amount of wastewater that could require disposal. Use decontamination techniques that reduce waste generation. Institute preventive maintenance and inventory management programs to minimize waste from breakdowns and overstocking. Develop a standard operating procedure to maximize the amount of recycling; minimize the production of hazardous waste; and for the collection, sorting, and temporary storage of all solid, non-hazardous solid waste. Salvage extra materials, and use them for other construction activities.
	Waste Storage and Containment	Avoid using hazardous materials when possible. Store and properly label hazardous chemicals in an appropriate area away from byproduct material to prevent any potential release. Isolate byproduct material inside a restricted area until a full shipment can be transferred to an NRC-approved disposal site. Install curbs or berms on all liquid waste storage areas. Install leak detection and warning systems in all liquid waste facilities. Develop a spill prevention plan for petroleum products and other hazardous materials. Ensure that equipment is available to respond to spills, and identify the location of such equipment. Inspect and replace worn or damaged components.

Table 6-2. Summary of Mitigation Measures Identified by the NRC		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Land Use	Land Disturbance	Use best management practices (BMPs) to control waste disposal, erosion, and runoff to limit the effect of facility operation on surrounding land use.
Transportation	Transportation Safety	Use accepted industry codes and standards for handling and transporting hazardous chemicals. Implement safe driving training for personnel and truck drivers. Use check-in/check-out or global positioning satellite technology to track shipments.
Geology and Soils	Soils	Maintain a log of all spills occurring at the site, whether or not these spills are reportable to U.S. Nuclear Regulatory Commission (NRC) per Title 10 of the *Code of Federal Regulations* (CFR) 10 Part 40.60. Implement alternatives or mitigation measures to manage drilling fluid during well drilling operations, including (i) lining mud pits with an impermeable membrane, (ii) disposing of potentially contaminated drilling mud and other fluids offsite, and (iii) using portable tanks or tubs to contain drilling mud and other fluids.
Surface Water Resources	Water Quality	Collect monthly preoperational water quality samples from streams and quarterly preoperational water quality samples from impoundments.

Table 6-2. Summary of Mitigation Measures Identified by the NRC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Groundwater Resources	Contamination and Excursions	Locate all boreholes and wells within 305 meters [1,000 feet] of a wellfield, if possible, and properly plug and abandon them. Submit results of the hydrogeological characterization and aquifer pump tests (hydrologic test data packages) for NRC review and written verification or approval prior to development of any proposed wellfields. Prior to in situ recovery operations in partially saturated portions of the aquifer, require the applicant to demonstrate the ability to detect and remediate excursions in partially saturated production zones. Monitor potential mobilization and migration of contaminants from abandoned open-pit mines into production zones during aquifer restoration.
Ecology	Restoration/Reclamation	Use weed control techniques that incorporate BMPs approved by Wyoming Department of Environmental Quality (WDEQ). Use seed mixes that are beneficial to pollinators, birds, and other wildlife Place anti-perch devices over vents that could be hazardous to birds Employ operational practices (e.g. netting or screening) to deter birds and other wildlife from using mud pits after 30 days of excavation
	Fencing and Screening	Cover vent pipes with either netting or other methods to prevent bats, birds, or small mammals from being trapped.
	Transmission Lines	Bury transmission lines after step-down to minimize risks to raptors and large birds. Adhere to timing and spatial restrictions within specified distances of occupied and unoccupied migratory bird and raptor nests, as determined by appropriate regulatory agencies [e.g., U.S. Fish and Wildlife Service (FWS), Wyoming Game and Fish Division, and Bureau of Land Management]. Develop a written FWS-reviewed bird mitigation and monitoring plan that is incorporated into the mine permit before beginning project activities.
	Reduce Human Disturbances	Allow snakes and lizards that are encountered to retreat. Inform employees of applicable wildlife laws and penalties associated with unlawful taking and harassment of wildlife. Train employees on (i) the types of wildlife in the area susceptible to collisions with motor vehicles, (ii) the circumstances when collisions are most likely to occur, and (iii) measures that should be taken to avoid wildlife–vehicle collisions. Sign and gate, as needed, all new and improved roads related to the proposed project to minimize public traffic. Comply with applicable state and local requirements to design or treat mud pits and ponds to prevent the development of favorable mosquito habitat (to reduce possible transmission of West Nile virus). Remove road-killed animals from roadways to reduce scavenging Cover openings with mesh or screen to prevent birds or other small animals from entering structures. Follow the geology and soils alternatives or mitigation measures to manage drilling fluid, which will also minimize impacts to vegetation and wildlife.

Table 6-2. Summary of Mitigation Measures Identified by the NRC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Air Quality	Fugitive Dust and Combustion Emissions from Construction Equipment and Vehicles	Implement fuel-saving practices, such as minimizing vehicle and equipment idle time or utilizing a no-idle rule. Utilize fossil-fuel vehicles that meet the latest emission standards. Utilize newer, cleaner-running equipment (e.g., using drill rig engines and construction equipment engines with higher tier levels than the applicant specified in SEIS Table 6-1). Utilize add-on controls such as catalyst and diesel particulate filters for the drill rigs. Minimize unnecessary travel. Ensure that diesel-powered construction equipment and drill rigs are properly tuned and maintained. Limit access to construction sites, staging areas, and wellfields to authorized vehicles only, through designated treated roads. Pave or put gravel on dirt roads and parking lots, if appropriate. Develop and implement a fugitive dust control plan. Cover trucks carrying soil and debris to reduce dust emissions from the back of trucks. Burn low-sulfur fuels in all diesel engines and generators. Train workers to comply with the speed limit, use good engineering practices, minimize disturbed areas, and employ other BMPs, as appropriate. To the extent practicable, avoid conducting soil-disturbing activities, and travel on unpaved roads during periods of unfavorable meteorological conditions (e.g., high winds). Implement any permit conditions identified in the WDEQ air permit, if applicable. Limit the numbers of hours in a day that effluent-generating activities can be conducted. Perform road maintenance (i.e., promptly remove earthen material on paved roads). Apply erosion mitigation methods on disturbed lands.
Noise	Exposure of Workers and the Public to Noise	Maintain noise levels in work areas to below Occupational Safety and Health Administration regulatory limits.
Cultural and Historic Resources	Disturbance of Prehistoric Archaeological Sites and Sites Eligible for Listing on the National Register of Historic Places (NRHP)	Stop work upon discovery of previously undocumented historic and cultural resources, and notify appropriate federal, tribal, and state agencies with regard to mitigation measures. Develop an agreement outlining the mitigation process for each affected resource and why sites cannot be avoided, if required. Prior to construction, develop an Unexpected Discovery Plan that will outline the steps required in the event that unexpected historical and cultural resources are encountered at the site. Submit a decommissioning plan for NRC review to ensure compliance with Section 106 of National Historic Preservation Act during the decommissioning phase.

Table 6-2. Summary of Mitigation Measures Identified by the NRC (Continued)		
Resource Area	**Activity**	**Proposed Mitigation Measures**
Visual and Scenic	Potential Visual Intrusions in the Existing Landscape Character	Limit the number of drill rigs operating during wellfield construction. To the extent possible, use existing secondary roads within the project area to access wellfields, and other facility infrastructure.
Socioeconomics	Effects on Surrounding Communities	Coordinate emergency response activities with local authorities, fire departments, medical facilities, and other emergency services before operations begin.
Occupational and Public Health and Safety	Effects from Facility Operation	Use high-efficiency particulate air filters or similar controls for particulates. Design task procedures to reduce potential accidents. Develop contingency plans with county and municipal governments to ensure adequate medical, fire, and emergency services are available in case of a major accident.
Waste Management	Disposal Capacity	Dispose of decommissioning nonhazardous solid waste at the Casper landfill in the event that the disposal capacities of local landfills are limited or otherwise unavailable at the time of decommissioning.

6.4 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20. “Standards for Protection Against Radiation.” Washington, DC: U.S. Government Printing Office.

10 CFR Part 40. Code of Federal Regulations, Title 10, *Energy*, Part 40. “Domestic Licensing of Source Material.” Washington, DC: U.S. Government Printing Office.

10 CFR Part 40. Code of Federal Regulations, Title 10, *Energy*, Part 40. Appendix A. “Criteria Relating to the Operation of Uranium Mills and to the Disposition of Tailings or Wastes Produced by the Extraction and Concentration of Source Material from Ores Processed Primarily from their Source Material Content.” Washington, DC: U.S. Government Printing Office.

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 1508. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 1508. “Terminology and Index.” Washington, DC: U.S. Government Printing Office.

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, RAI Response Package: Environmental Report Round 1.” ML14169A450 and ML14169A449. Lakewood, Colorado: AUC, LLC. 2014a.

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, RAI Response Package: Technical Report Round 1.” ML14169A447. Lakewood, Colorado: AUC, LLC. 2014b.

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, RAI Response Package: Environmental Report Round 2.” ML15002A082. Lakewood, Colorado: AUC, LLC. 2014c.

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Avian Power Line Interaction Committee. “Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006.” ML12243A391. Washington, DC: Edison Electric Institute; and Sacramento, California: Avian Power Line Interaction Committee and the California Energy Commission. 2006.

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7 ENVIRONMENTAL MEASURES AND MONITORING PROGRAMS

7.1 Introduction

As discussed in Section 8.0 of NUREG–1910, Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (GEIS) (NRC, 2009), monitoring programs are developed for in situ uranium recovery (ISR) facilities to verify compliance with standards for the protection of worker health and safety in operational areas and for protection of the public and environment beyond the facility boundary. Monitoring programs provide data on operational and environmental conditions so that prompt corrective actions can be implemented when adverse conditions are detected. Thus, these programs help to limit potential environmental impacts at ISR facilities and the surrounding areas.

Required monitoring programs or those proposed in the license application, can be modified to address unique site-specific characteristics by adding license conditions to address finding from the U.S. Nuclear Regulatory Commission (NRC) safety and environmental reviews. The NRC staff are conducting the safety review of the proposed Reno Creek ISR Project, which will be documented in a Safety Evaluation Report (SER), and any license conditions resulting from the safety review would be discussed in the final supplemental environmental impact statement (SEIS). The description of the proposed monitoring programs for the proposed Reno Creek ISR Project is organized as follows:

- Radiological Monitoring (Section 7.2)
- Physiochemical Monitoring (Section 7.3)
- Ecological Monitoring (Section 7.4)

The occurrence of spills and leaks at ISR facilities is considered in GEIS Section 2.11.2 (NRC, 2009), and the management of spills and leaks is not part of the routine environmental monitoring program described herein. Rather, spills and leaks, including the design of the infrastructure to detect leaks, are described in the NRC SER.

7.2 Radiological Monitoring

This section discusses AUC, LLC's (hereafter AUC, or the applicant) proposed radiological monitoring program, as described in its license application (AUC, 2012a,b), supporting documents for the proposed Reno Creek ISR Project, and subsequent responses to NRC requests for additional information (RAIs) (AUC, 2014a,b). The purpose of the monitoring program is to (i) characterize and evaluate the radiological environment, (ii) provide data on measurable levels of radiation and radioactivity, and (iii) provide data on the principal pathways of radiological exposure to the public (NRC, 2003).

In accordance with NRC regulations in Title 10 of the *Code of Federal Regulations* (CFR) 10 CFR Part 40, Appendix A, Criterion 7, a preoperational monitoring program is required to establish facility baseline conditions. After establishing the baseline program, ISR facility operators must conduct an operational monitoring program to measure or evaluate compliance with standards and to evaluate environmental impacts of an ISR facility under operational conditions. In accordance with 10 CFR 40.65, the applicant must submit to NRC a semiannual effluent and environmental monitoring report (AUC, 2012b). This report would specify the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in gaseous effluents during the previous 6 months of operation. The applicant-supplied report would also provide other NRC-required information to estimate the maximum potential annual radiation doses to the public resulting from effluent releases. Although not a requirement, NRC Regulatory Guide 4.14 (NRC, 1980) provides guidance for establishing a radioactive effluent and environmental monitoring program for uranium mills (which include ISR facilities) that are acceptable to the NRC staff.

The results of the applicant's baseline radiological monitoring program are presented in SEIS Section 3.12.1. The following sections briefly describe the applicant's proposed operational monitoring program.

7.2.1 Airborne Radiation Monitoring

The applicant proposes to conduct continuous air particulate sampling at five air monitoring sample locations (SEIS Figure 7-1). There are three onsite stations (AM 2, AM 4-2, and AM 7), one offsite station (AM 6-2) located approximately 1.7 km [1.1 mi] west of the southwestern boundary of the proposed project area, and one offsite station (AM 8) located approximately 2.1 km [1.3 mi] east of the southeastern boundary of the proposed project area (AUC, 2014b, 2015a). The air particulate monitoring program would be conducted using solar powered stations employing electronic air flow control and that maintain digital records of total air volume passing through the air particulate sampling filters during the collection periods (AUC, 2014b). The filters from air samplers would be exchanged monthly and composited quarterly. The composited filters would be analyzed to calculate quarterly average radionuclide air concentrations for total uranium, thorium (Th-230), radium (Ra-226), and lead (Pb-210), in accordance with Regulatory Guide 4.14 (NRC, 1980; AUC, 2012a, 2014b). The applicant proposes to measure ambient radon (Rn-222) concentrations in air continuously using track-etch radon detectors replaced quarterly (AUC, 2012a, 2014b).

To monitor exposure to uranium particulates within the central processing plant (CPP), the applicant proposes to collect air samples on a monthly basis in accordance with Regulatory Guide 8.25. The applicant would also monitor the CPP area for radon (Rn-222) and its progeny in accordance with Regulatory Guide 8.30. Initial sampling would determine specific monitoring locations and frequency. Sampled areas exceeding 10 percent of the 10 CFR Part 20 occupational annual dose limit of 0.05 Sv [5 rem] would be monitored monthly, while all other areas would be monitored quarterly (AUC, 2012a,b).

The applicant would also have an external personnel radiation monitoring program. Occupational exposure to gamma and beta radiation would be measured using thermoluminescent or optically stimulated dosimeters. During initial operations, workers would be monitored to establish an adequate exposure history, and then the applicant may discontinue monitoring workers that show no likelihood for exceeding 10 percent of the allowable occupational dose limit (AUC, 2012a).

7.2.2 Soils and Sediment Monitoring

Samples of surface soil from a 0–5 cm [0–2 in] depth would be collected annually at the air monitoring sampling sites (see SEIS Figure 7-1). The samples would be analyzed for total uranium, radium (Ra-226), thorium (Th-230), and lead (Pb-210) (AUC, 2012a, 2014b). Sediments will also be collected annually at each of the surface water-sampling sites established for pre-operational surface water monitoring (see SEIS Figure 3-14). The sediment

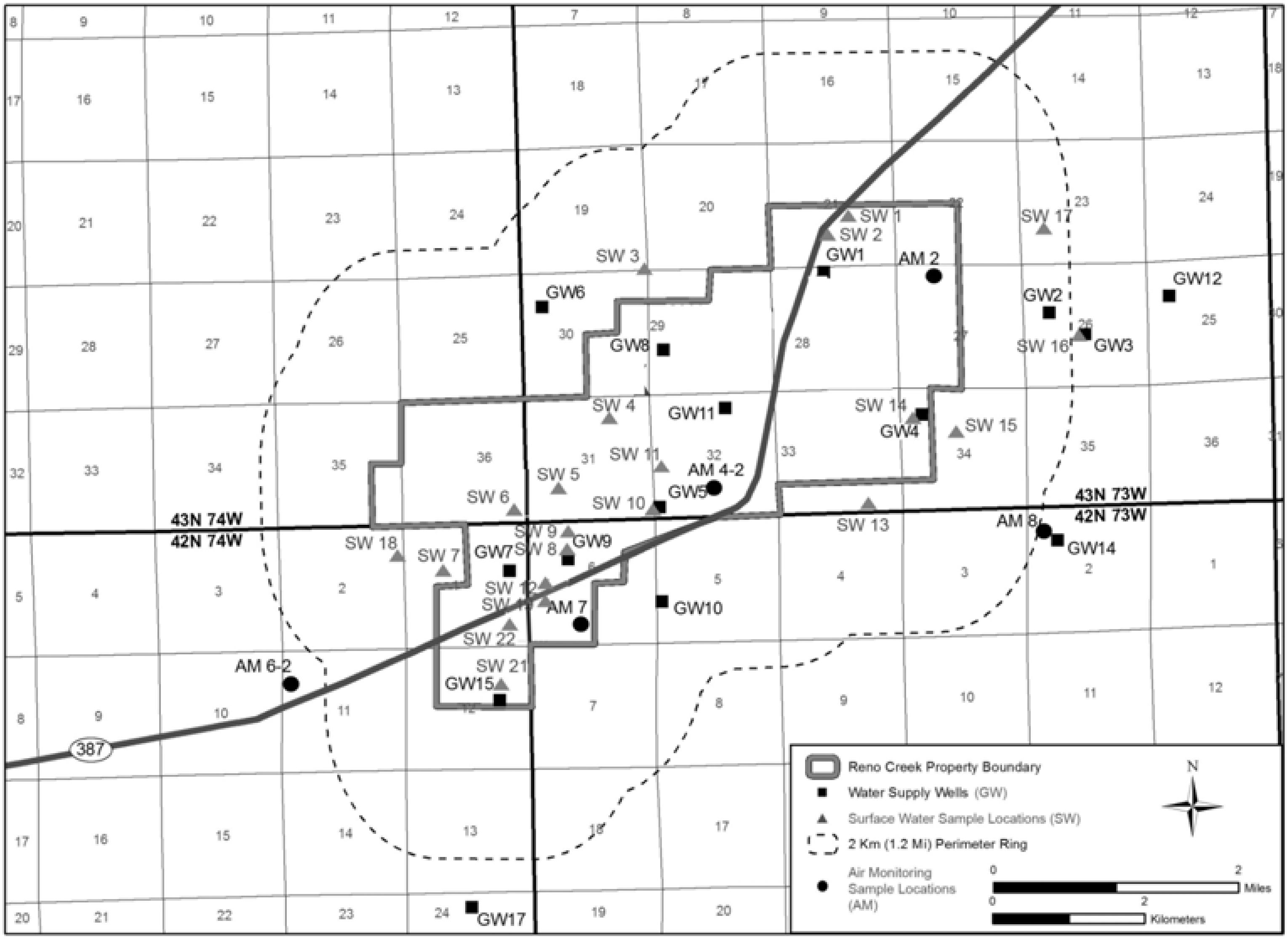

Figure 7-1. Locations of Operational Monitoring Stations at the Proposed Reno Creek ISR Project Area (AUC, 2014a)

samples would be analyzed for total uranium, thorium (Th-230), radium (Ra-226), and lead (Pb-210) (AUC, 2012a, 2014b). The maximum lower limits of detection for the analyses would be consistent with the recommendations of Regulatory Guide 4.14 (NRC, 1980), unless matrix interferences prohibit attainment of these low-detection-limit goals.

7.2.3 Vegetation, Food, and Fish Monitoring

During the grazing season, the applicant collected vegetation samples quarterly at three locations in the northeastern area of the proposed Reno Creek ISR Project area (AUC, 2012a). Composite samples of the vegetation were analyzed for radium (Ra-226), uranium, thorium (Th-230), lead (Pb-210), and (polonium) Po-210 (AUC, 2012a, 2014b). In response to an NRC RAI, AUC has committed to collecting additional vegetation samples prior to preconstruction activities at least three times during the grazing season in grazing areas in three different sectors that would have the highest predicted air particulate concentrations due to operations (AUC, 2014b).

In January 2015, the applicant collected three livestock meat samples as part of the baseline assessment of radiological conditions (AUC, 2015a). Food sampling was analyzed for uranium, thorium (Th-230), radium (Ra-226), lead (Pb-210), and polonium (Po-210), per regulatory guidance (NRC, 1980). Because the CPP and wellfields would be fenced, cattle would be excluded from these areas. Furthermore, cattle are only in the immediate grazing area for approximately half of the year and graze over large areas due to the limited food supply. Therefore, cattle and game sampling would not be part of the routine environmental monitoring program. Additionally, no fish sampling was conducted based on the lack of available habitat (AUC, 2012a).

7.2.4 Surface Water Monitoring

The proposed Reno Creek ISR Project area does not contain perennial streams. Surface water features are ephemeral and only contain natural runoff during heavy rainfall and snowmelt events. Throughout portions of the year, coalbed methane (CBM) operations contribute to some runoff, which ponds at select locations. Consistent with recommendations in Regulatory Guide 4.14 (NRC, 1980), water samples would be collected quarterly from the 21 surface water sampling locations established for preoperational (baseline) surface water monitoring (SEIS Figure 7.1). All locations are existing stock ponds, CBM outfalls, or areas in drainages where ponding occasionally occurs (AUC, 2014b). The surface water samples would be analyzed for Regulatory Guide 4.14 Table 2 (1980) parameters [e.g., dissolved and suspended natural uranium, radium (Ra-226), thorium (Th-230), lead (Pb-210), and polonium (Po-210)] (AUC, 2012a, 2014b). Surface water monitoring results would be submitted to the NRC in the semi-annual environmental and effluent reports (AUC, 2012a).

7.2.5 Groundwater Monitoring

As part of the groundwater monitoring program, all water supply wells used for drinking water, livestock watering, or crop irrigation within 3.2 km [2 mi] of the proposed wellfield boundaries would be sampled quarterly (see SEIS Figure 7-1). These wells are located hydrologically upgradient and downgradient of proposed ISR facilities and wellfields. Samples would be analyzed for dissolved and suspended uranium and other radiological parameters, including radium (Ra-226), thorium (Th-230), lead (Pb-210), and polonium (Po-210) (AUC, 2012a, 2014b).

The NRC safety analysis of the applicant's well construction methods identified the use of sand filter packs that would extend several feet above and below the screen interval. If this well-completion method was used on monitoring wells directly affected by ISR operations, there would be the potential for migration of fluids from the mineralized zone. Therefore, the NRC SER would require an applicant commitment to not use this well-completion method. Additionally, existing production unit wells using this method would be abandoned and the sand pack would be removed prior to plugging the well (NRC, 2015).

7.3 Physiochemical Monitoring

This section discusses the applicant's proposed physiochemical monitoring program, as detailed in its license application and supporting documents (AUC, 2012a,b; 2014a,b). The purpose of this monitoring program is to (i) provide data on operational and environmental conditions so that prompt corrective actions can be taken when adverse conditions are detected and (ii) comply with environmental requirements or license conditions. In this regard, this monitoring program helps to limit potential environmental impacts at an ISR facility.

7.3.1 Wellfield Groundwater Monitoring

As discussed in GEIS Section 8.3, the ISR production process directly affects the groundwater within the operating wellfield. For this reason, groundwater conditions are extensively monitored both before and during operations. The groundwater monitoring program includes production zone monitoring wells and wells monitoring aquifers overlying and underlying the production aquifer zone (NRC, 2009). The background groundwater monitoring that would occur as part of the proposed Reno Creek ISR Project is discussed in SEIS Section 7.3.1.1. The groundwater quality monitoring that would occur during operations is discussed in SEIS Section 7.3.1.2. The applicant's groundwater restoration monitoring and stabilization plan is detailed in SEIS Section 2.1.1.1.4 which addresses the schedule and all activities associated with aquifer restoration.

In accordance with 10 CFR Part 40, Appendix A, Criterion 5B(5), Commission-approved background groundwater quality values must be established before beginning uranium production in a wellfield. This is done to characterize the water quality in monitoring wells that are used to detect lixiviant excursions from the production zone. This is also done to establish standards for aquifer restoration (i.e., target restoration goals) after uranium-recovery operations are complete. The requirements and details of sampling programs to establish background groundwater quality are described in GEIS Section 8.3.1.1 (NRC, 2009). Background water quality can be established through examining records and reports for existing local water wells and/or by sampling wells developed for the ISR project before production begins.

7.3.1.1 Background Groundwater Quality

GEIS Section 8.3.1.1 discusses how a background groundwater quality program would be established prior to uranium production (NRC, 2009). The groundwater monitoring program is designed to establish background groundwater quality in monitoring wells prior to ISR operations, detect any potential excursions of lixiviant either horizontally or vertically outside of the recovery zone during active ISR, and determine when the groundwater in the production zone aquifer (PZA) has been restored adequately following ISR operations. Consistent with NUREG–1569, Section 5.7.8.3 (NRC, 2003), the applicant would be expected to sample wells over sufficiently spaced intervals to indicate seasonal variability. Samples would be analyzed for the constituents and parameters shown in SEIS Table 7-1.

To establish background groundwater quality in production units, the applicant would install a ring of perimeter monitoring wells in the PZA around each wellfield production pattern area (AUC, 2012a). As described in SEIS Section 4.5.2.1.2, the NRC staff have proposed and the applicant has agreed to a license condition that requires a 122 m [400 ft] distance to, and spacing of, the perimeter wells for a wellfield production pattern in either the fully or partially saturated portions of the PZA (AUC, 2015b). In addition, the applicant would install monitoring wells in the overlying aquifer at a minimum density of one well per every 1.6 ha [4.0 ac] of pattern area (AUC, 2012b). Four samples would be collected from each perimeter and overlying monitoring well for background characterization, with a minimum of 2 weeks between sampling events (AUC, 2012b). The first and second sampling events would include all constituents listed in SEIS Table 7-1. If specific constituents are not detected during the first and second sampling events, those constituents would not be analyzed during the third and fourth sampling events (AUC, 2012b).

The background groundwater quality data would be used to establish target restoration goals for each production unit. Target restoration goals, which would be used to assess the effectiveness of groundwater restoration activities, would be established based on statistical methods described in “Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance” (EPA, 2009). This guidance describes a series of sampling and laboratory analytical procedures to be used to validate the background groundwater quality data. Groundwater quality data that passes the data validation process would be incorporated into a database that would be used to set target restoration goals (AUC, 2012a).

After completion of well installation, wellfield background groundwater sampling, and wellfield characterization, the applicant would conduct multi-well pumping tests to verify hydraulic communication between the wellfield and monitoring well ring. The hydrogeologic test will allow the applicant to demonstrate that a hydraulic gradient can be maintained to prevent excursions beyond the perimeter production zone monitoring well ring (AUC, 2012b).

After wellfield testing is completed, the applicant would prepare a production area pump test report for each production area describing the production area geology, hydrogeology, pumping test results, baseline groundwater quality for all aquifers, upper control limits (UCLs) for the excursion monitoring wells, and restoration target values for the production zone. The applicant’s Safety and Environmental Review Panel would be responsible for monitoring any proposed change in the facility or process and would review these reports to ensure that the hydrologic testing results and proposed ISR activities were consistent with the technical requirements and did not conflict with NRC regulatory requirements. The report would then be submitted to Wyoming Department of Environmental Quality (WDEQ) for review and approval before ISR operations commence (AUC, 2012b). The applicant would submit the first Production Unit Hydrologic Data Package to NRC staff for review and verification. The applicant would submit all subsequent Production Unit Hydrologic Data Packages to NRC staff for review.

Table 7-1. Background Water Quality Parameters and Indicators for Operational Groundwater Monitoring*	
Test Analyte/Parameter	
Bulk Properties	pH Total Dissolved Solids (TDS) Conductivity
Cations/Anions	Bicarbonate (as HCO_3^-) Calcium, Ca^{2+} Carbonate (as CO_3^{2-}) Chloride, Cl^- Magnesium, Mg^{2+} Nitrate, NO_3^- (as Nitrogen) Potassium, K^+ Sodium, Na^+ Sulfate, SO_4^{2-} Total Alkalinity
Trace Metals	Arsenic, As Barium, Ba Boron, B Cadmium, Cd Chromium, Cr Copper, Cu Fluoride, F Iron, Fe Lead, Pb Manganese, Mn Mercury, Hg Molybdenum, Mo Nickel, Ni Selenium, Se Silver, Ag Uranium, U Vanadium, V Zinc, Zn
Radionuclides	Gross Alpha = Alpha Particles Gross Beta = Beta Particles and Photons Radium, Ra-226
*All metals analyses are for dissolved metals. Source: NRC (2003)	

7.3.1.2 Excursion Monitoring

As discussed in GEIS Section 8.3.1.2, monitoring wells are situated around the wellfields, in the aquifers overlying and underlying the ore-bearing production aquifers, and within the wellfields (NRC, 2009). Wells are placed in these locations to ensure the early detection of potential horizontal and vertical excursions of lixiviants. Monitoring well placement is based on what is known about the nature and extent of the confining unit and the presence of drill holes, hydraulic gradient and aquifer transmissivity, and well abandonment procedures used in the region. The ability of a monitoring well to detect groundwater excursions is influenced by several factors, such as the thickness of the aquifer, the distance between the monitoring wells and the wellfield, the distance between the adjacent monitoring wells, the frequency of groundwater sampling, and the magnitude of changes in lixiviant migration indicator parameters. As a result, the spacing, distribution, and number of monitoring wells at a given ISR facility are site specific. The factors that control the spacing, distribution, and number of monitoring wells are detailed in GEIS Section 8.3.1.2 (NRC, 2009). The applicant's monitoring well design is described in SEIS Section 2.1.1.1.2.

The applicant proposes to install production and nonproduction zone monitoring wells to detect any horizontal and vertical lixiviant excursions at the proposed project site (AUC, 2012a). As described previously, production zone monitoring wells would be located in the PZA, in a ring around the perimeter of the production wellfields at a spacing of one well every 122 m [400 ft]. Injection and recovery well flow rates would be monitored at each header house so that injection and recovery can be balanced for each pattern and each wellfield. Recovery flow rates would always be greater than injection rates to establish a bleed rate that maintains an inward gradient for each production unit (AUC, 2012a).

Nonproduction monitoring wells within the production area may consist of two types of monitoring wells: overlying and underlying (Mackin et al., 2001; NRC, 2003, 2009). As described previously, the applicant would install monitoring wells in the overlying aquifer at a minimum density of one well per every 1.6 ha [4.0 ac] of pattern area (AUC, 2012b). The screened intervals of overlying monitoring wells would be located in the sand unit or aquifer (either the Overlying Aquifer Unit or the Shallow Water Table Unit) immediately above the PZA. The overlying nonproduction monitoring wells are designed to monitor any upward movement of lixiviant that may occur from the production zone and to guard against potential leakage from production and injection well casings into any overlying aquifer (Mackin et al., 2001; NRC, 2003, 2009). The overlying wells are used to obtain background water quality data and to develop UCLs for the overlying zones that would be used to determine whether vertical migration of lixiviant is occurring (NRC, 2003, 2009).

Vertical monitoring is generally set up with a density of wells ranging from one every 1.2 to 2 ha [3 to 5 ac]. However, where confining units are very thick and permeabilities are negligible, requirements for vertical excursion monitoring can be relaxed or eliminated (Mackin et al., 2001). The screened zone for the overlying wells is determined from electric logs by qualified geologists or hydrogeologists.

After background groundwater quality is established for the monitoring wells for an individual production unit, UCLs are selected and set for chemical constituents or parameters that would be indicative of lixiviant migration from the wellfield (Mackin et al., 2001; NRC, 2003, 2009). The constituents and parameters selected as lixiviant migration indicators and for which UCLs would be set at the proposed Reno Creek ISR Project are chloride, conductivity, and total alkalinity (AUC, 2012a). Chloride would be measured because the ion-exchange process increases concentrations in the lixiviant. In addition, chloride is highly mobile in groundwater and is not influenced by pH changes and oxidation-reduction reactions that occur in the production zone. Conductivity would be evaluated because it indicates changes in groundwater quality and is more easily measured than parameters such as total dissolved solids. Total alkalinity would be examined because its concentration significantly increases during the ISR process and, therefore, provides a conservative indicator (AUC, 2012a).

The applicant's operational excursion monitoring would consist of sampling the monitoring wells at least twice monthly and at least 10 days apart and analyzing the samples for the excursion indicators (i.e., chloride, conductivity, and total alkalinity) (AUC, 2012a). Monitoring wells would be purged before sample collection to ensure that water within the well casing is adequately displaced and formation water is sampled. Samples would be collected for analysis when field water quality parameters such as pH and specific conductivity are stable. Water level and analytical monitoring data for the UCL parameters would be reported to WDEQ on a quarterly basis and retained onsite for NRC review (AUC, 2012a).

An excursion occurs when two or more excursion indicators in a monitoring well exceed their UCLs (NRC, 2003). If the concentration of two or three excursion indicators exceeds established UCL concentrations during a sampling event, a second sample would be taken within 48 hours after results of the first analysis are received and reviewed (AUC, 2012a). If an excursion is not confirmed by a second sample, a third sample would be taken within 48 hours after the second set of sampling data are received. If the second or third samples produce results where two or more excursion indicators exceed the UCL concentrations, the well producing these results would be placed on excursion status and corrective action would be required. The first sample results would be considered in error if the second and third samples do not confirm the results from the first sample (AUC, 2012a).

If an excursion is verified, the applicant would be required to notify the NRC and WDEQ within 24 hours by telephone or email and in writing within 7 days; corrective actions should begin immediately. Corrective actions would include increasing sampling frequency to weekly, increasing the pumping rates of production wells in the area of the excursion to increase the net bleed, and pumping individual wells to enhance recovery of solutions (AUC, 2012a). If these actions do not retrieve the excursion within 60 days, the applicant would suspend injection of lixiviant into the production zone adjacent to the excursion until the excursion is retrieved and the UCL parameters are no longer exceeded. Within 60 days of a confirmed excursion, the applicant would be required to file a written report to NRC describing the event and the corrective action taken (NRC, 2003).

After operations are complete, the wellfields would be restored. As part of aquifer restoration, the applicant would sample the same horizontal perimeter and overlying and underlying monitoring wells used during production, as described in SEIS Section 2.1.1.1.4. During restoration, lixiviant injection ceases, thereby reducing the potential for an excursion. The applicant would, therefore, implement a reduced groundwater monitoring program during aquifer restoration. During this phase, wells located in the perimeter monitoring ring and completed in the overlying and underlying aquifers would be sampled every 60 days for chloride, total alkalinity, and conductivity excursion parameters. An excursion would be defined in the same manner as during operations and subject to the same corrective action requirements (AUC, 2012a).

7.3.2 Wellfield and Pipeline Flow and Pressure Monitoring

As indicated in GEIS Section 8.3.2, the operator typically monitors injection and production well flow rates to manage water balance for the entire wellfield. Additionally, the pressure of each production well and the production trunk line in each wellfield header house is monitored. Unexpected losses of pressure may indicate equipment failure, a leak, or a problem with well integrity (NRC, 2009).

The applicant’s program would include monitoring of the injection well and production well flow rates and pressures at each header house. Individual well flow readings would be recorded during each shift, and the overall wellfield flow rates would be balanced daily (AUC, 2012a, 2014b). Flow and total volume data would be transferred to and checked automatically at the CPP. The recovery and injection trunk lines would have electronic pressure gauges. Information from these gauges would be monitored from each unit's control room. The control system would have both high and low alarms for pressure and flow. If the pressure and/or flow are out of range, the alarms would sound, alerting personnel to make adjustments. Certain high or low readings would signal automatic shutoffs or shutdowns. Activation of the flow alarms would prompt the applicant to take corrective actions, which include inspections for leaks and spills (AUC, 2012a, 2014b).

7.3.3 Meteorological Monitoring

The applicant has committed to continue meteorological monitoring at the proposed project during ISR operations (AUC, 2012a). As part of the site characterization process, the applicant installed a weather station near the northeast corner of the proposed project area (see SEIS Section 3.7). This weather station was monitored for a year to establish baseline conditions and then to analyze and describe the long-term and site-specific meteorological conditions and trends (AUC, 2012a). In addition, data sets from several regional weather stations were reviewed (see SEIS Section 3.7).

