Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

April 24, 2018
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Attention: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
2017 South Texas Project Electric Generating Station
Annual Environmental Operating Report

Pursuant to South Texas Project Unit 1 Renewed Operating License NPF-76 and Unit 2 Renewed Operating License NPF-80 Appendix B, Environmental Protection Plan (Non-radiological), and Technical Specification 6.9.1.3, the STP Nuclear Operating Company provides the attached South Texas Project Electric Generating Station 2017 Annual Environmental Operating Report.

There are no commitments included in this report.

If there are any questions, please contact Nicholas Boehmisch at (361) 972-8172.

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NB

Attachment: 2017 South Texas Project Electric Generating Station Annual Environmental Operating Report

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NRR

STI: 34660491

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# 2017

## South Texas Project Electric Generation Station

# Annual Environmental Operating Report

STP Nuclear Operating Company

The 2017 Annual Environmental Operating Report for the South Texas Project Electric Generating Station combines in one report the requirements for the Annual Environmental Operating Report (Non-radiological) found in Appendix B to the renewed Facility Operating License Nos. NPF-76 and NPF-80 and the requirements for the Annual Radiological Environmental Operating Report found in Part A of the station's Offsite Dose Calculation Manual.

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STP
Nuclear Operating Company

**Completed in accordance with**
**Technical Specifications for**
**United States Nuclear Regulatory Commission**
**Renewed License Nos.**
**NPF-76 and NPF-80**
**April 2018**

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# 2017
## Annual Environmental
# Operating Report

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

# Table of Contents



**List of Figures**

**List of Tables**

# Executive Summary

*Photo courtesy of: Jodie Jankauskas*

## Chapter 1

## Executive Summary

***The South Texas Project Electric Generating Station (South Texas Project) continues to operate with no adverse effect on the population or the environment. The exposure for people living in the area remains at less than one millirem per year. Environmental programs at the site monitor known and predictable relationships between the operation of the South Texas Project and the surrounding area. These monitoring programs verify that the operation of the South Texas Project has no impact offsite and is well below state and federal regulations and guidelines. These programs are verified by the State of Texas through collection and analysis of samples and placement of the State's monitoring dosimeters and other onsite and offsite inspections.***

This report describes the environmental monitoring programs, radiological and nonradiological, conducted at the South Texas Project during 2017. Included in this report are the Environmental Protection Plan Status, the results of the Radiological Environmental Monitoring Program, and the Land Use Census.

Nonradiological environmental monitoring is performed each year as part of the station's overall Environmental Protection Plan which is intended to provide for protection of nonradiological environmental values during station operations. Nonradiological monitoring encompasses, as a minimum, water quality, air quality, waste generation and minimization, and local aquatic and terrestrial ecological conditions. In 2017, nonradiological monitoring by the station confirmed that the South Texas Project's efforts to respect and protect local environmental conditions were successful. The South Texas Project continued to provide high-quality habitat areas for a variety of flora and fauna and continued to have no indications of negative nonradiological impacts to local environmental conditions.

The environment within a 15-mile radius of the South Texas Project is routinely monitored for radiation and radioactivity. Sampling locations are selected using weather, land use, and water use information. Two types of sampling locations are used. The first type, control stations, are located in areas that are beyond the measurable influence of the South Texas Project or any other nuclear facility. The sample results from these stations are used to explain radiation from sources other than the South Texas Project. Indicator stations are the second type of station. The samples from these stations measure any radiation contributed to the environment that could be caused by the South Texas Project. Indicator stations are located in areas close to the South Texas Project where any plant releases would be detected.

Prior to initial operation of the South Texas Project, samples were collected and analyzed to determine the amount of radioactivity present in the area. These results are used as a "preoperational baseline." Results from the indicator stations are compared to both current control sample results and the preoperational baseline values to determine if changes in radioactivity levels are attributable to station operations or other causes such as previous nuclear weapons testing programs and natural variations.

Radioactivity levels in the South Texas Project's environment frequently fall below the minimum detection capabilities of state-of-the-art scientific instruments. Samples with radiation levels that cannot be detected are below the Lower Limits of Detection. The United States Nuclear Regulatory

Commission requires that equipment used for radiological monitoring must be able to detect specified minimum limits for certain types of samples. This ensures that radiation measurements are sufficiently sensitive to detect small changes in the environment. The United States Nuclear Regulatory Commission also has a required reporting level. Licensed nuclear facilities must prepare a special report and increase their sampling if any measured radiation level is equal to or greater than this reporting level. No sample from the South Texas Project has ever reached or exceeded this reporting level. Measurements performed are divided into four categories, or pathways, based upon how the results may affect the public. Airborne, waterborne, ingestion, and direct radiation are the four pathways that are sampled. Each pathway is described below.

- The airborne pathway is sampled in areas around the South Texas Project by measuring the levels of radioactive iodine and particulate radioactivity on air filters. The 2017 airborne results were similar to preoperational levels detecting only naturally occurring radioactive material unrelated to the operation of the South Texas Project.

- The waterborne pathway includes samples taken from surface water, groundwater, and drinking water. Also included in this pathway are sediment samples taken from the Main Cooling Reservoir and the Colorado River. Tritium was the only man-made nuclide consistently detected in water samples and was measured in the shallow aquifer, the Main Cooling Reservoir, ditches, and sloughs consistent with the South Texas Project Main Cooling Reservoir operating design. The levels of tritium found were near or lower than the concentration of tritium in the Main Cooling Reservoir. Additional onsite wells have been sampled to map tritium migration. The average tritium level in the Main Cooling Reservoir remained stable throughout 2017. Tritium levels remain well below United States Nuclear Regulatory Commission reporting limits and within United States Environmental Protection Agency drinking water standards. Previously detected plant-related nuclides, such as cobalt-60 and cesium-137, were detected in the reservoir sediment at designated sample locations at very low concentrations. Additional samples had detectable cesium-137 which is normally present in the environment and is consistent with preoperational concentrations. Offsite sediment samples continue to show no radioactivity from the South Texas Project. In summary, the station produced no detectable waterborne effects offsite.

*Photo courtesy of: Michael Kubecka*

- The ingestion pathway includes broadleaf vegetation, agricultural products, and food products. Naturally occurring nuclides were detected at average environmental levels in the samples. The data indicated there were no man-made nuclides detected in these types of samples.

- The direct exposure pathway measures environmental radiation doses using thermoluminescent dosimeters. These results are consistent with the readings from previous years and preoperational measurements indicating no effect from South Texas Project operations.

The South Texas Project continues to operate with no negative effect on the population or the environment. The exposure for people living in the area is maintained at less than one millirem per year. Environmental programs at the site monitor known and predictable relationships between the operation of the South Texas Project and the surrounding area. These monitoring programs verify that the operation of the South Texas Project has no impact offsite and is well within state and federal regulations and guidelines. These programs are verified by United States Nuclear Regulatory Commission inspections, STP Nuclear Operating Company sponsored quality assurance audits, and the State of Texas through collection and analysis of samples and State radiation monitoring dosimeters.