7.4 Ecological Monitoring

This section describes the applicant's proposed ecological monitoring program, as described in its license application (AUC, 2012a,b). As discussed in GEIS Section 8.4, ecological monitoring may include surveys of habitat; species counts; or other measures of the health of endangered, threatened, and sensitive species (NRC, 2009). Records of all sampling activities and analyses would be maintained onsite for NRC review, and periodic reports of all sampling and analyses would be submitted to the NRC.

7.4.1 Vegetation Monitoring

Based on results from its preoperational vegetation sampling program and through modeling, the applicant concluded in their environmental review that consumption of vegetation would not be a significant contributor to radiological dose through the ingestion pathway (AUC, 2012a). Therefore, the applicant does not intend to conduct vegetation, food, or fish sampling during operations, because the predicted dose to an individual from these pathways would be less than 5 percent of the applicable radiation protection standard (AUC, 2012a). However, in response to NRC RAIs, the applicant has committed to provide data for an additional round of vegetation samples (AUC, 2015b, NRC, 2015). An updated Preoperational Monitoring Radiological Report would include this additional round of vegetation samples and results prior to prelicense NRC inspection and start of operations (NRC, 2015).

7.4.2 Wildlife Monitoring

Large game animals, such as deer or pronghorn, have extensive ranges and are not confined to the proposed project area. Therefore, the potential for bioaccumulation of radionuclides in these animals would be limited because they would likely derive only a small fraction of total sustenance from the flora or fauna in the proposed Reno Creek ISR Project area. No fish species occur within the proposed project area, because surface water is ephemeral and there is not a sufficient volume of surface water to support aquatic species (AUC, 2012a). For more information on aquatic species, see SEIS Section 3.6.2.

The applicant would conduct annual raptor surveys at the proposed project site during the lifespan of the project (AUC, 2012a). Any required wildlife monitoring surveys would follow the same regimen as other ISR operations in the region (NRC, 2009). This would facilitate comparisons among survey results and impact assessments.

To further minimize impacts to birds and as described in SEIS Section 3.6.3, no federally listed threatened or endangered species were documented within the proposed project area during the baseline study (AUC, 2012a). The baseline ecological study demonstrated that three Greater sage-grouse leks (i.e., a species that was recently removed from the FWS candidate species list), are located east and southeast of the proposed project between the 1.6-km [1-mi] buffer project buffer and the larger 6.4 km [4 mi] area surrounding the proposed project area (AUC, 2012a). Activities for the proposed Reno Creek ISR Project are within 3.2 km [2 mi] of an occupied lek (Porcupine Creek lek) and are therefore subject to recommendations in the Wyoming Governor's executive order. As stated in SEIS Section 4.6.1.1, the applicant has committed to conducting annual spring monitoring of the Porcupine Creek Greater sage-grouse lek, in coordination with the WGFD biologist in Gillette, Wyoming (AUC, 2014a).

7.5 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation." Washington, DC: U.S. Government Printing Office.

10 CFR Part 40. Code of Federal Regulations, Title 10, *Energy*, Part 40. "Domestic Licensing of Source Material." Washington, DC: U.S. Government Printing Office.

10 CFR Part 40, Appendix A. Code of Federal Regulations, Title 10, *Energy*, Part 40 Appendix A. "Criteria Relating to the Operation of Uranium Mills and to the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily from their Source Material Content." Washington, DC: U.S. Government Printing Office.

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8 COST-BENEFITS ANALYSIS

8.1 Introduction

This chapter summarizes benefits and costs associated with the proposed project and the No-Action Alternative. Under the proposed action, the applicant would use the license for the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek In Situ Uranium Recovery (ISR) Project. Supplemental Environmental Impact Statement (SEIS) Section 4.11 discusses the potential socioeconomic impacts of the proposed project.

Implementation of the proposed action would generate regional and local benefits and costs. The regional and local benefits of constructing and operating the proposed Reno Creek ISR Project include increases in employment, economic activity, and tax revenues. The benefits of increased tax revenues would accrue primarily to Campbell County, Wyoming, and the surrounding towns of Wright, Gillette, and potentially Edgerton in neighboring Natrona County. Costs associated with the proposed Reno Creek ISR Project would be, for the most part, limited to the area surrounding the site. Examples of these costs include changes to current land and water use and increased road traffic.

8.2 Proposed Action (Alternative 1)

Under the proposed action, the U.S. Nuclear Regulatory Commission (NRC) would issue the applicant an NRC license. With this license, the applicant would construct, operate, restore the aquifer, and decommission the proposed Reno Creek ISR Project. The timeframes for the proposed activities are important to note as part of cost and benefit quantification. After approximately 2 years of site development and facility construction, there would be 11 years of wellfield and uranium recovery operations (see SEIS Figure 2-1). During the 11-year operations phase of the project, wellfield construction would be phased, with three to seven wellfields in various stages of construction at one time. Wellfield restoration at the proposed Reno Creek ISR Project would begin immediately after production activities in the wellfields end. The applicant projects that restoration activities in the first wellfields would begin 2 to 3 years after production activities commence, depending on uranium recovery levels and available central processing plant (CPP) capacity. Aquifer restoration activities, including restoration construction, stability monitoring, and regulatory approval of restoration, would continue for 11 years.

Some overlap between wellfield decommissioning and groundwater restoration activities would be expected. Wellfield decommissioning would continue for approximately 8 years. Decommissioning of the CPP would begin after aquifer restoration and wellfield decommissioning activities are complete. It is anticipated that these activities would take 1 year to complete (AUC, 2012). The duration of each of these activities/project phases would be tied to the overall cost and benefit analysis in terms of employment and additional indirect and induced impacts.

8.2.1 Benefits of the Proposed Action

The principal socioeconomic benefit expected to result from the proposed Reno Creek ISR Project would be an increase in employment opportunities in the region. The applicant expects to directly employ 80 workers during construction and 92 workers during operations of the proposed project (AUC, 2012). Fewer workers would be involved in aquifer restoration and decommissioning activities: 52 and 22 workers, respectively (AUC, 2012). As discussed in SEIS Section 4.11.1, the construction workforce would most likely not relocate permanently to the area because of the short duration (1 to 2 years) of these activities. Workers would be more likely to relocate near the facility during the operations, aquifer restoration, and decommissioning phases of the proposed project.

The majority of jobs are expected to be filled by workers commuting from nearby towns or relocating from outside the region. A standard employment multiplier of 0.7[1] was used to calculate the expected influx of approximately 56 jobs (i.e., 80 jobs × 0.7 = 56) during construction, 64 jobs (i.e., 92 jobs × 0.7 = 64) during operations, 36 jobs during aquifer restoration (i.e., 52 jobs × 0.7 = 36), and 15 jobs during decommissioning (i.e., 22 jobs × 0.7 = 6) activities.[1]

The town nearest to the proposed project is Wright, with a population of 1,852 (USCB, 2012). However, employees supporting project activities might prefer to reside in larger surrounding communities such as Gillette and Casper, which have populations of 31,797 and 59,628, respectively (USCB, 2012). However, Casper is 148 km [92 mi] away and outside the immediate region of influence of the proposed project. The influx of jobs created by the proposed Reno Creek ISR Project and the expected reduction in unemployment are expected to have a MODERATE beneficial impact to the businesses of Wright and a SMALL beneficial impact to the businesses of the larger towns surrounding the proposed project, such as Gillette and Casper.

In addition to job creation, the proposed project's operations and the addition of regionally based employees would be expected to contribute to local, regional, and state revenues. Revenues would be expected to increase through the purchase of goods and services and through the taxes levied on goods and services. Overall, the applicant estimates that the proposed project would be expected to generate $21.85 million in total indirect business tax revenue over the lifetime of construction, operations, restoration, and decommissioning activities (AUC, 2012). Sources of indirect business tax revenue include property taxes, sales taxes, and motor vehicle license charges.

The State of Wyoming, Department of Revenue levies a severance tax of 4.0 percent for uranium solid mineral production. Of the total severance tax paid by the applicant, a portion of that is put into the Wyoming Permanent Mineral Trust Fund (PMTF). The PMTF was established to provide for the state when the minerals were not profitable to extract and severance taxes became a smaller portion of the government revenues. The applicant's estimate of uranium resources to be recovered at the proposed Reno Creek ISR Project is 7.1 million kg [15.7 million lb] of uranium (as U_3O_8) (AUC, 2012). If the applicant recovers 4.98 million kg [10.99 million lb] (i.e., less the total recoverable amount) and sold the product at the current long-term market rate of $65.00 per pound, the State of Wyoming would receive $41.5 million in severance taxes over the course of the proposed project, with an additional $26.75 million paid in other state and local taxes over the same period (AUC, 2012).

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[1]The economic multiplier provides a statistical estimate of the total impact that is expected from a regional change in a given economic activity. The multiplier is a ratio of total change to initial change. The multiplier of 0.7 is used in these calculations because it is the standard employment multiplier for the milling/mining industry (Economic Policy Institute, 2003).

8.2.2 Benefits from Uranium Production

The taxes to be generated by operations at the proposed Reno Creek ISR Project would be dependent on yellowcake production levels and the number of persons employed in facility operations. The applicant projects 7.1 million kg [15.7 million lb] of uranium would be recovered (AUC, 2012). However, production of yellowcake would depend on the market price for yellowcake (as uranium) and production costs. Since 2002, the spot market price for uranium has fluctuated significantly, from a high of more than $130.00 per pound in 2007 to a low of $20.00 per pound in 2002. As of May 15, 2016, the price was $27.50 per pound (UXC, 2016).

The proposed project's potential benefits to the local community depend on the applicant's operating costs being lower than the future price of uranium. If the price of uranium falls sufficiently low, the revenue generated from the proposed project may fall below the costs of operations and then operations would likely be suspended or discontinued. In addition, the State of Wyoming would receive less than the estimated severance taxes based on the long-term current market rate of $65.00 pound.

8.2.3 Costs to the Local Communities

SEIS Table 8-1 lists the towns near the proposed Reno Creek ISR Project. These towns would be expected to provide the majority of the workers for the proposed project. The NRC staff anticipate that the majority of workers would commute from the larger communities of Gillette and Casper, Wyoming. The table also lists the population of the towns and the distances to the proposed project. As stated in SEIS Section 8.2.1, the construction of the proposed project is expected to employ 80 workers, and if it is assumed that a workforce from outside the region fills the majority of the construction employment requirements, there could be an influx of 56 jobs (80 jobs × 0.7[2] = 56). Because of the short duration of construction (2 years) and small size of the construction force, the impact to housing demand would be SMALL (see SEIS Section 4.11.1.1). Workers would not be expected to bring families and school-aged children with them; therefore, there would be a SMALL impact on education services and on health and social services (see SEIS Section 4.11.1.1).

As mentioned in SEIS Section 8.2.1, the proposed project would be expected to employ 92 workers during the period of operations, 52 workers during the period of aquifer restoration, and 22 workers during the period of site decommissioning. As described in SEIS Section 4.11.1.2, employment types would be expected to be more technical during operations, and as a result, the majority of the operational workforce would be expected to be staffed from outside the region. Therefore, it is anticipated that there would be an influx of workers into the towns closest to the proposed project area.

Specifically, it is anticipated that there would be an influx of 64 workers (i.e., 92 jobs × 0.7[3] = 64) during operations, 36 jobs during aquifer restoration (i.e., 52 jobs × 0.7 = 36), and 15 jobs during decommissioning activities (i.e., 22 jobs × 0.7 = 15).

[2] The multiplier of 0.7 is used in these calculations because it is the standard employment multiplier for the milling/mining industry (Economic Policy Institute, 2003).
[3] The multiplier of 0.7 is used in these calculations because it is the standard employment multiplier for the milling/mining industry (Economic Policy Institute, 2003).

Table 8-1. Towns Near the Proposed Reno Creek ISR Project		
Town	**Population (2010 Estimate)**	**Distance From Proposed Project in km [mi]**
Wright, Wyoming	1,852	13 [8]
Gillette, Wyoming	31,797	64 [40]
Casper, Wyoming	59,628	148 [92]
Source: USCB, 2012		

It would be expected that workers moving to communities nearby or within commuting distance of the proposed Reno Creek ISR Project area for employment opportunities would arrive with their families. The average household size in Wyoming is 2.50 persons (USCB, 2012). Therefore, newly created jobs have the potential to increase the local population by as many as 288 persons (64 + 36 + 15 = 115 workers from outside the region × 2.50 persons per household = 288 persons). The influx of workers and their families would increase the demand for housing and may spur an increase in the construction of new homes in towns surrounding the proposed project area. It is anticipated that the impact of increased housing demand and construction may be MODERATE for the small town of Wright. For larger towns such as Gillette and Casper, which have more available housing, the impact would be SMALL.

The projected population growth from the proposed project would have a SMALL impact on education infrastructure and health and social services. As assessed in SEIS Section 4.11.1, the impact on schools and education-related services during operations, aquifer restoration, and decommissioning would be SMALL. As presented in SEIS Section 3.11.7, towns surrounding the proposed project have adequate medical facilities, social services, and police, fire, and emergency medical services to accommodate the projected project workforce and their families. Furthermore, as discussed in SEIS Section 4.11.1, local governments would be expected to have the capacity to effectively plan for and manage increased demand for health and social services from workers and their families relocating to towns near the proposed project.

8.3 Evaluation of Findings of the Proposed Reno Creek ISR Project

If the NRC issues the applicant a license, it is anticipated that the proposed Reno Creek ISR Project would have a SMALL to MODERATE overall economic impact on the region of influence and would generate primarily regional and local benefits and costs. As discussed, the regional benefits of the proposed project include increased employment opportunities and increased economic activity that would add to tax revenues in the region. Increases in tax revenues would be expected to bring the largest benefit to Campbell County, although economic benefits would most likely be shared by neighboring counties and communities in Wyoming. Social and economic costs associated with the proposed Reno Creek ISR Project would, for the most part, be limited to communities within commuting distance of the site. SEIS Table 8-2 summarizes the costs and benefits of the proposed Reno Creek ISR Project.

8.4 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the NRC would not approve the license application for the proposed Reno Creek ISR Project. The No-Action Alternative would result in the applicant not constructing and operating the proposed project. No facilities, roads, or wellfields would be built, and no pipelines would be laid, as described in SEIS Section 2.1.2. No uranium would be recovered from the subsurface orebody; therefore, production, and monitoring wells would not be installed to operate the facility. No lixiviant would be introduced in the subsurface, and no

Table 8-2. Summary of Costs and Benefits of the Proposed Reno Creek ISR Project	
Cost-Benefit Category	**Proposed Project Benefits**
Production Capacity	7.1 million kg [15.7 million lb] of yellowcake (as uranium)
Other Monetary: Severance taxes Other state and local taxes (including indirect business tax revenues)	 $41.5 million (estimated) $26.75 million (estimated)
Nonmonetary benefits	80 jobs—during construction 56 jobs—local jobs from economic multiplier during construction 92 jobs—during operations 64 jobs—local jobs from economic multiplier during operations 52 jobs—during aquifer restoration 36 jobs—local jobs from economic multiplier during aquifer restoration 22 jobs—during decommissioning 15 jobs—local jobs from economic multiplier during decommissioning
	Costs
Education Infrastructure	SMALL
Health and Social Services	SMALL
Housing Demand	SMALL for larger towns (Gillette and Casper) MODERATE for Wright
Emergency Response	SMALL
Source: AUC, 2012	

buildings would be constructed to process extracted uranium or store chemicals involved in that process. Because no uranium would be recovered, neither aquifer restoration nor decommissioning activities would occur. No liquid or solid effluents would be generated. As a result, the proposed project would not be disturbed by proposed project activities and ecological, natural, and socioeconomic resources would remain unaffected. All potential environmental impacts from the proposed project would be avoided. Similarly, all project-specific socioeconomic impacts, whether positive or negative (e.g., employment, economic activity, population, housing, and local finance), would also be avoided, as discussed in SEIS Sections 3.11 and 4.11.

8.5 References

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report.” ML12291A332 and ML12291A335. Lakewood, Colorado: AUC, LLC. 2012.

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9 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

This chapter summarizes the potential environmental impacts of the Proposed Action (Alternative 1) and the No-Action Alternative (Alternative 2). The potential impacts of the proposed action are discussed in terms of (i) unavoidable adverse environmental impacts, (ii) irreversible and irretrievable commitments of resources, (iii) short-term impacts and uses of the environment, and (iv) long-term impacts and the maintenance and enhancement of productivity. The information is presented for each of the 13 resource areas that may be affected by the proposed Reno Creek In Situ Recovery (ISR) Project. This information addresses the impacts during each phase of the project (i.e., construction, operations, aquifer restoration, and decommissioning). The specific impacts are described in Supplemental Environmental Impact Statement (SEIS) Table 9-1.

The following terms are defined in NUREG–1748 (NRC, 2003).

- Unavoidable adverse environmental impacts: applies to impacts that cannot be avoided and for which no practical means of mitigation are available
- Irreversible: involves commitments of environmental resources that cannot be restored
- Irretrievable: applies to material resources and will involve commitments of materials that, when used, cannot be recycled or restored for other uses by practical means
- Short-term: represents the period from preconstruction to the end of the decommissioning activities and, therefore, generally affects the present quality of life for the public
- Long-term: represents the period of time following the termination of the U.S. Nuclear Regulatory Commission (NRC) license, with the potential to affect the quality of life for future generations

As discussed in SEIS Chapter 4, the significance of potential environmental impacts is categorized as follows:

SMALL: The environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: The environmental effects would be sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: The environmental effects would be clearly noticeable and are sufficient to destabilize important attributes of the resource.

Section 9.1 describes the environmental impacts from implementing the proposed action and Section 9.2 describes the environmental impacts from implementing the No-Action Alternative.

Table 9-1. Summary of Environmental Impacts of the Proposed Project				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Land Use	There would be a SMALL impact to land use. During construction, the total amount of land affected by earthmoving activities to construct surface facilities, wellfields and associated infrastructure, and to build access roads would be approximately 62.4 ha [154.3 ac] with an additional 187 ha [461 ac] of land around the production units fenced off from livestock grazing. This accounts for approximately 10 percent of the proposed project area. During decommissioning, land would be impacted by earthmoving activities to reclaim and reseed the affected areas.	No impact. There would be no irreversible and irretrievable commitment of land resources from implementing the proposed project. The duration of the project would be approximately 16 years, after which time the land could be reclaimed and made available for other uses.	There would be a SMALL impact to land use from implementing the proposed project. The proposed project would cause temporary alteration of rangeland and short-term restricted access to adjacent lands. Approximately 187 ha [461 ac] would be controlled and unavailable for other uses, such as grazing and recreation; oil and gas exploration could coexist with the applicant's proposed project.	There would be no long-term impact to land resources from implementing the proposed project. The land would be available for other uses following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Transportation	During the construction and operations phases, there would be a SMALL increase in local traffic counts associated with project-related traffic on State Highway 387 and along Highway 50.	No impact. There would be no irreversible and irretrievable commitment of fuel for vehicle and equipment operation, heating, commuter traffic, and regional transport. Upon project completion, fuel resources would be allocated for other uses in the area.	During construction and operations, there would be a SMALL impact due to increased traffic on State Highway 387 and along Highway 50, which has the potential to degrade the road surface, and increase the potential for traffic accidents and wildlife and livestock kills. During operations, aquifer restoration, and decommissioning, there would be a SMALL increased accident risk from transporting yellowcake, ion-exchange resin, byproduct material, and hazardous chemicals. During construction, no short-term hazardous material transportation impacts would occur because no chemical or radioactive material would be transported.	There would be no long-term impacts to transportation following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Geology and Soils	There would be a SMALL impact on geology and soils. The construction, operations, and decommissioning phases would disturb surface soils during construction of the central processing plant, development of the wellfields, laying of pipelines, and construction of new access roads. These impacts would be temporary, and at the end of the decommissioning phase, topsoil would be replaced and surfaces reseeded.	Soil layers would be irreversibly disturbed by the proposed project; however, topsoil salvaged during the construction phase would be stored and replaced during decom-missioning; therefore, the potential impact would be SMALL. Reseeding and recontouring would mitigate the impact to topsoil.	There would be a SMALL impact to geology and soils. No significant matrix compression or ground subsidence is expected, because the net withdrawal of fluid from the target sandstones would be about 1 percent or less. Topsoil salvaged during the construction phase of the project would be replaced during the reclamation and reseeding processes.	There would be no long-term impacts to geology and soils following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Surface Waters and Wetlands	There would be a SMALL impact to surface water and wetlands from the proposed project. The occurrence of surface water is limited. The applicant would use erosion control mitigation measures, such as grading and contouring, and implementation of a stormwater pollution management plan to ensure surface water runoff from disturbed areas met Wyoming Pollutant Discharge Elimination System permit limits.	There would be no irreversible and irretrievable commitment of either surface water or wetlands from implementing the proposed project. No drainage or body of water would be significantly altered by the proposed project. In addition, the impact to wetlands would be SMALL because the applicant would not allow discharge of treated wastewater into wetland areas.	There would be a SMALL impact to surface waters. The proposed project would not discharge to ephemeral surface water drainages.	No impact. The proposed project would not discharge to ephemeral surface water drainages.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Groundwater	There would be a SMALL impact on groundwater from the proposed project due to consumption of groundwater, degradation of water quality in the ore production zone, and the drawdown in water levels affecting wells located outside the project boundaries that are drilled into the ore-bearing aquifer. The groundwater chemistry could be affected by spills, leaks, or excursions over the ISR facility lifecycle.	There would be a SMALL impact on groundwater resources. Approximately 99 percent of groundwater used during the ISR process at the proposed project would be treated and reinjected into the subsurface. About 1 percent of groundwater would be consumed.	Short-term impacts to groundwater would include degradation of water quality in production zones and the potential to draw down the water level in neighboring private wells. These impacts would be SMALL.	Both the State of Wyoming and the NRC require restoration of affected groundwater following operations. The groundwater quality would be restored to ensure that aquifers would not be adversely affected. Although water levels would be affected in the short-term, the water levels should eventually recover with time.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Ecological Resources	There would be SMALL to MODERATE impacts until vegetation has been reestablished, and then the impact would be SMALL. The MODERATE impact is for sagebrush from decommissioning due to the nature of the slower-establishment of plants that compose the sagebrush shrubland plant community. Construction and decommissioning of the proposed Reno Creek ISR Project would result in short-term loss (over the ISR facility lifecycle) of vegetation on approximately 62 ha [154 ac]. The short-term loss of vegetation could stimulate the introduction and spread of undesirable and invasive, nonnative species, and displacement of wildlife species. During operations and aquifer restoration, use of fences will limit wildlife ingress and egress to wellfields.	Vegetative communities directly impacted by earthmoving activities and wildlife injuries and mortalities would be irreversible. However, the implementation of mitigation measures, such as the use of fencing to limit wildlife movement and the applicant's enforcement of speed limits would reduce potential impacts to wildlife. Furthermore, areas impacted by earthmoving activities would be reclaimed and reseeded.	During any of the ISR phases, SMALL direct impacts to ecological resources could include injuries and fatalities to wildlife caused by either collisions with project-related traffic or habitat damage due to the removal of topsoil. Wildlife could be temporarily displaced by increased noise and traffic during operations. The applicant has committed to implement mitigation measures to reduce the potential impact to SMALL for wildlife species. Some of the vegetative communities that exist within the proposed Reno Creek ISR Project could take 10 years or more to be reestablished, resulting in MODERATE short-term impacts.	Vegetation and wildlife species could experience SMALL long-term impacts if the composition and abundance of both plant and wildlife species in the proposed project area are altered or reduced in number.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Meteorology, Climatology, and Air Quality	There would be a SMALL impact to air quality. During all four phases, the generation of air pollutants results in the degradation of air quality. Project-specific modeled results would be lower than National Ambient Air Quality Standards and Prevention of Significant Deterioration (PSD) Class II regulatory thresholds. Due to the level and nature of fugitive emissions, there is potential for intermittent impacts to localized areas in and around the proposed project area. Project-specific impacts on the Wind Cave National Park (i.e., Class I PSD, visibility, and acid deposition) would be SMALL because project emission levels would be relatively low and the proposed project area is 181.9 km [113 mi] away from the Class I area.	There would be no irreversible or irretrievable commitment of air resources from the proposed project.	There would be a SMALL impact. Fugitive dust generated from the construction phase and peak year (i.e., when all four phases occur simultaneously) has the potential to result in short-term, intermittent impacts in and around the proposed project area, particularly when vehicles travel on unpaved roads. The effect would be localized and temporary. Use of mitigation measures, such as applying water for dust suppression, would limit fugitive dust emissions.	No impact. There would be no long-term effect on air quality either from the proposed project or following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Noise	There would be a SMALL impact. There would be no residences within the proposed project area. Any noise impacts would be short term, intermittent, and mitigated by sound-abatement controls on operating equipment.	Not applicable.	There would be a SMALL impact due to expected noise levels generated during construction activities, most notably in proximity to operating equipment, such as drill rigs, heavy trucks, bulldozers, or excavators. However, noise impacts would be short-term, intermittent, and mitigated by sound-abatement controls on operating equipment.	No impact. There would be no noise impact following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Historic and Cultural Resources	Impact on historic and cultural resources during the ISR construction phase would be SMALL. There are no National Register of Historic Places eligible sites within the proposed project area of potential effect. The applicant would be required, under conditions in a potential NRC license, to adhere to an inadvertent discovery plan regarding the discovery of previously undocumented historic and cultural resources during the project lifetime. These procedures would entail the stoppage of work and the notification of appropriate parties (federal, tribal, and state agencies)	If historic and cultural sites are discovered as part of an inadvertent discovery plan but cannot be avoided, or the impacts to these sites cannot be mitigated, this could result in an irreversible and irretrievable loss of cultural resources.	There would be a SMALL impact on historic and cultural resources during the ISR construction phase. If any unidentified historic or cultural resources are encountered, work would stop and appropriate authorities would be notified per the inadvertent discovery plan.	No impact. If no historic and cultural sites are discovered, there would be no potential impact following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Visual and Scenic Resources	There will be a SMALL impact on the visual landscape. Visual impacts from drilling and earthmoving activities that generate fugitive dust would be short term. Mitigation measures would be implemented to reduce fugitive dust and visual impacts from buildings (i.e., selecting building materials and paint that complement the natural environment). In addition, disturbed areas would be reclaimed as soon as practicable, and debris would be removed after construction activities.	No impact.	There would be a SMALL short-term impact to the visual landscape from the proposed project. The activities would be consistent with the Bureau of Land Management Visual Resource Management designation of the area and the existing natural resource exploration activities in the area.	No impact. There would be no impact on the visual landscape following license termination.
Socioeconomics	The proposed project would have a SMALL socioeconomic impact over the life of the project. A MODERATE cumulative impact could occur if a disproportionate number of employees at the proposed Reno Creek ISR Project elect to relocate and reside in smaller communities close to the proposed project.	Not applicable.	The proposed project would have a SMALL impact on local communities.	Following license termination, workers who supported activities at the proposed project would need to find other employment. There would be a loss of revenue to nearby communities.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Environmental Justice	There would be no disproportionately high and adverse impacts to minority or low-income populations from the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project. While certain Native Americans may have a heightened interest in cultural resources potentially affected by the proposed project, the impacts to Native Americans in this and other areas is not expected to be disproportionately high or adverse.	Not applicable.	The proposed project would have a SMALL impact on environmental justice. However, the impacts are short term and there would be no disproportionately high and adverse impacts to minority or low-income populations from any of the proposed project phases.	There would be no long-term environmental justice impacts following license termination. While certain Native Americans have a heightened interest in cultural resources potentially affected by the proposed project, the impacts to Native Americans in this and other areas is not expected to be disproportionately high or adverse. The applicant would be required, under conditions in a potential NRC license, to adhere to an inadvertent discovery plan regarding the discovery of previously undocumented historic and cultural resources during the project lifetime. These procedures would entail the stoppage of work and the notification of appropriate parties (federal, tribal, and state agencies)

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Public and Occupational Health	There would be a SMALL impact on public and occupational health. Construction and decommissioning would generate fugitive dust. The applicant's compliance with federal and state occupational safety regulations would limit the potential for radiological and nonradiological effects of fugitive dust emissions to levels acceptable for the public and workers. The emissions from construction equipment would be of short duration and readily dispersed into the atmosphere. Based on compliance with the required radiological safety program that includes monitoring and emergency response procedures, the radiological health and safety impacts from a potential unmitigated accident would be SMALL for the public.	Not applicable.	There would be a SMALL impact from radiological exposure. The radiological impacts from accidents would be SMALL for workers, if procedures to deal with accident scenarios are followed, and SMALL for the public because of the facility's remote location. The nonradiological public and occupational health impacts from normal operations, accidents, and chemical exposures would be SMALL, if handling and storage procedures are followed.	No impact. There would be no long-term impact to public and occupational health following license termination.

Table 9-1. Summary of Environmental Impacts of the Proposed Project (Continued)				
Impact Category	**Unavoidable Adverse Environmental Impacts**	**Irreversible and Irretrievable Commitment of Resources**	**Short-Term Impacts and Uses of the Environment**	**Long-Term Impacts and the Maintenance and Enhancement of Productivity**
Waste Management	Solid byproduct material generation and disposal from activities implemented during all post-construction phases of the Reno Creek ISR Project would result in SMALL impacts on available disposal capacity because permitted facilities are available to accept the wastes. Disposal of liquid byproduct material using Class I deep disposal wells would be conducted in accordance with NRC dose limits and waste disposal standards in 10 CFR Part 20, and Wyoming Department of Environmental Quality permit conditions, and impacts would be SMALL.	The energy consumed during the ISR phases, the construction materials used that could not be reused or recycled, and the space used to properly handle and dispose of all waste types (i.e., wells for liquid wastes and permitted disposal space of solid wastes) would represent an irretrievable commitment of resources, resulting in a SMALL impact.	During all phases, hazards associated with handling and transport of wastes would represent a short-term and SMALL impact.	During all phases, permanent disposal of liquid wastes in onsite disposal wells would represent a SMALL impact on the long-term productivity of the land allocated for these wells.

9.1 Proposed Action (Alternative 1)

AUC, LLC (referred hereafter as AUC or the applicant) is seeking an NRC license for the construction, operations, aquifer restoration, and decommissioning of the proposed Reno Creek ISR Project (AUC, 2012a). Under the proposed federal action, the NRC would grant AUC's license request. The proposed project would consist of processing facilities and sequentially developed wellfields.

Construction of the proposed Reno Creek ISR Project is expected to last about 2 years (see SEIS Figure 2-1). During this phase, the applicant would construct buildings, access roads, wellfields, pipelines, and Class I deep disposal wells for liquid waste disposal.

Operations are expected to last 11 years. Construction and operations activities would disturb approximately 62 hectares (ha) [154 acres (ac)] (AUC, 2012a).

During the operations phase, production wells would be used to inject lixiviant (recovery) solutions into the orebody to recover uranium. Production wells would also be used to recover the dissolved uranium, which then would be processed through the central processing plant. Finally, monitoring wells would be installed to monitor the performance of the wellfields and to mitigate potential excursions from the production zone.

Up to approximately 0.91 million kg [2 million lb] of yellowcake (U_3O_8) would be produced per year. After operations at a wellfield ceased, the applicant would begin aquifer restoration, which would ensure that water quality in surrounding aquifers would not be adversely affected by the proposed project.

The aquifer restoration process is expected to last about 9 years and would include (i) groundwater transfer, (ii) groundwater sweep, and (iii) reverse osmosis with permeate injection and reductant addition (AUC, 2012b). During wellfield and facility decommissioning (expected to last 10 years), disturbed lands would be returned to their prior uses. Wells would be plugged and abandoned, and the land surface would be reclaimed.

The potential environmental impacts from the proposed project are summarized in SEIS Table 9-1.

9.2 No-Action Alternative (Alternative 2)

Under the No-Action Alternative, the NRC staff would not issue a license. The applicant would not construct buildings, roads, or wellfields, nor would the facility be operated at the proposed Reno Creek ISR Project. Uranium ore would not be recovered. Under the No-Action Alternative, there would be no impact to any of the 13 resource areas from the proposed project. There would be no unavoidable adverse environmental impacts attributable to the proposed project and no relationship between local short-term or long-term uses of the environment. Therefore, there would be no irreversible and irretrievable commitment of resources.

9.3 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20. “Standards for Protection Against Radiation.” Washington, DC: U.S. Government Printing Office.

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report.” ML12291A335 and ML12291A332. Lakewood, Colorado: AUC, LLC. 2012a.

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Technical Report.” ML12291A009 and ML12291A010. Lakewood, Colorado: AUC, LLC. 2012b.

NRC. NUREG–1748, “Environmental Review Guidance for Licensing Actions Associated With NMSS Programs.” Washington, DC: U.S. Nuclear Regulatory Commission. 2003.

10 LIST OF PREPARERS

This section documents all individuals who were involved with the preparation of this final Supplemental Environmental Impact Statement (SEIS). Contributors include staff from the U.S. Nuclear Regulatory Commission (NRC) and consultants. Each individual's role, education, and experience are outlined next.

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11 DISTRIBUTION LIST

The U.S. Nuclear Regulatory Commission (NRC) is providing copies of this final Supplemental Environmental Impact Statement (SEIS) to the organizations and individuals listed as follows. NRC will provide copies to other interested organizations and individuals upon request.

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Campbell County Library
Wright Branch
Wright, Wyoming

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Gillette Branch
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APPENDIX A

CONSULTATION CORRESPONDENCE

CONSULTATION CORRESPONDENCE

The Endangered Species Act of 1973, as amended, and the National Historic Preservation Act of 1966 require that federal agencies consult with applicable state and federal agencies and groups prior to taking action that may affect threatened and endangered species, essential fish habitat, or historic and archaeological resources. This appendix contains consultation documentation related to these federal acts.

Table A–1. Chronology of Consultation Correspondence			
Author	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
U.S. Nuclear Regulatory Commission (L. Camper)	Northern Arapaho Business Committee (J. Shakespeare)	January 12, 2012*	ML120120068*
	Crow Tribe (C. Black Eagle)		ML120120128
	Fort Belknap Tribe (T. King)		ML120120141
	Fort Peck Tribes (A.T. Stafne)		ML120120149
	Turtle Mountain Chippewa Tribe (M. St. Claire)		ML120120150
	Cheyenne River Sioux Tribe (K. Keckler)		ML120120161
	Sisseton-Wahpeton Tribe (R. Shepherd)		ML120120169
	Crow Creek Sioux Tribe (D. Big Eagle)		ML120120170
	Yankton Sioux Tribe (R. Courneyor)		ML120120189
	Lower Brule Sioux Tribe (M. Jandreau)		ML120120195
	The Ute Indian Tribe (I. Cuch)		ML120120218
	Eastern Shoshone Tribe (M. LaJeunesse)		ML120120232
	Santee Sioux Tribe of Nebraska (R. Trudell)		ML120120244
	Standing Rock Sioux Tribe (C. Murphy)		ML120120264
	Flandreau-Santee Sioux Tribe (A. Reider)		ML120120265
	Spirit Lake Tribe (R. Yankton, Sr.)		ML120120276
	Mandan, Hidatsa & Arikara Nation (T. Hall)		ML120120279
	Northern Cheyenne Tribe (L. Spang)		ML120120289
U.S. Nuclear Regulatory Commission (L. Camper)	Cheyenne and Arapaho Tribe (J. Prairie Chief-Boswell)	February 22,2013	ML12363A099

Table A–1. Chronology of Consultation Correspondence (Continued)			
Author	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
U.S. Nuclear Regulatory Commission (L. Camper)	Cheyenne River Sioux Tribe (K. Keckler)	March 27, 2013*	ML13085A065*
	Chippewa Cree Tribe (K. Blatt)		ML13085A069
	Crow Tribe (D. Old Coyote)		ML13085A073
	Crow Creek Sioux Tribe (B. Sauze. Sr.)		ML13085A076
	Eastern Shoshone Tribe (D. Sinclair, Jr.)		ML13085A077
	Flandreau-Santee Sioux Tribe (A. Reider)		ML13085A099
	Fort Belknap Tribe (T. King)		ML13085A105
	Fort Peck Tribes (F. Azure)		ML13085A114
	Kiowa Indian Tribe of Oklahoma (A. Poppah)		ML13085A119
	Lower Brule Sioux Tribe (M. Jandreau)		ML13085A136
	North Arapahoe Tribe (D. O'Neal)		ML13085A141
	Northern Cheyenne Tribe (J. Robinson)		ML13085A156
	Oglala Sioux Tribe (B. Brewer)		ML13085A226
	Rosebud Sioux Tribe (C. Scott)		ML13085A235
	Santee Sioux Tribe of Nebraska (R. Trudell)		ML13085A244
	Sisseton-Wahpeton Oyate Tribes (R. Shepherd)		ML13085A262
	Spirit Lake Tribe (R. Yankton, Sr.)		ML13085A268
	Standing Rock Sioux Tribe (C. Murphy)		ML13085A274
	Mandan, Hidatsa & Arikara Nation (T. Hall)		ML13085A294
	Turtle Mountain Band of Chippewa (R. McCloud)		ML13085A305
	Yankton Sioux Tribe (R. Courneyor)		ML13085A307
Santee Sioux Tribe (R. Thomas)	U.S. Nuclear Regulatory Commission	April 15, 2013	ML13109A555

Table A–1. Chronology of Consultation Correspondence (Continued)			
Author	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
Cheyenne and Arapaho Tribes (M. Anquoe)	U.S. Nuclear Regulatory Commission	May 14, 2014	ML13149A168
Standing Rock Sioux Tribe (M. Wilson)	U.S. Nuclear Regulatory Commission	May 1, 2014	ML13149A183
U.S. Nuclear Regulatory Commission (L. Camper)	Wyoming State Historic Preservation Officer (M. Hopkins)	June 13, 2013	ML13128A497
Wyoming State Historic Preservation Officer (R. Currit)	U.S. Nuclear Regulatory Commission (J. Caverly)	July 10, 2013	ML13221A007
U.S. Nuclear Regulatory Commission - Report	Site visit report	September 19, 2013	ML15040A171
Campbell County Board of Commissioners	U.S. Nuclear Regulatory Commission (Staff)	October 8, 2013	ML13290A671
U.S. Nuclear Regulatory Commission (K. Hsueh)	U.S. Fish and Wildlife Service (M. Sattelberg)	October 17, 2013	ML13268A438
U.S. Nuclear Regulatory Commission (K. Hsueh)	Wyoming State Historic Preservation Office (M. Hopkins)	November 8, 2013	ML13280A332
Cheyenne River Sioux Tribe (S. Vance)	U.S. Nuclear Regulatory Commission (J. Caverly)	Dec. 17, 2013	ML13351A471
U.S. Nuclear Regulatory Commission (J. Caverly)	Wyoming DEQ (A. Keyfauver)	January 8, 2014	ML14009A111
U.S. Nuclear Regulatory Commission (K. Hsueh)	Ft Belknap Tribe (M. Blackwolf)	February 19, 2014*	ML14017A322*
	Chippewa Cree Tribe (A. Windy Boy)		ML14017A317
	Cheyenne River Sioux (S. Vance)		ML14017A315
	Santee Sioux Tribe (R. Thomas)		ML14017A325
	Standing Rock Sioux Tribe (W. Young)		ML14017A198
	Cheyenne and Arapaho Tribe (M. Anquoe)		ML14017A310
	Kiowa Indian Tribe (A. Tah-bone)	February 28, 2014*	ML14056A366*
	Spirit Lake Tribe (E. Longie)		ML14056A374
	Oglala Sioux Tribe (M. Catches Enemy)		ML14056A373

Table A–1. Chronology of Consultation Correspondence (Continued)

Author	Recipient	Date of Letter	ADAMS Accession Number
U.S. Nuclear Regulatory Commission (K. Hsueh)	Northern Cheyenne Tribe (C. Fisher)		ML14056A378
	Turtle Mountain Band of the Chippewa (B. Naeau)		ML14056A386
	Northern Arapaho Tribe (C. Headley)		ML14056A359
	Apsaalooke (Crow) Nation (E. Bullchief)		ML14056A390
	Sisseton-Wahpeton Oyate Tribe (D. Desrosiers)		ML14056A391
	Flandreau- Santee Sioux Tribe		ML14056A369
	Yankton Sioux (L. Miller)		ML14056A372
	Lower Brule Sioux Tribe (C. Green)		ML14056A361
	Three Affiliated Tribes (E. Crows Breast)		ML14056A376
Santee Sioux Tribe (R. Thomas)	U.S. Nuclear Regulatory Commission	July 22, 2014*	ML15349A913*
U.S. Nuclear Regulatory Commission (K. Hsueh)	Chippewa Cree Tribe (A. Windy Boy, Sr.)	April 22, 2014*	ML14111A353*
	Cheyenne and Arapaho Tribes (A. Wiley)		ML14112A466
	Crow Tribe (R. Backbone Fitch)		ML14112A479
	Turtle Mountain Band of Chippewa (B. Grant)		ML14112A488
	Spirit Lake Tribe (E. Longie)		ML14112A495
	Northern Arapaho Tribe (Y. Soldier Wolf)		ML14112A525
	Crow Creek Sioux Tribe (G. Zephier)		ML14112A539
	Crow Creek Sioux Tribe (D. Zephier)		ML14112A542
	Santee Sioux Tribe (C. Campbell, Sr.)		ML14112A553
	Santee Sioux Tribe (W. White)		ML14112A558
	Northern Cheyenne Tribe (R. Fisher)		ML14113A027

Table A–1. Chronology of Consultation Correspondence (Continued)			
Author	**Recipient**	**Date of Letter**	**ADAMS Accession Number**
U.S. Nuclear Regulatory Commission (K. Hsueh)	Tribal Historic Preservation Officer	May 1, 2014	ML14113A459
U.S. Nuclear Regulatory Commission (L. Chang)	Cheyenne River Sioux Tribe (S. Vance)	October 8, 2014*	ML14279A294*
	Chippewa Cree Tribe (A. Windy Boy, Sr.)		ML14279A478
	Apsaalooke (Crow) Nation (E. Bullchief)		ML14279A507
	Crow Creek Sioux Tribe (D. Zephier)		ML14279A516
	Flandreau-Santee Sioux Tribe (S. Allen)		ML14279A526
	Fort Belknap Tribe (M. Blackwolf)		ML14279A542
	Fort Peck Tribe (D. Youpee)		ML14279A554
	Northern Arapaho Business Committee (C. Headley)		ML14280A094
	Northern Cheyenne Tribe (C. Fisher)		ML14280A099
	Turtle Mountain Band of Chippewa (B. Nadeau)		ML14280A123
	Yankton Sioux Tribe (L. Miller)		ML14280A135
U.S. Fish and Wildlife Service (M. Sattelberg)	U.S. Nuclear Regulatory Commission	March 6, 2015	ML15086A428

Table A–1. Chronology of Consultation Correspondence (Continued)

Author	Recipient	Date of Letter	ADAMS Accession Number
U.S. Nuclear Regulatory Commission (L. Chang)	Apsaalooke (Crow) Nation (E. Bullchief)	May 6, 2015*	ML15125A116*
	Cheyenne River Sioux Tribe (S. Vance)		ML15125A130
	Chippewa Cree Tribe (A. Windy Boy, Sr.)		ML15125A127
	Crow Creek Sioux Tribe (D. Zephier)		ML15125A148 ML15125A118
	Flandreau-Santee Sioux Tribe (S. Allen)		ML15125A199
	Fort Belknap Tribe (M. Blackwolf)		ML15125A136
	Fort Peck Tribe (D. Youpee)		ML15125A146
	Northern Arapaho Business Committee (C. Headley)		ML15121A753
	Northern Cheyenne Tribe (J. Walksalong)		ML15125A126
	Santee Sioux Tribe of Nebraska (R. Thomas)		ML15125A148
	Turtle Mountain Band of Chippewa (B. Nadeau)		ML15125A143
	Yankton Sioux Tribe (L. Miller)		
U.S. Nuclear Regulatory Commission (L. Chang)	Fort Peck Tribe (D. Youpee)	August 5, 2015*	ML15215A428*
	Northern Cheyenne Tribe (J. Walksalong)		ML15215A503
	Cheyenne River Sioux (S. Vance)		ML15212A803
	Northern Arapaho Tribe (C. Headley)		ML15215A498
	Flandreau-Santee Sioux Tribe (S. Allen)		ML15215A423
	Crow Creek Sioux Tribe (D. Zephier)		ML15215A421
	Santee Sioux Tribe of Nebraska (R. Thomas)		ML15215A514
	Turtle Mountain Band of Chippewa (B. Nadeau)		ML15215A522
	Apsaalooke (Crow) Nation (E. Bullchief)		ML15215A418

Table A–1. Chronology of Consultation Correspondence (Continued)

Author	Recipient	Date of Letter	ADAMS Accession Number
U.S. Nuclear Regulatory Commission (L. Chang)	Yankton Sioux Tribe (L. Miller)		ML15215A541
	Chippewa Cree Tribe (A. Windy Boy)		ML15215A415
	Fort Belknap Tribe (M. Blackwolf)		ML15215A426
U.S. Nuclear Regulatory Commission	U.S. Environmental Protection Agency	August 11, 2015	ML15215A571
Northern Arapaho Tribe	U.S. Nuclear Regulatory Commission	October 19,2015	ML15317A483
Santee Sioux Tribe	U.S. Nuclear Regulatory Commission	Dec. 16, 2015	ML15349A917
U.S. Nuclear Regulatory Commission	Wyoming SHPO	Jan. 29, 2016	ML15324A301
Wyoming SHPO	U.S. Nuclear Regulatory Commission	Feb. 18, 2016	ML16169A290
Northern Arapaho Tribe	U.S. Nuclear Regulatory Commission	May 2, 2016	ML16175A416
U.S. Nuclear Regulatory Commission (L. Chang)	Advisory Council on Historic Preservation (S. Stokley)	June 28, 2016	ML16154A113
U.S. Nuclear Regulatory Commission (L. Chang)	Wyoming SHPO	September 26, 2016	ML16245A926
Wyoming SHPO (R. Currit)	U.S. Nuclear Regulatory Commission	October 11, 2016	ML16302A379

*Copy of letter provided. Similar letters were sent to listed parties.

APPENDIX B

ALTERNATE CONCENTRATION LIMITS

APPENDIX B—ALTERNATE CONCENTRATION LIMITS

In-situ recovery (ISR) facilities operate by first extracting uranium from specific areas called wellfields. After uranium recovery has ended, the groundwater in the wellfield contains constituents that the lixiviant mobilized. Licensees shall commence aquifer restoration in each wellfield soon after the uranium recovery operations end (NRC, 2009). Aquifer restoration criteria for the site-specific baseline constituents are determined either for each individual well or as a wellfield average.

U.S. Nuclear Regulatory Commission (NRC) licensees are required to return water quality parameters to the standards in Title 10 *Code of Federal Regulations* (CFR) 10 CFR Part 40, Appendix A, Criterion 5B(5). As stated in the regulations: "5B(5)—At the point of compliance, the concentration of a hazardous constituent must not exceed—(a) The Commission approved background concentration of that constituent in the groundwater; (b) The respective value given in the table in paragraph 5C if the constituent is listed in the table and if the background level of the constituent is below the value listed; or (c) An alternate concentration limit (ACL) is established by the Commission."

For an ACL to be considered by the NRC, a licensee must submit a license amendment application to request an ACL. In this ACL license amendment request, the licensee must provide the basis for any proposed limits, including consideration of practicable corrective actions that limits are as low as reasonably achievable (ALARA), and information on the factors the Commission must consider. NRC will establish a site-specific ACL for a hazardous constituent as provided in Criterion 5B(5) if NRC finds the proposed limit ALARA, after considering practicable corrective actions, and determining that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the ACL is not exceeded.

To determine if the ACL does not pose a potential hazard to human health or the environment, NRC performs three risk assessments (NRC, 2003a). The first is a hazard assessment which evaluates the radiological dose and toxicity of the constituents in question and the risk to human health and environment. The second is an exposure assessment to examine the existing distribution of hazardous constituents, as well as potential sources for future releases and the potential consequences associated with the human and environmental exposure to the hazardous constituents. The last assessment is a corrective action assessment, which evaluates (i) all applicant proposed corrective actions; (ii) the technical feasibility of each proposed corrective actions; (iii) the costs and benefits associated with each proposed corrective action; and (iv) the preferred corrective action to achieve the hazardous constituent concentration, which is protective of human health and the environment.

To perform these assessments, the NRC staff uses a rigorous review process. Licensees must provide a comprehensive ACL amendment that addresses groundwater and surface water quality and expected impacts on human health and the environment. Such information required in an amendment request pursuant to 10 CFR Part 40, Appendix A, Criterion 5B(6) includes the following factors:

- Potential adverse effects on groundwater quality, considering the following:
  - — The physical and chemical characteristics of the waste in the licensed site including its potential for migration

- — The hydrogeologic characteristics of the facility and surrounding land
- — The quantity of groundwater and the direction of groundwater flow
- — The proximity and withdrawal rates of groundwater users
- — The current and future uses of groundwater in the area
- — The existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality
- — The potential for health risks caused by human exposure to waste constituents
- — The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents
- — The persistence and permanence of the potential adverse effects

- Potential adverse effects on hydraulically connected surface water quality, considering the following:
  - — The volume and physical and chemical characteristics of the waste in the licensed site
  - — The hydrogeologic characteristics of the facility and surrounding land
  - — The quantity and quality of groundwater, and the direction of groundwater flow
  - — The patterns of rainfall in the region
  - — The proximity of the licensed site to surface waters
  - — The current and future uses of surface waters in the area and any water quality standards established for those surface waters
  - — The existing quality of surface water including other sources of contamination and the cumulative impact on surface water quality
  - — The potential for health risks caused by human exposure to waste constituents
  - — The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents
  - — The persistence and permanence of the potential adverse effects

Although state “class of use” standards are not recognized in NRC’s regulations as restoration standards, these standards may be considered as one factor in evaluating ACL requests for ISR facilities located in Wyoming. Furthermore, in considering ACL requests, particular importance is placed on protecting underground sources of drinking water (USDWs). The use of modeling and additional groundwater monitoring may be necessary to show that ACLs in ISR wellfields would not adversely impact USDWs. It must be demonstrated that the licensee it has attempted to restore hazardous constituents in groundwater to background or a maximum contaminant level—whichever level is higher.

Before an ISR licensee is allowed to extract uranium, the U.S. Environmental Protection Agency (EPA) under 40 CFR 146.4 and in accordance with the Safe Drinking Water Act must issue an aquifer exemption covering the portion of the aquifer in which the uranium-bearing rock is located. EPA cannot exempt the portion of the aquifer unless it is found that "it does not currently serve as a source of drinking water" and "cannot now and will not in the future serve as a source of drinking water." Due to these criteria, only impacts outside of the exempted aquifer are evaluated. In most cases, the water in aquifers adjacent to the uranium ore zones does not meet drinking water standards. The staff will not approve an ACL if it will impact any adjacent USDWs. Therefore, the impact of granting an ACL request is SMALL.

Further guidance for the review of ACLs for ISR facilities is being developed in a revision of NUREG–1569 (NRC, 2003a). Existing guidance for the review of ACLs for conventional mills is in NUREG–1620, "Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978" (NRC, 2003b).

References

10 CFR Part 40. Appendix A. Code of Federal Regulations, Title 10, *Energy*, Part 40, Appendix A. "Criteria Relating to the Operations of Uranium Mills and to the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily from their Source Material Content." Washington, DC: U.S. Government Printing Office.

40 CFR Part 146. Code of Federal Regulations, Title 40, *Protection of Environment,* Part 146. "Underground Injection Control Program: Criteria and Standards." Washington, DC: U.S. Government Printing Office.

NRC. NUREG–1910, "Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities." ML091480244, ML091480188. Washington, DC. U.S. Nuclear Regulatory Commission. May 2009.

NRC. NUREG–1569, "Standard Review Plan for *In-Situ* Leach Uranium Extraction License Applications." Final Report. Washington, DC: U.S. Nuclear Regulatory Commission. June 2003a.

NRC. NUREG–1620, "Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978." Final Report. Washington, DC: U.S. Nuclear Regulatory Commission. June 2003b.

APPENDIX C

NONRADIOLOGICAL AIR QUALITY SUPPORTING DOCUMENTATION

NONRADIOLOGICAL AIR QUALITY SUPPORTING DOCUMENTATION

C–1 Introduction

This appendix provides detailed nonradiological air emissions information associated with the proposed Reno Creek In Situ Recovery (ISR) Project. The information in this appendix consolidates and supplements information from several sources (AUC, 2012; 2014a,b). This appendix is divided into seven sections: Introduction (Section C–1), Air Quality Permitting (Section C–2), Proposed Project Emission Inventories (Section C–3), Proposed Project Analyses and Air Dispersion Modeling (Section C–4), Cumulative Effects Analyses (Section C–5), Impact Analyses Using Air Dispersion Modeling without Dry Depletion (Section C–6), and References (Section C–7).

C–2 Air Quality Permitting

This air quality permitting discussion is divided into two sections. Section C–2.1 addresses the relationship between the supplemental environmental impact statement (SEIS) analysis and air quality permitting. Section C–2.2 describes the general air quality permitting process in greater detail.

C–2.1 Relationship Between the SEIS Analysis and Air Permitting

While the U.S. Nuclear Regulatory Commission (NRC) is responsible for assessing the potential environmental impacts from the proposed project pursuant to the National Environmental Policy Act of 1969 (NEPA) as amended, the NRC does not have the authority to develop or enforce regulations to control nonradiological air emissions from equipment that NRC licensees use. The U.S. Environmental Protection Agency (EPA) and the Wyoming Department of Environmental Quality (WDEQ) have the authority to develop federal and state air quality regulations, respectively. For the proposed Reno Creek ISR Project, the authority to enforce air quality regulations and require any implementation of mitigation resides with the WDEQ and not with the NRC. To ensure the air quality of Wyoming is adequately protected, in addition to addressing all of the NRC regulatory requirements pertaining to radiological emissions, NRC applicants and licensees must comply with all applicable state and federal air quality regulatory compliance and permitting requirements.

The applicant has submitted the air quality permit information to WDEQ and approval is pending (see SEIS Table 1-2). Regulatory determinations for air permits often primarily focus on stationary sources, although Wyoming’s New Source Review program also analyzes mobile and fugitive sources. Since mobile and fugitive sources compose the majority of the proposed project emissions (see SEIS Table 2-4), the NRC staff determined that the SEIS analysis would include mobile and fugitive dust emission sources as well as stationary sources. The NRC staff have, in part, characterized the magnitude of air effluents from the proposed project by comparing the emission levels to EPA Prevention of Significant Deterioration (PSD) and Title V thresholds, and the modeled concentrations to EPA regulatory standards such as National Ambient Air Quality Standards (NAAQS). This characterization is intended to provide a context for understanding the magnitude of the proposed Reno Creek ISR Project air effluents. In addition, the characterization identified what emissions the analysis should focus on to evaluate potential environmental effects. The comparison of pollutant concentrations to NAAQS and PSD increments in this SEIS does not document or represent a formal regulatory determination for air permitting or regulatory compliance, which is outside the NRC’s jurisdiction.

C–2.2 Air Permitting

As described under air permitting in the Generic Environmental Impact Statement (GEIS) Section 1.7.2, the Clean Air Act permitting process is divided into two programs: the New Source Review program (preconstruction) and the Title V program (operation). The New Source Review requires stationary air pollution sources to obtain permits prior to construction. Three types of New Source Review permits exist: PSD, nonattainment New Source Review, and minor New Source Review. In attainment areas (i.e., those areas where air quality meets the NAAQS), PSD permits are required for major stationary pollutant sources that are new or making major modifications. Classification as a major source in an attainment area is based on the potential to emit more than 90.7 or 227 metric tons [100 or 250 short tons] of a regulated pollutant, depending on the source. In nonattainment areas, the nonattainment New Source Review permits are required for major stationary pollutant sources that are new or making major modifications. Classification as a major source in a nonattainment area is generally based on the potential to emit more than 90.7 metric tons [100 short tons] of a regulated pollutant. This threshold can be lower for areas with more serious nonattainment problems. A minor New Source Review permit supplements the PSD and nonattainment New Source Review programs. The New Source Review permit provides regulators (i.e., the WDEQ for the proposed Reno Creek ISR Project) a method to implement permit conditions as needed to limit emissions from sources not covered by those two programs. Title V permits are required for stationary sources that, during operations, have the potential to emit more than 90.7 metric tons [100 short tons] of any regulated pollutant (lower thresholds for areas that are in nonattainment) (NRC, 2009).

C–3 Proposed Project Emission Inventories

The emissions inventory discussion includes the proposed project emission inventory (Section C–3.1) and the preconstruction emission inventory (Section C–3.2).

C–3.1 Proposed Project Emission Inventory

The proposed project emission inventory is divided into six sections. The first three sections describe the emission inventory in terms of the three main source categories: fugitive (Section C–3.1.1), mobile (Section C–3.1.2), and stationary (Section C–3-1.3). Section C–3.1.4 describes the peak year emission inventory and Section C–3.1.5 describes the emission inventory of each of the phases when operating at the 100 percent activity level. Section C–3.1.6 describes the mitigation incorporated into the emission inventory.

C–3.1.1 Fugitive Dust Emissions

Fugitive dust emissions are one of the three primary source categories considered when examining air emissions from the proposed project. Fugitive dust comprises particulate matter ($PM_{2.5}$ and PM_{10}.)[1] SEIS Appendix C, Table C–1 presents total fugitive dust emissions for each year of the project. This table also specifies the contributions from the two primary fugitive dust emission sources: vehicular travel on unpaved roads and wind erosion to disturbed land. The number of hours during which mobile sources would be active and travel on unpaved roads vary

[1]Particulate matter $PM_{2.5}$ is defined as particles which are 2.5 micrometers in diameter or smaller and particulate matter PM_{10} is defined as particles which are 10 micrometers in diameter or smaller.

over the lifespan of the project; therefore, the amount of fugitive dust emissions annually generated from mobile sources traveling on unpaved roads also varies. The amount of fugitive dust emissions from wind erosion would be a function of the amount of disturbed land. The calculation for the amount of dust generated by wind erosion was based on the net amount of land exposed, which accounts for both the amount of land disturbed as well as the amount of land reclaimed. SEIS Appendix C, Table C–2 provides information by project year for the amounts of disturbed land, reclaimed land, and net exposed land as well as the associated fugitive dust emissions from wind erosion. This table includes information for preconstruction (i.e., project year zero). Preconstruction was not part of the analyses in SEIS Chapter 4 and is addressed separately in SEIS Chapter 5 on cumulative effects. However, for the purpose of determining net land exposed, the preconstruction value was included since it would be part of the disturbed land within the footprint of the proposed Reno Creek ISR Project area that would be reclaimed during the project lifespan. The amount of net land exposed and the associated fugitive dust emissions would vary little over the project lifespan. Fugitive dust emissions from wind erosion were much lower in magnitude when compared to the emissions from travel on unpaved roads. The Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides additional details concerning the calculation of fugitive dust emissions throughout the document, but primarily in Appendix A.

C–3.1.2 Mobile Combustion Emissions

Combustion emissions from mobile sources are one of the three primary source categories considered when examining air emissions from the proposed project. SEIS Appendix C, Table C–3 presents the total combustion emissions from mobile sources for each project year and also specifies the emissions attributed to each of the various phases by project year. The number of hours during which mobile sources would be active varies over the lifespan of the project; therefore, the amount of combustion emissions annually generated also varies. The Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides additional details concerning the calculation of mobile source emissions throughout the document, but primarily in Appendix A.

C–3.1.3 Stationary Combustion Emissions

Combustion emissions from stationary sources are one of the three primary source categories considered when examining air emissions from the proposed project. SEIS Appendix C, Table C–4 presents the stationary source emissions associated with the proposed project. For the purpose of this SEIS, point or stationary sources would be limited to the equipment identified in SEIS Appendix C, Table C–4. Stationary source emissions would be assumed to be constant over the project lifespan except for project year one, which would produce the lowest levels of stationary emissions. The Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides additional details concerning the calculation of stationary source emissions throughout the document, but primarily in Appendix A.

C–3.1.4 Peak Year Emissions

For the proposed Reno Creek ISR project, phases overlap or occur simultaneously. The peak year accounts for the time when activities associated with all four phases would occur simultaneously and therefore the maximum emissions the proposed project would generate in any one project year. As described in SEIS Section 4.7.1, the applicant conducted atmospheric dispersion modeling system (AERMOD) using the peak year emission levels to predict the NAAQS and PSD pollutant concentrations at various receptor locations. The peak year emission estimates were used as input for the AERMOD air dispersion modeling since the highest amount of emissions for a single project year would correspond to the highest potential effect on air quality.

To identify the peak year for each pollutant, emission levels from fugitive (SEIS Appendix C, Table C–1), mobile (SEIS Appendix C, Table C–3), and stationary sources (SEIS Appendix C, Table C–4) were considered. The mobile and fugitive dust emission levels would vary by project year and the applicant assumed stationary emissions would be constant over the project lifespan (except for year one when they would be lowest). The stationary source emissions considered in this analysis (see SEIS Appendix C, Table C–4) are limited to equipment within the central processing plant (CPP). Because the CPP would be constructed in project year one, and the emission sources would not be operational over the entire year, year one would generate the lowest stationary source emission levels. Particulate matter emissions from fugitive dust sources would be much greater than those from mobile and stationary sources. Therefore, fugitive dust emissions determined the peak year for particulate matter $PM_{2.5}$ and PM_{10}. The highest level of emissions for both types of particulate matter would occur in project year six (SEIS Appendix C, Table C–1). Mobile source emissions determined the peak year for carbon monoxide, nitrogen oxides, and sulfur dioxide. Stationary source emission levels would be much lower than mobile source emission levels for these pollutants, and fugitive dust emissions would be limited to particulate matter. For mobile sources, project years three through six produce the same – and highest –level of emissions for nitrogen oxides and sulfur dioxide (see the “Totals” section of SEIS Appendix C, Table C–3). The highest carbon monoxide emissions would occur in project year two at 39.09 metric tons [43.09 short tons] which is slightly more than the 38.32 metric tons [42.24 short tons] estimated annually for project years three to six. Because the difference in carbon monoxide emission levels between project year two and project years three through six would only be about two percent, and the carbon monoxide estimated concentrations from the modeling results range between 3.4 to 5.3 percent of the NAAQS (see SEIS Table 4-9), this SEIS considers project year six to be the peak year for all pollutants, including carbon monoxide.

SEIS Appendix C, Table C–5 presents the estimated peak year emission levels (i.e., project year six). This table also specifies the emission levels attributed to mobile, fugitive, and stationary emission sources for the peak year. SEIS Appendix C, Table C–6 identifies the contribution (i.e., percent) of the various source categories to the various pollutants for the peak year.

Modeling was conducted using the peak year emission inventory, which included fugitive, mobile, and stationary sources. Although the modeling was conducted using emissions from the peak year (i.e., one year of emission data), which the applicant provided in The Ambient Air Quality Modeling Protocol and Results (AUC, 2014a), the model uses three years of hourly meteorological data in accordance with EPA recommendations (AUC, 2014a). The peak year emission estimates represent the highest amount of emissions for a single project year and correspond to the highest potential effect on air quality. Other project years with lower emission levels would have lower impacts. Emission levels for the proposed Reno Creek ISR Project are noticeably lower during the second half of the project lifespan (see SEIS Tables C–1 and C–3).

C–3.1.5 Individual Phase Emissions at the 100 Percent Activity Level

In addition to the peak year, the air quality analysis in SEIS Section 4.7 examines air impacts by individual project phases. To assess impacts for individual phases, the NRC staff determined the maximum emission levels over a single project year for each of the phases (i.e., the emission levels associated with the 100 percent activity level for each phase). As previously stated, more than one phase can occur within a given project year (see SEIS Figure 2-1). Even though a phase may be active in a given year, that does not mean it would function at the 100 percent activity level (i.e., generate the maximum emissions associated with the activities for that phase). For the proposed Reno Creek ISR Project, all four phases were assumed to be active during the peak year, but with no phase active at the 100 percent activity level. Based on information provided by the applicant, the NRC staff determined the emissions associated with the 100 percent activity levels for the various project phases.

SEIS Appendix C, Table C–3 contains the emissions associated with the 100 percent activity level for the various phases for the mobile source combustion emissions. This table presents the mobile source combustion emissions for each project year as well as the emissions for each phase. For each phase, the emissions associated with the 100 percent activity level can be determined by identifying the project year with the highest emission levels. SEIS Appendix C, Table C–7 presents the estimated mass flow rates for the 100 percent activity levels for each individual phase from the mobile source combustions emissions and specifies the project year when these emissions would occur.

The primary fugitive dust emission sources would be travel on unpaved roads and wind erosion to disturbed land. The determination of the emissions associated with the 100 percent activity level from these two sources was calculated separately.

The calculation for particulate matter generated from travel on unpaved roads requires three steps. The first step is to identify the project year associated with the 100 percent activity level for each phase for travel on unpaved roads. The sources and activity levels (e.g., hours of operation) used to estimate the mobile combustion emissions would be the same sources and activity levels used to estimate the fugitive dust emissions from travel on unpaved roads (AUC, 2014a). Therefore, the assumption can be made that the project year with the highest emission levels for each phase would be the same for both the fugitive dust from travel on unpaved roads and mobile combustion emission sources. SEIS Appendix C, Table C–7 identifies the project year for 100 percent activity level for each phase for the mobile sources.

SEIS Appendix C, Table C–1 identifies the fugitive dust emissions from travel on unpaved roads for each project year. However, the information in this table does not specify how much can be attributed to each phase. The second step in calculating particulate matter from travel on unpaved roads is to determine the contribution by phase. The NRC staff assume that the contribution (percent) of particulate matter attributed to an individual phase for any given project year would be the same for both the fugitive dust emissions associated with travel on unpaved roads and the mobile combustion emissions, as previously discussed. SEIS Appendix C, Table C–3 contains the information needed to calculate the contribution (percent) of particulate matter from mobile combustion sources attributed to an individual phase for any given project year. Based on the combustion emission from mobile sources, SEIS Appendix C, Table C–8 identifies the 100 percent activity level project years for each phase and specifies the percent contribution of that phase to the total particulate matter emissions for that same year.

The third step in calculating particulate matter from travel on unpaved roads is to apply the percent contributions for individual phases (as listed in SEIS Appendix C, Table C–8) to the associated total fugitive dust emissions from travel on unpaved roads (as listed in SEIS Appendix C, Table C–1) to determine the annual mass flow rate of fugitive dust from travel on unpaved roads for the 100 percent activity level for each phase (see SEIS Appendix C, Table C–9).

The other primary source of fugitive dust emissions would be from wind erosion from disturbed lands. As described in SEIS Section 2.1.2, particulate matter emissions from wind erosion were not provided for individual phases because they would not vary significantly based on the activity levels of the individual phases. The NRC staff conservatively assume that the entire wind erosion estimate for the associated individual project year in SEIS Appendix C, Table C–1 would be generated by one phase rather than a possible combination of several phases. SEIS Appendix C, Table C–10 presents the estimated mass flow rates for the 100 percent activity levels for each individual phase from the fugitive dust emission sources (both travel on unpaved roads and wind erosion) and specifies the project year when these emissions occur.

Finally, stationary source emissions would be assumed to be constant over the project lifespan except for project year one, which would produce the lowest levels of stationary emissions. Emission levels from stationary sources (see SEIS Appendix C, Table C–4) are much lower than emission levels from mobile source combustion emissions (see SEIS Appendix C, Table C–3) or fugitive dust emission sources (see SEIS Appendix C, Table C–1). The discrepancy in emission levels between the stationary sources and both the mobile and fugitive sources allows for the assumption that stationary source emission estimates do not need to be further broken down into contributions associated with individual phases. The NRC staff conservatively assume that the entire stationary combustion emission estimates for the associated individual project year in SEIS Appendix C, Table C–4 are generated by one phase rather than a possible combination of several phases.

SEIS Appendix C, Table C–11 presents the estimated mass flow rates for the 100 percent activity levels for each individual phase from all three of the primary emission source categories and specifies the project year when these emissions occur. This table also specifies the contribution from each of the three emission sources to the overall total.

C–3.1.6 Mitigation Incorporated into the Emission Inventory

The air emission inventory used in this SEIS incorporates the following applicant-committed mitigation measures:

- Tier 1 engines for drill rigs,
- Tier 3 engines for construction equipment,
- Dust suppression for unpaved roads,
- Carpooling, and
- Reclamation of disturbed land.

The terms “Tier 1” and “Tier 3” refer to a phased program of standards mandated by the federal government that requires newly manufactured engines to generate lower pollutant emission levels. Higher tier numbers mean stricter emission standards and lower pollutant levels. The emission inventory was calculated using emission factors based on tier levels specified by the applicant. Emission factors are values used to relate the levels of activities to the amounts of pollution produced. In this case, the emission factor relates the amount of fuel consumed by the equipment to the mass of pollutants generated. As described in the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a), the inventory used EPA emission factors. The specific emission factor values associated with each piece of equipment proposed for use in the Reno Creek ISR Project are found in Table A–3 of the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a). SEIS Appendix C, Table C–12 describes the effectiveness (i.e., the percent that the emissions are reduced) of the different tier levels based on the associated emission factors. The Tier 0 level in SEIS Appendix C, Table C–12 represents the baseline of uncontrolled emission factors associated with older equipment.

The emission inventory also incorporates two different dust suppression methods for travel on unpaved roads. The applicant has committed to treat the CPP facility access road with water and, semi-annually, with chemical dust suppressant. The applicant has also committed to treat the remaining unpaved project roads with only water. As described in Tables A-14 to A-17 of the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a), the emission levels for pieces of equipment were reduced by the appropriate control efficiency. A control efficiency of 85 percent was applied to all equipment whose primary travel would be on the CPP facility access road where the treatment included chemical dust suppression. A control efficiency of 50 percent was applied to all equipment whose primary travel would be on the other remaining project roads, based on a watering frequency of more than once every two hours (AUC, 2014a). Appendix D of the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides details for the project specific watering-only control of fugitive dust emissions.

Carpooling reduces the number of commuter vehicles on the road, which would result in fewer emissions and lower pollutant levels. SEIS Appendix C, Table C–13 describes the effectiveness (i.e., the percent that the emissions would be reduced) of the carpooling plan committed to by the applicant.