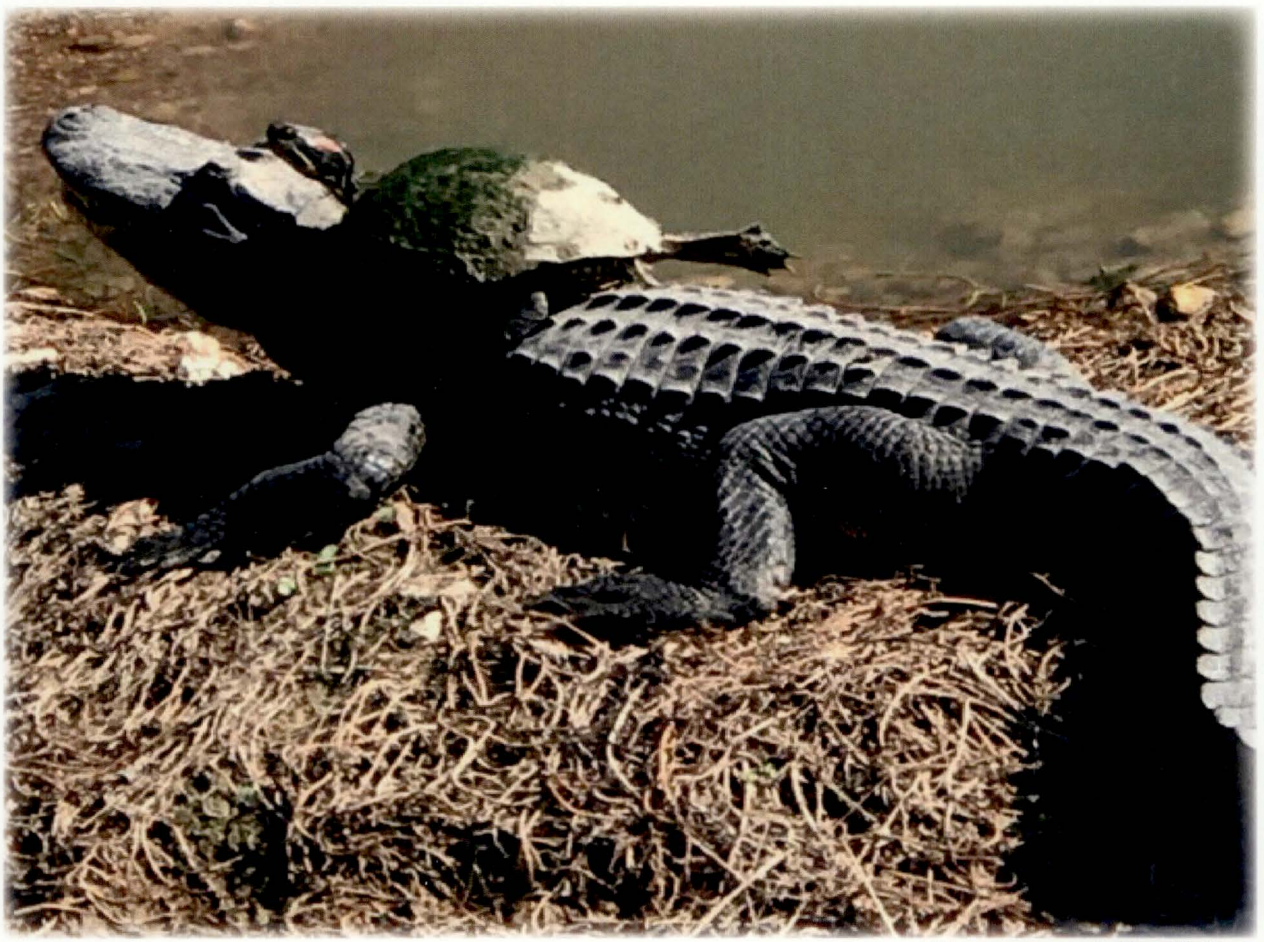


*Photo courtesy of: Rodolfo Perez*

# Site and Area Description

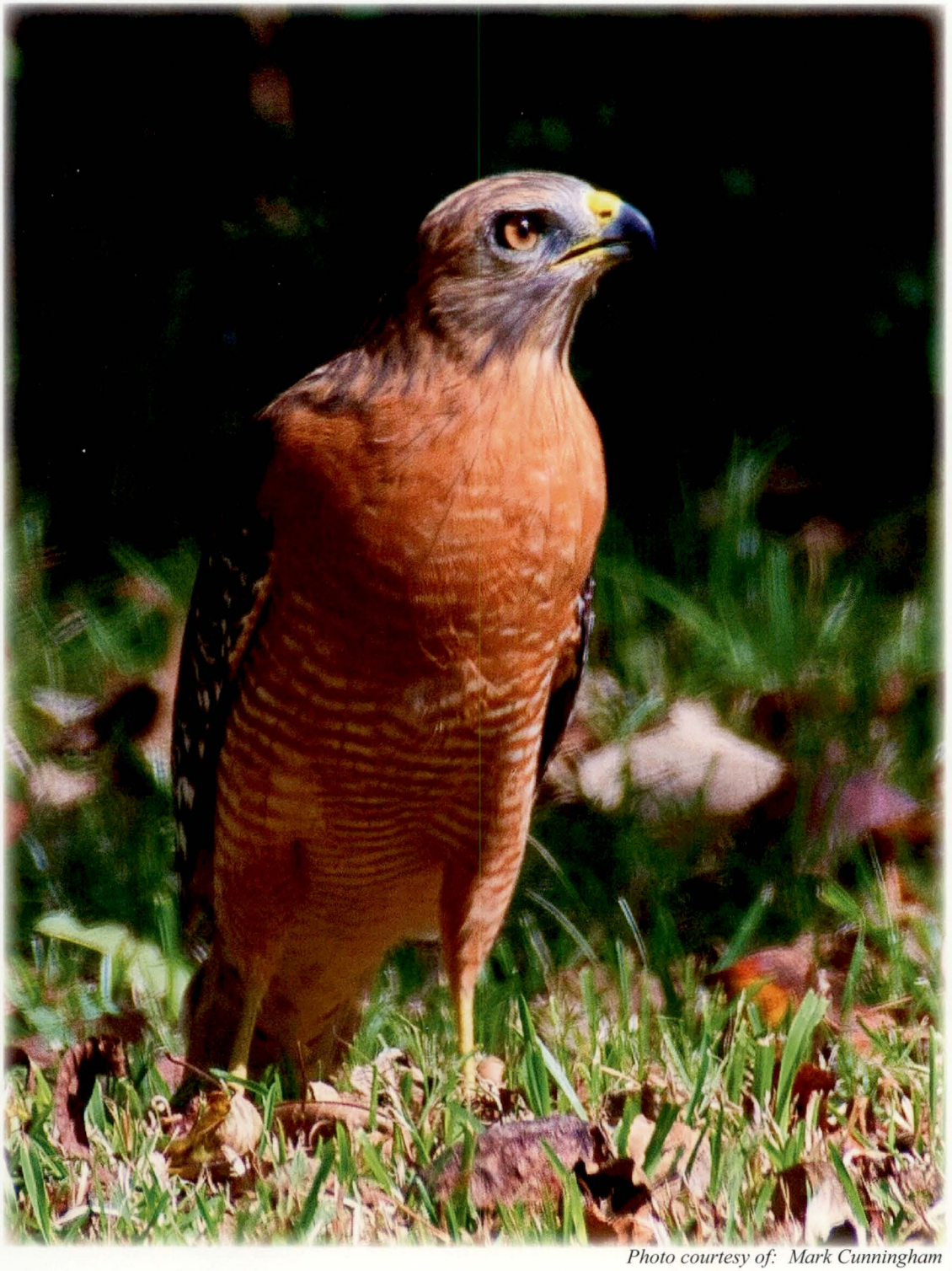


*Photo courtesy of: Mark Cunningham*

## Chapter 2

## *Site and Area Description*

The South Texas Project is located on 12,220 acres in Matagorda County, Texas, approximately 15 miles southwest of Bay City along the west bank of the Colorado River. The South Texas Project is owned by NRG South Texas LP, City of Austin, and City Public Service Board of San Antonio as tenants in common. Houston Lighting & Power Company was the original project manager of the South Texas Project and was responsible for the engineering, design, licensing, construction, startup, and initial commercial operation of the two-unit facility. In 1997, the STP Nuclear Operating Company assumed operational control of the South Texas Project and responsibility for implementation of associated environmental programs.

*Photo courtesy of: Mark Cunningham*

The South Texas Project has two Westinghouse pressurized water reactors. The rated core thermal power of each unit is 3,853 megawatts-thermal (MWt). Each unit was originally designed for a net electrical power output of 1,250 megawatts-electric (MWe). Unit 1 received a low-power testing license on August 21, 1987, achieved initial criticality on March 8, 1988, and was declared commercially operational on August 25, 1988. Unit 2 received a low-power testing license on December 16, 1988, achieved initial criticality on March 12, 1989, and was declared commercially operational on June 19, 1989. On September 28, 2017, the United States Nuclear Regulatory Commission approved the South Texas Project's request to extend the operating licenses an additional twenty years through 2047 and 2048. The Nuclear Regulatory Commission issued the final Supplemental Environmental Impact Statement, prepared in compliance with the National Environmental Policy Act, for the license renewal in November of 2013.

The combined units currently produce enough electricity to serve more than two million homes and businesses throughout Texas. With nearly 1,200 baseline employees, the STP Nuclear Operating Company is the largest employer and source of revenue for Matagorda County. Nuclear energy continues to provide long-term cost stability and promote energy independence. It is our nation's largest source of carbon-free energy. As we work collectively to secure our state's long-term energy future, nuclear energy will continue to play an important role as a safe and reliable supply of clean baseload electricity.

### HOW THE SOUTH TEXAS PROJECT WORKS

Fossil-fueled and nuclear-powered steam generating plants operate on the same principle. Fuel is used to produce heat to convert water into high-pressure steam. The steam is directed through a turbine to turn a generator. In a fossil fuel plant, either coal, lignite, oil or natural gas is burned in a boiler to produce the heat. In a nuclear plant, the reactor replaces the boiler and the "fissioning" or splitting of uranium atoms inside the reactor produces the heat.

The fuel for a nuclear reactor is uranium. It is formed into cylindrical ceramic pellets, each about the size of the end of your little finger. One pellet has the energy potential of about a ton of coal. Millions of these pellets are stacked in fuel rods that are arranged into assemblies that make up the core of the reactor. The use of uranium allows us to conserve natural gas, oil and coal and to avoid the associated production of greenhouse gases.

The fission process and generation of usable heat begins in a nuclear reactor when control rods in the core are withdrawn. In pressurized water reactors, like those at the South Texas Project, the fuel rods heat water circulating in sealed, stainless steel piping that passes through large heat exchangers called steam generators. The water in the reactor is under pressure to prevent boiling. This is why the South Texas Project's Units 1 and 2 reactors are called "pressurized water reactors."

This hot, pressurized water heats a separate supply of water in the steam generators to produce steam that is directed through the blades of a turbine generator to produce electricity. The steam is then fed to a condenser where a separate supply of cooling water from the Main Cooling Reservoir condenses it back into water that is then pumped back to the steam generator for reuse. A diagram of the plant water systems is shown in Figure 2-1.

In addition to its safety systems, the South Texas Project has many built-in physical barriers designed to prevent the release of radioactive materials in the unlikely event of an accident. The most visible ones are the 200-foot-tall, domed containment buildings with steel reinforced concrete walls four feet thick. Inside each of these massive structures, two more concrete walls provide another 11 feet of radiation shielding. The reactor vessel itself has steel walls six inches thick, and the fuel pellets inside it are sheathed in hardened metal tubes.

Nuclear energy has one of the lowest impacts on the environment. It is the most eco-efficient energy source because it produces the most electricity in relation to its minimal environmental impact. In 2016, the most recent year for which data is available, nuclear generation in the United States prevented 553.5 million metric tons of carbon dioxide, 0.42 million short tons of sulfur dioxide, and 0.36 million short tons of nitrogen oxide from entering the Earth's atmosphere.[1] Nuclear power plants also generated approximately 59.9 percent of emission-free electricity generation in the United States in 2016.[2] Additional information on nuclear energy and the environment can be found on the website maintained by the Nuclear Energy Institute at http://www.nei.org.

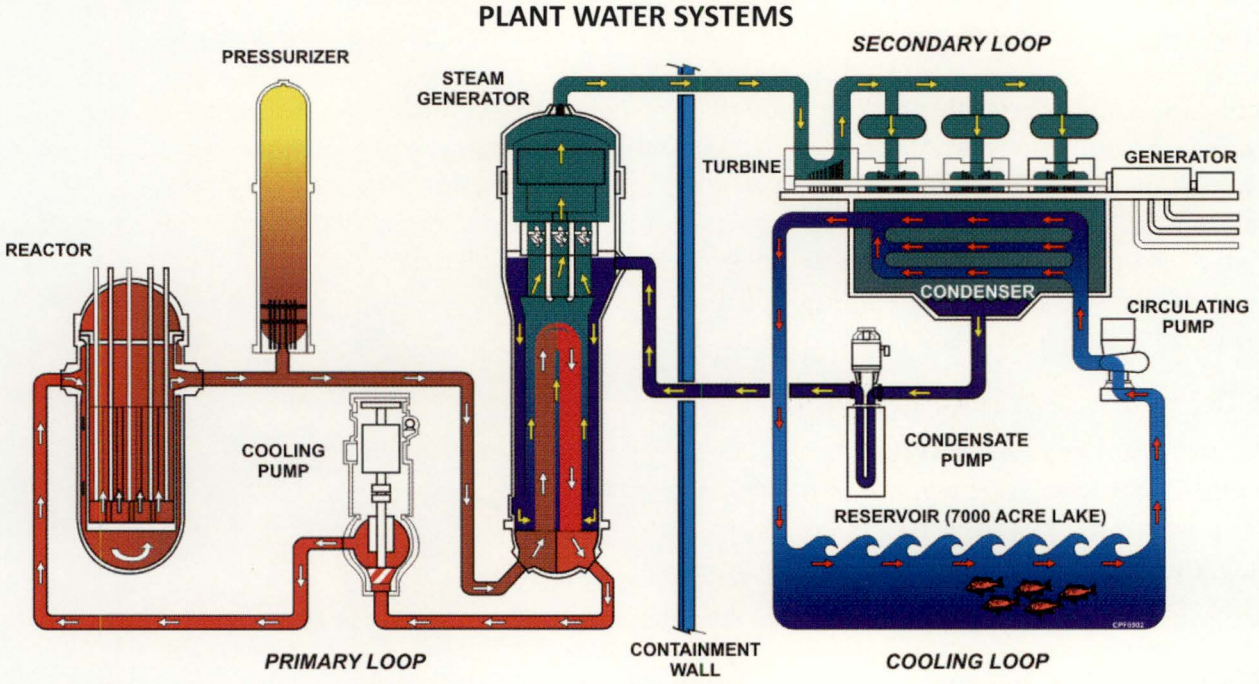



**Figure 2-1**

[1] Nuclear Energy Institute. Emissions Avoided by the U.S. Nuclear Industry. http://www.nei.org/ KnowledgeCenter/ Nuclear-Statistics/Environment-Emissions-Prevented/Emissions-Avoided-by-the-US-Nuclear-Industry. Viewed on February 13, 2018.
[2] Nuclear Energy Institute. Environment: Emissions Prevented. http://www.nei.org/Knowledge-Center/ NuclearStatistics/ Environment -Emissions-Prevented. Viewed on February 13, 2018.