As previously noted, the amount of fugitive dust emissions from wind erosion is a function of the amount of disturbed land. Reclaiming land reduces the amount of disturbed land, which results in fewer fugitive dust emissions and lower pollutant levels. Fugitive dust emission estimates from wind erosion were based on the net exposed land rather than the total disturbed land. The net exposed land accounts for both the amount of land disturbed as well as the amount of land reclaimed. SEIS Appendix C, Table C–2 presents the calculation for the net exposed land for each project year, which was then used to estimate the fugitive dust emissions from wind erosion. The NRC staff determined the effectiveness of reclamation as mitigation by comparing the fugitive dust emission levels with and without reclamation (i.e., comparing fugitive dust emissions from the net exposed land versus the total disturbed land). This comparison requires two steps. The first step is identifying the total amount of land disturbed by the proposed project as well as the largest amount of net exposed land for any single project year (see SEIS Appendix C, Table C–2). These amounts are 62.4 ha [154.3 ac], and 20.9 ha [51.6 ac], respectively (see SEIS Appendix C, Table C–2). The second step is to relate the amount of disturbed land to the amount of fugitive dust emissions generated (see SEIS Appendix C, Table C–2). The data show that generation of fugitive dust emissions would change equivalently with the amount of land disturbed (see SEIS Appendix C, Table C–14). Based on the values identified in the first step, the largest amount of net exposed land for any given project year is about 33 percent of the total disturbed land. Correspondingly, the fugitive dust emission levels associated with the project with reclamation are 33 percent of the emissions levels without reclamation. In other words, this mitigation reduces fugitive dust emission levels by about 67 percent because reclamation reduces the amount of land actually disturbed (i.e., the net exposed land) by 67 percent relative to the amount of land that would be disturbed without reclamation.

C–3.2 Preconstruction Emission Inventory

Emissions from the proposed Reno Creek ISR Project preconstruction activities are not analyzed in SEIS Chapter 4 and are addressed separately in SEIS Chapter 5 on cumulative effects. SEIS Appendix C, Table C–15 presents the emissions from the proposed Reno Creek ISR Project preconstruction activities and compares these to the peak year emission levels from project activities. In this SEIS, the NRC staff assumed that no stationary source emissions occur during preconstruction activities. The Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides additional details concerning the calculation of the fugitive dust emissions and mobile combustion emissions.

C–4 Proposed Project Analyses and Air Dispersion Modeling

This discussion is divided into three sections. Section C–4.1 addresses background information for the SEIS analyses conducted with site-specific modeling. Section C–4.2 describes background information for the SEIS analyses conducted without site-specific modeling. Section C–4.3 describes additional background information for the site-specific modeling results.

C–4.1 Background Information for SEIS Analyses Conducted With Site-Specific Air Dispersion Modeling

Site-specific air dispersion modeling can be used to analyze the effects of project level emissions for a variety of pollutants at a number of receptors (i.e., locations where pollutant concentrations are estimated). For this analysis, the applicant conducted site-specific air dispersion modeling to analyze the NAAQS and PSD pollutant concentrations at and beyond the proposed project area boundary, as well as the NAAQS pollutant concentrations around the area of U.S. Highway 387 that bisects the proposed project area. SEIS Section C–4.1.1 describes the modeling domain for the site-specific air dispersion modeling. Section C–4.1.2 describes the AERMOD dry depletion option used for assessing the proposed project air quality impacts in this SEIS.

C–4.1.1 Modeling Domain

The primary modeling domain was located at and beyond the proposed Reno Creek ISR Project boundary. The applicant predicted NAAQS and PSD pollutant concentrations at 5,964 receptors that extended in all directions away from the proposed project area boundary to form a 60 km by 60 km [37.2 mi by 37.2 mi] modeling domain. The spacing between the receptors was not uniform within this modeling domain. The modeling domain included fence line, fine grid, intermediate grid, and coarse grid receptors areas. The spacing between the receptors for these areas increased as the distance from the proposed project increased, which provides a greater level of detail for the area near the emission source. Section 3.6 of the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides a more detailed description of the various receptor grids and includes several figures displaying receptor placement.

The modeling domain within the proposed Reno Creek ISR Project boundary was limited to the area along the section of U.S. Highway 387 that bisects the proposed project area. The highway is fenced on both sides, with a right-of-way width of 76.2 m [250 ft]. The applicant predicted NAAQS pollutant concentrations at 354 receptors that were located on either side of the highway. Section 5.2.2 of the Ambient Air Quality Modeling Protocol and Results

(AUC, 2014a) provides a more detailed description of the highway receptors and includes a figure displaying receptor placement.

C–4.1.2 Dry Depletion Option

The dry depletion option discussion is divided into four sections. Section C–4.1.2.1 addresses background information on the dry depletion option and the SEIS analyses. Section C–4.1.2.2 addresses the rationale for basing the SEIS impact magnitude determinations on the modeling that implements the dry depletion option. Section C–4.1.2.3 discusses the rationale for not modeling the entire domain using the dry depletion option. Section C–4.1.2.4 discusses the rationale for applying the dry depletion option to all particulate matter PM_{10} sources.

C–4.1.2.1 Background Information on the Dry Depletion Option and the SEIS Analyses

As described in SEIS Section 4.7.1, the applicant conducted two modeling runs for the primary modeling domain. The initial modeling run used the AERMOD regulatory default settings and predicted pollutant concentrations at all 5,964 receptors within this domain. The final modeling run used the AERMOD dry depletion option and predicted particulate matter PM_{10} pollutant concentrations at the 21 receptor locations with the highest concentrations of that pollutant from the initial modeling run. Implementation of the dry depletion option only changes the modeling results for the particulate matter PM_{10} estimates. The majority of the particulate matter PM_{10} emissions associated with the proposed project result from vehicle travel on unpaved roads, and the dry depletion option accounts for the fact that heavier particles (i.e., the particulate matter PM_{10}) from these types of fugitive dust emissions tend to settle out of the air relatively quickly as the dust plume disperses from the source (Countess, 2001). In the SEIS, the NRC staff base the proposed project impact magnitude determination (i.e., SMALL, MODERATE, or LARGE) in part on the particulate matter PM_{10} modeling results that implement the dry depletion option.[2]

C–4.1.2.2 Rationale for Basing the SEIS Impact Magnitude Determinations on the Modeling that Implements the Dry Depletion Option

The model options and approach for the air quality impact assessment selected by the NRC staff for this SEIS did not completely align with the regulatory default conditions in EPA's guidelines (40 CFR Part 51, Appendix W). The NRC staff concluded that it is appropriate to use dry depletion in the AERMOD analysis for this SEIS for two reasons. First, modeling using the regulatory default options can overestimate short-term (i.e., 24-hour) particulate matter PM_{10} concentrations because the rapid deposition phenomenon is not adequately addressed.

Specifically, a 2011 study (MMA, 2011) describes that AERMOD noticeably over-predicts the 24-hour particulate matter PM_{10} concentrations for locations close to the source {e.g., between 100 to 500 meters [328.1 to 1,640.4 ft]}. While the studies citing the tendency of the models to over-predict particulate matter PM_{10} concentrations over the short term (i.e., 24 hours) predate the AERMOD version used by the applicant for this analysis, the history of over-prediction by the model is indicative that implementing the dry depletion option is an appropriate measure for characterizing the particulate matter PM_{10} concentrations for this proposed project.

[2]In addition, Section C-6 of this appendix includes an impact magnitude determination that relies only on the initial modeling run (i.e., does not consider the results from the final modeling run that implements the dry depletion option).

Second, the NRC staff conclude that the proposed Reno Creek ISR project conditions meet EPA guidelines for deviating from the regulatory default conditions and implementing the dry depletion option. General guidelines in Appendix W of 40 CFR 51 state that dry depletion may be directly included in a model when particulate matter sources can be quantified and dry deposition is a significant factor. Mechanically-generated particulate matter PM_{10} emissions are the type of emissions likely to be removed from the air close to the generating source (Countess, 2001). Based on the information in SEIS Tables C–1 and Table C–5, 93 percent of the proposed project's peak year particulate matter PM_{10} emissions are from mechanically-generated sources, which are the type of fugitive dust emissions predicted to partially settle out within a short distance of the emission source. The nature of the proposed project's emissions indicates that deposition of particulate matter PM_{10} is likely. In addition to gravity settling, the initial AERMOD results show that the highest particulate matter PM_{10} 24-hour concentrations occur near the sources and concentrations fall off rapidly with distance from the source. This suggests the likelihood of high concentration gradients, which are expected to produce meaningful diffusion-based settling. Input parameters for the dry depletion option, including particle size distribution and particle density, are described in Section 3.9.3 of the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a).

C–4.1.2.3 Rationale for Not Modeling the Entire Domain Using the Dry Depletion Option

The initial modeling run analyzed all of the receptors in the modeling domain. The final modeling run was a refined analysis that predicted the particulate matter PM_{10} pollutant concentrations at the 21 receptors with the highest concentrations of that pollutant from the initial modeling run. The NRC staff acknowledges that without modeling the entire domain using dry depletion, results for the final modeling run are only available for those 21 receptors. While there may be some merit to modeling the entire domain with dry depletion, the NRC staff concluded that it is appropriate to limit the final modeling run to the receptors with the highest concentrations because the SEIS impact conclusions would be expected to be the same whether the dry depletion option is applied to all of the receptors or limited to the 21 receptors with the highest concentrations from the initial run. For all 21 receptors, the results from the final modeling run that implemented the dry depletion option were lower than the results from the initial modeling run that did not implement the dry depletion option (AUC, 2014a). The NRC staff expect that this trend would be true for the other receptors not modeled in the final run, since the dry depletion option reduces the amount of particulate matter that migrates beyond the proposed project area boundary by accounting for the partial settling and deposition of the heavier particulates close to the source. Because of this trend, the NRC staff conclude that the same receptors that generated the highest results for the initial run would also generate the highest results for the final modeling run, and the final results for the 21 receptors can be used to accurately characterize the impact magnitude.

C–4.1.2.4 Rationale for Applying the Dry Depletion Option to All Particulate Matter PM_{10} Sources

The dry depletion option was applied to all of the particulate matter PM_{10} sources (i.e., stationary, mobile, and fugitive sources) rather than just the particulate matter PM_{10} sources from mechanically-generated emissions (i.e., fugitive dust emissions from travel on unpaved roads). Mechanically-generated particulate matter PM_{10} emissions are the type of emissions likely to be removed from the air close to the generating source (Countess, 2001). While there may be some merit to conducting modeling with the dry depletion option only applied to the portion of particulate matter PM_{10} emissions that are mechanically-generated, the NRC staff concluded that it is acceptable to conduct the modeling with the dry depletion option applied to all of the particulate matter PM_{10} emissions because the vast majority of emissions are from mechanically-generated sources. Based on the information in SEIS Tables C–1 and Table C–5, 93 percent of the peak year particulate matter PM_{10} emissions are from mechanically-generated sources. Based on the predominance of mechanically-generated emission levels, the NRC staff conclude that it is not necessary for characterizing the particulate matter PM_{10} impacts in this SEIS to perform the AERMOD analysis where dry depletion is applied only to the mechanically-generated emissions because the difference (about 8 percent) would not significantly affect the result.

C–4.2 Background Information for SEIS Analyses Conducted Without Site-Specific Air Dispersion Modeling

The NRC staff determined that for three types of analyses considered in this SEIS, the proposed project's potential impacts could be determined without site-specific air dispersion modeling. This section provides the rationale for determining the potential impacts from the proposed project without site-specific air dispersion modeling to the nearest Class I and sensitive Class II areas (see Section C–4.2.1), for the PSD analysis at the highway bisecting the proposed project area (see Section C–4.2.2), and for hazardous air pollutants (see Section C–4.2.3).

C–4.2.1 Class I and Sensitive Class II Analysis

Wind Cave National Park is located 181.9 km [133 mi] away, and is the closest Class I area to the proposed Reno Creek ISR Project. Due to the large distance between proposed project and the Class I area and the proposed project's relatively low emission levels from the combined stationary, mobile, and fugitive sources, site-specific modeling was not conducted to assess effects from the proposed project. As described in the following paragraphs, application of the federal land managers' guidance (National Park Service, 2010) provided the basis for why site-specific modeling for air quality related values is not warranted, and consideration of the air dispersion modeling conducted for the Dewey-Burdock SEIS analysis provided the basis for why site-specific modeling for Class I PSD increments is not warranted. The NRC staff did not collaborate with any other federal or state agencies when making the decision not to conduct site-specific modeling for air quality related values or PSD Class I increments.

As described in SEIS Section 3.7.2.1, areas are designated into different PSD classifications. Class I areas have the most stringent requirements concerning allowable PSD increments. Protection of Class I areas considers air quality related values such as visibility and atmospheric deposition. No Class I areas exist within the 80-km [50-mi] region of influence for the proposed Reno Creek ISR Project. Federal land managers responsible for managing Class I areas developed guidance that recommends a screening test be applied to proposed sources greater than 50 km [31 mi] from a Class I area to determine whether analysis for air quality related values is warranted (National Park Service, et. al., 2010). The screening test considers the project's distance to the nearest Class I area and the project's emission levels. If the combined annual mass emission rate (i.e., tons per year) of nitrogen oxides, particulate matter PM_{10}, sulfur dioxide, and sulfuric acid divided by the distance in kilometers from the Class I area is 10 or less, then this source is considered to have negligible impacts with respect to air quality related values and further analysis is not warranted. Based on the proposed project's estimated peak year values in SEIS Table C–5, which includes emissions from stationary, mobile, and fugitive sources, the combined annual mass emission rate for the specified pollutants is 151.4 metric tons [166.9 short tons] per year. Dividing this value by the 181.9 km [113 mi] distance results in a ratio of 0.9, which is well below the threshold ratio of 10. Based on screening test results, the proposed Reno Creek ISR Project's impacts to the nearest Class I area are negligible, and site-specific modeling for air quality related values is not warranted.

The NRC staff conclude that site-specific modeling analyzing effects for air quality related values from the proposed Reno Creek ISR Project's emissions at sensitive Class II areas is not warranted based on the same rationale. The nearest Class II sensitive area is Cloud Peak Wilderness Area located about 169 km [105 mi] to the northwest of the proposed Reno Creek ISR Project area. Based on this distance, the screening test ratio of emission levels to distance is about 1.0, which is well below the threshold ratio of 10 for determining whether analysis for air quality related values is warranted.

Site specific modeling for the Dewey-Burdock ISR Project provides the basis for not conducting site-specific modeling to assess PSD impacts from the proposed Reno Creek ISR Project's emissions to the nearest Class I area. The Dewey-Burdock SEIS analysis modeled impacts from the Dewey-Burdock Project's emissions to Wind Cave National Park, the nearest Class I area. All of the estimated pollutant concentrations at the Wind Cave National Park attributed to emissions from the Dewey-Burdock ISR project are below the PSD Class I increments (NRC, 2014). The Dewey–Burdock ISR Project was estimated to have much higher emission levels and is located much closer to the Class I area than the proposed Reno Creek ISR Project. Therefore, the NRC staff concluded that site-specific modeling to analyze impacts from proposed Reno Creek ISR Project emissions at Wind Cave National Park for Class I PSD increments is not warranted because the site-specific modeling for Dewey–Burdock Project emissions did not exceed the PSD Class I increments at the Class I area and the proposed Reno Creek ISR Project would be located farther away from the Class I site and has lower emissions than the Dewey–Burdock Project. The following paragraph provides a detailed comparison of the Dewey-Burdock and proposed Reno Creek ISR project emissions and distance to Wind Cave National Park.

The Dewey Burdock Project area is located about 46.7 km [29.0 mi] west of Wind Cave National Park and the predominant wind blows in the general direction from the ISR project area towards the Class I location (NRC, 2014). As described in SEIS Section 3.7, the proposed Reno Creek ISR Project area is located about 181.9 km [113 mi] west of Wind Cave National Park and the predominant wind blows in the general direction from the proposed project area towards the Class I location. The proposed Reno Creek ISR Project area is approximately four times farther away from Wind Cave National Park than the Dewey-Burdock Project. Although the distances between the two ISR locations and the Class I area vary, the general alignment and wind direction are similar. Since both projects are ISR projects, the NRC staff can assume that the activities and sources that generate air emissions would be similar. For the proposed Reno Creek ISR Project, the Ambient Air Quality Modeling Protocol and Results (AUC, 2014a) provides the detailed description of these activities and sources; and for the Dewey-Burdock Project, the Ambient Air Quality Final Modeling Protocol and Impact Analysis (IML, 2013) provides the detailed description of these activities and sources. SEIS Appendix C, Table C–16 contains the annual masses of pollutants generated by the two ISR projects. The projects are similar in that the particulate matter emissions are primarily generated by fugitive sources, and carbon monoxide, nitrogen oxide, and sulfur dioxide emissions are primarily generated by mobile sources [see SEIS Table C–6 and Table C–8 of the Dewey-Burdock SEIS (NRC, 2014)]. Information in SEIS Table C–16 presents an important distinction between the two projects: Dewey-Burdock emission levels are greater than those for the proposed Reno Creek ISR Project. The pollutant with the greatest discrepancy in emission levels between the two projects is particulate matter PM_{10} where the Dewey-Burdock emissions are four times greater than the proposed Reno Creek ISR project emissions.

Site-specific modeling was not conducted to assess PSD impacts from the proposed Reno Creek ISR Project emissions at the nearest sensitive Class II area, Cloud Peak Wilderness Area. Site-specific modeling was used to assess the Class II PSD impacts within the primary modeling domain, which extended in all directions away from the proposed project area boundary to form a 60 km by 60 km [37.2 mi by 37.2 mi] modeling domain. As described in SEIS Table 4-10, all of the results were below the PSD Class II increments. Pollutant concentrations are reduced as the plume disperses and moves away from the sources that generate the emissions. The Cloud Peak Wilderness Area is located about 169 km [105 mi] from the proposed project, which places this sensitive Class II area outside of the modeling domain. The NRC staff conclude that site-specific modeling to analyze impacts from proposed Reno Creek ISR Project emissions at Cloud Peak Wilderness Area for Class II PSD increments would not be warranted because the site-specific modeling for the proposed Reno Creek ISR Project emissions did not exceed the PSD Class II increments within the modeling domain and the sensitive Class II area is located outside or beyond this modeling domain where pollutant concentrations would not be expected to exceed those within the modeling domain.

C–4.2.2 Highway Receptor PSD Analysis

This SEIS did not examine the PSD analysis at the receptors along U.S. Highway 387 where it bisects the proposed project area. The PSD analysis in this SEIS provides a context for understanding the magnitude of the potential effects of the proposed project rather than a regulatory determination associated with air permitting by WDEQ. The results in SEIS Table 4-10 reveal that the greatest effect from project emissions can be attributed to short term (i.e., 24-hour time frame) particulate matter emissions. Nitrogen dioxide and sulfur dioxide concentrations range between 1.5 and 9.6 percent of the applicable PSD increment. For particulate matter, the annual concentrations range between 15 and 22.9 percent of the PSD increment and the 24-hour concentrations range between 61.1 and 74.3 percent of the PSD increment.

C–4.2.3 Hazardous Air Pollutants Analysis

Site-specific modeling of hazardous air pollutants was not conducted because of the low magnitude of the estimated emissions. The peak year emission estimate for hazardous air pollutants is 1.68 metric tons [1.85 short tons]. This estimate includes emissions from mobile (see SEIS Table 2-2), stationary (see SEIS Table 2-3), and fugitive sources (see SEIS Table 2-1). Because the proposed project would have low estimated emission levels, the NRC staff do not consider that site-specific modeling of the hazardous air pollutants is warranted.

C–4.3 Background Information for the Site-Specific Modeling Results

The proposed project site-specific modeling results discussion is divided into two sections. Section C–4.3.1 addresses continuity issues between the forms for the peak year modeling results and the regulations. Section C–4.3.2 addresses the modeling results for individual phases operating at the 100 percent activity level.

C–4.3.1 Continuity Between the Forms for the Modeling and Regulations

SEIS Table C–17 presents the peak year AERMOD modeling results with respect to the NAAQS and SEIS Table C–18 presents the peak year AERMOD modeling results with respect to the PSD increments. Not all of the modeling result forms in SEIS Table C–17 and Table C–18 are the same as the forms for the NAAQS and PSD regulations. A form expresses both the statistical (e.g., maximum, average, 98^{th} percentile, etc.) and temporal (e.g., once per year, over 1 year, over 3 years, etc.) nature of the value. Both tables have a column that indicates whether the modeling form for each result is the same as the NAAQS or PSD increment form. In cases where the modeling and regulation forms do not match, a value was derived by the NRC staff from the modeling results that did match the NAAQS or PSD increment form. These derived values were used in SEIS Tables 4-9 and 4-10. The remaining part of this section describes how each of these values is derived. All of the NAAQS discrepancies are addressed first, followed by the PSD discrepancies. In cases where the modeling form matches the NAAQS or PSD increment form, no adjustments were necessary.

Carbon Monoxide 1-Hour NAAQS

The forms for the modeling results and the NAAQS are different for the carbon monoxide 1-hour timeframe. The modeling results are the highest value over a 3 year period. The NAAQS is the second highest value over a single year. A conservative approach is taken where the modeling results are designated as the values that match the NAAQS form.

Carbon Monoxide 8-Hour NAAQS

The forms for the modeling results and the NAAQS are different for the carbon monoxide 8-hour timeframe. The modeling results are the highest value over a 3 year period. The NAAQS is the second highest value over a single year. A conservative approach is taken where the modeling results are designated as the values that match the NAAQS form.

Nitrogen Dioxide Annual NAAQS

The forms for the modeling results and the NAAQS are different for the nitrogen dioxide annual timeframe. The modeling results are the average of three single year means. The NAAQS is an annual mean. A conservative approach is taken by assuming that the mean for two of the years is zero, and all of the emissions occur in the third year. Thus, the values used are three times the modeling results.

Particulate Matter PM_{10} Annual Wyoming Standard

As indicated, the federal particulate matter PM_{10} annual standard was revoked; however, the State of Wyoming standard still exists. The forms for the modeling results and the Wyoming standard are different for the particulate matter PM_{10} annual timeframe. The modeling results are the average of three single year means. The Wyoming standard is an annual mean. A conservative approach is taken by assuming that the mean for two of the years is zero, and all of the emissions occur in the third year. Thus, the values used are three times the modeling results.

Sulfur Dioxide 3-Hour NAAQS

The forms for the modeling results and the NAAQS are different for the sulfur dioxide 3-hour timeframe. The modeling results are the highest value over the 3 year period. The NAAQS is the second highest value over a single year. A conservative approach is taken where the modeling results are designated as the values that match the NAAQS form.

Nitrogen Dioxide Annual PSD

The forms for the modeling result and the PSD increment are different for the nitrogen dioxide annual timeframe. The modeling result is the average of three single year means. The NAAQS is an annual mean. A conservative approach is taken by assuming that the mean for two of the years is zero and all of the emissions occur in the third year. Thus, the value used is three times the modeling result.

Particulate Matter $PM_{2.5}$ 24-Hour PSD

The modeling result and the PSD increment forms are different for the particulate matter $PM_{2.5}$ 24-hour timeframe. The modeling result is the highest value over the three year period. The PSD increment is the second highest value over a single year. A conservative approach is taken where the modeling result is designated as the value that matches the PSD increment form.

Particulate Matter $PM_{2.5}$ Annual PSD

The modeling result and the PSD increment forms are different for the particulate matter $PM_{2.5}$ annual values. The modeling result is the average of three single year means. The PSD increment is not to be exceeded over the year (i.e., an annual mean). A conservative approach is taken by assuming that the mean for two of the years is zero and all of the emissions occur in the third year. Thus, the value used is three times the modeling result.

Particulate Matter PM_{10} 24-Hour PSD (Final Run Only)

The final run modeling result and the PSD increment forms are different for the particulate matter PM_{10} 24-hour timeframe. The modeling result is the highest daily value over the 3 year period. The PSD increment is the second highest value over a single year. A conservative approach is taken where the modeling result is designated as the value that matches the PSD increment form. The initial run modeling result and the PSD increment forms are the same for the particulate matter PM_{10} 24-hour timeframe.

Particulate Matter PM_{10} Annual PSD

The modeling results and the PSD increment forms are different for the particulate matter PM_{10} annual timeframe. The modeling results are the average of three single year means. The PSD increment is not to be exceeded over the year (i.e., an annual mean). A conservative approach is taken by assuming that the mean for two of the years is zero and all of the emissions occur in the third year. Thus, the values used are three times the modeling results.

Sulfur Dioxide 3-Hour PSD

The modeling result and the PSD increment forms are different for the sulfur dioxide 3-hour timeframe. The modeling result is the highest value over a 3 year period. The PSD increment is the second highest value over a single year. A conservative approach is taken where the modeling result is designated as the value that matches the PSD increment form.

Sulfur Dioxide 24-Hour PSD

The modeling result and the PSD increment forms are different for the sulfur dioxide 24-hour timeframe. The modeling result is the highest value over a 3 year period. The PSD increment is the second highest value over a single year. A conservative approach is taken where the modeling result is designated as the value that matches the PSD increment form.

Sulfur Dioxide Annual PSD

The modeling result and the PSD increment forms are different for the sulfur dioxide annual timeframe. The modeling result is the annual mean averaged over 3 years. The PSD increment is not to be exceeded over the year (i.e., an annual mean). A conservative approach is taken by assuming that the mean for two of the years is zero and all of the emissions occur in the third year. Thus, the value used is three times the modeling result.

SEIS Table C–19 presents the values used in the SEIS analysis for comparison to the NAAQS and SEIS Table C–20 presents the values used in the SEIS analysis for comparison to the PSD increments.

C–4.3.2 Individual Phases Operating at the 100 Percent Activity Level

This section of the SEIS appendix explains how the NRC staff derived pollutant concentrations for the individual phases operating at the 100 percent activity level because the applicant only conducted AERMOD air dispersion modeling for the peak year emission levels. Emissions from a single phase can vary in any given year, and the 100 percent activity level refers to the largest amount of emissions attributed to that particular phase for a single project year.

Pollutant concentrations for each individual phase are derived from the peak year modeling results (for concentration) based on the relative emission level of the 100 percent activity level for each individual phase when compared to the emission level for the peak year. SEIS Table C–11 presents the estimated annual mass flow rates for the 100 percent activity levels for the individual phases which included fugitive, mobile, and stationary sources. SEIS Table C–21 presents the percentage of emission levels for the 100 percent activity levels for the various phases relative to the peak year emission levels. Next, the percentages from SEIS Table C–21 are applied to the peak year concentrations used for comparison to the NAAQS (see SEIS Table C–19) and the PSD increments (see SEIS Table C–20). The NAAQS compares the total concentration (i.e., the project emission concentration levels added to the background concentration levels) to the various thresholds. The percentage only applies to the contribution from the proposed project and not the background concentration levels, which remain the same. Tables are generated for each individual phase to specify the changes to both the project-specific and total concentrations. The following tables compare the pollutant concentrations for the various phases at the 100 percent activity level to NAAQS: facility construction (SEIS Table C–22), wellfield construction (SEIS Table C–23), operation (SEIS Table C–24), aquifer restoration (SEIS Table C–25), and decommissioning and reclamation (SEIS Table C–26). The PSD increments compare the project concentrations rather than the total concentrations to the various thresholds. This means the percentages from SEIS Table C–21 can be directly applied to the concentrations in SEIS Table C–20. SEIS Table C–27 specifies the concentrations for various phases operating at the 100 percent activity level and compares these values to the appropriate PSD increments.

C–5 Cumulative Effects Analyses as Considered in this SEIS

The cumulative effects analyses include a near-field analysis and a far-field analysis.

The impact magnitude determination for the near-field analysis in SEIS Section 5.7.1.1 in part relies on qualitative information. While there is merit in considering additional information (e.g., emission inventories or modeling results) from other air quality analyses to support conclusions for the near-field impacts, the NRC staff do not consider this necessary because

- The analysis in this SEIS includes an appropriate quantitative analysis of impacts from past and present activities and a qualitative analysis of impacts from reasonably foreseeable future impacts,
- The NRC staff did not identify another information source that would allow for an appropriate quantitative discussion of future impacts, and
- Project level emissions and the associated potential for overlapping impacts drops noticeably during the second half of the project lifespan.

The impact magnitude determination for the far-field analysis in SEIS Section 5.7.2.1 in part relies on qualitative information. Additional modeling could be conducted to support these conclusions for the impacts to the far-field from the region of influence; however, the NRC staff do not consider this necessary for this SEIS because

- Modeling to assess impacts from regional emissions is more appropriate for EISs associated with larger scale projects such as regional management plans,
- Such efforts are already underway (see SEIS Section 5.7.1.2 for a description of two relevant EISs). Should those documents become available prior to publication of the final SEIS, then the NRC staff would consider incorporating any relevant information,
- Uncertainty is associated with future impacts from future actions, whereas impacts from past and present activities, as well as the impacts from the proposed Reno Creek ISR Project, are thoroughly characterized in SEIS Section 5.7.1.2, and
- The contribution of emissions from the proposed Reno Creek ISR Project to the region of influence is small.

C–6 Impact Analyses Using Air Dispersion Modeling Without Dry Depletion

The air quality analysis in this SEIS relies in part on air modeling that implements dry depletion. As specified in footnotes in SEIS Section 4.7.1 and 5.7.1, Appendix C contains an assessment of the impact magnitude determinations that rely only on the initial modeling run (i.e., does not consider the results from the final modeling run that implements the dry depletion option). The discussion of impact magnitude determinations using the initial modeling run is divided into two sections. SEIS Section C-6.1 describes the impact magnitude determination for the proposed project, and SEIS Section C-6.2 describes the impact magnitude determination for the cumulative effects.

Implementing the dry depletion option only changes the modeling results for the particulate matter PM_{10}. Therefore, SEIS Section C-6 only describes the impact analyses in terms of particulate matter PM_{10}. SEIS Section 4.7.1 and Section C-4.1.2 contain additional information about dry depletion.

C–6.1 Proposed Project Impacts

The discussion about impacts of the proposed project is divided into two sections. Section C-6.1.1 presents the proposed project's impact based on the initial modeling run. Section C-6.1.2 compares the proposed project's impact based on the initial and final modeling runs.

C–6.1.1 Initial Modeling Run Impact

SEIS Table C–28 presents the initial modeling run peak year pollutant concentrations associated with the proposed Reno Creek ISR Project with respect to the particulate matter PM_{10} NAAQS. For comparison to the NAAQS, project level modeling results are combined with the current background ambient air pollutant concentrations. The peak year concentrations of particulate matter PM_{10} are below the NAAQS. While the NAAQS primarily relate to an area's attainment classification (see SEIS Section 3.7.2), the PSD increments primarily relate to pollution levels generated by individual projects. SEIS Table C–29 presents the initial modeling run peak year pollutant concentrations with respect to the PSD increments. The particulate matter PM_{10}
24-hour project level concentration was above the allowable PSD increment. Due to the level (i.e., above the PSD increment) and nature of the fugitive dust particulate matter PM_{10} emissions, short-term (i.e., 24-hour) impacts that would be noticeable but not destabilizing are possible at locations in close proximity to emission sources. At times, the fugitive dust emissions would result in a MODERATE impact on air quality for the peak year. The NRC staff conclude that for an analysis relying on the initial modeling results that do not implement the dry depletion option, the overall impact to air quality for the peak year would range from SMALL to MODERATE.

C–6.1.2 Comparing the Proposed Project Impacts Based on the Initial and Final Modeling Runs

The project level impacts based on the initial modeling results described in the preceding paragraph would be greater than the impacts based on the final modeling results described in SEIS Section 4.7.1.1. This distinction is because the initial modeling result is above the particulate matter PM_{10} 24-hour PSD increment, whereas the final modeling result is below this threshold (see SEIS Table C–30).

C–6.2 Cumulative Effects

The cumulative effects discussion is divided into two sections. Section C-6.2.1 describes the near-field cumulative effects and Section C-6.2.2 describes the far-field cumulative effects.

Cumulative impacts on air quality include incremental effects from the proposed Reno Creek ISR Project added to the effects of other past, present, and reasonably foreseeable future actions. The site-specific modeling and whether the initial or final run results are used influences the project level impacts. The impacts from other past, present, and reasonably foreseeable future actions (i.e., excluding impacts from the proposed project) remain the same for the near-field and far-field, as described in SEIS Section 5.7.1, regardless of whether the site-specific modeling includes the dry depletion option.

C–6.2.1 Near-Field

The near-field cumulative effects discussion is divided into two sections. Section C-6.2.1.1 describes the near-field impacts based on the initial modeling run. Section C-6.2.1.2 compares the near-field impacts based on the initial and final modeling runs.

C–6.2.1.1 Initial Modeling Run Impacts for the Near Field

Cumulative impacts on air quality for the near field include the incremental effect from the proposed Reno Creek ISR Project added to the effects of other past, present, and reasonably foreseeable future actions. In SEIS Section C-6.1.1, the NRC staff conclude that, based on the initial modeling results, the overall impact to air quality for the peak year would range from SMALL to MODERATE. As described in SEIS Section 5.7.1.1, the NRC staff conclude that the impact on air quality within the region of influence for the proposed Reno Creek ISR Project resulting from past, present, and reasonably foreseeable future actions is MODERATE. When combining the incremental impacts from the proposed Reno Creek ISR Project with all other impacts from past, present, and reasonably foreseeable future actions in the region of influence, the NRC staff conclude that the cumulative impact for the near-field would be MODERATE because

- The proposed project's particulate matter PM_{10} level, when combined with the current background ambient air pollutant concentrations (i.e., the impacts from past and present emissions), would be below the NAAQS (see Table C–28) and the NRC staff consider that these combined results relative to NAAQS would be noticeable but not destabilizing; and

- Based on the description of the possible overlap between the proposed project and the reasonably foreseeable future actions as described in SEIS Section 5.7.1.1, the NRC staff expect the air quality in the near-field would continue in a similar manner.

C-6.2.1.2 Comparing the Near-Field Impacts Based on the Initial and Final Modeling Runs

The near-field cumulative impact magnitude determination relying on the initial modeling results described in the preceding section would be the same as the impact magnitude relying on the final modeling results described in SEIS Section 5.7.1.1 because both modeling results are below the NAAQS (see SEIS Table C–30), and the NAAQS considers background pollutant levels. To put this another way, when the impact assessment includes emissions from other sources (i.e., comparing the combined emissions from the proposed project and background concentrations to NAAQS), the impacts for the initial and final modeling are the same.

C–6.2.2 Far-Field

The far-field cumulative effects discussion is divided into two sections. Section C-6.2.2.1 describes the far-field impacts based on the initial modeling run. Section C-6.2.2.2 compares the far-field impact based on the initial and final modeling runs.

C–6.2.2.1 Initial Modeling Run Impacts for the Far-Field

Cumulative impacts on air quality for the far-field include the incremental effect from the proposed Reno Creek ISR Project added to the effects of other past, present, and reasonably foreseeable future actions. In SEIS Section C-6.1.1, the NRC staff conclude that, based on the initial modeling results, the overall impact to air quality for the peak year would range from SMALL to MODERATE. As described in SEIS Section 5.7.1.2, the NRC staff conclude that the impact on air quality for the far-field resulting from other past, present, and reasonably foreseeable future actions could range from MODERATE to LARGE (specifically, the past and present impacts are MODERATE and the future impacts could be LARGE). When combining the incremental impacts from the proposed Reno Creek ISR Project with all other impacts from past, present, and reasonably foreseeable future actions in the far-field, the NRC staff conclude that the cumulative impact for the far-field would be MODERATE to LARGE because

- The proposed project's particulate matter PM_{10} level when combined with the current background ambient air pollutant concentrations (i.e., the impacts from past and present emissions) are below the NAAQS (see Table C–28), and the NRC staff consider that these combined results relative to NAAQS would be noticeable but not destabilizing; and

- Based on the description of the possible overlap between the proposed project and the reasonably foreseeable future actions as described in SEIS Section 5.7.1.2, the NRC staff determine that the air quality in the far-field would range from MODERATE to LARGE.