## THE PLANT SITE

Sixty-five of the total 12,220 acres at the South Texas Project are occupied by the two current power plants. Plant facilities include a 7,000-acre main cooling reservoir and a 47-acre essential cooling pond. Many smaller bodies of water onsite include wetlands, Kelly Lake, drainage ditches, sloughs, and depressions. Much of the land east of the cooling reservoir is leased for cattle grazing. Approximately 1,700 acres remain in a more natural state as a lowland habitat. A 110-acre wetland habitat area was established in 1996 on previously unused land located northeast of the power plants. The area surrounding the South Texas Project is characterized by coastal plain with farmland and pasture predominating. Local relief of the area is characterized by flat land, approximately 23 feet above sea level.

## THE AREA

Matagorda County's economy is based primarily on ranching, farming, oil and natural gas production and refinement, petrochemical production, electricity generation, and commercial fishing and fisheries. The area within 10 miles of the site is generally rural and characterized as farmland, which is primarily pastureland used for livestock ranching. Although the surrounding area is heavily cultivated, significant amounts of woodlands, thicket, brush, fields, marsh, and open water exist to support wildlife. The area lies in the southern region of the central flyway and is host to an abundance of migratory birds. The local estuary environments provide the necessary habitat for a variety of fish types to complete their life cycles. The area also affords opportunity for recreational hunting and fishing.

*Photo courtesy of: Raihan Khondker*

The South Texas Project is home to many species of animals. Inhabitants include American alligators, a variety of birds, and several hundred deer. In winter, literally hundreds of thousands of waterfowl, principally migratory geese as well as white pelicans, have found that the plant's 7,000-acre cooling reservoir provides a good resting place during their migrations.

The climate of the region is subtropical maritime, with continental influence. It is characterized by short, mild winters and long, hot and humid summers. Rainfall normally ranges from about two inches per month in February peaking to about four to five inches per month in May, June, September and October. The prevailing wind direction is from the south-southeast, shifting to north-northeast for short intervals during the winter months.

*Photo courtesy of: Bud Nosbisch*

# Nonradiological Environmental Introduction and Summary

*Photo courtesy of: Gary Parkey*

## Chapter 3

Nonradiological environmental conditions and performance at the South Texas Project during 2017 remained satisfactory and demonstrated that the South Texas Project continued to operate in an environmentally responsible manner during the year. The South Texas Project achieved and maintained high standards of environmental performance and compliance throughout 2017.

The South Texas Project is committed to the production of electricity in a safe, reliable, and economical manner using nuclear energy. The station's programs, policies, and business plan objectives also incorporate a commitment to environmental protection and management. The station's commitment to sound environmental management in 2017 is illustrated by the following:

- Continued classification as a high performer[3] by the Texas Commission on Environmental Quality based on the station's environmental compliance record in all areas considered, including water quality, waste management, and air quality compliance;
- Continued emphasis on waste minimization and source reduction allowing the station to maintain its classification as a small quantity generator of industrial waste; and,
- Maintained safe, reliable and environmentally-compliant operations throughout Hurricane Harvey and its aftermath of heavy rains.

*Photo courtesy of: Marilyn Kistler*

Everyone at the South Texas Project has a responsibility to protect the environment. Commitment to environmental safety is an integral component of the South Texas Project operating policy and core values. This responsibility reaches further than mere compliance with laws and regulations to encompass the integration of sound environmental practices into our daily operational and business decisions. The people at the South Texas Project understand the need to balance economic, operational and environmental issues for the benefit of the station and the public. We recognize our responsibility to hold ourselves to the highest principles of environmental stewardship for station activities.

[3] Per Compliance History Report for CN601658669, RN102395654, Rating Year 2017; as prepared by the Texas Commission on Environmental Quality on February 13, 2018.

*Photo courtesy of: Robyn Savage*

# Nonradiological Environmental Operating Report

*Photo courtesy of: Gary Parkey*

## Chapter 4

## ENVIRONMENTAL CONDITIONS

This section of the report describes the South Texas Project's nonradiological environmental program performance and environmental conditions from January 1 through December 31, 2017. The STP Nuclear Operating Company closely monitors environmental conditions at the South Texas Project. NRG Energy, Inc. provides support and technical assistance to the South Texas Project.

The Texas Commission on Environmental Quality rated the South Texas Project as a high performer in 2017 based on the station's environmental compliance record. Facilities, such as the South Texas Project, can be classified by the state as a high performer, satisfactory performer, or unsatisfactory performer based on that facility's compliance history. The state's classification of the South Texas Project as a high performer was based on the station's environmental performance over the last five year period.

The South Texas Project, along with other local industries and organizations, co-sponsored and participated in the annual Matagorda County Household Hazardous Waste Collection Day in the fall of 2017, and station employees also participated in other community area environmental projects such as the Matagorda County Beach Cleanup. During the period of this report, the station continued to promote "green" initiatives including encouraging carpooling among employees and the recycling of paper, plastics and aluminum by site employees. The station also continued to support various bird counts and surveys in 2017 sponsored by federal and state agencies and volunteer organizations such as the annual National Audubon Society Christmas Bird Count, the Great Texas Birding Classic, and the United States Fish and Wildlife Service's Colonial Waterbird Survey.

On August 25, 2017, Hurricane Harvey made landfall on the middle Texas coast as a Category 4 storm, then weakened and stalled before going through Matagorda Bay and back into the Gulf of Mexico before making its final landfall in Louisiana on August 30, 2017. This storm constituted an unprecedented rain event. Harvey was the most significant tropical cyclone rainfall event in United States history since reliable rainfall records began in the late 19$^{th}$ century. However, there was no damage from either wind or rain at the site that affected station operations. A storm crew of approximately 250 individuals was sequestered onsite at the South Texas Project for the duration of the storm. Throughout Harvey, the South Texas Project maintained full power operations providing safe, reliable electricity to Texas.

## AQUATIC AND ECOLOGICAL MONITORING

The location of the South Texas Project falls within the Texas Land Resource Area designation as coastal prairie and can be divided into two broad ecological areas – bottomland and upland areas - based on topography, soils, and vegetation. The bottomland lowland habitat is a swampy, marshy area that provides an important habitat for birds and other wildlife and occupies approximately 1,700 acres of the site near the Colorado River. An upland spoil containment area, originally constructed in 1972 by the United States Army Corps of Engineers, is included in this area. In addition, a 110-acre wetland habitat area that attracts a variety of

bird groups and other wildlife was established in 1996 on previously unused land located northeast of the power plants. In 2012, the Matagorda County chapter of Ducks Unlimited awarded the station the John Runnels Good Steward Award for maintenance of the wetland habitat area. The remaining area of the site offers diverse habitats for mammals and several types of birds. The South Texas Project regularly monitors the site's environs for changing conditions. Ecological conditions onsite in 2017 remained generally unchanged and stable.

The South Texas Project is located on the state-sponsored Great Texas Coastal Birding Trail that spans the entire Texas Gulf Coast from Brownsville to the Louisiana border. Matagorda County, in which the South Texas Project is located, consistently ranks at or near the top of the National Audubon Society's annual Christmas Bird Count for the number of species identified. Many bird species have been observed visiting the wetland habitat and elsewhere onsite. These include the bald eagle, white-faced ibis, and brown pelican. Additional migratory and resident bird species such as a variety of ducks, geese, turkey and pelicans (both brown and white) have been observed during informal surveys of the site's diverse natural and man-made habitats. Intensive bird nesting continues throughout the lowland habitat, particularly in a heron rookery around the perimeter of Kelly Lake and on the internal dikes of the Main Cooling Reservoir at the South Texas Project. The South Texas Project continues to provide vital habitat for more than an estimated 125 different species of wintering and resident birds.

*Photo courtesy of: John Savage*

The South Texas Project continues to monitor important wildlife species to detect population changes. Informal observations continue to indicate that the site provides high-quality habitat in which a wide range of animals live. The site continues to attract extensive wildlife populations, offering a refuge for resident species as well as seasonal migrants. The lowland habitat located between the Colorado River and the east bank of the Main Cooling Reservoir offers a significant source of water year-round. These natural resource areas, in concert with numerous additional wetland and grassland areas, offer the key ingredients necessary to sustain the extensive wildlife population at the South Texas Project.

## WATER QUALITY MANAGEMENT

Water is an essential component in electricity production, and electric utilities must comply with extensive federal, state and local water regulations. These regulations govern virtually every aspect of business operations at the South Texas Project. Water usage, wastewater treatment onsite and certain maintenance and repair activities are regulated under the Safe Drinking Water Act, the Federal Clean Water Act, and the Texas Water Quality Act. Collectively, these acts provide for the safeguarding of public drinking water supplies and maintaining the

integrity of state and federal waters. Regulating agencies that administer these requirements include the United States Army Corps of Engineers, the United States Environmental Protection Agency, the Texas Commission on Environmental Quality, the Texas General Land Office, the Lower Colorado River Authority and the Coastal Plains Groundwater Conservation District. The South Texas Project uses both surface water and groundwater for station purposes. Groundwater is pumped from deep aquifer wells to provide onsite drinking water for station personnel, to replenish the Essential Cooling Pond, and for other industrial purposes onsite. Consistent with the station's environmental principles encouraging efficient water usage and conservation, surface and groundwater usage is carefully managed to conserve this important resource. Water from the Main Cooling Reservoir and the Essential Cooling Pond is used as cooling water for plant activities. Water from the Colorado River replenishes the Main Cooling Reservoir via intermittent diversion periods. Surface water diverted to the Main Cooling Reservoir from the Colorado River accounted for approximately 98 percent of the water used at the South Texas Project in 2017. Information regarding water use in Texas can be found on the website maintained by the Texas Water Development Board at http://www.twdb.texas.gov/.

Most of the water used by the South Texas Project is needed to condense steam and provide cooling for plant generating systems. The majority of this water is drawn from and returned to the station's Main Cooling Reservoir. The Main Cooling Reservoir is a 7,000-acre, above grade, off-channel reservoir capable of impounding 202,600 acre-feet of water at its maximum level. Water is diverted intermittently from the adjacent Colorado River to replenish the Main Cooling Reservoir. In addition, the Essential Cooling Pond, a 47-acre, below grade, off-channel reservoir that supplies water to cool crucial plant components, is capable of impounding 388 acre-feet of water. Various water rights permits, contractual agreements, and compliance documents authorize the South Texas Project to maintain these reservoirs, impound water diverted from the Colorado River, and to circulate, divert, and use water from the reservoirs for industrial purposes to operate the plant. These authorizations also limit the amount and rate of diversion from the Colorado River to protect downstream environmental flow requirements for bays and estuaries. The South Texas Project diverted 55,908 acre-feet in 2017 from the Colorado River for Main Cooling Reservoir fill operations while preserving adequate freshwater flow conditions for downstream bay and estuarine ecosystems. Approximately 1,160 acre-feet, of the water used by the station was withdrawn from onsite groundwater sources in 2017.