C–6.2.2.2 Comparing the Far-Field Impacts Based on the Initial and Final Modeling Runs

The far-field cumulative impacts relying on the initial modeling results described in the preceding section would be the same as the impacts relying on the final modeling results described SEIS Section 5.7.1.2 because both modeling results are below the NAAQS (see Table C–30) and the NAAQS considers background pollutant levels. To put this another way, when the impact assessment includes emissions from other sources (i.e., comparing the combined emissions from the proposed project and background concentrations to NAAQS), the impacts for the initial and final modeling are the same.

C–7 <u>References</u>

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Table C–1. Estimated Mass Flow Rates (Short* Tons Per Year) for Particulate Matter (PM) From Fugitive Sources for the Proposed Project						
Project Year	**Travel on Unpaved Roads**[†]		**Wind Erosion**		**Total**	
	$PM_{2.5}$	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**
1	7.39	73.88	0.55	3.64	7.94	77.52
2	8.90	89.00	0.69	4.60	9.59	93.60
3	10.67	106.78	0.70	4.64	11.37	111.42
4	10.63	106.45	0.75	5.02	11.38	111.47
5	10.63	106.44	0.81	5.41	11.44	111.85
6	10.68	106.83	0.87	5.79	11.55	112.62
7	9.89	98.97	0.88	5.88	10.77	104.85
8	9.65	96.47	0.88	5.88	10.53	102.35
9	8.19	81.58	0.78	5.23	8.97	86.81
10	4.97	49.14	0.60	3.99	5.57	53.13
11	<5.46	<50.40	0.54	3.60	<6	<54
12	<5.52	<50.78	0.48	3.22	<6	<54
13	<5.57	<51.16	0.43	2.84	<6	<54
14	<4.63	<47.54	0.37	2.46	<5	<50
15	<5.00	<50.00	0.00	0.00	<5	<50

Source: Modified from AUC (2014a)

*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

[†]Emissions from travel on unpaved roads calculated by subtracting the wind erosion estimates from the total estimates.

Table C–2. Estimated Mass Flow Rates (Short* Tons Per Year) for Particulate Matter (PM) From Wind Erosion for the Proposed Project

Year	Total Acres† Disturbed per Year	Total Acres† Disturbed	Total Acres† Reclaimed	Net Acres† Exposed	Emissions (short* tons per year)	
					Particulate Matter $PM_{2.5}$	Particulate Matter PM_{10}
0‡	17.4	17.4	0	17.4	0.30	1.98
1	14.6	32.0	0	32.0	0.55	3.64
2	20.3	52.3	12	40.3	0.69	4.60
3	15.4	67.7	15	40.7	0.70	4.64
4	15.4	83.1	12	44.1	0.75	5.02
5	15.4	98.5	12	47.4	0.81	5.41
6	15.4	113.9	12	50.8	0.87	5.79
7	15.4	129.3	14.6	51.6	0.88	5.88
8	15.4	144.7	15.4	51.6	0.88	5.88
9	9.6	154.3	15.4	45.9	0.78	5.23
10	0	154.3	10.9	35.0	0.60	3.99
11	0	154.3	3.4	31.6	0.54	3.60
12	0	154.3	3.4	28.3	0.48	3.22
13	0	154.3	3.4	24.9	0.43	2.84
14	0	154.3	3.4	21.6	0.37	2.46
15	0	154.3	21.6	0.0	0.00	0

Source: Modified from AUC (2014a)

*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

†Source documents and SEIS appendix table land area expressed in acres only (dual units used in SEIS text with metric being primary)

‡Preconstruction (i.e., project year zero) is not part of the proposed project and is addressed separately in the SEIS Chapter 5 on cumulative effects. However, for purposes of net land exposed, the preconstruction value is included since it is part of the disturbed land within the footprint of the proposed Reno Creek ISR Project area that would be reclaimed during the project lifespan.

Table C–3. Estimated Mass Flow Rates (Short Tons* Per Year) for Various Pollutants From Mobile Source Combustion Emissions Associated With the Proposed Project

Phase and Pollutant†	Project Year															
Con - CPP	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
CO_2	0.00	785	378	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO	0.00	8.33	6.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HAP	0.00	0.32	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NOx	0.00	8.74	4.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$PM_{2.5}$	0.00	0.51	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM_{10}	0.00	0.52	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SO_2	0.00	1.34	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THC	0.00	2.42	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Con - WF	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
CO_2	0.00	2704	3477	3863	3863	3863	3752	3284	3090	1932	0.00	0.00	0.00	0.00	0.00	0.00
CO	0.00	27.14	34.89	38.77	38.77	38.77	38.07	32.96	31.02	19.39	0.00	0.00	0.00	0.00	0.00	0.00
HAP	0.00	1.11	1.43	1.59	1.59	1.59	1.54	1.35	1.27	0.79	0.00	0.00	0.00	0.00	0.00	0.00
NOx	0.00	26.63	34.24	38.05	38.05	38.05	37.05	32.34	30.44	19.02	0.00	0.00	0.00	0.00	0.00	0.00
$PM_{2.5}$	0.00	1.54	1.98	2.19	2.19	2.19	2.13	1.87	1.76	1.10	0.00	0.00	0.00	0.00	0.00	0.00
PM_{10}	0.00	1.58	2.04	2.26	2.26	2.26	2.20	1.92	1.81	1.13	0.00	0.00	0.00	0.00	0.00	0.00
SO_2	0.00	4.21	5.42	6.02	6.02	6.02	5.88	5.12	4.82	3.01	0.00	0.00	0.00	0.00	0.00	0.00
THC	0.00	14.42	18.54	20.61	20.61	20.61	19.47	17.51	16.48	10.30	0.00	0.00	0.00	0.00	0.00	0.00
Ops	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
CO_2	0.00	226	371	616	578	566	570	571	568	567	543	403	93	64	35	35
CO	0.00	1.22	2.04	3.46	3.25	3.17	3.20	3.20	3.19	3.18	3.05	2.25	0.50	0.34	0.17	0.17
HAP	0.00	0.09	0.16	0.26	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.17	0.04	0.03	0.01	0.01
NOx	0.00	1.81	3.13	5.37	5.07	4.97	5.00	5.01	4.99	4.98	4.77	3.54	0.83	0.58	0.32	0.32
$PM_{2.5}$	0.00	0.09	0.17	0.31	0.29	0.29	0.29	0.29	0.29	0.29	0.27	0.20	0.04	0.02	0.01	0.01

Table C–3. Estimated Mass Flow Rates (Short Tons* Per Year) for Various Pollutants From Mobile Source Combustion Emissions Associated With the Proposed Project (Continued)

Phase and Pollutant[†]	Project Year															
PM_{10}	0.00	0.10	0.18	0.32	0.30	0.29	0.30	0.30	0.30	0.29	0.28	0.21	0.04	0.03	0.01	0.01
SO_2	0.00	0.32	0.50	0.78	0.74	0.73	0.73	0.73	0.73	0.73	0.70	0.52	0.14	0.10	0.06	0.06
THC	0.00	1.64	3.11	5.96	5.53	5.38	5.43	5.44	5.42	5.41	5.16	3.76	0.66	0.36	0.07	0.07
GR	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
CO_2	0.00	0.00	0.00	0.00	38	51	46	45	48	48	69	190	275	290	202	0.00
CO	0.00	0.00	0.00	0.00	0.22	0.29	0.26	0.26	0.27	0.28	0.40	1.08	1.54	1.62	1.19	0.00
HAP	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.08	0.12	0.12	0.09	0.00
NOx	0.00	0.00	0.00	0.00	0.30	0.40	0.37	0.36	0.38	0.39	0.55	1.51	2.09	2.21	1.73	0.00
$PM_{2.5}$	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.09	0.12	0.13	0.10	0.00
PM_{10}	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.09	0.12	0.13	0.11	0.00
SO_2	0.00	0.00	0.00	0.00	0.04	0.06	0.05	0.05	0.06	0.06	0.08	0.22	0.35	0.37	0.20	0.00
THC	0.00	0.00	0.00	0.00	0.43	0.57	0.52	0.51	0.54	0.55	0.79	2.15	2.69	2.84	2.76	0.00
Decom	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
CO_2	0.00	0.00	0.00	0.00	0.00	0.00	111	58	77	193	265	303	338	338	506	506
CO	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.37	0.49	1.24	1.69	1.88	2.06	2.06	2.96	2.96
HAP	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.03	0.03	0.08	0.11	0.13	0.14	0.14	0.21	0.21
NOx	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.63	0.84	2.10	2.97	3.18	3.50	3.50	5.54	5.54
$PM_{2.5}$	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.04	0.05	0.14	0.20	0.21	0.22	0.22	0.34	0.34
PM_{10}	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.04	0.06	0.14	0.20	0.21	0.22	0.22	0.35	0.35
SO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.05	0.07	0.18	0.29	0.36	0.42	0.42	0.70	0.70
THC	0.00	0.00	0.00	0.00	0.00	0.00	1.13	0.85	1.13	2.83	3.20	3.28	3.35	3.35	3.99	3.99
Totals	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
CO_2	292	3715	4225	4479	4479	4479	4479	3958	3783	2740	877	896	706	692	742	541
CO	2.31	36.69	43.09	42.24	42.24	42.24	42.24	36.79	34.97	24.08	5.14	5.22	4.10	4.02	4.32	3.13

Table C–3. Estimated Mass Flow Rates (Short Tons* Per Year) for Various Pollutants From Mobile Source Combustion Emissions Associated With the Proposed Project (Continued)

Phase and Pollutant[†]	Project Year															
HAP	0.12	1.52	1.74	1.85	1.85	1.85	1.85	1.63	1.56	1.14	0.37	0.38	0.30	0.29	0.31	0.23
NOx	2.41	37.18	42.34	43.42	43.42	43.42	43.42	38.34	36.65	26.49	8.29	8.24	6.42	6.28	7.58	5.86
$PM_{2.5}$	0.14	2.14	2.43	2.50	2.50	2.50	2.50	2.22	2.12	1.54	0.50	0.50	0.38	0.37	0.46	0.35
PM_{10}	0.14	2.21	2.51	2.58	2.58	2.58	2.58	2.28	2.19	1.59	0.52	0.51	0.39	0.38	0.47	0.36
SO_2	0.49	5.88	6.59	6.80	6.80	6.80	6.80	5.96	5.67	3.97	1.07	1.10	0.91	0.89	0.97	0.77
THC	1.05	18.48	22.35	26.56	26.56	26.56	26.56	24.32	23.57	19.09	9.14	9.18	6.69	6.54	6.82	4.06

Source: Modified from AUC (2014a)

*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

[†]Con CPP = Construction Central Processing Plant, Con WF =Construction Wellfield, Ops = Operations, GR = Aquifer Restoration, Decom = Decommissioning/reclamation, CO_2 = Carbon Dioxide, CO = Carbon Monoxide, HAP = Hazardous Air Pollutants, NOx = Nitrogen Oxides, $PM_{2.5}$ = Particulate Matter 2.5 micrometers, PM_{10} = Particulate Matter 10 micrometers, SO_2 = Sulfur Dioxide, and THC = Total Hydrocarbons

Table C–4. Estimated Mass Flow Rates* (Short Tons† Per Year) for Various Pollutants From Stationary Source Combustion Emissions Associated With the Proposed Project‡

Pollutant	Stationary Emission Source: Vacuum Dryers	Main Heater	Furnace	Radiant Heaters	Total
Carbon Monoxide	0.39	0.22	0.02	0.18	0.80
Hazardous Air Pollutants	0.00‡	0.00	0.00	0.00	0.00
Nitrogen Oxides	0.67	0.37	0.03	0.30	1.39
Particulate Matter $PM_{2.5}$	0.04	0.02	0.00	0.02	0.07
Particulate Matter PM_{10}	0.04	0.02	0.00	0.02	0.07
Sulfur Dioxide	0.00	0.00	0.00	0.00	0.00
Total Organic Compounds	0.05	0.03	0.00	0.02	0.11
Volatile Organic Compounds	0.00	0.00	0.00	0.00	0.00

Source: Modified from AUC (2014a)
*Mass flow rates of 0.00 short tons per year in this table means that emissions were below this level and do not necessarily mean that none of the pollutant was emitted.
†Source documents and SEIS appendix table mass expressed in short tons only (dual unit used in SEIS text with metric being primary)
‡Except for project year one, stationary emission are assumed to be constant over the project lifespan.

Table C–5. Estimated Peak Year Emission Mass Flow Rates (Short Tons* Per Year) for Various National Ambient Air Quality Standard Pollutants From All Sources for the Proposed Project

Pollutant	Fugitive Dust Emission Sources	Mobile Emission Sources	Stationary Emission Sources	Peak Year
Carbon Monoxide	0	42.24	0.80	43.04
Nitrogen Oxides	0	43.42	1.39	44.81
Particulate Matter $PM_{2.5}$	11.55	2.50	0.07	14.12
Particulate Matter PM_{10}	112.62	2.58	0.07	115.27
Sulfur Dioxide	0	6.80	0.00†	6.80

Source: Modified from AUC (2014a)
*Source documents and SEIS appendix table mass expressed in short tons only (dual unit used in SEIS text with metric being primary)
†This emission value of 0.00 short tons per year means that emissions were below this level and do not necessarily mean that none of the pollutant was emitted.

Table C–6. Percentage of Emissions by Source for Various National Ambient Air Quality Standard Pollutant From All Sources for the Peak Year for the Proposed Project

Pollutant	Percentage from Fugitive Sources	Percentage from Mobile Sources	Percentage from Stationary Sources
Carbon Monoxide	0	98.14	1.86
Nitrogen Oxides	0	96.90	3.10
Particulate Matter $PM_{2.5}$	81.80	17.71	0.49
Particulate Matter PM_{10}	97.70	2.24	0.06
Sulfur Dioxide	0	100.00	0

Source: Modified from AUC (2014a)

Table C–7. Estimated Mass Flow Rates (Short Tons* Per Year) for the 100 Percent Activity Levels for Individual Phases From Mobile Source Combustions Emissions for the Proposed Project

Phase†	Project Year	Pollutant‡						
		CO	HAP	NOx	$PM_{2.5}$	PM_{10}	SO_2	THC
Con - CPP	1	8.33	0.32	8.74	0.51	0.52	1.34	2.42
Con – WF	5§	38.77	1.59	38.05	2.19	2.26	6.02	20.61
Ops	3	3.46	0.26	5.37	0.31	0.32	0.78	5.96
GR	13	1.62	0.12	2.21	0.13	0.13	0.37	2.84
Decom	14‖	2.96	0.21	5.54	0.34	0.35	0.70	3.99

Source: Modified from AUC (2014a)

*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

†Con CPP = Construction Central Processing Plant, Con WF =Construction Wellfield, Ops = Operations, GR = Aquifer Restoration, Decom = Decommissioning/reclamation.

‡CO_2 = Carbon Dioxide, CO = Carbon Monoxide, HAP = Hazardous Air Pollutants, NOx = Nitrogen Oxides, $PM_{2.5}$ = Particulate Matter 2.5 micrometers, PM_{10} = Particulate Matter 10 micrometers, SO_2 = Sulfur Dioxide, and THC = Total Hydrocarbons.

§Project years three to five tied for the highest emission levels. Project year five is specified here because the this information was used in conjunction with fugitive dust emissions and the total fugitive dust emissions over those three years do vary slightly with the highest level of fugitive dust emissions occurring in year five (see Table C–1 of SEIS Appendix C).

‖Project years fourteen and fifteen tied for the highest emission levels. Project year fourteen is specified here for convenience because the this information was used in conjunction with fugitive dust emissions and the total fugitive dust emissions over those two years do not vary (see Table C–1 of SEIS Appendix C).

Table C–8. For Particulate Matter From Mobile Source Combustion Emissions, the Contribution of the 100 Percent Activity Level Emissions for Individual Phases Compared to the Associated Total Emissions From All Phases for the Proposed Project

Phase	Project Year	Particulate Matter	Mass Flow Rate (Short Tons* per Year) from 100 Percent Activity Level of a Single Phase	Mass Flow Rate (Short Tons*) from All Phases	Percent Attributed to the 100 Percent Activity of a Single Phase
Construction – Facility	1	$PM_{2.5}$	0.51	2.14	23.8
		PM_{10}	0.52	2.21	23.5
Construction – Wellfield	5†	$PM_{2.5}$	2.19	2.50	87.6
		PM_{10}	2.26	2.58	87.6
Operation	3	$PM_{2.5}$	0.31	2.50	12.4
		PM_{10}	0.32	2.58	12.4
Aquifer Restoration	13	$PM_{2.5}$	0.13	0.37	35.1
		PM_{10}	0.13	0.38	34.2
Decommissioning / Reclamation	14‡	$PM_{2.5}$	0.34	0.46	73.9
		PM_{10}	0.35	0.47	74.5

Source: Modified from AUC (2014a)

*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

†For combustion emissions from mobile sources, project years three to five tied for the highest emission levels. Project year five is specified here because the this information was used in conjunction with fugitive dust emissions and the total fugitive dust emissions over those three years do vary slightly with the highest level of fugitive dust emissions occurring in year five (see Table C–1 in SEIS Appendix C).

‡For combustion emissions from mobile sources, project years fourteen to fifteen tied for the highest emission levels. Project year fourteen is specified here for convenience because the this information was used in conjunction with fugitive dust emissions and the total fugitive dust emissions over those two years do not vary (see Table C–1 in SEIS Appendix C).

Table C–9. Estimated Mass Flow Rates (Short Tons* Per Year) for the 100 Percent Activity Levels for Individual Phases From Fugitive Dust Emissions From Travel on Unpaved Roads for the Proposed Project

Phase	Project Year	Particulate Matter	Mass Flow Rates (Short Tons* per Year) from All Phases	Percent Attributed to the 100 Percent Activity of a Single Phase	Mass Flow Rate (Short Tons* per Year) from 100 Percent Activity Level of a Single Phase
Construction - Facility	1	$PM_{2.5}$	7.39	23.8	1.76
		PM_{10}	73.88	23.5	17.36
Construction – Wellfield	5[†]	$PM_{2.5}$	10.63	87.6	9.31
		PM_{10}	106.44	87.6	93.24
Operation	3	$PM_{2.5}$	10.67	12.4	1.32
		PM_{10}	106.78	12.4	13.24
Aquifer Restoration	13	$PM_{2.5}$	5.57	35.1	1.96
		PM_{10}	51.16	34.2	17.50
Decommissioning/Reclamation	14[‡]	$PM_{2.5}$	4.63	73.9	3.42
		PM_{10}	47.54	74.5	35.42

Source: Modified from AUC (2014a)

*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

[†]For combustion emissions from mobile sources, project years three to five tied for the highest emission levels. Project year five is specified here because the this information was used in conjunction with fugitive dust emissions and the total fugitive dust emissions over those three years do vary slightly with the highest level of fugitive dust emissions occurring in year five (see Table C–1 in SEIS Appendix C).

[‡]For combustion emissions from mobile sources, project years fourteen to fifteen tied for the highest emission levels. Project year fourteen is specified here for convenience because the this information was used in conjunction with fugitive dust emissions and the total fugitive dust emissions over those two years do not vary (see Table C–1 of SEIS Appendix C).

Table C–10. Estimated Mass Flow Rates (Short Tons* Per Year) for the 100 Percent Activity Levels for Individual Phases From Fugitive Source Dust Emissions for the Proposed Project

Phase	Project Year	Particulate Matter	Mass Flow Rate (Short Tons* per Year) from Travel on Unpaved Roads for the 100 Percent Activity Level of a Single Phase	Mass Flow Rate (Short Tons* per Year) from Wind Erosion for the 100 Percent Activity Level of a Single Phase	Total Mass Flow Rate (Short Tons* per Year) for the 100 Percent Activity Level of a Single Phase
Construction – Facility	1	$PM_{2.5}$	1.76	0.55	2.31
		PM_{10}	17.36	3.64	21.00
Construction – Wellfield	5	$PM_{2.5}$	9.31	0.81	10.12
		PM_{10}	93.24	5.41	98.65
Operation	3	$PM_{2.5}$	1.32	0.70	2.02
		PM_{10}	13.24	4.64	17.88
Aquifer Restoration	13	$PM_{2.5}$	1.96	0.43	2.39
		PM_{10}	17.50	2.84	20.34
Decommissioning/Reclamation	14	$PM_{2.5}$	3.42	0.37	3.79
		PM_{10}	35.42	2.46	37.88

Source: Modified from AUC (2014a)
*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

Table C–11. Estimated Mass Flow Rates (Short Tons* Per Year) for the 100 Percent Activity Levels for Individual Phases from All Emission Sources for the Proposed Project

Phase	Project Year	Pollutant[†]	Mass Flow Rates (Short Tons* per Year) for Emission Source			Total Mass Flow Rate (Short Tons* Per Year) for the 100 Percent Activity Level
			Mobile Combustion	Fugitive[‡]	Stationary Combustion[§]	
Construction – Facility	1	CO	8.33	0	0.80	9.13
		NOx	8.74	0	1.39	10.13
		$PM_{2.5}$	0.51	2.31	0.07	2.89
		PM_{10}	0.52	21.00	0.07	21.59
		SO_2	1.34	0	0.00	1.34
Construction – Wellfield	5	CO	38.77	0	0.80	39.57
		NOx	38.05	0	1.39	39.44
		$PM_{2.5}$	2.19	10.12	0.07	12.38
		PM_{10}	2.26	98.65	0.07	100.98
		SO_2	6.02	0	0.00	6.02
Operations	3	CO	3.46	0	0.80	4.26
		NOx	5.37	0	1.39	6.76
		$PM_{2.5}$	0.31	2.02	0.07	2.40
		PM_{10}	0.32	17.88	0.07	18.27
		SO_2	0.78	0	0.00	0.78
Groundwater Restoration	13	CO	1.62	0	0.80	2.42
		NOx	2.21	0	1.39	3.60
		$PM_{2.5}$	0.13	2.39	0.07	2.59
		PM_{10}	0.13	20.34	0.07	20.54
		SO_2	0.37	0	0.00	0.37

Table C–11. Estimated Mass Flow Rates (Short Tons* Per Year) for the 100 Percent Activity Levels for Individual Phases from All Emission Sources for the Proposed Project (Continued)

Phase	Project Year	Pollutant[†]	Mass Flow Rates (Short Tons* per Year) for Emission Source: Mobile Combustion	Fugitive[‡]	Stationary Combustion[§]	Total Mass Flow Rate (Short Tons* Per Year) for the 100 Percent Activity Level
Decommissioning/ Reclamation	14	CO	2.96	0	0.80	3.76
		NOx	5.54	0	1.39	6.93
		$PM_{2.5}$	0.34	3.79	0.07	4.20
		PM_{10}	0.35	37.88	0.07	38.30
		SO_2	0.70	0	0.00	0.70

Source: Modified from AUC (2014a)
*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).
[†]CO = Carbon Monoxide, NOx = Nitrogen Oxides, $PM_{2.5}$ = Particulate Matter 2.5 micrometers, PM_{10} = Particulate Matter 10 micrometers, and SO_2 = Sulfur Dioxide.
[‡]Fugitive emissions are limited to particulate matter
[§]Stationary sources emissions are not broken down by phase. The assumption is made that the entire stationary combustion emission estimates for the associated individual project year is generate by the one phase rather than a combination of several phases. For project year one, the estimated values are lower but unspecified. Therefore, the Construction – Facility phase estimate, with the 100 percent activity level occurring in project year one, is considered conservative. The mass flow rates of 0.00 short tons per year for sulfur dioxide means that emissions were below this level and do not necessarily mean that none of the pollutant was emitted.

Table C–12. Effect of Using Updated Emissions Factors* That Account for Pollution Controls

			Tier 1[‡]		Tier 3[§]	
Pollutant	**Equipment Power (hp[†])**	**Tier 0 Emission Factor (g/hp-hr)**	**Emission Factor (g/hp-hr)**	**Percent Emissions Reduced from Tier 0 Levels[‖]**	**Emission Factor (g/hp-hr)**	**Percent Emissions Reduced from Tier 0 Levels¶**
Carbon Monoxide	≥ 75 to > 100	3.49			2.3655	32
	≥ 100 to > 175	2.70			0.8667	68
	≥ 175 to > 300	2.70			0.7475	72
	≥ 300 to > 600	2.70	1.3060	52	0.8425	31
	≥ 600 to 750	2.70	1.3272	51		
Nitrogen Dioxides	≥ 75 to > 100	6.9			3.00	56
	≥ 100 to > 175	8.38			2.5	70
	≥ 175 to > 300	8.38			2.5	70
	≥ 300 to > 600	8.38	6.0153	28	2.5	70
	≥ 600 to 750	8.38	5.8215	31		
Particulate Matter PM_{10}	≥ 75 to > 100	0.722			0.30	58
	≥ 100 to > 175	0.402			0.22	55
	≥ 175 to > 300	0.402			0.15	63
	≥ 300 to > 600	0.402	0.2008	50	0.15	63
	≥ 600 to 750	0.402	0.2201	45		

Source: EPA (2004)

*Source document and SEIS table express emission factors g/hp-hr. Dual units were not calculated because the value of interest is the percent emissions reduced, which is unitless.

[†]Source document and SEIS table express equipment power in horsepower only.

[‡]Tier 1 controls are limited to drill rigs. The power for the two types of drill rigs were 300 and 750 horsepower. Tier 1 controls for other horsepower ranges are not applicable and the associated cells in the table are grayed out.

[§]Tier 3 controls apply to all equipment other than drill rigs. None of this equipment exceeded 600 horsepower. Tier 3 controls for horsepower ranges in this table above 600 horsepower are not applicable and the associated cells in the table are grayed out.

[‖]Calculated using the following equation: [1-(Tier 1 emission factor/Tier 0 emission factor)]*100

¶Calculated using the following equation: [1-(Tier 3 emission factor/Tier 0 emission factor)]*100

Table C–13. Effectiveness (i.e., the Percent That the Emissions are Reduced) of the Commuter Carpooling Implemented by the Applicant			
Project Phase	**Number of Vehicles Without Carpooling***	**Number of Vehicles With Carpooling**	**Percent Emission Reduced†**
Construction	80	29	63.8
Operation	92	32	65.2
Groundwater Restoration	52	18	65.4
Decommissioning	22	6	72.7
Total	246	85	65.4

Source: Modified from AUC (2014a)
*Number of vehicles without carpooling assumes a single vehicle for each worker
†Calculated using the following equation:
[(# vehicles without carpooling - # vehicles with carpooling)/# of vehicles without carpooling]*100

Table C–14. Data Showing That Changes in the Amount of Disturbed Land and the Associated Changes in Particulate Matter Emission Levels Occur by the Same Factor						
		Project Year 0†	**Project Year 10**		**Project Year 7**	
Parameter	**Units***	**Values**	**Values**	**Factor‡**	**Values**	**Factor‡**
Net Land Exposed	Acres	17.4	35.0	2.01	51.6	2.96
Particulate Matter $PM_{2.5}$ Emissions	Short tons	0.30	0.60	2.00	0.88	2.93
Particulate Matter PM_{10} Emissions	Short tons	1.98	3.99	2.01	5.88	2.97

Source: modified from AUC (2014a)
*Source documents and SEIS appendix table only express mass in short tons and land size in acres (dual units used in SEIS text with metric being primary).
†Preconstruction (i.e., project year zero) is not part of the proposed project and is addressed separately in the SEIS Chapter 5 on cumulative effects. However, for purposes of net land exposed, the preconstruction value is included since it is part of the disturbed land within the footprint of the proposed Reno Creek ISR Project area that would be reclaimed during the project lifespan.
‡Factors are relative to the project year 0 values

Table C–15. Estimated Preconstruction Emission Mass Flow Rates (Short Tons* Per Year) for Various Pollutants Compared to the Proposed Project Peak Year Estimated Mass Flow Rates (Short Tons* Per Year)					
Pollutant	**Preconstruction†**			**Proposed Project Peak Year**	**% of Peak Year**
	Fugitive Dust Sources	**Mobile Emission Sources**	**Total**		
Carbon Monoxide	0	2.31	2.31	43.04	5.4
Nitrogen Oxides	0	2.41	2.41	44.81	5.4
Particulate Matter $PM_{2.5}$	2.10	0.14	2.24	14.12	15.9
Particulate Matter PM_{10}	20.02	0.14	20.16	115.27	17.5
Sulfur Dioxide	0	0.49	0.49	6.80	7.2

Source: Modified from AUC (2014a)
*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).
†The SEIS assumes that no emissions from stationary sources occur during preconstruction

Table C–16. Comparison of Estimated Peak Year Emission Mass Flow Rates (Short Tons* Per Year) for the Dewey–Burdock and Proposed Reno Creek ISR Projects			
Pollutant	**Proposed Reno Creek ISR Project Emissions**	**Dewey–Burdock ISR Project Emissions**	**Reno Creek as Percentage of Dewey-Burdock**
Carbon Monoxide	43.04	59.86	71.9
Nitrogen Oxides	44.81	70.15	63.9
Particulate Matter $PM_{2.5}$	14.12	51.25	27.5
Particulate Matter PM_{10}	115.27	461.89	25.0
Sulfur Dioxide	6.80	11.31	60.1

Source: Modified from AUC (2014a) and NRC (2014)
*Source documents and SEIS appendix table mass expressed in short tons only (dual unit used in SEIS text with metric being primary)

Table C–17. The AERMOD Modeling Results for the National Ambient Air Quality Standards (NAAQS) From Fugitive, Mobile, and Stationary Sources for the Peak Year for the Proposed Project

Pollutant	Averaging Time	Modeling Results			Additional or Detailed Values Available from the Modeling			
		Value (μg/m³)	Form*	Same as NAAQS form?	Value (μg/m³)	Value (μg/m³)	Value (μg/m³)	Form
Carbon Monoxide	1 hour	682.5	Highest value over the 3-year period	No	na[†]	na	na	na
	8 hour	88.4	Highest value over the 3-year period	No	na	na	na	na
Carbon Monoxide Highway Run	1 hour	1,055.1	Highest value over the 3-year period	No	na	na	na	na
	8 hour	156.3	Highest value over the 3-year period	No	na	na	na	na
Nitrogen Dioxide	1 hour	62.9	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Yes	85.0	57.2	46.4	98th percentile of 1-hour daily maximum concentrations for each of the 3 individual years modeled
	Annual	0.8	Annual mean, averaged over 3 years	No	na	na	na	na
Nitrogen Dioxide Highway Run	1 hour	142.9	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Yes	165.3	161.2	102.1	98th percentile of 1-hour daily maximum concentrations for each of the 3 individual years modeled
	Annual	2.5	Annual mean, averaged over 3 years	No	na	na	na	na
Particulate Matter $PM_{2.5}$	24 hour	1.7	98th percentile, averaged over 3 years	Yes	1.9	1.6	1.7	98th percentile for each of the 3 individual years modeled
	Annual	0.2	Annual mean, averaged over 3 years	Yes	na	na	na	na
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	3.3	98th percentile, averaged over 3 years	Yes	3.5	3.6	2.8	98th percentile for each of the 3 individual years modeled
	Annual	0.7	Annual mean, averaged over 3 years	Yes	na	na	na	na
Particulate Matter PM_{10} Initial Run[‡]	24 hour	38.4	Not to be exceeded more than once per year on average over 3 years	Yes	50.9	42.1	39.5	Three highest daily values over the 3-year period (values can occur in the same model year)
	Annual	1.8	Average of 3 single year means	No[§]	na	na	na	na

Table C–17. The AERMOD Modeling Results for the National Ambient Air Quality Standards (NAAQS) From Fugitive, Mobile, and Stationary Sources for the Peak Year for the Proposed Project (Continued)

Pollutant	Averaging Time	Modeling Results			Additional or Detailed Values Available from the Modeling			
		Value (μg/m³)	Form*	Same as NAAQS form?	Value (μg/m³)	Value (μg/m³)	Value (μg/m³)	Form
Particulate Matter PM_{10} Final Run[‖]	24 hour	18.8	Not to be exceeded more than once per year on average over 3 years	Yes	22.4	22.3	19.1	Three highest daily values over the 3-year period (values can occur in the same model year)
	Annual	1.3	Average of 3 single year means	No[§]	na	na	na	na
Particulate Matter PM_{10} Highway Run	24 hour	54.6	Not to be exceeded more than once per year on average over 3 years	Yes	85.4	82.0	60.6	Three highest daily values over the 3-year period (values can occur in the same model year)
	Annual	5.2	Average of 3 single year means	No[§]	na	na	na	na
Sulfur Dioxide	1 hour	22.9	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Yes	20.3	27.1	21.2	99th percentile of 1-hr daily maximum concentrations for each of the 3 individual years modeled
	3 hour	37.6	Highest value over the 3-year period	No	na	na	na	na
Sulfur Dioxide Highway Run	1 hour	49.2	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Yes	37.0	70.6	39.9	99th percentile of 1-hr daily maximum concentrations for each of the 3 individual years modeled
	3 hour	72.0	Highest value over the 3-year period	No	na	na	na	na

Source: Modified from AUC (2014a)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†na is not available

‡Initial modeling run conducted without dry depletion option for all receptor locations

§There is no longer an annual PM_{10} particulate matter NAAQS. This is compared to Wyoming's supplemental standard.

‖Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–18. The AERMOD Modeling Results for the Prevention of Significant Deterioration (PSD) Increments From Fugitive, Mobile, and Stationary Sources for the Peak Year for the Proposed Project

Pollutant	Averaging Time	Value ($\mu g/m^3$)	Modeling Form*	Same as PSD Form?
Nitrogen Dioxide	Annual	0.8	Annual mean, averaged over 3 years	No
Particulate Matter $PM_{2.5}$	24 hour	5.5	Highest daily value over the 3-year period	No
	Annual	0.2	Annual mean, averaged over 3 years	No
Particulate Matter PM_{10} Initial Run†	24 hour	42.1	Not to be exceeded more than once per year	Yes
	Annual	1.8	Average of 3 single year means	No
Particulate Matter PM_{10} Final Run‡	24 hour	22.4	Highest daily value over the 3-year period	No
	Annual	1.3	Average of 3 single year means	No
Sulfur Dioxide	3 hour	37.6	Highest value over the 3-year period	No
	24 hour	6.3	Highest value over the 3-year period	No
	Annual	0.1	Annual mean, averaged over 3 years	No

Source: Modified from AUC (2014a)

*The form expresses both the statistic (e.g., maximum, average, or 98^{th} percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†Initial modeling run conducted without dry depletion option for all receptor locations

‡Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–19. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	NAAQS Form*	Value ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS Limit ($\mu g/m^3$)	Percentage of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	682.5[†]	680	1,362.5	40,000	3.4
	8 hour	Not to be exceeded more than once per year	88.4[†]	378	466.4	10,000	4.7
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	1055.1[†]	680	1,735.1	40,000	4.3
	8 hour	Not to be exceeded more than once per year	156.3[†]	378	534.3	10,000	5.3
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	62.9	21	83.9	188	44.6
	Annual	Annual mean	2.4[†]	6	8.4	100	8.4
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	142.9	21	163.9	188	87.2
	Annual	Annual mean	7.5[†]	6	13.5	100	13.5
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	1.7	8	9.7	35	27.7
	Annual	Annual mean, averaged over 3 years	0.2	3.4	3.6	12[‡]	30.0
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	3.3	8	11.3	35	32.3
	Annual	Annual mean, averaged over 3 years	0.7	3.4	4.1	12[‡]	34.2
Particulate Matter PM_{10} Initial Run[§]	24 hour	Not to be exceeded more than once per year on average over 3 years	38.4	40	78.4	150	52.3
	Annual	Annual mean	5.4[†]	15	20.4	50[‖]	40.8
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	18.8	40	58.8	150	39.2
	Annual	Annual mean	3.9[†]	15	18.9	50[‖]	37.8
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	54.6	40	94.6	150	63.1
	Annual	Annual mean	15.6[†]	15	30.6	50[‖]	61.2

Table C–19. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS Limit (µg/m³)	Percentage of NAAQS Limit
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	22.9	43.2	66.1	200	33.0
	3 hour	Not to be exceeded more than once per year	37.6†	124.7	162.3	1,300	12.5
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	49.2	43.2	92.4	200	46.2
	3 hour	Not to be exceeded more than once per year	72.0†	124.7	196.7	1,300	15.1

Source: Modified from AUC (2014a)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix.