*Photo courtesy of: Jodie Jankauskas*

Existing federal and state water quality standards are implemented and enforced through the Texas Pollutant Discharge Elimination System (TPDES) permit program to restore and maintain the state's waters. Under this permit program, the South Texas Project monitors, records, and reports the types and quantities of pollutants from wastewater discharges to ensure that the South Texas Project meets the stringent levels set in the permit. A monthly monitoring report is submitted to

the Texas Commission on Environmental Quality for wastewater discharges. Reports identifying groundwater use, surface water use and water conservation are submitted annually to the Texas Water Development Board. Reports of surface water diversion and consumptive use are submitted to the Texas Commission on Environmental Quality and the Lower Colorado River Authority. An annual groundwater use report is also submitted to the Coastal Plains Groundwater Conservation District in accordance with groundwater district requirements.

Wastewater generated at the South Texas Project is processed and discharged to the onsite Main Cooling Reservoir to be re-used by the station as cooling water for plant systems. No water was discharged from the Main Cooling Reservoir in 2017. No aquatic monitoring was required to be conducted at the site in 2017 by the United States Environmental Protection Agency or the Texas Commission on Environmental Quality. Wastewater discharges met state and federal water quality standards during the year, while conserving and maximizing efficient water usage at the South Texas Project. In addition to the wastewater discharge permit program, the Federal Clean Water Act, as amended, requires permits for storm water discharges associated with industrial activity. The South Texas Project's Storm Water Pollution Prevention Plan ensures that potential pollution sources at the site are evaluated and that appropriate measures are selected and implemented to prevent or control the discharge of pollutants in storm water runoff. This plan is a document that is revised whenever there is a change in design, construction, operation, or maintenance that has a significant effect on the potential for the discharge of pollutants from the station. The station's Multi-Sector General Permit for storm water discharges was last renewed in 2016.

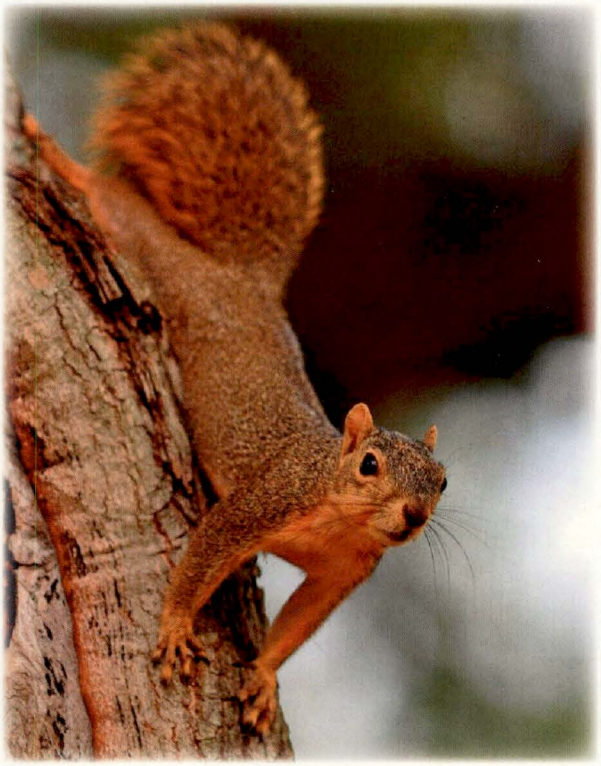


*Photo courtesy of: Michael Simons*

Following a severe drought in 1996, the Texas Legislature recognized the need to address a wide range of state water resource management issues. In 1997, the Texas Senate drafted legislation known as Senate Bill 1 to address these issues and to develop a comprehensive state water policy. Towards this end, this legislation required that the Texas Water Development Board create a statewide water plan that emphasizes regional planning. Sixteen planning regions were created, each tasked to prepare a regional plan for the orderly development, management, and conservation of water resources. The South Texas Project was chosen to represent the electric generating utility interest for the water-planning region, Region K, encompassing the lower Colorado River Basin. A state water plan is prepared by the Texas Water Development Board based on the regional water plans that are developed every five years by the regional water planning groups. The fourth cycle of regional and state water planning concluded in 2015 and the fifth planning cycle commenced in 2016. The regional water plans are revised each planning

cycle based on updated population and water demand projections, water supply analyses, and water management strategies for a water planning horizon out to the year 2070. In December of 2015, the water plan adopted by the Region K water planning group was submitted to the Texas Water Development Board for approval. This plan was incorporated into the state water plan which was published in 2016 for all water user groups in the state. The South Texas Project continues to actively participate in the Lower Colorado Regional Water Planning Group to identify strategies to meet future water supply demand projections for the region and update the existing plan accordingly. Additional information regarding regional water planning in Texas can be found on the website maintained by the Texas Water Development Board at http://www.twdb.texas.gov/.

Senate Bill 1 also required groundwater conservation districts to develop groundwater management plans with estimates on the availability of groundwater in the district, details of how the district would manage groundwater, and management goals for the district. The water planning and management provisions were further clarified in 2001 with the enactment of Senate Bill 2. Accordingly, the Coastal Plains Groundwater Conservation District, encompassing Matagorda County, was confirmed by local election in late 2001. The purpose of the District is to manage and protect the groundwater resources of the District. The South Texas Project groundwater wells are registered with the Coastal Plains Groundwater Conservation District. The station's groundwater wells' operating permits were renewed in 2017 as required every three years. Station personnel continue to monitor onsite groundwater usage according to the requirements of the District's rules. Additional information regarding the Coastal Plains Groundwater Conservation District can be found on its website at http://www.coastalplainsgcd.com/.

In 2007, in further recognition of the importance of water conservation to meet future demands in the state, Senate Bill 3, enacted by the Texas Legislature, created a stakeholder-driven process for the development of environmental flows. Environmental flows are the amount of water necessary for a river, estuary, or other freshwater system to maintain its health and productivity. The law established a process to develop environmental flow regime recommendations for each major river basin in Texas. The process tasked a team of stakeholders for each area of the state, working with a science team, to develop a set of recommendations to submit to the Texas Commission on Environmental Quality and to perform ongoing periodic reviews of the recommendations. The South Texas Project participated as a member of the stakeholder committee that included the Colorado River and Matagorda Bay. The environmental flow standards set flow levels at various points in rivers and streams to protect water in the rivers and estuaries along the coast. The existing South Texas Project surface water diversion right is not impacted by this legislation. Additional information regarding environmental flows can be found at http://www. tceq.texas.gov/ permitting/ water_supply/water_rights/eflows/.

*Photo courtesy of: Michael Kubecka*

In November 2015, the Texas Commission on Environmental Quality approved a revised Lower Colorado River Authority Water Management Plan. The Lower Colorado River Authority Water Management Plan determines how water is allocated from the Highland Lakes (specifically. Lakes Travis and Buchanan) to meet the needs of water users, including the South Texas Project, during water supply shortages. To assist with the development of a revised plan, the Lower Colorado River Authority assembled an advisory committee to represent the diverse interests that rely on the Highlands Lakes water supply. The advisory committee included representatives from cities, industry, lake area business and residents, the environment and agriculture. The South Texas Project represented industrial firm water customers on the advisory committee. Additional information on the Lower Colorado River Authority Water Management Plan can be found at http:// www.lcra.org.

In 1999, the South Texas Project implemented a station Water Conservation Plan in accordance with state water use regulations. The purpose of the station's Water Conservation Plan is to identify and establish principles, practices, and standards to effectively conserve and efficiently use available ground and surface water supplies and provide historical and projected average industrial water demand. Annual implementation reports are submitted to the Texas Water Development Board and the plan is required to be updated every five years. The station reviewed, updated and re-submitted a revised plan to the Texas Water Development Board in 2014. The South Texas Project personnel understand that the water resources of the state are a critical natural resource requiring careful management and conservation to preserve water quality and availability. Accordingly, the station continues to explore and support efforts focusing on the efficient use and conservation of water resources.

## AIR QUALITY MANAGEMENT

Air emission sources at the South Texas Project fall under the scope of air pollution regulations promulgated under the Texas Clean Air Act and the Federal Clean Air Act and the numerous associated amendments. The purpose of these regulations is to protect air resources from pollution by controlling or abating air pollution and harmful emissions. The South Texas Project uses small amounts of fossil fuel for backup and emergency equipment. Regulated emission sources at the South Texas Project include fossil-fueled emergency generators and fire pumps, fire-fighting training, and other minor maintenance equipment and activities. The station submits a report of air emissions annually to the Texas Commission on Environmental Quality. In 2017, one reportable opacity emission event occurred and was reported to the Texas Commission on Environmental Quality. This event was associated with visible emissions from a small grass fire caused by an electrical power line that came in contact with the ground in a field on site property in April of 2017.

The South Texas Project had one fossil fuel-fired auxiliary steam boiler formerly used to furnish steam for plant use when steam was not available from the nuclear steam supply system. In 2017, following a determination that the boiler was no longer needed, it was permanently shut down and its operating permit voided. In addition to the auxiliary steam boiler, a number of fossil-fueled emergency generators are located onsite. These generators are designed to provide power to various plant systems or buildings in the event of a loss of power from normal sources. This equipment is not normally needed for daily operations and the station does not use it to produce electricity for distribution. Routine maintenance runs are conducted to ensure availability, if needed, and for required equipment maintenance.

The Federal Clean Air Act mandates a permitting program to clearly define applicable air quality requirements for affected facilities such as the South Texas Project. This program is commonly known as the Title V Federal Operating Permit Program and is administered by the state. The station's Federal Operating Permit grants authority to operate identified emission sources at the station in accordance with applicable permit and regulatory requirements. Under the terms and conditions of the permit, the station is also required to submit reports of deviations, if any, from permit terms and conditions to the Texas Commission on Environmental Quality on a semi-annual basis. Two non-reportable emission events due to small grass fires occurred in 2017, in addition to the emission event discussed earlier in this section. These occurrences were included in deviation reports to the Texas Commission on Environmental Quality.

Unlike conventional electrical generating stations, nuclear power plants do not burn fossil fuel for the production of electricity. Therefore, the South Texas Project produces virtually no greenhouse gases or other air pollutants that are the typical by-products of industrial power production processes. The use of emissions-free nuclear power is a significant contributor to the preservation of our community's clean air resources.

## NON RADIOACTIVE WASTE MANAGEMENT

Solid waste management procedures for hazardous and non-hazardous wastes generated at the South Texas Project ensure that wastes are properly dispositioned in accordance with applicable federal, state, and local environmental and health regulations. By regulatory definition, solid waste includes solid, semi-solid, liquid, and gaseous waste material. The Texas Commission on Environmental Quality, which administers the Texas Solid Waste Disposal Act and also the federal Resource Conservation and Recovery Act program, is the primary agency regulating nonradioactive wastes generated at the South Texas Project. The Texas Commission on Environmental Quality regulates the collection, handling, storage, and disposal of solid wastes, including hazardous wastes. The transportation of waste materials is regulated by the United States Department of Transportation.

The South Texas Project is classified as a small quantity generator of industrial solid wastes. Texas Commission on Environmental Quality regulations require that industrial solid wastes generated at the South Texas Project be identified to the Commission. These are listed in the Texas Commission on Environmental Quality Notice of Registration for the South Texas Project. The registration is revised whenever there is a change in waste management practices at the site. Hazardous waste and Class I non-hazardous waste handling and disposal activities are summarized and documented in a waste summary report for the South Texas Project that is submitted annually to the Texas Commission on Environmental Quality. The station's five-year Source Reduction and Waste Minimization plan for hazardous waste was last updated and the associated executive summary submitted to the Texas Commission on Environmental Quality in 2014.

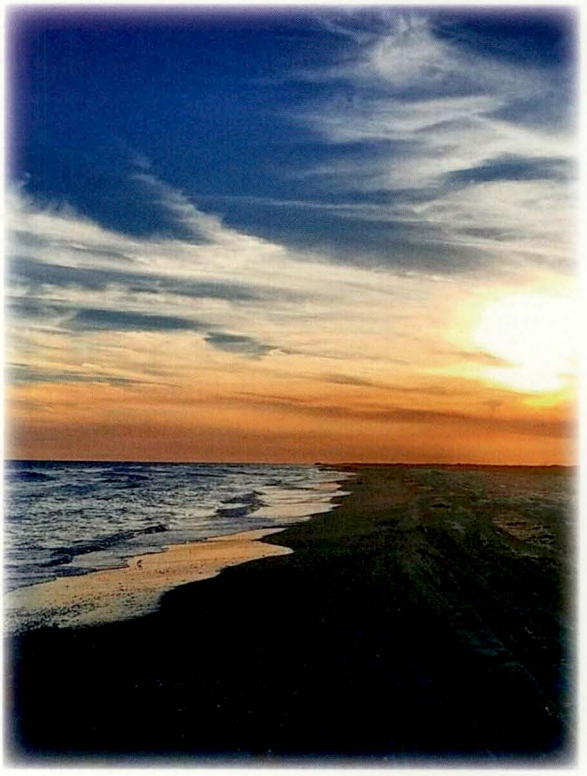


*Photo courtesy of: Christopher Kubecka*

Hazardous waste accumulation at the South Texas Project in 2017 was limited to a maximum holding period of 180 days. The Resource Conservation and Recovery Act and Texas Solid Waste Disposal Act also requires the use of proper storage and shipping containers, labels, manifests, reports, personnel training, a spill control plan, and an accident contingency plan. South Texas Project personnel routinely inspect areas throughout the site to ensure wastes are not stored or accumulated inappropriately. South Texas Project policies and regulations encourage the recycling, recovery, or reuse of waste when possible to reduce the amount of waste generated or disposed of in landfills. Approximately 97 percent of the industrial nonradioactive waste generated in 2017 at the South Texas Project was recycled or processed for reuse (Reference Figure 4-1). Used oil, diesel fuels, electro-hydraulic fluid, and used oil filters were sent to a recycling vendor for reprocessing. Empty polyethylene drums are returned, when possible, to the original manufacturer for reuse. Non-hazardous construction debris was also shipped for recycle in 2017. In addition, the station supports recycling programs for cardboard, paper, aluminum, printer cartridges and plastic. Approximately 71 tons of scrap metal were removed from the station for recycle in 2017. The South Texas Project continues to explore new areas where recycling may be expanded or initiated.

Nonradioactive solid waste that cannot be shipped for recycling is shipped for disposal. Municipal type trash is transported to an offsite landfill. Of the waste generated at the South Texas Project, hazardous waste accounts for only a small portion. Minimization and reduction of hazardous waste generation where feasible remains an important goal. Changes in the amount of hazardous waste shipped each year generally reflect differences in operation and maintenance activities that result in the generation of hazardous waste. Approximately 48 percent of the hazardous waste generated and shipped in 2017 was attributable to one-time disposal of product material that was no longer useable due to process changes or other conditions. Successful waste minimization and source reduction efforts by employees have allowed the South Texas Project to remain classified as a small-quantity waste generator since 2004. (Reference Figures 4-2 and 4-3)

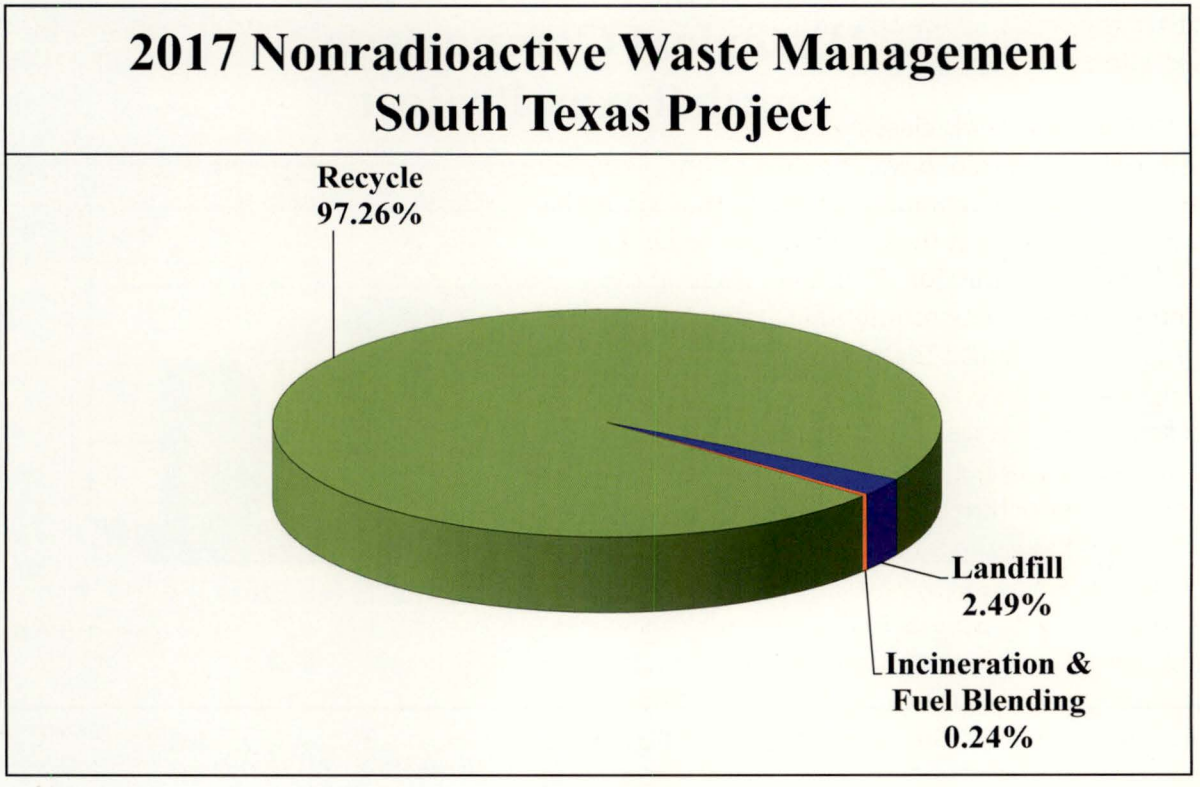



**Figure 4-1**

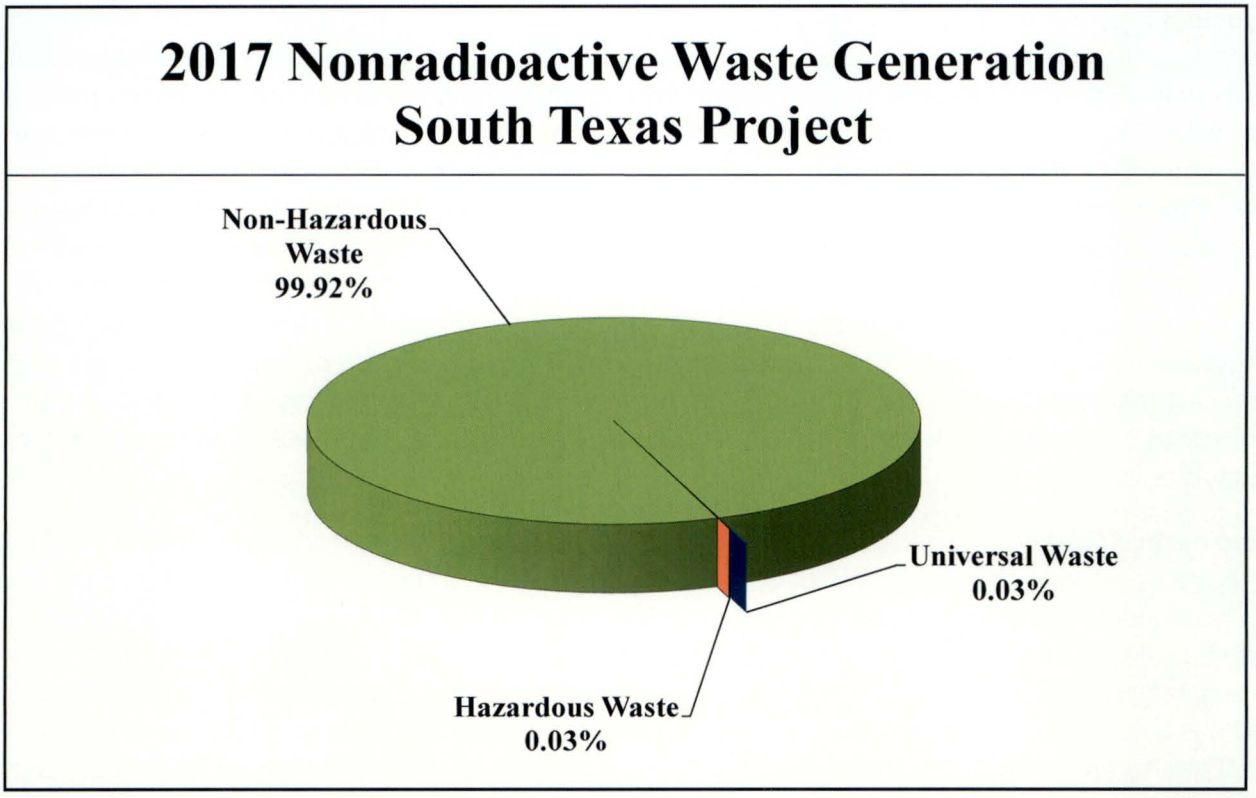



Figure 4-2


Figure 4-3

## CHEMICAL CONTROL AND MANAGEMENT

The station's Integrated Spill Contingency Plan for the South Texas Project, last updated and recertified in 2014, consolidates multiple federal and state requirements into one plan. The plan is implemented through standard site operating procedures and guidelines. The South Texas Project uses standard operating procedures, policies, and programs to minimize the generation of waste materials, control chemical use, and prevent spills. The South Texas Project also evaluates chemicals and products prior to their approval for use at the station. Site procedures that implement the station's Integrated Spill Contingency Plan and the station's Chemical Control Program address the evaluation, storage, use, labeling, spill control, and disposal requirements of chemicals. These guidelines also assist in reducing waste generation, ensuring proper packaging for disposal and mitigating the consequences of inadvertent spillage. The South Texas Project emphasizes awareness training for spill prevention and maintains spill response readiness to respond should a spill occur. Spill response team members receive annual refresher training in hazardous material incident response. No reportable liquid spills occurred in 2017.