‡This table identifies the primary NAAQS limit. The secondary limit is larger (i.e., 15 µg/m³). Results that meet the primary standard automatically meet the secondary standard.

§Initial modeling run conducted without dry depletion option for all receptor locations

‖There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

¶Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–20. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the Prevention of Significant Deterioration (PSD) Increments

Pollutant	Averaging Time	PSD Increment Form*	Value ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Percentage of PSD Increment
Nitrogen Dioxide	Annual	Not to be exceeded over the year	2.4†	25	9.6
Particulate Matter $PM_{2.5}$	24 hour	Not to be exceeded more than once per year	5.5†	9	61.1
	Annual	Not to be exceeded over the year	0.6†	4	15
Particulate Matter PM_{10} Initial Run‡	24 hour	Not to be exceeded more than once per year	42.1	30	140.3
	Annual	Not to be exceeded over the year	5.4†	17	31.8
Particulate Matter PM_{10} Final Run§	24 hour	Not to be exceeded more than once per year	22.4†	30	74.3
	Annual	Not to be exceeded over the year	3.9†	17	22.9
Sulfur Dioxide	3 hour	Not to be exceeded more than once per year	37.6†	512	7.3
	24 hour	Not to be exceeded more than once per year	6.3†	91	6.9
	Annual	Not to be exceeded over the year	0.3†	20	1.5

Source: Modified from AUC (2014a)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†The modeling result form is not the same as the PSD increment form. The value in this table has a form that matches the PSD increment form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.

‡Initial modeling run conducted without dry depletion option for all receptor locations

§Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–21. Percentage of Emission Levels From the 100 Percent Activity Levels for the Various Phases When Compared to the Peak Year Emission Levels for the Proposed Project

Phase	Pollutant	Mass Flow Rates (Short Tons* per Year) for the 100 Percent Activity Level	Mass Flow Rates (Short Tons* per Year) for the Peak Year	Percentage of Emissions from 100 Percent Activity Levels Compared to Peak Year Emission Levels
Construction – Facility	Carbon Monoxide	9.13	43.04	21.2
	Nitrogen Oxides	10.13	44.81	22.6
	Particulate Matter $PM_{2.5}$	2.89	14.12	20.5
	Particulate Matter PM_{10}	21.59	115.27	18.7
	Sulfur Dioxide	1.34	6.80	19.7
Construction – Wellfield	Carbon Monoxide	39.57	43.04	91.9
	Nitrogen Oxides	39.44	44.81	88.0
	Particulate Matter $PM_{2.5}$	12.38	14.12	87.7
	Particulate Matter PM_{10}	100.98	115.27	87.6
	Sulfur Dioxide	6.02	6.80	88.5
Operations	Carbon Monoxide	4.26	43.04	9.9
	Nitrogen Oxides	6.76	44.81	15.1
	Particulate Matter $PM_{2.5}$	2.40	14.12	17.0
	Particulate Matter PM_{10}	18.27	115.27	15.8
	Sulfur Dioxide	0.78	6.80	11.5
Aquifer Restoration	Carbon Monoxide	2.42	43.04	5.6
	Nitrogen Oxides	3.60	44.81	8.0
	Particulate Matter $PM_{2.5}$	2.59	14.12	18.3
	Particulate Matter PM_{10}	20.54	115.27	17.8
	Sulfur Dioxide	0.37	6.80	5.4

Table C–21. Percentage of Emission Levels From the 100 Percent Activity Levels for the Various Phases When Compared to the Peak Year Emission Levels for the Proposed Project (Continued)

Phase	Pollutant	Mass Flow Rates (Short Tons* per Year) for the 100 Percent Activity Level	Mass Flow Rates (Short Tons* per Year) for the Peak Year	Percentage of Emissions from 100 Percent Activity Levels Compared to Peak Year Emission Levels
Decommissioning/ Reclamation	Carbon Monoxide	3.76	43.04	8.7
	Nitrogen Oxides	6.93	44.81	15.5
	Particulate Matter $PM_{2.5}$	4.20	14.12	29.7
	Particulate Matter PM_{10}	38.30	115.27	33.2
	Sulfur Dioxide	0.70	6.80	10.3

Source: Modified from AUC (2014a)
*Source documents and SEIS appendix table mass expressed in short tons only (dual units used in SEIS text with metric being primary).

Table C–22. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Facility Construction Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)	NAAQS Limit (µg/m^3)	Percentage of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	144.7[†]	680	824.7	40,000	2.1
	8 hour	Not to be exceeded more than once per year	18.7[†]	378	396.7	10,000	4.0
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	223.7[†]	680	903.7	40,000	2.3
	8 hour	Not to be exceeded more than once per year	33.1[†]	378	411.1	10,000	4.1
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	14.2	21	35.2	188	18.7
	Annual	Annual mean	0.54[†]	6	6.54	100	6.5
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	32.3	21	53.3	188	28.3
	Annual	Annual mean	1.7[†]	6	7.7	100	7.7
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	0.35	8	8.35	35	23.9
	Annual	Annual mean, averaged over 3 years	0.041	3.4	3.44	12[‡]	28.7
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	0.68	8	8.68	35	24.8
	Annual	Annual mean, averaged over 3 years	0.14	3.4	3.54	12[‡]	29.5
Particulate Matter PM_{10} Initial Run[§]	24 hour	Not to be exceeded more than once per year on average over 3 years	7.2	40	47.2	150	31.5
	Annual	Annual mean	1.0[†]	15	16.0	50[‖]	32.0
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	3.5	40	43.5	150	29.0
	Annual	Annual mean	0.73[†]	15	15.73	50[‖]	31.5
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	10.2	40	50.2	150	33.5
	Annual	Annual mean	2.9[†]	15	17.9	50[‖]	35.8

Table C–22. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Facility Construction Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS Limit (µg/m³)	Percentage of NAAQS Limit
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	4.5	43.2	52.2	200	26.1
	3 hour	Not to be exceeded more than once per year	7.4†	124.7	132.1	1,300	10.2
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	9.7	43.2	52.9	200	26.4
	3 hour	Not to be exceeded more than once per year	14.2†	124.7	138.9	1,300	10.7

Source: Modified from AUC (2014a)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.

‡This table identifies the primary NAAQS limit. The secondary limit is larger (i.e., 15 µg/m³). Results that meet the primary standard automatically meet the secondary standard.

§Initial modeling run conducted without dry depletion option for all receptor locations

‖There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

¶Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–23. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Wellfield Construction Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	NAAQS Form*	Value (μg/m^3)	Background Concentration (μg/m^3)	Total Concentration (μg/m^3)	NAAQS Limit (μg/m^3)	Percentage of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	627.2†	680	1,307.7	40,000	3.3
	8 hour	Not to be exceeded more than once per year	81.2†	378	459.2	10,000	4.6
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	969.6†	680	1,649.6	40,000	4.1
	8 hour	Not to be exceeded more than once per year	143.6†	378	521.6	10,000	5.2
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	55.3	21	76.3	188	40.6
	Annual	Annual mean	2.1†	6	8.1	100	8.1
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	125.7	21	146.7	188	78.0
	Annual	Annual mean	6.6†	6	12.6	100	12.6
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	1.5	8	9.5	35	27.1
	Annual	Annual mean, averaged over 3 years	0.17	3.4	3.57	12‡	29.7
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	2.9	8	10.9	35	31.1
	Annual	Annual mean, averaged over 3 years	0.61	3.4	4.01	12‡	33.4
Particulate Matter PM_{10} Initial Run§	24 hour	Not to be exceeded more than once per year on average over 3 years	33.6	40	73.6	150	49.1
	Annual	Annual mean	4.7†	15	19.7	50‖	39.4
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	16.5	40	56.5	150	37.7
	Annual	Annual mean	3.4†	15	18.4	50‖	36.8
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	47.8	40	87.8	150	58.5
	Annual	Annual mean	13.7†	15	28.7	50‖	57.4

Table C–23. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Wellfield Construction Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)	NAAQS Limit (µg/m^3)	Percentage of NAAQS Limit
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	20.3	43.2	63.5	200	31.7
	3 hour	Not to be exceeded more than once per year	33.3[†]	124.7	158.0	1,300	12.1
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	43.5	43.2	86.7	200	43.3
	3 hour	Not to be exceeded more than once per year	63.7[†]	124.7	188.4	1,300	14.5

Source: Modified from AUC (2014a-)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

[†]The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.

[‡]This table identifies the primary NAAQS limit. The secondary limit is larger (i.e., 15 µg/m^3). Results that meet the primary standard automatically meet the secondary standard.

[§]Initial modeling run conducted without dry depletion option for all receptor locations

[‖]There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

¶Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–24. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Operation Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)	NAAQS Limit (µg/m^3)	Percentage of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	67.6†	680	747.6	40,000	1.9
	8 hour	Not to be exceeded more than once per year	8.7†	378	386.7	10,000	3.9
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	104.4†	680	784.4	40,000	2.0
	8 hour	Not to be exceeded more than once per year	15.5†	378	393.5	10,000	3.9
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	9.5	21	30.5	188	16.2
	Annual	Annual mean	0.36†	6	6.36	100	6.4
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	21.6	21	42.6	188	22.7
	Annual	Annual mean	1.1†	6	7.1	100	7.1
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	0.29	8	8.29	35	23.7
	Annual	Annual mean, averaged over 3 years	0.034	3.4	3.43	12‡	28.6
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	0.56	8	8.56	35	24.4
	Annual	Annual mean, averaged over 3 years	0.12	3.4	3.52	12‡	29.3
Particulate Matter PM_{10} Initial Run§	24 hour	Not to be exceeded more than once per year on average over 3 years	6.1	40	46.1	150	30.7
	Annual	Annual mean	0.85†	15	15.8	50‖	31.7
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	3.0	40	43	150	28.7
	Annual	Annual mean	0.62†	15	15.6	50‖	31.2
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	8.6	40	48.6	150	32.4
	Annual	Annual mean	2.5†	15	17.5	50‖	35.0

Table C–24. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Operation Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS Limit (µg/m³)	Percentage of NAAQS Limit
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	2.6	43.2	45.8	200	22.9
	3 hour	Not to be exceeded more than once per year	4.3†	124.7	129.0	1,300	9.9
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	5.7	43.2	48.9	200	24.4
	3 hour	Not to be exceeded more than once per year	8.3†	124.7	133.0	1,300	10.2

Source: Modified from AUC (2014a-)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.

‡This table identifies the primary NAAQS limit. The secondary limit is larger (i.e., 15 µg/m³). Results that meet the primary standard automatically meet the secondary standard.

§Initial modeling run conducted without dry depletion option for all receptor locations

‖There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

¶Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–25. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Aquifer Restoration Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	NAAQS Form*	Value (μg/m^3)	Background Concentration (μg/m^3)	Total Concentration (μg/m^3)	NAAQS Limit (μg/m^3)	Percentage of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	38.2†	680	718.2	40,000	1.8
	8 hour	Not to be exceeded more than once per year	4.9†	378	382.9	10,000	3.8
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	59.1†	680	739.1	40,000	1.8
	8 hour	Not to be exceeded more than once per year	8.7†	378	386.7	10,000	3.9
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	5.0	21	26.0	188	13.8
	Annual	Annual mean	0.19†	6	6.19	100	6.2
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	11.4	21	32.4	188	17.2
	Annual	Annual mean	0.60†	6	6.6	100	6.6
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	0.31	8	8.31	35	23.7
	Annual	Annual mean, averaged over 3 years	0.037	3.4	3.44	12‡	28.6
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	0.60	8	8.6	35	24.6
	Annual	Annual mean, averaged over 3 years	0.13	3.4	3.53	12‡	29.4
Particulate Matter PM_{10} Initial Run§	24 hour	Not to be exceeded more than once per year on average over 3 years	6.8	40	46.8	150	31.2
	Annual	Annual mean	0.96†	15	15.96	50ǁ	31.9
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	3.3	40	43.3	150	28.9
	Annual	Annual mean	0.69†	15	15.69	50ǁ	31.4
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	9.7	40	49.7	150	33.1
	Annual	Annual mean	2.8†	15	17.8	50ǁ	35.6

Table C–25. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Aquifer Restoration Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)

Pollutant	Averaging Time	NAAQS Form*	Value (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS Limit (µg/m³)	Percentage of NAAQS Limit
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	1.2	43.2	44.4	200	22.2
	3 hour	Not to be exceeded more than once per year	2.0†	124.7	126.7	1,300	9.7
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	2.7	43.2	45.9	200	22.9
	3 hour	Not to be exceeded more than once per year	3.9†	124.7	128.6	1,300	9.9

Source: Modified from AUC (2014a-)
*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.
†The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.
‡This table identifies the primary NAAQS limit. The secondary limit is larger (i.e., 15 µg/m³). Results that meet the primary standard automatically meet the secondary standard.
§Initial modeling run conducted without dry depletion option for all receptor locations
‖There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.
¶Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–26. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Decommissioning/Restoration Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	NAAQS Form*	Value ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS Limit ($\mu g/m^3$)	Percentage of NAAQS Limit
Carbon Monoxide	1 hour	Not to be exceeded more than once per year	59.4†	680	739.4	40,000	1.8
	8 hour	Not to be exceeded more than once per year	7.7†	378	385.7	10,000	3.9
Carbon Monoxide Highway Run	1 hour	Not to be exceeded more than once per year	91.8†	680	771.8	40,000	1.9
	8 hour	Not to be exceeded more than once per year	13.6†	378	391.6	10,000	3.9
Nitrogen Dioxide	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	9.7	21	30.7	188	16.3
	Annual	Annual mean	0.37†	6	6.37	100	6.4
Nitrogen Dioxide Highway Run	1 hour	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	22.1	21	43.1	188	22.9
	Annual	Annual mean	1.2†	6	7.2	100	7.2
Particulate Matter $PM_{2.5}$	24 hour	98th percentile, averaged over 3 years	0.50	8	8.5	35	24.3
	Annual	Annual mean, averaged over 3 years	0.059	3.4	3.46	12‡	28.8
Particulate Matter $PM_{2.5}$ Highway Run	24 hour	98th percentile, averaged over 3 years	0.98	8	8.98	35	25.7
	Annual	Annual mean, averaged over 3 years	0.21	3.4	3.61	12‡	30.1
Particulate Matter PM_{10} Initial Run§	24 hour	Not to be exceeded more than once per year on average over 3 years	12.7	40	52.7	150	35.1
	Annual	Annual mean	1.8†	15	16.8	50‖	33.6
Particulate Matter PM_{10} Final Run¶	24 hour	Not to be exceeded more than once per year on average over 3 years	6.2	40	46.2	150	30.8
	Annual	Annual mean	1.3†	15	16.3	50‖	32.6
Particulate Matter PM_{10} Highway Run	24 hour	Not to be exceeded more than once per year on average over 3 years	18.1	40	58.1	150	38.7
	Annual	Annual mean	5.2†	15	20.2	50‖	40.4

Table C–26. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Decommissioning/Restoration Phase for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS) (Continued)

Pollutant	Averaging Time	NAAQS Form*	Value ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS Limit ($\mu g/m^3$)	Percentage of NAAQS Limit
Sulfur Dioxide	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	2.4	43.2	45.6	200	22.8
	3 hour	Not to be exceeded more than once per year	3.9†	124.7	128.6	1,300	9.9
Sulfur Dioxide Highway Run	1 hour	99th percentile of 1 hour daily maximum concentrations, averaged over 3 years	5.1	43.2	48.3	200	24.1
	3 hour	Not to be exceeded more than once per year	7.4†	124.7	132.1	1,300	10.2

Source: Modified from AUC (2014a-)

*The form expresses both the statistic (e.g., maximum, average, or 98th percentile) and the time period (e.g., once per year, over one year, or over three years) associated with the numerical value.

†The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.

‡This table identifies the primary NAAQS limit. The secondary limit is larger (i.e., 15 $\mu g/m^3$). Results that meet the primary standard automatically meet the secondary standard.

§Initial modeling run conducted without dry depletion option for all receptor locations

‖There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

¶Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–27. Nonradiological Concentration Estimates From Stationary, Mobile, and Fugitive Sources for the Various Individual Phases for the Proposed Project Compared to the Prevention of Significant Deterioration (PSD) Increments

Pollutant	Averaging Time	PSD Class II Increment (μg/m³)	Construction – Facilities		Construction – Wellfield		Operations		Aquifer Restoration		Decommissioning/ Reclamation	
			Value (μg/m3)	Percent of PSD	Value (μg/m3)	Percent of PSD	Value (μg/m3)	Percent of PSD	Value (μg/m3)	Percent of PSD	Value (μg/m3)	Percent of PSD
Nitrogen Dioxide	Annual	25	0.54*	2.2	2.1*	8.4	0.36*	1.4	0.19*	0.8	0.37*	1.5
Particulate Matter $PM_{2.5}$	24 hour	9	1.1*	12.2	4.8*	53.3	0.93*	10.3	1.0*	11.1	1.6*	17.8
	Annual	4	0.12*	3.0	0.53*	13.2	0.10*	2.5	0.11*	2.7	0.18*	4.5
Particulate Matter PM_{10} Initial Run†	24 hour	30	7.9	26.3	36.9	123.0	6.6	22.0	7.5	25.0	14.0	46.7
	Annual	17	1.0*	5.9	4.7*	27.6	0.85*	5.0	0.96*	5.6	1.8*	10.6
Particulate Matter PM_{10} Final Run‡	24 hour	30	4.2*	14.0	19.6*	65.3	3.5*	11.7	4.0*	13.3	7.4*	24.7
	Annual	17	0.73*	4.3	3.4*	20.0	0.62*	3.6	0.69*	4.1	1.3*	7.6
Sulfur Dioxide	3 hour	512	7.4*	1.4	33.3*	6.5	4.3*	0.8	2.0*	0.4	3.9*	0.8
	24 hour	91	1.2*	1.3	5.6*	6.1	0.72*	0.8	0.34*	0.4	0.65*	0.7
	Annual	20	0.059*	0.3	0.26*	1.3	0.034*	0.2	0.016*	0.1	0.031*	0.1

Source: modified from AUC (2014a-)

*The modeling result form is not the same as the PSD increment form. The value in this table has a form that matches the PSD increment form and was derived from the modeling results as described in Section 4.2.1 of the SEIS Appendix C.

†Initial modeling run conducted without dry depletion option for all receptor locations

‡Final modeling run conducted with dry depletion option for the top 21 receptor locations

Table C–28. Particulate Matter PM_{10} Concentration Estimates for the Initial Modeling Run* From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the National Ambient Air Quality Standards (NAAQS)

Average Time	NAAQS Form†	Value (µg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)	NAAQS Limit (µg/m^3)	Percent of NAAQS Limit
24 hour	Not to be exceeded more than once per year on average over 3 years	38.4	40	78.4	150	52.3
Annual	Annual mean	5.4‡	15	20.4	50§	40.8

Source: Modified from AUC (2014a).
*Initial modeling run conducted without the dry depletion option for all receptor locations.
†The form expresses both the statistical (e.g., maximum, average, or 98th percentile) and temporal (e.g., once per year, over 1 year, or over 3 years) nature of the values.
‡The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Appendix C, Section C-4.3.1.
§There is no longer an annual PM_{10} particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

Table C–29 Particulate Matter PM_{10} Concentration Estimates for the Initial Modeling Run* From Stationary, Mobile, and Fugitive Sources for the Peak Year for the Proposed Project Compared to the Prevention of Significant (PSD) Increments

Average Time	PSD Increment Form†	Value (µg/m^3)	PSD Class II Increment (µg/m^3)	Percentage of PSD Increment
24 hour	Not to be exceeded more than once per year	42.1	30	140.3
Annual	Not to be exceeded over the year	5.4‡	17	31.8

Source: Modified from AUC (2014a).
*Initial modeling run conducted without the dry depletion option for all receptor locations.
†The form expresses both the statistical (e.g., maximum, average, or 98th percentile) and temporal (e.g., once per year, over 1 year, or over 3 years) nature of the values.
‡The modeling result form is not the same as the NAAQS form. The value in this table has a form that matches the NAAQS form and was derived from the modeling results as described in Appendix C, Section C-4.3.1.

Table C–30. Comparison of the Particulate Matter PM_{10} Initial* and Final[†] Modeling Runs to the NAAQS and PSD Increments.			
Average Time	**Modeling Run**	**Percentage of the NAAQS**	**Percentage of the PSD Increment**
24 Hour	Initial	52.3	140.3
	Final	39.2[‡]	74.3
Annual	Initial	40.8	31.8
	Final	37.8[‡]	22.9

Source: Modified from AUC (2014a)

*Initial modeling run conducted without the dry depletion option for all receptor locations.

[†]Final modeling run conducted with the dry depletion option at the 21 receptor locations with the highest results from the initial modeling run.

[‡]There is no longer an annual PM10 particulate matter NAAQS. This limit represents Wyoming's supplemental standard.

APPENDIX D

PUBLIC COMMENTS ON THE DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE RENO CREEK ISR PROJECT IN CAMPBELL COUNTY, WYOMING, AND NRC RESPONSES

COMMENTS SUMMARIES AND RESPONSES

D1 Overview

On July 7, 2016, the U.S. Nuclear Regulatory Commission (NRC) staff published a notice in the *Federal Register* (FR) requesting public review and comment on the draft Supplemental Environmental Impact Statement (SEIS) for the Reno Creek In Situ Recovery (ISR) Project in Campbell County, Wyoming, a supplement to the Generic Environmental Impact Statement for In Situ Leach (ISL) Uranium Milling Facilities (GEIS) (81 FR 44333) in accordance with Title 10 of the U.S. *Code of Federal Regulations* (CFR) Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions. In publishing the notice for the draft SEIS, the NRC staff stated that the public comment period closed August 22, 2016, which is the minimum 45-day comment period required under NRC regulations. Subsequently, the NRC staff extended the comment period until September, 6, 2016 (81 FR 47442) to match the U.S. Environmental Protection Agency (EPA) comment period. The notice for the draft SEIS stated that comments received after this date would be considered if it is practical to do so, but the NRC staff was able to ensure consideration only for comments received on or before the September 6, 2016 extension. The NRC accepted all comments on the draft SEIS received on or before September 6, 2016. No additional comment letters were received after September 6, 2016. By electronic and postal correspondence, four agencies and organizations submitted 172 comments on the Reno Creek draft SEIS.

D2 Public Participation

Public participation is an essential part of the NRC environmental review process. This section describes the process for public participation during the NRC staff's development of the SEIS. The NRC conducted an open, public SEIS development process consistent with the requirements of the *National Environmental Policy Act of 1969* (NEPA) and NRC regulations. On August 5, 2013, the NRC published a Notice of Opportunity for Hearing on the proposed Reno Creek ISR Project license application in the 78 FR 47427. The NRC did not receive any requests for hearings. In September 2013, the NRC staff met with federal, state, and local agencies and authorities, as well as public organizations, as part of a site visit to gather site-specific information. The NRC public comment period (until September 6, 2016) was provided for agencies, organizations, and the general public to review the draft SEIS and provide comments.

D2.1 Notice of Intent to Develop the SEIS

The NRC staff published a Notice of Intent to prepare the SEIS in the 78 FR 51753 on August 21, 2013, in accordance with NRC regulations.

D2.2 Public Participation Activities

As described in SEIS Sections 1.4.2 and 1.7.3, the NRC staff met with federal, state, tribal, and local agencies and authorities during the course of a site visit to the proposed Reno Creek Project area and vicinity. The purpose of this visit and these meetings was to gather additional site-specific information to help prepare the Reno Creek ISR Project environmental review. As a separate activity, but also part of information gathering, the NRC staff also contacted potentially interested Native American Tribes. Additional information about tribal engagement and correspondence can be found in SEIS Section 1.7.3.6.

D2.3 Issuance and Availability of the SEIS

On July 7, 2016, the NRC staff published a Notice of Availability of the draft SEIS in the 81 FR 44333. In this notice, the NRC staff provided information on how to access or obtain a copy of the SEIS. Electronic versions of the SEIS and supporting information were made available through the NRC Agencywide Documents Access and Management System (ADAMS) accessible through the NRC website (http://www.nrc.gov/readingrm/adams.html). Copies of the SEIS were also available at the Campbell County Public Library, Wright and Gillette Branches.

D2.4 Public Comment Period

In the draft SEIS Notice of Availability published on July 7, 2016 (81 FR 44333), the NRC stated that public comments on the draft SEIS should be submitted by August 22, 2016. The comment period was extended to September 6, 2016 (81 FR 47442). Members of the public were invited and encouraged to submit related comments. Comments could be submitted electronically to the federal rulemaking website or submitted in writing by mail. The Notice of Availability for the draft SEIS also stated that comments received after September 6, 2016, would be considered if it was practical to do so, but NRC would assure consideration only for comments received on or before September 6, 2016. The NRC accepted all comments on the draft SEIS received on or before September 6, 2016. No additional comment letters were received after September 6, 2016. By electronic and postal correspondence, four agencies and organizations submitted 172 comments on the Reno Creek ISR Project SEIS.

D3 Comment Review Methods

Each of the comments received are included in the following comment summaries and addressed in the responses provided. A systematic approach was used for comment response development, which involved identifying individual comments from the source documents, sorting comments by topic, and distributing comments to subject matter experts for appropriate NRC staff review and response.

The NRC staff reviewed all comment documents and identified, marked, and consecutively numbered individual (unique) comments in each document. Comment numbers followed a two-part numbering system separated by a hyphen. The three-digit number to the left of the hyphen is the document number. The three-digit number to the right of the hyphen is a consecutive unique-count number for each comment identified in a specific document. Table D–1 lists all commenter names, their affiliations, and the document number assigned to the comment document. Table D–2 provides this same information sorted by comment document number in the first column. Readers can use these tables to electronically search the report to locate comments submitted by specific individuals or to find individuals associated with comments described in Section D5.

In addition to the numbering, each unique comment was assigned a topic category (i.e., bin) to facilitate sorting and reviewing comments on similar topics. Bin categories align with the topics addressed in Section D5 of this appendix. Following the initial comment identification review, the identified comments were entered into a spreadsheet that allowed individual comments to be sorted by topic and distributed to staff for further consideration. The NRC staff then continued sorting and reviewing all comments within specific topic categories, developed comment summaries and responses for this appendix, and made changes to the SEIS, as appropriate, to address the comments.

Table D–1. Public Commenter Name/Group with Affiliation and Comment Document Number			
Last Name	**First Name**	**Affiliation**	**Comment Document Number**
Loewen	Walt	U.S. Bureau of Land Management	001
Viellennave	James	AUC, LLC.	002
Stewart	Robert	U.S. Department of the Interior	003
Viellennave	James	AUC, LLC.	004
Strobel	Philip	U.S. Environmental Protection Agency	005

Table D–2. Comment Document Number, Commenter Name/Group, Affiliation, and ADAMS Accession Number				
Comment Document Number	**Last Name**	**First Name**	**Affiliation**	**ADAMS Accession Number**
001	Loewen	Walt	U.S. Bureau of Land Management	ML16216A284
002	Viellennave	James	AUC, LLC.	ML16258A427
003	Stewart	Robert	U.S. Department of the Interior	ML16237A050
004	Viellennave	James	AUC, LLC.	ML16250A020
005	Strobel	Philip	U.S. Environmental Protection Agency	ML16260A049

Where several similar comments related to a specific topic were received, the NRC staff consolidated the same or similar comments within each topic to facilitate developing responses. This approach allowed multiple similar comments to be addressed with a single response to avoid duplication of effort and enhance readability of this report. A response has been provided for each comment or group of comments.

D4 Major Issues and Topics of Concern

The comments received addressed specific items within the scope of the SEIS. Topics raised included, but were not limited to, groundwater; surface water; ecology; air quality; and the Underground Injection Control (UIC) permitting.

D5 Comment Summaries and Responses

Detailed responses to comments are provided in this section. The structure of this section is based on the topics of comments provided. Within each topic-specific subsection, the detailed presentation of comment and response information includes the applicable comment identification numbers, comment summaries, and the NRC staff response.

D5.1 Regulatory Issues and Process

Comment: **004-006**

One commenter suggested a text clarification to amend the NRC’s statement of the federal action for the Reno Creek ISR Project. The commenter suggested noting that the NRC could “grant with conditions” in addition to granting or denying the license.

Response*: As a regulatory agency, the NRC’s federal action is the decision whether to grant or deny the applicant’s license request to construct and operate an ISR facility. The NRC does not* *use the term "grant with conditions" when describing the federal action for ISR licensing actions. SEIS Sections 1.2 and 1.3 clearly identify the proposed federal action and the purpose and need for the proposed action. No change was made to the SEIS as a result of this comment.*

Comment: **005-003**

One commenter suggested that edits be made to an SEIS summary of Title 40 of the *Code of Federal Regulations* (CFR) Part 146 to make it accurately reflect the referenced CFR.

Response: *The NRC staff agree with the suggested edits. SEIS Section 2.1.1.1.2 has been revised in response to this comment.*

Comments: **005-018, 005-021**

One commenter suggested including both the applicant- and NRC-proposed mitigations, as listed in SEIS Tables 6-1 and 6-2, for resource areas such as surface water and air quality as part of the record of decision (ROD), license requirements, or both.

Response: *As a NEPA document that provides information for decisionmakers, the SEIS contains both mitigation measures committed to by the applicant listed in Table 6-1, and the NRC-proposed mitigation measures listed in Table 6-2 of the SEIS. However, the ROD only notes license conditions or requirements that are specified as part of the license documentation that require a licensee's compliance. Therefore, the ROD does not contain proposed mitigation measures. No changes were made to the SEIS as a result of these comments.*

Comment: **005-024**

One commenter requested that NRC staff consider the effect that proposed changes to the U.S. Environmental Protection Agency (EPA's) regulations in 40 CFR Part 192 that are applicable to uranium ISR facilities would have on the monitoring plan and decommissioning of the Reno Creek ISR Project.

Response: *The NRC staff used current regulatory provisions to evaluate the environmental impacts associated with the proposed Reno Creek ISR Project. The NRC does not use proposed regulatory requirements for an impact analysis, such as the proposed 40 CFR 192 rule. No changes were made to the SEIS in response to this comment.*

D5.2 Federal and State Agency Permitting

Comment: **005-001**

One commenter noted that although Wyoming Department of Environmental Quality (WDEQ) has primacy for the UIC program, it is EPA, not WDEQ, which grants the aquifer exemption. As such, the commenter stated that Table 1-2 of the SEIS could be misleading because WDEQ cannot grant aquifer exemptions. Additionally, the commenter stated that the applicant has submitted the documentation to WDEQ regarding the aquifer exemption for the UIC Class I deep disposal wells; however, the aquifer exemption has not been granted.

Response: *The NRC staff acknowledge that the applicant has received the UIC Class I deep disposal well permit from WDEQ, but not the aquifer exemption from EPA. As suggested by the commenter, Table 1-2 of the SEIS was updated to correctly identify the issuing agency. In* *addition, text in the Executive Summary and SEIS Section 2.1.1.2 were updated to indicate that the aquifer exemption associated with the Class I deep disposal wells is pending.*

Comment: **005-004**

One commenter noted an inaccuracy in the draft SEIS text which stated that WDEQ granted aquifer exemptions. The commenter stated that WDEQ identifies and requests the aquifer to be exempt but that EPA approves the request.

***Response**: The NRC acknowledge the inaccuracy and have revised the Executive Summary; SEIS Sections 2.1.1.1.2, 2.1.1.1.4, 3.13.1; and Table 1-2 in response to this comment to clarify that EPA approves aquifer exemptions.*

D5.3 <u>ISR Process Description</u>

Comment: **005-007**

One commenter noted that excursion monitoring was mentioned in several SEIS chapters with references to the GEIS but provided limited site-specific information. The commenter also requested additional text be added to further explain excursions in the SEIS.

***Response**: The NRC staff disagree that additional information on excursion monitoring is warranted. SEIS Sections 2.1.1.1.3, 2.1.1.4, and 7.3.1.2 adequately describe both the general and site-specific monitoring parameters and metrics of excursions and excursion monitoring. The SEIS is intended to supplement the GEIS (NRC, 2009) with site-specific information for a given project, but is not intended to repeat more generic descriptive information from the GEIS. GEIS citations are included in the SEIS text to indicate that a reader can find more information in the GEIS if desired. No changes were made to the SEIS as a result of this comment.*

D5.3.1 Reference

NRC. NUREG–1910, "Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities." ML091480244, ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. May 2009.

D5.4 Land Use

Comments: **004-001, 004-002, 004-008, 004-009, 004-028**

One commenter stated that the description of the total land disturbance and wellfield disturbance areas as stated in the Executive Summary and SEIS Sections 2.1.1.1.1, 2.1.1.1.2, and 3.1 are not accurate. Specifically, the acreage described in the SEIS is inclusive, not exclusive, of the land disturbed by wellfields.

***Response**: The NRC staff reviewed the environmental report (AUC, 2012a) and technical report (AUC, 2012b) and agree that the total land disturbance area is inclusive of wellfields. The SEIS text in Sections 2.1.1.1.1, 2.1.1.1.2, and 3.1 is therefore inconsistent with the stated land disturbance areas in other sections of the SEIS. However, the NRC staff evaluated the total disturbed land in the Land Use resource area as a percentage of the total project area, and compared the land disturbance areas to those described in the GEIS Wyoming East Uranium Milling Region (NRC, 2009). This revised information had no effect on the impact conclusions* *presented in the SEIS. The Executive Summary and SEIS Sections 2.1.1.1.1, 2.1.1.1.2, and 3.1 were revised for consistency in response to this comment.*

Comments: **004-038; 004-092**

One commenter stated that the location of the nearest residence to the proposed Reno Creek ISR Project as identified in SEIS Sections 3.2 and 3.7.2.1 is inaccurate and suggested that the text be deleted.

***Response**: The NRC staff acknowledge that the nearest residence identified in the draft SEIS is incorrect. Text in SEIS Sections 3.2 and 3.7.2.1 has been updated to identify the current nearest resident. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comment: **005-019**

One commenter requested that text be added to the Executive Summary to clarify the duration of construction activities; specifically, to explain that while construction activities occur for 1 to 2 years per wellfield, the wellfields are constructed sequentially. The commenter noted that the total construction time would be approximately 9 years for the whole project.

***Response**: The NRC staff have revised text in the Executive Summary to clarify the construction phase timeframe. Text in SEIS Section 2.1.1.1.2 and Figure 2-1 clearly describe and illustrate the construction phase and timeframe for activities. All resource area impacts are based on the phased approached as described in SEIS Section 2.1.1.1.2. Therefore, the revised information had no effect on the impact conclusions presented in the SEIS.*

D5.4.1 References

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Technical Report." ML12291A009 and ML12291A010. Lakewood, Colorado: AUC LLC. 2012a.

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report." ML12291A335 and ML12291A332. Lakewood, Colorado: AUC, LLC. 2012b.

NRC. NUREG–1910, "Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities." ML091480244, ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. May 2009.

D5.5 <u>Geology and Soils</u>

D5.5.1 Characterization of Confining Units

Comments: **004-029; 004-064**

One commenter disagreed with the reported thickness of the Underlying Aquitard (UA) {46 to 76 m [150 to 250 ft]} in SEIS Sections 3.4.1.2 and 5.5.2. The commenter stated that, as referenced in the applicant's technical report Section 2.7.2.3, the UA is approximately 91 to 122 m [300 to 400 ft] (AUC, 2012a).