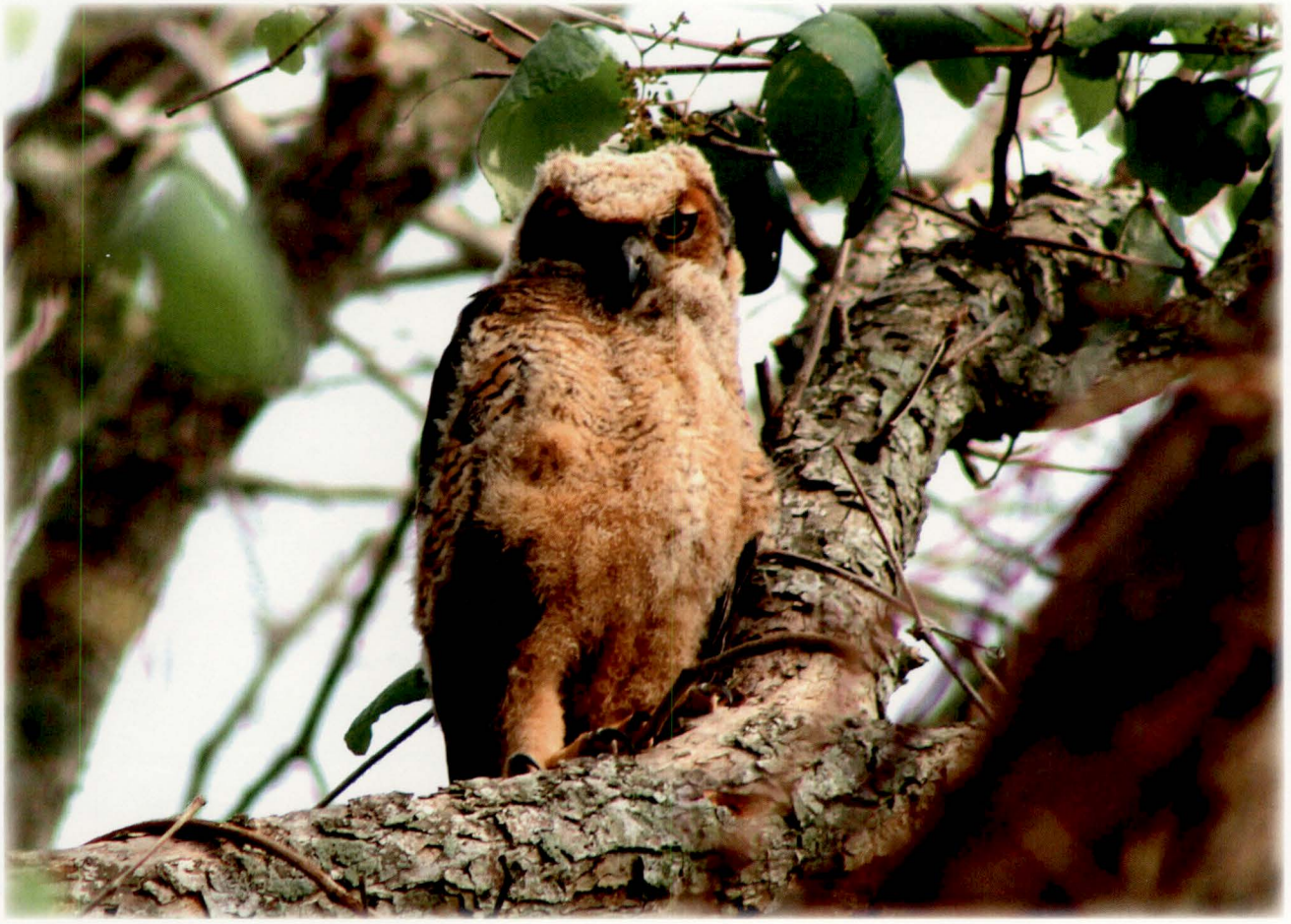


*Photo courtesy of: Bud Nosbisch*

## ENVIRONMENTAL PROTECTION PLAN STATUS

The South Texas Project's Environmental Protection Plan was issued in March of 1989 to protect nonradiological environmental values during operation of the South Texas Project. This report reviews Environmental Protection Plan non-compliances, if any, identified by the plant in 2017 and the associated corrective actions taken to prevent their recurrence. Potential nonconformities are promptly addressed, as identified, to maintain operations in an environmentally acceptable manner. The station uses its Condition Reporting Process to document these conditions and track corrective actions to completion. Internal assessments, reviews and inspections are also used to document compliance.

*Photo courtesy of: Mark Cunningham*

This annual report also reviews non-routine reports submitted by plant personnel and any activities that involved a potentially significant unreviewed environmental question. A proposed change, test or experiment is considered to present an unreviewed environmental question if it concerns:

1) A matter that may result in a significant increase in any adverse environmental impact previously evaluated in the Final Environmental Statement related to the Operation of South Texas Project, Units 1 and 2 (Docket Nos. 50-498 and 50-499), environmental impact appraisals, or in any decisions of the Atomic Safety and Licensing Board; or,

2) A significant change in effluents or power level; or,

3) A matter not previously reviewed and evaluated in the documents specified in (1) above, that may have a significant adverse environmental impact.

No unreviewed environmental questions were identified in 2017.

Events that require notifications to federal, state or local agencies, other than the United States Nuclear Regulatory Commission, are reported in accordance with the applicable reporting requirements. The United States Nuclear Regulatory Commission is provided with a copy of any such reports at the time they are submitted to the cognizant agency. If a nonroutine event occurs and a report is not required by another agency, then a 30-day report to the United States Nuclear Regulatory Commission is required by the Environmental Protection Plan. No such 30-day or other non-routine event report was required in 2017.

*Photo courtesy of: Michael Simons*

# Radiological Environmental Introduction and Summary

*Photo courtesy of: Gene Fisseler*

## Chapter 5

The Radiological Environmental Monitoring Program is designed to evaluate the radiological impact of the South Texas Project on the environment by collecting and analyzing samples for low levels of radioactivity. Measurements of samples from the different pathways indicate that there continues to be no adverse effect offsite from the operation of the South Texas Project.

Only tritium and naturally occurring radioactive material were identified in the offsite environmental samples in 2017. Samples of fish and meat collected and analyzed showed no South Texas Project related nuclides were present. Water samples from the onsite drinking water supply from the deep aquifer and from offsite sampling stations on the Colorado River show only natural background radioactivity. The station also continues to monitor for radioactivity in onsite sediment of the Main Cooling Reservoir and ditches. Measurements of direct radiation onsite and offsite indicated no federal dose limits were exceeded.

Tritium is a radioactive isotope of hydrogen that is produced in the reactor and cannot be removed from effluents released to the Main Cooling Reservoir because it is part of the water molecule.

*Photo courtesy of: Mark Cunningham*

Due to the design of the Main Cooling Reservoir, the presence of tritium in various sloughs and ditches onsite and the shallow aquifer is expected. Tritium has been detected in these types of samples and the concentrations remain below the United States Environmental Protection Agency drinking water limits.

A sampling program was developed to monitor the tritium in the immediate area around the plant for long term trending. Wells are sampled either semi-annually, annually, or once every five years, depending on location and the amount of tritium present. The tritium concentration remained below the United States Environmental Protection Agency drinking water limits in 2017 and within the design basis of the South Texas Project.

Analyses of the data collected from the implementation of the Radiological Environmental Monitoring Program indicates that the operation of the South Texas Project has no adverse offsite radiological impact.

*Photo courtesy of: Christopher Kubecka*

# Radiological Environmental Operating Report


*Photo courtesy of: Greg McMullin*

## Chapter 6

# PROGRAM DESCRIPTION

The South Texas Project initiated a comprehensive preoperational Radiological Environmental Monitoring Program in July 1985. That program terminated on March 7, 1988, when the operational program was implemented. The data from the preoperational monitoring program forms the baseline against which operational changes are measured.

Analyses of the environmental pathways require that samples be taken from water, air, and land environments. These samples are obtained to evaluate potential radiation exposure to people. Sample types are based on established pathways and experience gained at other nuclear facilities. Sample locations were determined after considering site meteorology, site hydrology, local demography, and land use. Sampling locations are further evaluated and modified according to field and analysis experience. Table 1 at the end of this section lists the required sampling locations and frequency of collection. Additional discretionary samples were also collected.

Sampling locations consist of indicator stations and control stations. Indicator stations are locations on or off the site that may be influenced by plant discharges during plant operation. Control stations are located beyond the measurable influence of the South Texas Project. Although most samples analyzed are accompanied by a control sample, it should be noted that this practice is not always possible or meaningful with all sample types. Fluctuations in the concentration of radionuclides and direct radiation exposure at indicator stations are evaluated in relation to historical data and against the control stations. Indicator stations are compared with characteristics identified during the preoperational program to monitor for radiological effects from plant operation.

Two sample identification methods are used in the program. Figures 6-1 and 6-2 are maps that identify permanent sample stations. Descriptions of sample stations shown on Figures 6-1 and 6-2 are found in Table 2. Table 2 also includes supplemental sampling locations and media types that may be used for additional information. Figure 6-3 illustrates zones that may be used to complement permanent, numbered sample stations.

*Photo courtesy of: Aubrey Passafuma*

## RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
## DESIGNATED SAMPLE LOCATION MAP

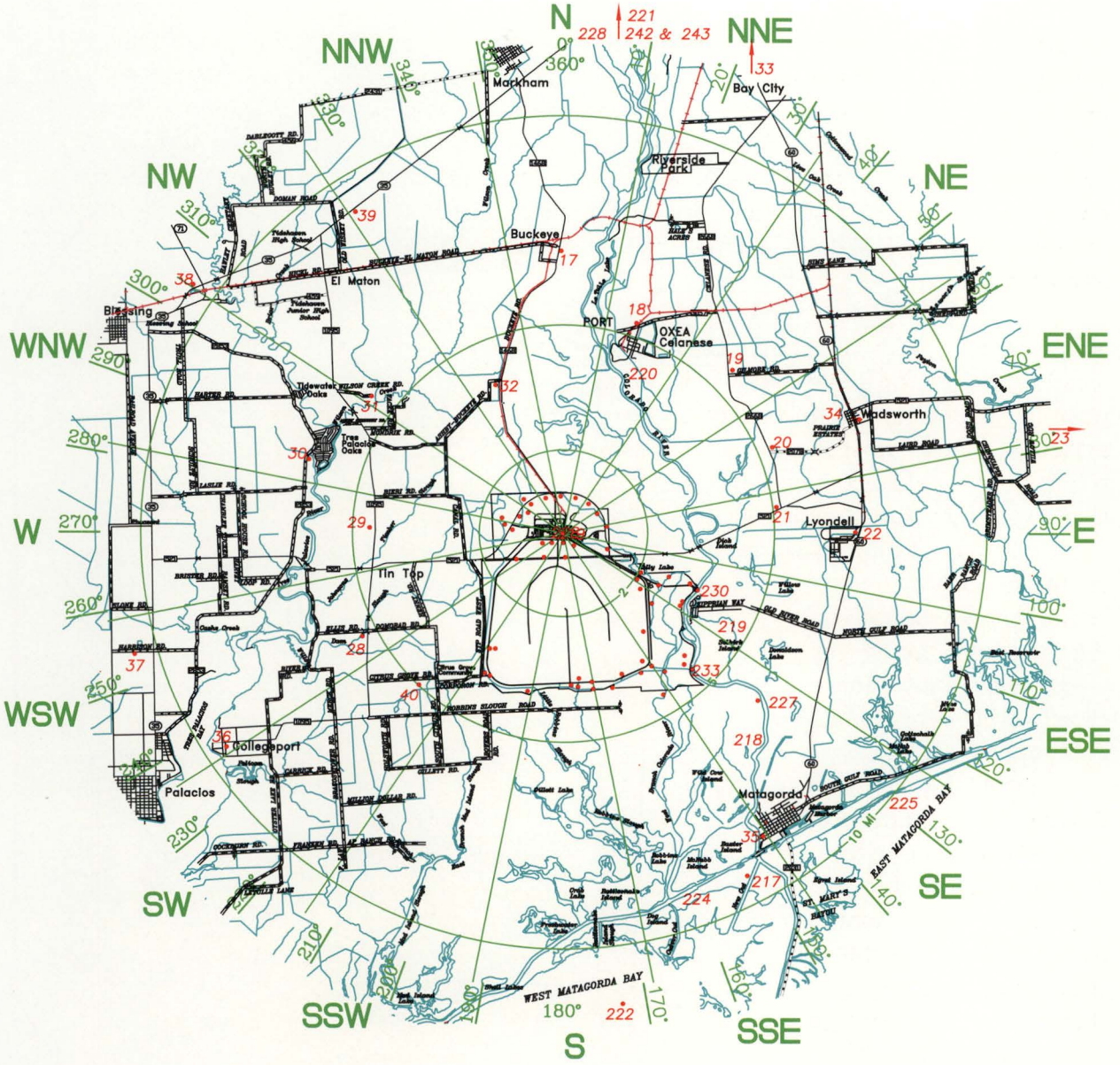



**Figure 6-1**

**RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM**
**ONSITE SAMPLE LOCATION MAP**

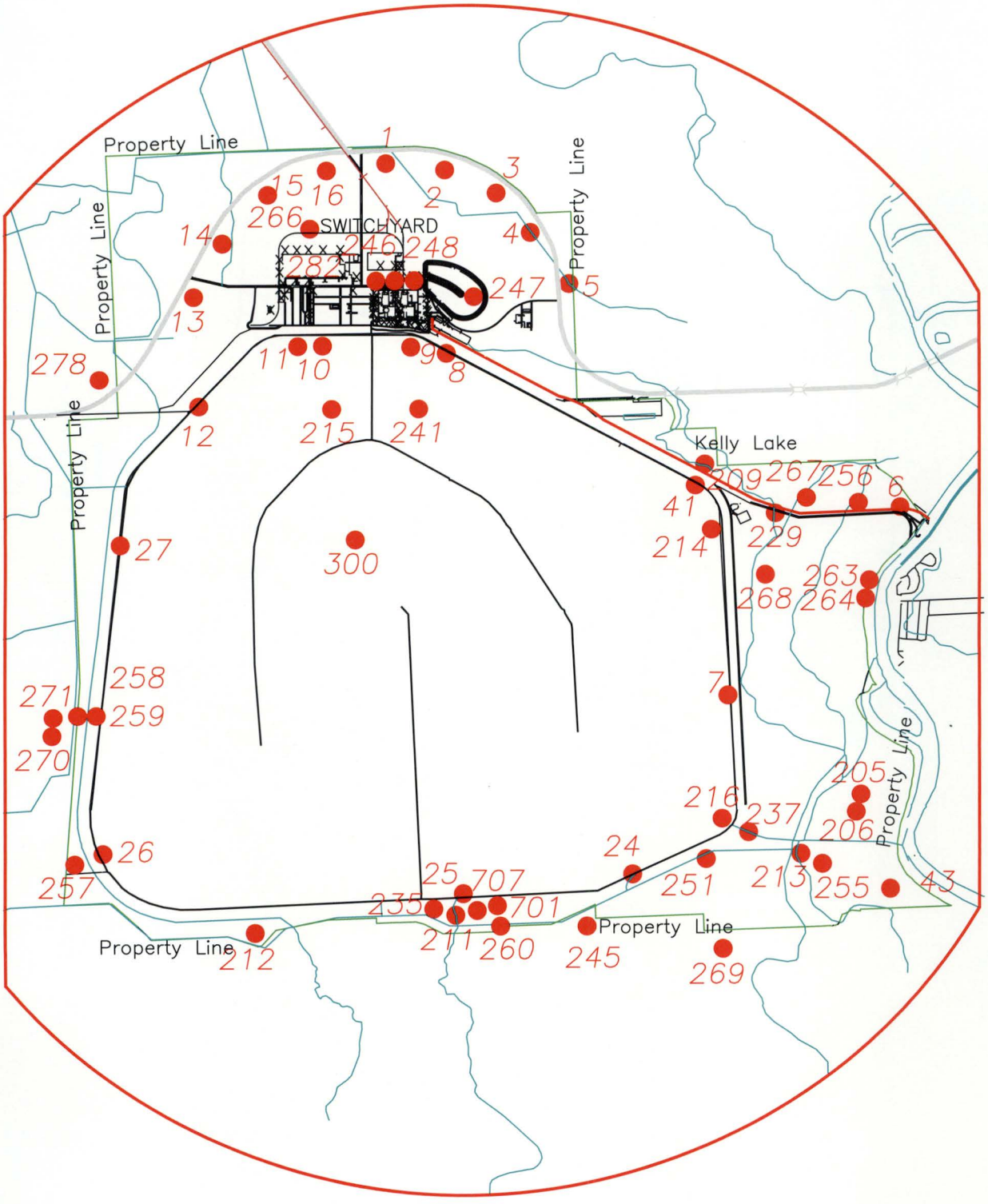
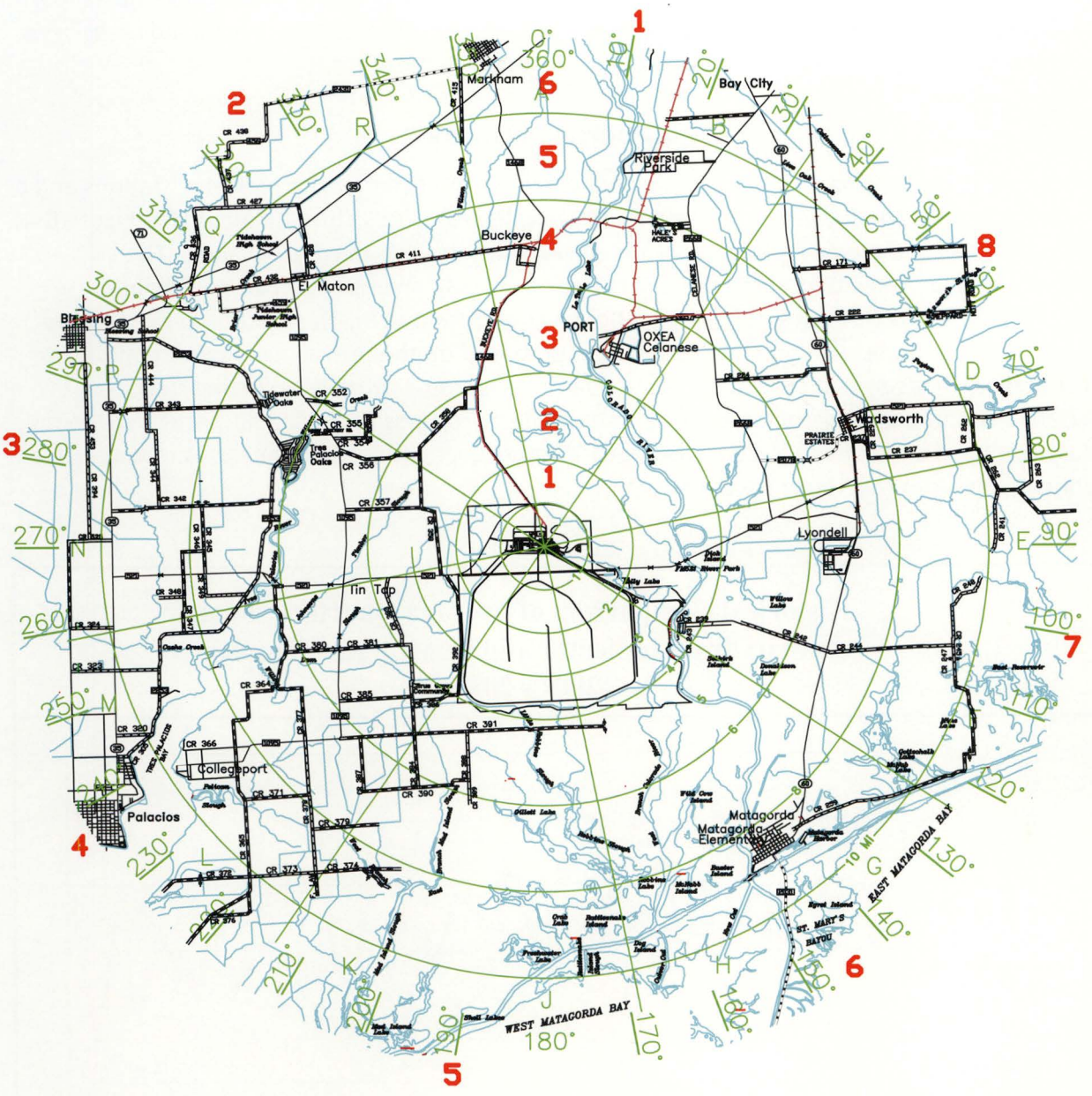



**Figure 6-2**

## RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ZONE LOCATION MAP




The zone station is determined in the following manner:

* The first character of the station number "Z" to identify it as a zone station.
* The second character is the direction coordinate number 1-8.
* The third character is the distance from the site number 1-6.

**Figure 6-3**

## ANALYSIS OF RESULTS AND TRENDS

Environmental samples from areas surrounding the South Texas Project continue to indicate no radiological effects from plant operation. Measured values from offsite indicator sample stations continue to trend with the control stations. Measurements from onsite indicator samples continued to fluctuate within normal historical ranges.