***Response**: The NRC staff acknowledge that on a regional scale, the UA may reach a maximum thickness of 91 to 122 m [300 to 400 ft]. However, an isopach map of the UA presented in Figure 2.6A-24 in the applicant's technical report Addendum 2.6 indicates that the UA aquitard ranges from approximately 46 to 76 m [150 to 250 ft] thick within the proposed project area (AUC, 2012a). Text in SEIS Section 3.4.1.2 was revised to clarify the thickness of the UA within the proposed project area: "An isopach map constructed by the applicant indicates that the UA ranges from approximately 46 to 76 m [150 to 250 ft] within the proposed project area (AUC, 2012a, Figure 2.6-A-24 in TR Addendum 2.6)." This revised information had no effect on the impact conclusions presented in the SEIS.*

No other changes were made in the SEIS beyond the information provided in this response.

D5.5.2 Characterization of Deep Well Disposal Horizons

Comment: **004-030**

One commenter stated that the reported depths for the Teckla and Teapot Sandstones in SEIS Section 3.4.1.2 {approximately 2,270 to 2,557 m [7,450 to 8,390 ft]} are incorrect. The commenter stated that, as referenced in the WDEQ Class I UIC permit determination, the Teckla and Teapot Sandstones are located at depths between approximately 2,130 and 2,400 m [7,000 to 7,860 ft] below ground surface in the proposed project area (WDEQ, 2015).

***Response**: The depths of the Teckla and Teapot Sandstones in the proposed project area were estimated based on information provided in Section 3.3.1 of the applicant's ER (AUC, 2012b). The NRC staff acknowledge that the WDEQ Class I UIC permit determination provides a more current and accurate estimate of the depth of the Teckla and Teapot Sandstones in the proposed project area (WDEQ, 2015). Text in SEIS Section 3.4.1.2 was revised as follows to clarify the depths of the Teckla and Teapot Sandstones in the proposed project area: "…The Teckla and Teapot Sandstones are located at depths approximately 2,130 and 2,400 m [7,000 to 7,860 ft] below ground surface in the proposed project area (WDEQ, 2015)." This revised information had no effect on the impact conclusions presented in the SEIS.*

D5.5.3 Editorial-Geology and Soils

Comment: 002-024

One commenter stated that the words "if necessary" should be added to text in SEIS Section 4.4.1.1 to more accurately describe the potential actions the applicant could take regarding mitigation measures to limit soil loss.

***Response**: The NRC staff have reviewed the environmental and technical reports to confirm the applicant's commitment regarding soil loss and the accuracy of adding the suggested phrase. The mitigations listed in SEIS Section 4.4.1.1 are considered best management practices for limiting soil loss. The NRC staff used these best management practices along with applicant commitments to determine the impact conclusion. The requested text was determined to be accurate and was added; however, this wording revision had no effect on the impact conclusions presented in the SEIS.*

Comment: **004-051**

One commenter proposed text to further clarify the commitment of the applicant to best management practices to reduce potential erosion impacts as stated in its Storm Water Pollution Prevention Plans (SWPPPs) as part of a Wyoming Pollutant Discharge Elimination System (WYPDES) permit issued by WDEQ.

***Response**: The NRC staff disagree with the inclusion of the clarifying text in the SEIS Section 4.4.1.1. The text referred to by the commenter is a summary of potential mitigations as described in the GEIS (NRC, 2009). Inclusion of applicant commitments in this section of the SEIS would be inappropriate. However, SEIS Section 4.5.1.1 does accurately include text which specifically addresses the monitoring and mitigation included in the applicant's SWPPPs and WYPDES permit. No change was made to the SEIS in response to this comment.*

D5.5.4 References

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Technical Report." ML12291A009 and ML12291A010. Lakewood, Colorado: AUC, LLC. 2012a.

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report." ML12291A335 and ML12291A332. Lakewood, Colorado: AUC, LLC. 2012b.

NRC. NUREG–1910, "Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities." ML091480244, ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. May 2009.

WDEQ. "Underground Injection Control Permit. Permit 09-621." Cheyenne, Wyoming: State of Wyoming Department of Environmental Quality, Water Quality Division. 2015.

D5.6 Surface Water and Wetlands

D5.6.1 Location of Wetlands

Comment: **005-016**

One commenter noted that it would be helpful to include a map displaying the types and locations of wetlands within the proposed project area. The commenter stated that such a figure would provide a picture of the wetlands in relation to the proposed central processing plant and wellfield locations.

***Response**: As described in SEIS Section 3.5.1.4 and documented in SEIS Table 3-9, a wetland delineation survey identified a total of 17.12 ha [42.33 ac] of wetlands within the proposed project area, consisting of eight wetland classes. Because of the limited areal extent of wetlands {17.12 ha [42.33 ac]} compared to the total area of the proposed project area {2,451 ha [6,057 ac]}, the NRC staff did not include a map showing the location of the identified wetlands in the SEIS. However, as discussed in SEIS Section 3.5.1.4, the wetlands identified within the proposed project area are mostly of the Palustrine Emergent (PEM) designation and were found mainly within the channels of the Belle Fourche River and its tributaries. Furthermore, a map showing the location of wetlands identified by the wetland delineation* *survey is included as Figure 1 in the applicant's environmental report Addendum 3.5-F (AUC, 2012). A reference to Figure 1 in the applicant's environmental report Addendum 3.5-F was added to SEIS Section 3.5.1.4.*

D5.6.2 Delineation of 100-Year Floodplain

Comment: **005-017**

One commenter pointed out that it is not possible to read the legend on the map depicted in SEIS Figure 3-13, and thus understand the map. The commenter also noted that because the figure is presented in grayscale, it is difficult to delineate the 100-year floodplain. The commenter suggested enlarging the figure legend and illuminating the 100-year floodplain boundary.

***Response**: The NRC staff agree that, as depicted in the draft SEIS, the legend in Figure 3-13 was difficult to read and the 100-year flood plain was difficult to delineate. As suggested by the commenter, SEIS Figure 3-13 was revised as follows: (i) the legend was enlarged, (ii) grayscale colors were enhanced to illuminate the 100-year flood plain boundary, and (iii) labels were added within the figure to show the 100-year inundation boundary of the Belle Fourche River.*

D5.6.3 Reference

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report." ML12291A335, ML12291A332, and ML12291A354. Lakewood, Colorado: AUC, LLC. 2012.

D5.7 Groundwater Resources

D5.7.1 Characterization of Aquifers

Comment: **004-013**

One commenter stated that the Class III aquifer exemption has been granted and that SEIS Section 2.1.1.1.2 should be revised to reflect this update.

***Response**: The NRC staff agree with the clarification, and SEIS Section 2.1.1.1.2 and Table 1-2 were updated accordingly. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comment: **004-034**

A commenter stated that the Shallow Water Table Unit (SM Unit) can be considered the uppermost aquifer at the proposed Reno Creek ISR Project, if at a particular location the SM Unit contains a sufficient volume of groundwater for sampling, and provided suggestions for revisions to SEIS Section 3.5.2.3.

***Response**: The NRC staff agree that the SM Unit can be considered the uppermost aquifer at the proposed Reno Creek ISR Project, if at a particular location the SM Unit contains sufficient groundwater for sampling. As suggested by the commenter, text in SEIS Section 3.5.2.3 was revised as follows to clarify whether the SM Unit can be considered the uppermost aquifer: "The SM Unit can be considered the uppermost aquifer if at any specific location, the SM Unit or similar shallow sandstone unit contains sufficient groundwater."*

Comment: **004-035**

A commenter stated that the description of the eastern portion of the Production Zone Aquifer (PZA) in the proposed project area as "unsaturated" is not accurate in SEIS Section 3.5.2.3. The commenter suggested that this term be removed.

***Response**: The NRC staff agree that the term "unsaturated" is not accurate and should not be used to describe the PZA in the eastern portion of the proposed project area. Text in SEIS Section 3.5.2.3 was revised as follows to clarify hydrologic conditions in the eastern portion of the PZA within the proposed project area: "The aquifer conditions change from saturated conditions in the western portion of the proposed project area to partially saturated conditions in the eastern portion (~30 percent in area) of the proposed project area (AUC, 2012i)."*

D5.7.2 State and Federal Agency Permitting

Comment: **002-025**

One commenter suggested that a sentence in SEIS Section 4.5.2.1.1 be revised to clarify that the applicant has been granted a permit to discharge wastewater via Class I deep disposal wells into the Teckla and Teapot Sandstones.

***Response**: The NRC staff acknowledge that the applicant has been granted a permit to discharge wastewater via Class I deep disposal wells into the Teckla and Teapot Sandstones (WDEQ, 2015). As suggested by the commenter, text in SEIS Section 4.5.2.1.1 was revised to clarify the status of the applicant's aquifer exemption for Class I deep well disposal.*

D5.7.3 Groundwater Flow

Comment: **004-031**

A commenter pointed out that the direction of regional groundwater flow in the Lance and Fox Hills aquifer system is incorrectly stated in SEIS Section 3.5.2.2. Based on potentiometric maps, the commenter stated that regional groundwater flow in the Lance and Fox Hills aquifer system is generally northward with a groundwater divide in southeastern Campbell County and subsequent groundwater flow toward the northeast (AUC, 2012).

Response: *The NRC staff acknowledge that the direction of regional groundwater flow in the Lance and Fox Hills aquifer system is incorrectly stated as "southeast" in SEIS Section 3.5.2.2. Text in SEIS Section 3.5.2.2 was revised as follows to clarify the direction of regional groundwater flow in the Lance and Fox Hills aquifer system: "Based on potentiometric maps, the applicant observed a general northward regional groundwater flow in the Lance and Fox Hills aquifer system with a groundwater divide in southeastern Campbell County and subsequent groundwater flow toward the northeast (AUC, 2012a)."*

D5.7.4 Aquitard Properties

Comment: **004-032**

The commenter noted that the vertical movement of water between the Lance and Fox Hills aquifer system and the overlying Wasatch and Fort Union Formations is impeded by fine-grained shale and mudstone intervals within the formations. The commenter suggested that the sentence in SEIS Section 3.5.2.2 be revised for clarification.

Response: *The NRC staff agree that vertical movement of water between the Lance and Fox Hills aquifer system and the overlying Wasatch and Fort Union Formations is impeded by fine-grained shale and mudstone intervals within the formations. Text in SEIS Section 3.5.2.2 was revised as follows to clarify that the low vertical hydraulic conductivities of fine-grained shale and mudstone intervals within the formations is a reason to expect minimal vertical leakage: "Though a potential for vertical leakage form the overlying Wasatch and Fort Union Formations exists, the applicant cites the low vertical hydraulic conductivities (~10^{-8} cm/s [3.9×10^{-9} in/s]} of the fined-grained shale and mudstone intervals within the formations as a reason to expect minimal vertical leakage (AUC, 2012a)." This revised information had no effect on the impact conclusions presented in the SEIS.*

Comments: **005-008; 005-010**

A commenter stated that the SEIS seems to rely on the GEIS findings that the potential for vertical excursions is "SMALL" (SEIS Section 4.5.2.1.2). The commenter stated that specific information supporting this conclusion for the Reno Creek ISR Project is minimal, and appears to be based on one permeability test each for the overlying and underlying aquitards (SEIS Section 3.5.2.3) and the determination that the low hydraulic conductivity value of the aquitards "limit the potential impact of vertical excursions." The commenter stated further that the potential for excursions can vary substantially by project site and recommended a more robust site-specific analysis be provided in the final SEIS. The commenter specially suggested that the physical separation of the production zone from lower and upper aquifers be explained in more detail and in plain language.

Response: *The NRC staff do not agree with the commenter's argument that the SEIS relies on the GEIS findings that the potential for vertical excursions is "SMALL" and that specific information supporting this conclusion for the Reno Creek ISR Project is minimal, and is based on one permeability test each for the overlying and underlying aquitards. SEIS Section 4.5.2.1.2 provides a detailed assessment of the potential for vertical excursions to impact groundwater quality in overlying and underlying aquifers at the proposed Reno Creek ISR Project. This assessment includes available site-specific hydrogeologic information, a discussion of NRC regulatory requirements mandating preventive measures that must be implemented to further reduce the likelihood and consequences of potential vertical excursions,* *and the applicant's agreement to a license condition requiring abandonment of all historic drill holes within a wellfield before testing for a wellfield hydrogeologic data package.*

Site-specific information presented in SEIS Section 4.5.2.1.1 supporting a low potential for vertical excursions to impact groundwater in overlying and underlying aquifers includes: (i) analysis of two sets of permeability data for the overlying and underlying aquitards, (ii) review and analysis of hydrostratigraphic cross-sections (see SEIS Figures 3-17 through 3-22) illustrating the continuity and thickness of the overlying and underlying aquitards across the project area, and (iii) an analysis of calculated vertical hydraulic gradients between the production zone and overlying and underlying aquifers based on measured potentiometric head differences.

NRC regulations require the licensee of an ISR facility to take preventive measures to reduce the likelihood and consequences of potential vertical excursions. These preventive measures are discussed in SEIS Section 4.5.2.1.2 and include: (i) maintaining inward hydraulic gradients created by net groundwater withdrawals (production bleeds) to ensure groundwater flow is toward the production zone, (ii) implementing a NRC-mandated groundwater monitoring plan to ensure that excursions are detected and corrected, (iii) plugging and abandoning or mitigating any previously drilled wells and exploration drill holes that may potentially impact the control and containment of wellfield solutions within the proposed project area, and (iv) implementing a mechanical integrity test program to mitigate the impacts of potential vertical excursions resulting from borehole failure.

As described in SEIS Section 4.5.2.1.2, the NRC staff has proposed and the applicant has agreed to a license condition that would require abandonment of all historic drill holes within a wellfield before testing for a wellfield hydrogeologic data package (AUC, 2015). This commitment would ensure that all historic drill holes are properly abandoned before ISR activities at a wellfield are initiated; therefore, any historic drill holes would not be a pathway for lixiviant migration to overlying or underlying aquifers.

Because these discussions are already present in the SEIS text, no changes were made to the SEIS beyond the information provided in this response.

D5.7.5 Groundwater Use

Comment: **004-033**

The commenter pointed out that groundwater usage from the Madison Limestone and Minnelusa Formation is located along the eastern flank of the PRB, where these formations are at much shallower depths than in the center of the PRB. The commenter suggested that the aquifer characteristics discussion in SEIS Section 3.5.2.2 be revised to more accurately describe the water supplies and aquifers in the area.

***Response**: The NRC staff agree that groundwater usage from the Madison Limestone and Minnelusa Formation is located along the eastern flank of the PRB, where these formations are at much shallower depths than in the center of the PRB. As suggested by the commenter, text in SEIS Section 3.5.2.2 was revised to clarify the location of groundwater usage from the Madison Limestone and Minnelusa Formation.*

Comment: **004-063**

The commenter pointed out that it is important to note that the Madison Formation used for the city of Gillette's water supply is located along the eastern flank of the PRB and at much shallower depths than encountered near the Reno Creek project area. The commenter suggested that the cumulative impacts discussion in SEIS Section 5.5.2 be revised to clarify that Madison wells used for water supply are located east of the city of Gillette and the Madison Formation at these wells is encountered at significantly shallower depths than beneath the proposed project area.

***Response**: The NRC staff acknowledge that the Madison Formation used for Gillette's water supply is located along the eastern flank of the PRB and at much shallower depths than encountered near the Reno Creek ISR Project area. As suggested by the commenter, text in SEIS Section 5.5.2 was revised to clarify that Madison wells used for water supply are located east of the city of Gillette, and that the Madison Formation used for water supply for the city of Gillette is encountered at significantly shallower depths than beneath the Reno Creek ISR Project area.*

Comment: **005-013**

The commenter noted that it is important to identify all aquifers that qualify as "underground sources of drinking water" [USDWs; where a USDW is water with total dissolved solids (TDS) up to 10,000 mg/L as defined by the Safe Drinking Water Act], including those deeper than the Fox Hills Sandstone. The commenter stated that the SEIS does not clearly identify what deeper aquifers meet the USDW requirements, and that the SEIS appears to disregard aquifers labeled "too deep" or "too saline" from USDW classification. The commenter stated further that in order to understand the complete regional groundwater picture, all USDW aquifers should be identified.

***Response**: The NRC staff recognize the importance of identifying all aquifers that qualify as USDWs to understand the complete regional groundwater picture. The NRC staff notes that the definition of USDW is "an aquifer or part of an aquifer which supplies any public water system, or contains a sufficient quantity of groundwater to supply a public water system and currently supplies drinking water for human consumption or contains fewer than 10,000 mg/L TDS)." SEIS Figure 3-15 was revised to identify with an asterisk (*) all hydrostratigraphic units that can be USDWs in the PRB.*

Comment: **005-014**

The commenter stated that the SEIS discusses water consumptive use, its impacts, and potential ways to reduce consumptive use, but the discussion is in relative terms to different stages of the project or in relation to GEIS conclusions. The commenter stated that it is important to provide actual estimates of groundwater consumptive use in a site-specific analysis, which is important when looking at long-term cumulative impacts to aquifers.

***Response**: The applicant did not provide quantitative estimates of groundwater consumptive use for the different phases of the proposed project. However, quantitative estimates are not needed because analyses of water consumptive use presented in the GEIS for the Wyoming East Uranium Milling Region (NRC, 2009) along with available site-specific information provided by the applicant were adequate to assess the potential impacts to aquifers from consumptive* *water use for each phase of the proposed project. Information provided in the SEIS to support the NRC staff's impact conclusions concerning consumptive water use are summarized below.*

As described in SEIS Sections 4.5.2.1.1 and 4.5.2.1.4, consumptive water use would be limited to routine activities such as dust suppression, cement mixing, and drilling support during the construction phase of the proposed project and activities such as dust suppression, revegetation, and reclamation of disturbed areas during the decommissioning phase (AUC, 2012). The applicant did not provide an estimate of the volume of water that would be used for these activities. Therefore, to assess the impacts of the proposed project on consumptive use of groundwater during the construction and decommissioning phases, the NRC staff relied appropriately on analyses of consumptive use presented for the Wyoming East Uranium Milling Region in the GEIS (NRC, 2009). As described in the GEIS and documented in SEIS Section 4.5.2.1.1, the volume of water used for construction activities is small relative to available water and would have a SMALL impact to groundwater supplies within the Wyoming East Uranium Milling Region (NRC, 2009). As further described in the GEIS and documented in SEIS Section 4.5.2.1.4, the potential environmental impacts during the decommissioning phase (including impacts from consumptive use of groundwater) are expected to be similar to potential impacts during the construction phase.

The applicant also did not provide an estimate of groundwater use for the operations and aquifer restoration phases of the proposed project. However, the amount of liquid byproduct material produced for disposal is the primary source of groundwater that would be consumed (i.e., not returned to project aquifers) during the operations and aquifer restoration phases. Other sources of consumed groundwater, such as sanitary wastewater from restrooms and lunchrooms, would be minor in comparison to the liquid byproduct material produced for disposal. As noted in SEIS Sections 2.1.1.1.3 and 2.1.1.1.4, the applicant estimated the maximum flow of liquid byproduct material produced at any time by considering concurrent uranium recovery operations and aquifer restoration activities. For disposal in the proposed Class I deep disposal wells, the applicant's maximum calculated after-treatment liquid byproduct material production is 545 Lpm [144 gal/min]. Assuming continuous 24 hour-365 day operation, this flow rate equates to maximum yearly groundwater consumption of 286,504 m^3 [75,686,400 gal]. These values are consistent with estimates of consumptive groundwater use at other NRC-licensed ISR facilities in the Powder River Basin. For example, the estimated maximum flow of liquid byproduct material disposed of in Class I deep disposal wells during concurrent production and aquifer restoration activities at the Nichols Ranch ISR Project {located 20 km [12.4 mi] northwest of the Reno Creek Project} is 624 Lpm [165 gal/min]. This flow rate equates to maximum yearly groundwater consumption of 328,286 m^3 [86,724,000 gal/min], assuming continuous 24 hour-365 day operations.

Although the SEIS does not provide quantitative estimates of groundwater consumptive use, based on the information provided in this response, the NRC staff conclude that the SEIS provides adequate information on groundwater consumptive use for each phase of the proposed project to assess long-term cumulative impacts to aquifers.

No change was made to the SEIS beyond the information provided in this response.

Comment: **005-015**

The commenter pointed out that the SEIS states that potable water through a well will be supplied at the project site. The commenter stated that it would be helpful to include information on the aquifer this well will draw from and the estimated amount of water use so that any impacts from it can be included in the SEIS.

Response: *As described in SEIS Section 3.5.2.4, 15 wells are located within the proposed project area, including one well for domestic water supply, eight wells for stock watering usage, and six wells with water rights that have been cancelled. The wells with existing water rights include (i) four completed in the OM Unit, (ii) four completed in the PZA, and (iii) one completed in the sandstone interval below the Badger Coal. It is the NRC staff's understanding that one of these aquifers (i.e., the OM Unit, PZA, or sandstone interval below the Badger Coal) would provide domestic water for the proposed project.*

The applicant did not provide an estimate of the amount of potable water the proposed project would use for domestic purposes (e.g., drinking, cooking, cleaning, and flushing toilets). The NRC staff has concluded that such an estimate is not needed because the proposed project area is located in a remote area with few nearby residences or communities and would have no impact on surrounding residential or municipal water supply. Only four residences with six occupants are located within 8 km [5 mi] of the project boundary and the nearest community (Wright) is located 12 km [7.5] from the project area (see SEIS Sections 3.2 and 3.3). In addition, the amount of water used for domestic purposes at the proposed project would be small relative to pumpable water in the aquifers that could provide water for domestic use at the proposed project (i.e., the OM Unit, PZA, or sandstone interval below the Badger Coal).

No change was made to the SEIS beyond the information provided in this response.

D5.7.6 Groundwater Quality

Comment: **004-036**

The commenter pointed out that, as reported in Wells et al. (1979), TDS concentrations in the Minnelusa Formation in deeper portions of the Powder River Basin (PRB) in Campbell County exceed 10,000 mg/L [10,000 ppm] and often exceed 100,000 mg/L [100,000 ppm]. The commenter suggested that text be added to SEIS Section 3.5.3.1 describing TDS concentrations in the Minnelusa Formation in deeper portions of the PRB.

Response: *The NRC staff acknowledge that, as reported in Wells et al. (1979), TDS concentrations in the Minnelusa Formation in deeper portions of the PRB in Campbell County exceed 10,000 mg/L [10,000 ppm] and often exceed 100,000 mg/L [100,000 ppm]. Text in SEIS Section 3.5.3.1 was revised to clarify TDS concentrations in the Minnelusa Formation in deeper portions of the PRB.*

D5.7.7 Monitoring

Comments: **004-015; 004-085**

One commenter stated that monitoring wells had been specifically excluded from the 5-year Mechanical Integrity Tests (MITs), and statements in SEIS Section 2.1.1.1.2 and Table 6-1 should be corrected.

Response: *The NRC staff agree that, per the "Reno Creek ISR Project Public Meeting, October 8, 2015: Action Items" (AUC, 2015), that monitoring wells have been excluded from the 5-year MITs. SEIS Section 2.1.1.1.2 and Table 6-1 have been revised in response to this* *comment. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comments: **004-020; 004-022; 005-008; 005-009**

One commenter noted that there is no underlying aquifer within the proposed project area and, therefore, the applicant would not install underlying monitor wells. The commenter suggested that text in SEIS Section 2.1.1.1.4 be revised to clarify the disposition of underlying aquifers with respect to groundwater monitoring activities. Another commenter noted that while excursion monitoring specific to this project in the overlying aquifer is discussed in SEIS Chapter 7, there is no discussion of the underlying monitoring wells. The commenter recommended adding a discussion about the monitoring of the underlying aquifers and specifically recommended adding information about the location of both the overlying and underlying monitoring wells, the depth of the wells and relationship to the production zone, the frequency of monitoring, and how these wells are, or will be, installed to prevent connection between the production zone and the lower aquifers..

***Response**: Based on review of the hydraulic properties and thickness of the Underlying Aquitard (UA), the NRC staff have concluded that the potential for vertical leakage through the UA is minimal; therefore, monitoring of aquifers below the UA is not warranted (NRC, 2016). As discussed in SEIS Sections 3.5.2.3 and 4.5.2.1.2, the UA ranges in thickness from approximately 46 to 82 m [150 to 270 ft] and its measured hydraulic conductivity is low {3.0×10^{-8} cm/s [8.6×10^{-5} ft/day]}. As further described in SEIS Section 3.5.2.3, a discontinuous sand unit, referred to as the Underlying Unit (UM Unit), consisting of relatively thin and lenticular sandstones, lies within the UA beneath the PZA. However, the UM Unit does not meet the definition of an aquifer based on observed well yields and hydraulic conductivity estimates {0.001 to 0.006 m/day [0.005 to 0.02 ft/day]} (see SEIS Section 3.5.2.3). Therefore, the NRC staff do not intend to require the applicant to install monitoring wells in the UM Unit. Text in SEIS Section 2.1.1.1.4 was revised to clarify monitoring of underlying aquifers.*

SEIS Sections 2.1.1.1.2 and 7.3.1.1 describe the construction, placement, and sampling frequency of monitoring wells that would be installed at each proposed wellfield. As described in SEIS Section 2.1.1.1.2, the applicant has committed to installing perimeter-monitoring well rings within the production zone aquifer, outside the production pattern area in a "ring" around the wellfield area, and in the overlying aquifer within the production well pattern area at a minimum density of one well per every 1.6 ha [4 ac] of pattern area. The perimeter monitoring wells would be placed 122 m [400 ft] from the wellfield production pattern and would be 122 m [400 ft] from each other (see SEIS Section 7.3.1.1). Four samples would be collected from each overlying and perimeter ring monitoring well at least 2 weeks apart for constituents of concern. As further described in SEIS Section 2.1.1.1.2, all wells (production, injection, and monitoring) would be cased and cemented using methods approved by WDEQ and in compliance with WDEQ construction requirements for casing types to prevent fluids from migrating into or between aquifers. In addition, before an injection, production, or monitoring well enters service, the applicant would perform MITs to verify that the well casing would not fail, which could cause water loss and fluid migration across confining units during injection, production, and monitoring operations (see SEIS Section 2.1.1.1.2).

No additional changes were made to the SEIS beyond the information provided in this response.

Comment: **004-021**

The commenter suggested the following revisions to SEIS Section 2.1.1.1.4 to clarify details of excursion monitoring: "An excursion at a monitoring well is declared when the concentrations of certain indicator parameters exceed upper control limits (UCLs) established by the license and verified by the State and NRC. The purpose of the monitoring well ring is to ensure that groundwater quality in aquifers outside exempted zones is not impacted by ISR operations. Background water quality samples obtained from monitoring wells placed in the ore-bearing aquifers, as well as the underlying and overlying aquifers (where present), would be used to define excursion parameters and UCLs. UCLs must be established before ISR operations begin because they are used to control and manage any excursions that may occur during the ISR operations and restoration phases. Groundwater monitoring for selected constituents, throughout the life of the proposed project, is discussed in SEIS Sections 7.2.5 and 7.3.1."

Response*: The NRC staff agrees that the suggested revision to SEIS Section 2.1.1.1.4 would be useful in clarifying details of excursion monitoring. The commenter's suggested revisions were added to SEIS Section 2.1.1.1.4.*

D5.7.8 Editorial-Groundwater

Comments: **002-026; 002-031; 004-018; 004-026; 004-044; 004-049; 004-052**

One commenter provided suggested minor text revisions to more accurately distinguish between well depths and discharge zones.

Response*: The NRC staff reviewed the proposed changes and agree that the edits clarify the text. The edits did not change the staff's analysis in the SEIS. SEIS Sections 2.1.1.1.2, 4.5.2.1.2, and 5.5.2 were revised in response to the commenter's suggestions.*

Comments: **004-012; 004-014; 004-070; 004-087**

One commenter suggested minor text revisions in SEIS Sections 2.1.1.1.2 and 7.3.1.1 that describe the applicant commitments regarding the Hydrologic Wellfield Package and role of the NRC and WDEQ in the review process of the Hydrologic Wellfield Package. The comments pertained to the contents of the Hydrologic Wellfield Package and clarified that only the first wellfield package would be sent to NRC for review and verification; subsequent hydrologic wellfield packages would submitted for NRC review.

Response*: The NRC staff have reviewed the edits and agree that the suggested text both corrects inaccuracies and clarifies the review role of the NRC regarding the Hydrologic Wellfield Packages. SEIS Sections 2.1.1.1.2 and 7.3.1.1 and Table 6-1 were revised in response to these comments. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comment: **005-011**

The commenter noted that in the SEIS Executive Summary (page xxv), it is stated that, "[a]lluvial aquifers are separated from production zone and surrounding aquifers by aquitards (confining units) and, therefore, are not hydraulically connected to production zone and surrounding aquifers." The commenter noted further that in other areas of the draft SEIS, "shallow aquifer" is referenced and used to discuss the discontinuous aquifer above the production zone. The commenter recommended differentiating the terms “alluvial” versus “shallow” aquifer and describing to what extent alluvial aquifers are present, where they are found, whether or not they are in use, and if applicable, the type of uses.

***Response**: Alluvial aquifers have not been identified in stream drainages within the proposed project area and the term “alluvial” was inaccurately used to describe shallow aquifers on page xxv of the SEIS Executive Summary. As described in SEIS Section 3.5.2.3, the Shallow Water Table Unit (SM Unit) is the shallowest sand unit but is not continuous across the proposed project area. The SM Unit occurs 12 to 24 m [40 to 80 ft] below ground surface and can be considered the uppermost aquifer, if at any specific location, the SM Unit contains groundwater. As further described in SEIS Section 3.5.3.2, the Overlying Aquifer (OM Unit) is the uppermost aquifer if the OM Unit is the shallowest sandstone containing groundwater encountered in the subsurface within the proposed project area. The term “alluvial” was changed to “shallow” in the SEIS Executive Summary to describe near-surface aquifers above the production zone in the final SEIS.*

Comment: **005-012**

The commenter noted that three different terms are used throughout the SEIS to describe the aquitard: “confining layer,” “confining unit,” and “confining zone.” The commenter suggested clarifying the use and meaning of these terms to prevent any confusion.

***Response**: The NRC staff acknowledge that three different terms (confining layer, confining unit, and confining zone) are used to describe the aquitard (i.e., a confining bed that retards the flow of water to and from an adjacent aquifer) in the SEIS. To avoid confusion in the meaning of these terms, “confining unit” will be used to describe the aquitard throughout the SEIS. Occurrences of “confining layer” and “confining zone” have been changed accordingly.*

D5.7.9 References

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming,” Action Items Public Meeting October 8, 2015.” ML15296A541. Lakewood, Colorado: AUC, LLC. 2015.

AUC. “The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Technical Report.” ML12291A009 and ML12291A010. Lakewood, Colorado: AUC, LLC. 2012.

NRC. “Memo to Bill Von Till re: Safety Evaluation Report for AUC LLC, Reno Creek In Situ Recovery Project.” ML16237A141. Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

NRC. NUREG–1910, “Generic Environmental Impact Statement for *In-Situ* Leach Uranium Milling Facilities.” ML091480244, ML091480188. Washington, DC: U.S. Nuclear Regulatory Commission. May 2009.

WDEQ. “Underground Injection Control Permit. Permit 09-621.” Cheyenne, Wyoming: State of Wyoming Department of Environmental Quality, Water Quality Division. 2015.

Wells, D.K., J.F. Busby, and K.C. Glover. “Chemical Analyses of Water from the Minnelusa Formation and Equivalents in the Powder River Basin and Adjacent Areas, Northeastern

Wyoming." Prepared by USGS, Published by Wyoming Water Planning Program. Report No. 18. Cheyenne, Wyoming: State Engineer's Office. 1979.

D5.8 Ecology

D5.8.1 General Ecology Comments Endangered Species

Comment: **001-004**

One commenter stated that the draft SEIS is in conformance with state and federal management plans, including the State of Wyoming Governor's Executive Order (Mead, 2015), the U.S. Bureau of Land Management (BLM) Resource Management Plan Amendment, Wyoming Sage-grouse Management Environmental Impact Statement (BLM, 2015a) and the Buffalo Resource Management Plan (BLM, 2015b). The commenter noted that the Resource Management Plan Amendment could be included in the SEIS conformance statement, although no further action is needed for conformance.

***Response**: The NRC staff appreciate the comment provided by the BLM on the draft SEIS. The NRC does not include a formal conformance statement. The conformance statement referenced by the commenter is a BLM term that is not applicable to this document. BLM Environmental Assessments and EISs are required to include conformance statements that state whether the proposed action conforms to the applicable land use plans. No changes were made to the SEIS as a result of this comment.*

D5.8.2 Comments About Greater Sage-Grouse

Comment: **001-001**

One commenter suggested that the term "core area," as used in the SEIS, be clarified to be consistent with terminology that other agencies use. Specifically, the commenter noted that "non-core area" is consistent with a General Habitat Management Area (GHMA), and "core area" is consistent with a Priority Habitat Management Area (PHMA).

***Response**: The NRC staff agree that the boundaries identified by the BLM as GHMAs are consistent with Non-Core Habitat Areas (BLM, 2015a) identified in Wyoming's Executive Order for Greater sage-grouse management (Mead, 2015). Similarly, BLM PHMAs are consistent with Core Population Areas and Core Population Connectivity Corridors that are discussed in the SEIS. The NRC staff also agree that adding the terminology used by other agencies improves transparency and readability of the document. The NRC staff have revised the SEIS Sections 3.6.1.2.1, 3.6.1.2.3, 3.6.3, 4.6.1.1, and 5.6.1.2 where appropriate to clarify these habitat designations.*

Comment: **001-002**

One commenter suggested that SEIS Table 4-7, "FWS and WGFD Recommended Seasonal Wildlife Timing and Spatial Buffers," should be revised to include relevant timing and spatial buffers for Greater sage-grouse.

***Response**: The NRC staff agree with the commenter. The State of Wyoming Governor's Executive Order for Greater sage-grouse management (Mead, 2015) provides recommended timing and spatial buffers for active Greater sage-grouse leks in areas outside of core* *population areas/GHMAs. The recommendations provided in the Executive Order were developed with input by the Sage Grouse Implementation Team, which is composed of federal, state, and local agencies, including FWS and WGFD, as well as non-governmental organizations. WDEQ (2000) requires project proponents to consult with FWS and WGFD to ensure Greater sage-grouse conservation. However, FWS and WGFD do not have the authority to approve or decline permits issued by WDEQ. SEIS Table 4-7 was revised to include the recommended timing and spatial buffers for Greater sage-grouse. This revised information had no effect on the impact conclusions presented in the SEIS.*

D5.8.3 Vegetation Comments

Comments: **003-003, 003-004, 003-012**

One commenter was supportive of the applicant's commitments to fence newly seeded areas, to implement a vegetation monitoring plan, use a phased approach to reduce impacts to wildlife habitat, and construct overhead power lines in accordance with Avian Power Line Interaction Committee standards. In addition, the commenter suggested that, to minimize impacts on vegetation, the applicant should also bury transmission lines wherever possible and use native, pollinator-friendly seed mixes for revegetation that would benefit birds and other wildlife.

***Response**: As stated in SEIS Section 4.6.1.1, the WDEQ requires that mine operations include temporary seeding for reclamation during the first spring or fall with WDEQ-approved seed mixes. In addition, WDEQ requires that project operators reclaim vegetation in accordance with rules and regulations for final bond release (WDEQ, 2006; see SEIS Section 4.6.1.4). WDEQ's (2014) guidelines for vegetation requirements and the rules and regulations do not describe the use of pollinator-friendly seed mixes. The WDEQ, not the NRC, is responsible for reviewing the seed mixtures an applicant uses prior to revegetation activities and approving a final restoration plan. However, SEIS Section 4.6.1.1 and SEIS Table 6-2 were revised to include additional NRC-recommended mitigations that the applicant could choose to implement, but has not committed to (e.g., using native, pollinator-friendly seed mixes).*

The NRC staff notes that Table 6-2 does list burying overhead power lines after step-down as an NRC-identified mitigation. In response to the comments, SEIS Section 4.6.1.1 was revised to include burying overhead power lines after step-down as an NRC-recommended mitigation that would further reduce potential impacts to birds.

D5.8.4 Comments About Mitigation and Monitoring

Comments: **003-005, 003-006, 003-007, 003-008, 003-009**

One commenter agreed with several mitigation measures to protect wildlife proposed by AUC or recommended by the NRC, including enforcement of speed limits, managing drilling fluids, and mitigations for transmission lines such as burying overhead power lines, adhering to recommended timing and spatial restrictions for birds, and developing a bird mitigation and monitoring plan. The commenter suggested that additional mitigation measures be added that would further reduce potential impacts to wildlife if implemented by the applicant. These additional mitigation measures include removing road-killed animals from roadways, placing anti-perch devices over vents that could be hazardous to birds, and covering openings with mesh or screen to prevent birds or other small animals from entering structures.

***Response**: The NRC staff agree with the inclusion of the suggested mitigation measures. Revisions were made to SEIS Table 6-2 to include removing road-killed animals from roadways, placing anti-perch devices over vents that could be hazardous to birds, and covering openings with mesh or screen to prevent birds or other small animals from entering structures.*

Comments: **003-010, 003-011, 003-013**

One commenter stated that surveying and monitoring wildlife (in this case, birds) is not the same as mitigation, which is defined as avoidance, minimization, and compensation. The commenter suggested that the applicant's commitment to survey and monitor does not directly result in limiting impacts and should not be counted as part of the applicant's mitigation strategies. In addition, the commenter suggested that all migratory birds, not just raptors, should be considered in a mitigation and monitoring plan; furthermore, the mitigation and monitoring plan should apply to all aspects of the project, not just transmission lines.

***Response**: The NRC staff acknowledges the commenter's concern about distinguishing surveying and monitoring from mitigation. The NRC staff agree that surveying and monitoring activities alone should not be counted toward the applicant's mitigation strategies. As stated in SEIS Section 4.6.1.1, the NRC staff anticipate that the applicant would fulfill its commitment to prepare a detailed preoperational plan that reflects mitigation measures outlined by the Wyoming Game and Fish Department (WGFD) for oil and gas development (AUC, 2014). As required by WDEQ (2000) rules and regulations Chapter 2, Section 1(f), the applicant must consult with both the WGFD and U.S. Fish and Wildlife Service (FWS) prior to submission of the permit to mine application and incorporate mitigation plans resulting from consultations into the permit to mine application. The NRC staff note that WDEQ establishes requirements for obtaining a permit to mine, and the NRC does not have authority to enforce wildlife mitigation measures. Although the NRC staff has not reviewed the wildlife monitoring and mitigation plan for the proposed project, WDEQ has extensive experience in issuing permits to mine and implementing requirements. For these reasons, the NRC staff anticipate that appropriate wildlife mitigation measures, including measures to limit impacts to raptors and all migratory birds, would be implemented following state regulations.*

To clarify that the state requires incorporation of a WGFD and FWS approved wildlife mitigation plan as part of the permit to mine application, the NRC staff revised the text in the Executive Summary and Sections 4.6.1.1 and 7.4.2 of the SEIS.

D5.8.5 Comments About Ponds and Mud Pits

Comments: **003-001, 003-002**

One commenter stated that because birds seek out water sources for drinking and resting, preventive measures should be taken to ensure that migratory birds do not land on the water in the backup storage pond or on residual fluids in mud pits that are not backfilled within 30 days of being drilled.

***Response**: Regarding the commenter's concern about the backup storage pond, SEIS Section 4.6.1.1 states that wildlife are attracted to storage ponds and mud pits by mistaking them for fresh bodies of water. As stated in SEIS Section 4.6.1.2, the applicant has committed to employing operational practices that include installing visual deterrents at the backup storage pond to startle or make the birds feel uncomfortable and otherwise prevent the birds from using the backup storage pond (AUC, 2014). Changes were made to SEIS Table 6-1 to clarify that* *the applicant has committed to employing operational practices that will prevent birds from using the backup storage pond.*

Regarding the commenter's concern about mud pits, SEIS Sections 2.1.1.1.2, 4.4.1.1, and 4.13.1.1 state that mud pits that contain drilling fluids and cuttings would be backfilled and graded according to WDEQ regulations, typically within 30 days of excavation (AUC, 2012). The NRC staff agree with the commenter that additional recommended mitigation measures for mud pits are appropriate to include in the SEIS. SEIS Sections 4.4.1.1, 4.6.1.2, and Table 6-2 were revised to include NRC-recommended mitigation measures that if mud pits are not backfilled within 30 days of initial excavation, the applicant could employ operational practices to deter birds and other wildlife from the mud pits.

D5.8.6 References

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, RAI Response Package: Environmental Report Round 2." ML15002A082. Lakewood, Colorado: AUC, LLC. 2014.

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report." ML12291A332 and ML12291A335. Lakewood, Colorado: AUC, LLC. 2012.

BLM. "Wyoming Greater Sage-Grouse RMP/LRMP Amendments." Washington, DC: Bureau of Land Management. 2015a. <https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=9153> (2 September 2016).

BLM. "Resource Management Plan and Final Environmental Impact Statement for the Buffalo Field Office Planning Area." Buffalo, Wyoming: Bureau of Land Management, Buffalo Field Office. 2015b. <https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=48300> (16 February 2015).

Mead, Matthew. "Greater Sage-Grouse Core Area Protection." EO No. 2015-4. Cheyenne, Wyoming: Office of the Governor, State of Wyoming Executive Department. 2015. <https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Sage%20Grouse/SG_Executive_Order.pdf> (16 February 2016).

WDEQ. "Guideline No. 2, Vegetation Requirements for Exploration by Dozing, Regular Mines, and In Situ Leaching." Cheyenne, Wyoming: Wyoming Department of Environmental Quality-Land Quality Division. 2014.

WDEQ. "Noncoal Rules and Regulations, Chapter 3 – Noncoal Mine Environmental Performance Standards." Cheyenne, Wyoming: Wyoming Department of Environmental Quality Land Quality Division. 2006.

WDEQ. "Noncoal Rules and Regulations, Chapter 2 – Regular Noncoal Mine Permit Application." Cheyenne, Wyoming: Wyoming Department of Environmental Quality Land Quality Division. 2000.

D5.9 Meteorology, Climate, and Air Quality

D5.9.1 Air Impact Assessment

Comment: **004-058**

One commenter suggested that the No-Action Alternative impact description explicitly discuss particulates rather than only gaseous pollutants.

***Response**: The NRC staff agree that the suggested text would clarify the discussion. Text in SEIS Section 4.7.2 was revised to explicitly include particulates in the discussion of the impacts for the No-Action Alternative.*

Comment: **004-080**

One commenter suggested that the rationale for basing the SEIS impact magnitude determinations on modeling that implements the dry depletion option could be strengthened by also including additional information about the fugitive dust from wind erosion.

***Response**: As described in SEIS Appendix C Section C-4.1.2.2, the NRC staff conclude that the proposed Reno Creek ISR Project conditions meet EPA guidelines for deviating from the regulatory default conditions and implementing the dry depletion option. This is because 93% of the project emissions are from mechanically-generated sources (i.e., travel on unpaved roads), which are the type of emissions predicted to partially settle out within a short distance of the emission source. The NRC staff determined that only using mechanically-generated sources provided an appropriate basis for utilizing the dry depletion option without including a discussion of fugitive dust from wind erosion. No change was made to the SEIS based on this comment.*

Comment: **005-020**

A commenter expressed concerns about the air quality modeling analysis, the methods for disclosing air impacts, and a particular concern that the analysis lacked emissions representing a reasonable worst-case scenario and analyses of annual exceedances. To address these concerns, the commenter supports the implementation of the mitigation measures identified by NRC staff in SEIS Table 6-2 and recommended requiring the use of Tier 2 or better drill rigs, implementing a no-idle rule, ensuring all diesel-powered equipment and drill rigs are properly maintained, and developing and implementing a fugitive dust plan. The commenter (i.e., EPA) also states that they are a cooperating agency in developing the SEIS.

***Response**: While NRC cannot impose mitigation outside its regulatory authority under the Atomic Energy Act (AEA), as described in SEIS Section 4.7.1, the NRC has identified additional mitigation measures in SEIS Table 6-2 that could potentially reduce impacts of the proposed Reno Creek ISR Project. WDEQ has regulatory authority for requiring implementation of mitigation to reduce nonradiological air emissions. In response to the comment, SEIS Table 6-2 has been supplemented to include mitigation measures identified by the commenter. The NRC staff note that there were no cooperating agencies in developing the Reno Creek ISR Project SEIS.*

D5.9.2 Air Permitting, Regulations, and Standards

Comment: **004-037**

A commenter stated that the discussion about the data from the Antelope Coal Mine meteorological station confuses NRC guidance on long-term representativeness demonstration. The commenter also provided suggested revisions to the text to clarify this concern.

Response: *The NRC staff did not intend for this discussion in the SEIS to address the NRC guidance on the long-term representativeness demonstration for data collected at the Reno Creek meteorological station. That issue is addressed in the safety analysis rather than the environmental analysis. The description of the affected environment in the SEIS included data from locations other than the onsite meteorological station primarily because offsite meteorological stations have collected data over a longer period of time. Text was revised in SEIS Section 3.7.1 to clarify why the Antelope Coal Mine data was included in the SEIS analysis and to point to the safety analysis for a discussion on the long-term representativeness demonstration for data collected at the Reno Creek meteorological station.*

Comments: **004-039; 004-057; 004-076**

A commenter stated that the definition of particulate matter PM_{10} was not correct and suggested using the definition in 40 CFR Part 50, Appendix J.

Response: *The NRC staff agree with the commenter that the definition of particulate matter* PM_{10} *should be clarified, and this definition was revised in the text of SEIS Sections 3.7.2.1 and C–3.1.1, as well as SEIS Tables in Sections 2.1.1.1.6 and 4.7.1 for consistency. The edits did not change the staff's analysis in the SEIS. .*

Comment: **004-056**

One commenter noted that the applicant submitted their air quality permit to WDEQ. The application is currently under technical review. The commenter suggested updating text in SEIS Section 2.1.1.1.6.

Response: *The NRC staff acknowledge this comment and have updated SEIS Section 2.1.1.1.6. In addition, edits were made in SEIS Section 4.7.1 and Table 1-2 for consistency with the suggested edit. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comment: **004-075**

One commenter suggested supplementing the discussion about regulatory determinations for air permits, which often primarily focus on stationary sources. In particular, the commenter suggested that the discussion include a statement that the WDEQ permitting requirements are more stringent than other states and scrutinize mobile and fugitive sources in addition to stationary sources.

Response: *The NRC staff agree with the suggested clarification. Text in SEIS Section C–2.1 was supplemented to include text noting that the WDEQ's New Source Review program analyzes both mobile and fugitive sources.*

D5.9.3 Comments About Climate Change

Comment: **005-022**

One commenter suggested that the discussion of project specific greenhouse gases (GHG) and climate change be relocated from SEIS Chapter 5 (i.e., Cumulative Effects) to SEIS Chapter 4 (i.e., Environmental Impacts of Construction, Operations, Aquifer Restoration, and Decommissioning Activities and Mitigative Actions). The commenter suggested that if the discussion remains in Chapter 5, that Chapter 4 include a pointer indicating that the project-specific GHG and climate change discussion is located in Chapter 5.

***Response**: The NRC staff included the project specific GHG and climate change discussion in Chapter 5 because this is a cumulative effects topic. As described in SEIS Section 4.7.1.1, the NRC staff address this topic in SEIS Section 5.7 for two reasons. First, climate change effects are considered the result of overall GHG emissions from numerous sources rather than an individual source. Second, there is not a strong cause-and-effect relationship between where the GHG are emitted and where the impacts occur. SEIS Section 4.7.1.1 already includes a pointer indicating that the project GHG emissions and climate change impacts are presented in SEIS Section 5.7. No changes were made to the SEIS as a result of this comment.*

Comment: **005-023**

One commenter noted that the draft Council on Environmental Quality (CEQ) guidance referenced in the SEIS that describes how to address GHG emissions and the effects of climate change in NEPA reviews has been finalized. This commenter suggested that NRC staff review the final CEQ guidance and update the SEIS as needed.

***Response**: The NRC staff agree with the commenter that because the CEQ document has been finalized, it is appropriate to update certain areas of the SEIS text. As a result of NRC's review of the final CEQ guidance document, the following changes were made to the SEIS:*

- *The description of NRC's approach to addressing GHG emissions and climate change impacts in SEIS Section 5.7.2.1 was supplemented to include that:*
    - *The extent of the analyses should be commensurate with the quantity of GHG emissions generated by the proposed action, and*
    - *Resilience to climate change is another relevant factor in evaluating distinctions between various alternatives.*
- *Text was deleted in SEIS Section 5.7.2.1 which referred to the 25,000 metric tons [27,558 short tons] of carbon dioxide equivalents as a reference point for determining whether a quantitative analysis is appropriate and considering whether the proposed project potentially emits large levels of GHG because the final CEQ guidance no longer includes this metric.*
- *In-text citations in SEIS Sections 4.7.1.1 and 5.7.2.1 were updated to cite the 2016 final CEQ guidance.*
- *The reference sections in SEIS Chapters 4 and 5 were updated to cite the 2016 final CEQ guidance.*

D5.9.4 Editorial-Air Quality

Comments: **002-032; 002-034; 002-035; 004-077; 004-078; 004-079**

One commenter suggested several minor editorial revisions be made to references and table headings in the air quality sections of the SEIS that do not change the technical content of the SEIS.

Response*: SEIS Appendix Sections C–3.1, C–4.3.1, and Table C–16 were revised in response to the commenter's suggestions.*

D5.9.5 Reference

CEQ. "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews." Washington, DC: Council on Environmental Quality. 2016. <https://www.whitehouse.gov/sites/whitehouse.gov/files/documents/nepa_final_ghg_guidance.pdf > (14 September 2016).

D5.10 <u>Socioeconomics</u>

Comment: **004-059**

One commenter suggested that text be added to SEIS Section 4.11.1.2.4 to indicate that due to the recent decline in coal employment, the proposed project would have a more beneficial impact on local hiring and employment.

Response*: In SEIS Section 4.11, the NRC staff evaluated the socioeconomic impacts of the proposed project, including demographics, income, housing, employment, local finance, education, and health and social services. In addition, SEIS Section 5.11 evaluated the potential cumulative impacts for the same topic areas and specifically addressed the decline in employment in the region of influence. The NRC staff consider the scope of each of these categories, including employment, to be sufficient to characterize (SEIS Section 3.11) and evaluate (SEIS Sections 4.11 and 5.11) the socioeconomic impacts of the proposed Reno Creek ISR Project on the region. No changes were made to the SEIS in response to this comment.*

D5.11 <u>Public and Occupational Health and Safety</u>

Comments: **002-013; 004-040**

One commenter suggested a correction to statements in the public and occupational health section (SEIS Section 3.12.1) to indicate that if the applicant were granted an NRC license, they would provide additional data on radiological conditions prior to the pre-operational NRC inspection and start of operations, rather than during a pre-license inspection.

Response*: The NRC staff have reviewed and agree with the suggested correction. SEIS Section 3.12.1 has been revised in response to this comment. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comments: **002-014; 002-015; 002-016; 002-017; 002-018; 002-019; 002-020; 002-022; 004-066; 004-067, 004-069**

One commenter suggested several minor editorial revisions related to public and occupational health sections in the SEIS (Sections 3.12.1.1, 3.12.1.3, 3.12.1.5, and 7.2.1) to reduce redundancy, clarify text, and more accurately describe the applicant's actions associated with their sampling and monitoring program. Specifically, comments 002-014, 002-015, 002-016, 002-017, 002-018, 002-019, 002-020, 004-066, 004-067, and 004-069 pertain to air and soil baseline radiological conditions, monitoring, and sampling. Comment 002-022 is related to vegetation, livestock, and fish baseline radiological conditions and monitoring.

Response: *The NRC staff reviewed the suggested edits and agree that the cited text should be revised to correct minor errors or to clarify the descriptions in the SEIS. The edits did not change the staff's analysis in the SEIS. SEIS Sections 3.12.1.1, 3.12.1.3, 3.12.1.5, and 7.2.1 were revised in response to the commenter's suggestions. The revisions did not affect the impact conclusions or analyses presented in the SEIS.*

Comments: **002-029; 002-030**

One commenter suggested revisions to clarify the origin of solid byproduct waste during the operational period in SEIS Section 4.14.1.1.2.

Response: *The NRC staff reviewed the suggested edits and agree that SEIS Section 4.14.1.1.2 should be revised. The edits did not change the staff's analysis in the SEIS.*

Comments: **004-027; 004-071; 004-072**

One commenter suggested revisions to correct an inaccuracy in the applicant's commitment to continue to monitor livestock in SEIS Section 2.1.1.1.6, and minor editorial revisions to SEIS Section 7.4.1 to clarify the applicant's vegetation monitoring plan.

Response: *The NRC staff have reviewed the recommendations and agree with the suggested correction and editorial revisions. SEIS Sections 2.1.1.6 and 7.4.1 have been revised in response to these comments. This revised information had no effect on the impact conclusions presented in the SEIS.*

Comment: **004-041**

A commenter stated that the measured uranium groundwater concentrations in the PZA stated in the groundwater resource section (SEIS Section 3.5.3.2) {0.661 mg/L [0.661 ppm]} are inconsistent with the reported uranium groundwater concentration stated in the public and occupational health resource section (SEIS Section 3.12.1.4) {0.607 mg/L [0.607 ppm]}. The commenter suggested that the maximum uranium groundwater concentration be revised for consistency and reported as 0.661 mg/L [0.661 ppm].

Response: *The NRC staff confirmed that the most recent groundwater monitoring results the applicant provided in their preoperational monitoring report (AUC, 2015) were consistent with the maximum uranium value in the PZA {0.661 mg/L [0.661 ppm]}. In response to this comment, the NRC staff revised the maximum groundwater concentration of uranium in SEIS Section 3.12.1.4 and updated the reference for the same reported value in SEIS Section 3.5.3.2 to cite the preoperational monitoring report (AUC, 2015).*

D5.11.1 Reference

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, Preoperational Monitoring Radiological Report." ML15119A316. Lakewood, Colorado: AUC LLC. 2015.

D5.12 Waste Management

D5.12.1 Class I Deep Disposal Wells

Comments: **002-007; 004-003; 004-005; 004-043; 004-055; 004-062; 004-084**

One commenter provided several comments about the requirements that apply to the proposed Class I deep disposal wells and the status of the aquifer exemption requested by the applicant from the EPA. Some comments noted statements in the SEIS (Executive Summary, Section 4.6.1.3, and Table 6-1) that refer to requirements for wastewater treatment, disposal capacity, effluent limits, and compliance with NRC release standards in 10 CFR Part 20, Subparts D and K. The commenter stated that the wells are permitted by the WDEQ under UIC Permit 09-621 and no wastewater treatment is required; therefore, such statements should be deleted.

The commenter also noted statements in the SEIS (Executive Summary, and Sections 3.13.1 and 4.14.1.1.2) about the pending EPA decision on the applicant's request for an aquifer exemption that is needed before the proposed Class I deep disposal wells could be operated. The commenter also pointed to text in the SEIS (Section 2.1.1.2) that states that the exemption has been granted. The commenter suggested that these statements should be replaced with a statement about how the applicant has received a "conditional aquifer exemption" to the permitted discharge zones from EPA pending the collection of water quality data from these discharge zones.

Response*: In response to comments about the requirements that apply to Class I deep disposal wells, the NRC staff reviewed all descriptions of Class I deep disposal wells and the applicable requirements in the SEIS for consistency and correctness and made any necessary corrections. The corrections included removing or revising any text that could be interpreted as implying that treatment of the Class I deep disposal well injection fluid is required, or that NRC effluent limits in 10 CFR Part 20, Appendix B would apply. Furthermore, because the applicant is not proposing to treat the injection fluid, any statements in the SEIS referring to the Class I injection fluid as treated effluent were revised. The NRC has no specific requirement for treatment of Class I deep disposal well injection fluid, and the permit requires the operator to maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of the permit. Additionally, descriptions throughout the SEIS of the NRC "release standards" at 10 CFR 20, Subparts D and K were clarified using terminology from the regulations, such as "dose limits" and "disposal standards." Furthermore, the statement in Section 4.6.1.3 that the Class I deep disposal well permit requires adequate disposal capacity was removed. Regarding the comments about the Class I deep disposal well aquifer exemption, the aquifer exemption for the permitted Class I deep disposal wells is pending as described in comments provided by the EPA (Section D5.2, Comment 005-001); therefore, the suggested revisions to refer to a "conditional exemption" were rejected by the NRC staff, and text in SEIS Section 2.1.1.2 suggesting the exemption has been granted was revised to state that the permit is "pending."*

Comment: **004-045**

A commenter requested clarification of the description of the affected environment for the permitted Class I deep disposal wells in SEIS Section 3.13.1. The commenter suggested revising the description of existing injection zone penetrations to state that there are no artificial penetrations within the areas of review for any of the proposed Class I deep disposal wells that could allow for vertical migration of fluid out of the permitted discharge zones.

Response*: The NRC staff reviewed the text cited by the commenter and agree that an updated and more precise description of the existing injection zone penetrations (i.e., other wells that are drilled into the permitted injection zone) is warranted to complete the description of the affected environment in the SEIS. Because the description of these penetrations in the UIC Class I deep disposal well permit (WDEQ, 2015) is different than what is suggested by the commenter, the NRC staff revised the statement in the SEIS based on the information in the WDEQ permit.*

D5.12.2 Underground Injection Control

Comment: **005-002**

A commenter stated that the definitions of the well classes in the text box in SEIS Section 2.1.1.1.2 were inaccurate. The comment noted that (i) Class I injection of waste does not have to occur thousands of meters below the lowermost USDW, (ii) Class II wells are for oil and gas production (not just natural gas), and (iii) Class IV wells are for hazardous and radioactive waste and do not include nonhazardous waste. The commenter recommended revising the text box using the definitions from the applicable EPA regulations found in 40 CFR 144 for all well classes, and recommended noting that EPA has banned Class IV wells.

Response*: The NRC staff agree that refinement and additional clarification of these definitions in the text box is warranted. In response to the comments, the NRC staff revised the second text box in Section 2.1.1.1.2 of the SEIS to only describe the UIC well classes that are included in the SEIS impact analyses. The revised text box now only describes Class I, Class II, Class III, and Class V wells. Additionally, the introductory text of the text box was revised to refer to well descriptions rather than definitions, and a citation to the detailed regulatory definitions was added. The NRC staff evaluated the possibility of using the actual regulatory definitions in the text box as suggested by the commenter but found the size and complexity of the definitions impractical for such use. The description of Class I wells was also revised to state that wells "typically" occur thousands of meters below the lowermost USDW, to avoid any misinterpretation that the depth is required. The description of Class II wells in the SEIS text box was not modified based on the comment because it already mentions both oil and natural gas production.*

Comment: **005-006**

One commenter, referring to the description of Class V disposal wells in SEIS Section 2.1.1.2.1, suggested explaining that in addition to the effluent needing to meet WDEQ regulations prohibiting injection of hazardous waste, the injected material cannot be radioactive, as defined by the EPA UIC program.

Response*: The NRC staff agree with the suggested text clarification. In response to the comment, the NRC staff revised the description of Class V disposal wells in SEIS*

Section 2.1.1.2.1 and in the text box in SEIS Section 2.1.1.1.2 to include the prohibition on radioactive waste, as defined by EPA UIC regulations at 40 CFR 144.3.

D5.12.3 Wyoming Pollution Discharge Elimination System

Comment: **004-042**

One commenter stated that the SEIS text in Section 3.13.1 references the applicant's environmental report Section 4.13.1.1.3.2 on Technologically-Enhanced, Naturally-Occurring Radioactive Material, but misinterprets the meaning of the section. The commenter noted that the environmental report does not say the applicant will discharge development water to the mud pits. Rather, the environmental report states that pump test well water would be discharged under a Wyoming Pollutant Disposal Elimination System (WYPDES) permit. Therefore, the commenter recommended removing the text stating that the applicant proposes to obtain a WYPDES permit to discharge well development water into mud pits adjacent to drilling pads on each wellfield that is constructed.

Response*: In response to the comment, the NRC staff reviewed the cited section of the applicant's environmental report (AUC, 2012a) and found the text ambiguous regarding the location of the permitted discharge of well development water. Additionally, Section 7.4.2 of the applicant's technical report (AUC, 2012b) states that, "TENORM drilling fluids will be stored and disposed of on-site in mud pits, which will be constructed adjacent to the drilling pads" and, "[t]he quantity of drilling fluids will be minimized by using the minimum quantity of water that is technically practicable for well drilling and development." Therefore, based on the NRC staff's interpretation of these texts, some statements about the discharge of well development water into mud pits, such as the one identified by the commenter, were included in the SEIS. Because this comment from the applicant clarifies the meaning of the statements in the license application, the NRC staff has revised the cited SEIS text in Section 3.13.1 to state that the applicant anticipates obtaining WDEQ WYPDES permits to surface discharge well development water from constructed wellfields. Additionally, all statements in the SEIS pertaining to the proposed use of mud pits and the management of well development water were reviewed and clarified, as necessary, to remove any statements to suggest that well development water would be discharged into mud pits.*

D5.12.4 Editorial-Waste Management

Comments: 002-038; 002-039; 004-046; 004-047; 004-061

One commenter noted that the White Mesa Mill is now legally owned and operated under Energy Fuels Resources.

Response*: The NRC staff acknowledge the comment and have updated the SEIS to reflect the new ownership of the White Mesa Mill. SEIS Sections 3.13.2 and 4.14.1 have been revised in response to this comment. This correction does not affect the analysis in the SEIS.*

Comment: **004-016**

One commenter suggested additional text be added to SEIS Section 2.1.1.1.2 to clearly identify that the applicant has received the Class I deep disposal well permit from WDEQ.

Response*: The NRC staff reviewed and agree with the suggested clarification. SEIS Section 2.1.1.1.2 was revised in response to this comment. This revised information had no effect on the impact conclusions presented in the SEIS.*

D5.12.5 References

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Environmental Report." ML12291A335, ML12291A332, and ML12291A354. Lakewood, Colorado: AUC, LLC. 2012a.

AUC. "The Reno Creek ISR Project, Campbell County, Wyoming, License Application, Technical Report." ML12291A009 and ML12291A010. Lakewood, Colorado: AUC, LLC. 2012b.

WDEQ. "Underground Injection Control Permit. Permit 09-621." Cheyenne, Wyoming: State of Wyoming Department of Environmental Quality, Water Quality Division. 2015.

D5.13 Cumulative Impacts

Comment: **001-003**

One commenter suggested adding the Greater Crossbow Oil and Gas Development Project and the Converse County Oil and Gas Development Project (which would be located south of the proposed project) to the discussion of regional projects in the cumulative impacts section of the SEIS.

Response*: The NRC staff agree that the two projects should be added to the general description of past, present, and reasonably foreseeable future actions within the cumulative impacts analysis in the SEIS. Both projects have been proposed and are in varying stages of EIS development. The NRC staff have modified text within SEIS Section 5.1.1.3 to include the projects. However, inclusion of these projects in the analysis had no effect on the impact conclusions presented in the SEIS.*

Comment: **004-065**

One commenter stated that SEIS Section 5.7.1.2 overestimates that ISR projects contribute two percent of the total nitrogen oxides (NOx) emissions within the southern portion of the PRB. This commenter provided a justification for an alternate estimate of 0.3 percent.

Response*: The text in SEIS Section 5.7.1.2 refers to figures in Section 4.1.1.3 of the BLM Resource Management Plan and Final Environmental Impact Statement for the Buffalo Field Office Planning Area (2015) which indicate that uranium extraction activities contribute two percent of the overall NOx emissions in the southern portion of the PRB (i.e., Campbell, Johnson, and Sheridan Counties). Because the SEIS analyses were focused on particulate matter, the NOx emissions are not considered consequential to the overall analyses. Using the commenter's suggested estimate of 0.3 percent would not change the impact conclusion in this SEIS. While the commenter's estimate provides a lower value, the two percent estimate relied on in the SEIS analysis is essentially an upper bound. However, to acknowledge that the estimated contribution of uranium extraction activities to the overall NOx emission were taken from the BLM document, text in SEIS Section 5.7.1.2 has been clarified to provide the reference.*

D5.13.1 Reference

BLM. "Resource Management Plan and Final Environmental Impact Statement for the Buffalo Field Office Planning Area." Buffalo, Wyoming: Bureau of Land Management, Buffalo Field Office. 2015. <https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=48300> (28 March 2016).

D5.14 Cost Benefit

Comment: **004-073**

One commenter recommended that the SEIS include text in the cost-benefit analysis (SEIS Section 8.2.2) to note that the Reno Creek ISR Project would contribute to the fuel inventory for the U.S. nuclear fleet, and would therefore contribute significantly to the avoidance of CO_2 emissions that may be generated if energy was sourced from coal instead.

***Response**: The NRC staff evaluation of the costs and benefits of the proposed project are provided in SEIS Chapter 8 and are associated with increased employment opportunities and increased economic activity that will add to tax revenues. With regard to reduced CO_2 emissions and current uranium production for domestic needs, NRC's federal action for the proposed Reno Creek ISR Project is the decision of whether to grant or deny the applicant's license request. As part of that licensing decision, the NRC does not analyze the market conditions or business decisions of the entity submitting a license request, nor does it analyze other energy sources as alternatives or compare emissions from alternative energy sources. Therefore, the suggested text was not incorporated. No changes were made to the SEIS in response to this comment.*

D5.15 Editorial

D5.15.1 Editorial—Grammatical

Comments: **002-002, 002-003, 002-006, 002-008, 002-009, 002-011, 002-021, 002-023, 002-033,002-036, 002-037, 004-010, 004-017, 004-025, 004-086, 004-088, 004-089**

Commenters suggested several minor editorial corrections to the SEIS. These corrections included typographical errors, misspellings, or grammatical mistakes.

***Response**: The NRC staff checked the proposed changes to correct inaccuracies or inconsistencies for accuracy and updated the SEIS text to reflect the corrections. These minor revisions did not affect the analyses or the impact conclusions presented in the SEIS.*

D5.15.2 Editorial—Technical

Comments: **002-001, 002-004, 002-005, 002-010, 002-012, 002-027, 002-028, 004-004, 004-007, 004-011, 004-019, 004-023, 004-024, 004-053, 004-054, 004-068, 004-074, 004-081, 004-082**

Commenters suggested changes to the text to correct minor inaccuracies or inconsistencies, or proposed minor text revisions and updates to clarify information in the SEIS. These changes include, for example, incorrect section, figure, or table numbers, unit conversions, or updating the language of an applicant commitment if the commitment has been fulfilled.

Response*: The NRC staff evaluated the proposed changes and made the recommended updates to the text from these comments. Where a commenter proposed changes to correct inaccuracies or inconsistencies, the NRC staff checked the commenter's statements for accuracy prior to incorporating any new information in the SEIS. These minor revisions did not affect the analyses or impact conclusions presented in the SEIS.*

Comments: **004-090; 004-091**

One commenter provided updated SEIS figures for the location of proposed Class I deep disposal wells, and a schematic of the design of Class I deep disposal wells.

Response*: The NRC staff reviewed the figures for correctness and determined that they provide appropriate replacements for figures in the draft SEIS because the figures updated the location of the Class I deep disposal wells. Figures 2-8 and 2-9 in the SEIS have been replaced in response to these comments. These minor revisions did not affect the analyses or impact conclusions presented in the SEIS.*

Comment: **004-048**

One commenter stated that in addition to the four companies currently listed as oil and gas production companies operating in the proposed project area that an additional four companies should be added to the list (Ballard Petroleum, True Oil, EOG, and Peak Powder River) in SEIS Section 4.2.1.1.

Response*: The NRC staff reviewed the list and agreed it was appropriate to add the companies to the list. Text in SEIS Section 4.2.1.1 and in Table 6-1 was updated for consistency. These minor revisions did not affect the analyses or impact conclusions presented in the SEIS.*

Comments: **004-050; 004-060; 004-083**

One commenter noted that in SEIS Section 4.2.1.1 and Table 6-1 that Office of State Lands and Investments (BLC), not BLM, administered state-owned lands in Wyoming. Therefore, the applicant committed to contacting BLC to request access and hunting restrictions within the proposed project area.

Response*: The NRC staff acknowledge the error in those two occurrences. All other references to BLC were verified for accuracy. SEIS Section 4.2.1.1 and Table 6-1 were revised in response to this comment. These minor revisions did not affect the analyses or impact conclusions presented in the SEIS.*

Comment: **005-005**

One commenter noted that the word "not" was missing from a statement regarding the Class I deep disposal well aquifer exemption in SEIS Section 2.1.1.2. The commenter stated that the applicant has not received the aquifer exemption.

Response*: The NRC staff agree with the comment. Because of this and other comments regarding the status of the aquifer exemption associated with the Class I deep disposal wells, the SEIS text has since been revised. The text now clearly states that the aquifer exemption has not been received and is currently pending. These minor revisions did not affect the analyses or impact conclusions presented in the SEIS.*

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 - 1910 Supplement 6 FINAL
2. TITLE AND SUBTITLE Environmental Impact Statement for the Reno Creek In Situ Recovery Project In Campbell County, Wyoming. Supplement to the Generic Environmental Impact Statement for the In-Situ Leach Uranium Milling Facilities	3. DATE REPORT PUBLISHED MONTH: December YEAR: 2016 4. FIN OR GRANT NUMBER
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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

By letter dated October 3, 2012, AUC LLC (AUC, the "Applicant") submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a new source and byproduct materials license for the Reno Creek In Situ Uranium Recovery Project, located in Campbell County, Wyoming. The Reno Creek ISR Project would be located in Campbell County, Wyoming which is located in the Wyoming East Uranium Milling Region identified in NUREG-1910, Generic Environmental Impact Statement (GEIS) for In Situ Leach Uranium Milling Facilities. The NRC staff prepared this Supplemental Environmental Impact Statement (SEIS) to evaluate the potential environmental impacts of the Applicant's proposal to construct, operate, conduct aquifer restoration, and decommission an in situ uranium recovery facility at the Reno Creek ISR Project. The SEIS describes the environment that could be affected by the proposed Reno Creek ISR Project and discusses the corresponding proposed mitigation measures. The NRC staff evaluated site specific data and information to determine whether the site characteristics and the Applicant's proposed activities were consistent with those evaluated in the GEIS. The NRC staff requested public comments the Draft SEIS and responded to all comments in Appendix D of the Final SEIS.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	
Uranium Recovery In Situ Recovery Process Uranium Environmental Impact Statement Supplemental Environmental Impact Statement GEIS SEIS Wyoming East Uranium Milling Region	13. AVAILABILITY STATEMENT unlimited 14. SECURITY CLASSIFICATION *(This Page)* unclassified *(This Report)* unclassified 15. NUMBER OF PAGES 16. PRICE

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