### Airborne Pathway

Average quarterly air particulate sample beta activity from three onsite indicator stations and a single control station have been compared historically from 2001 through 2017 (see Figure 6-4). The average of the onsite indicators trends closely with the offsite control values. The comparison illustrates that plant operations are not having an impact on air particulate activity even at the Sensitive Indicator Stations (#1, #15, and #16). These stations are located near the site boundary downwind from the plant, based on the prevailing wind direction. The beta activity measured in the air particulate samples is from naturally occurring radioactive material. Gamma analyses are performed on quarterly composites of the air particulate samples to determine if any activity is from the South Texas Project. The gamma analyses revealed no radioactivity from the South Texas Project.

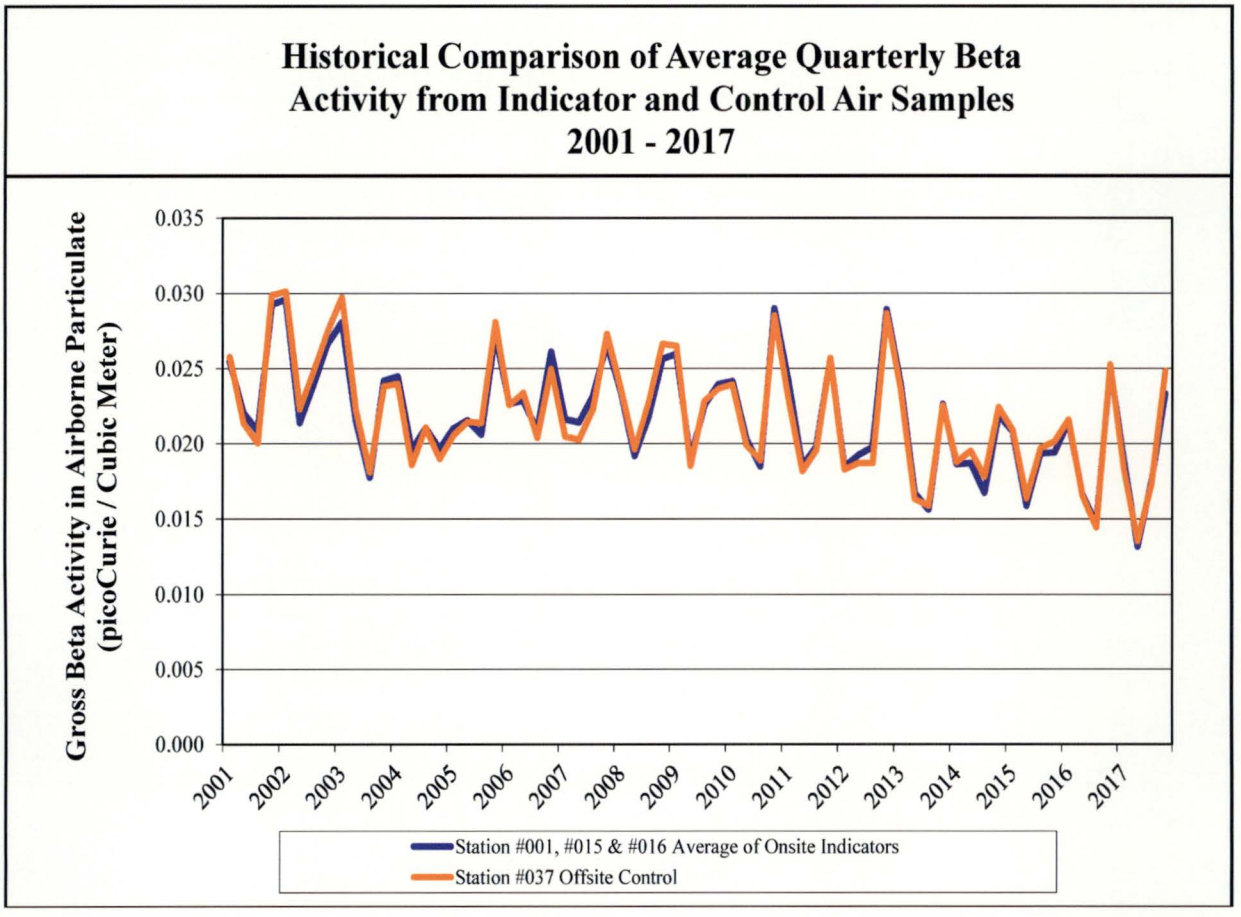



**Figure 6-4**

## Direct Exposure Pathway

Direct gamma exposure is monitored in the environment by thermoluminescent dosimeters (TLDs) located at 40 sites. The natural direct gamma exposure varies according to location because of differences in the natural radioactive materials in the soil, soil moisture content, and other factors. Figure 6-5 compares the amount of direct gamma exposure measured at the plant since the fourth quarter of 2001 from three different types of stations. The South Texas Project started using a vendor for offsite processing of the thermoluminescent dosimeters for environmental measurement of direct radiation during the third and fourth quarter of 2014. The Control Stations, Stations #23 and #37, are greater than 10 miles from the site in the minimal wind direction. The prevailing wind direction was into the N sector. The Sensitive Indicator Stations are one mile NW, NNW, and N from the plants on FM 521 at Stations #15, #16 and #1 respectively. The Indicator Stations are the remainder of the required stations. The values plotted are the averages for all of the stations according to type. The average of the Control Stations is higher than the other stations because station #23 is in an area that has a slightly higher natural background radiation. The trends of Figure 6-5 show that South Texas Project is not contributing to the direct radiation in the offsite environment

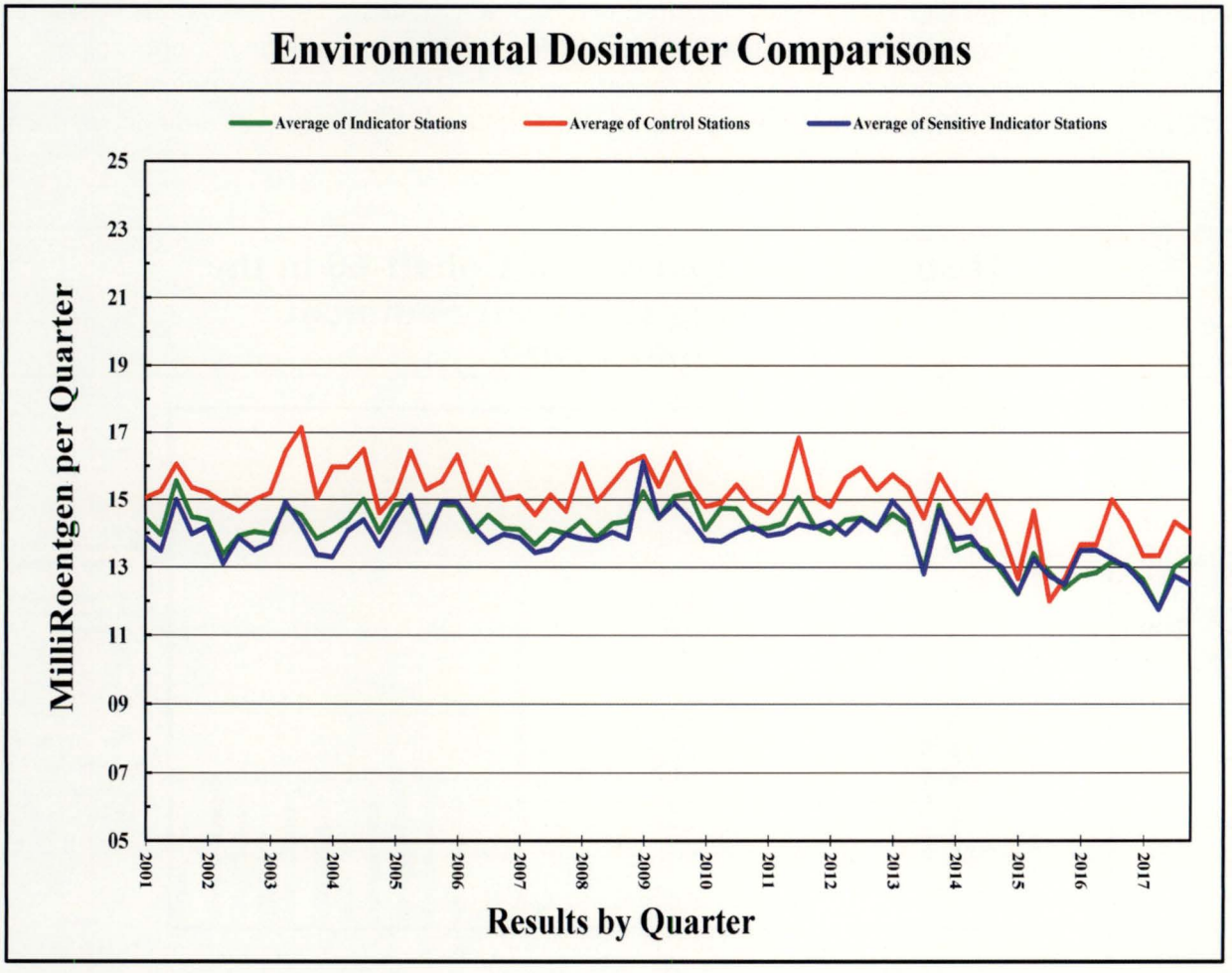



**Figure 6-5**

## Sediment Samples

The cobalt-60 inventory in the reservoir has decreased since 1992 because of radioactive decay and equipment installed to reduce radioactive effluents. Although the total activity of cobalt-60 has decreased over time, an inventory of cobalt-60 is still in the reservoir as seen occasionally at Stations #215 and #216. In 2017, cobalt-60 was identified in three out of six sediment samples taken, but all results were less than the reporting levels. Figure 6-7 demonstrates the calculated decline in the total amount of cobalt-60 in the reservoir. Bottom sediment samples are taken from the Main Cooling Reservoir each year. A study was performed in 2010 to locate the distribution and concentrations of cobalt-60 and cesium-137 in the Main Cooling Reservoir. Although no cobalt-60 was detected from 2007 through 2010 at Stations #215 and #216, the concentration of cobalt-60 is not uniformly distributed in the reservoir sediment and some cobalt-60 still remains. Figure 6-6 shows the positive results from the plant-produced cobalt-60.

Cesium-137 was measured in five out of six bottom sediment samples from Stations #215 and #216 in the Main Cooling Reservoir in 2017. The highest measurement was 120 pCi/kg at Station #216. The highest measurement at Station #215 was 77 pCi/kg. Cesium-137 is often found in environmental media including soil and sediment from residual radioactive material resulting from aboveground nuclear weapons testing conducted in the 1950's and 1960's. Soil and sediment samples taken in 1986 and 1987 prior to operation of the South Texas Project contained cesium-137 from weapons testing. The preoperational average cesium-137 concentration was 118 pCi/kg when it was detected in soil and sediment samples but the highest sample measured was 383 pCi/kg. Cesium-137 activities measured at Station #216 in 2017 were slightly higher than previously detected due to sampling nonhomogeneous media. Results remained considerably less than reportable levels. The measured values at Station #215 and #216 are consistent with preoperational concentrations reduced by 30 years of radioactive decay.

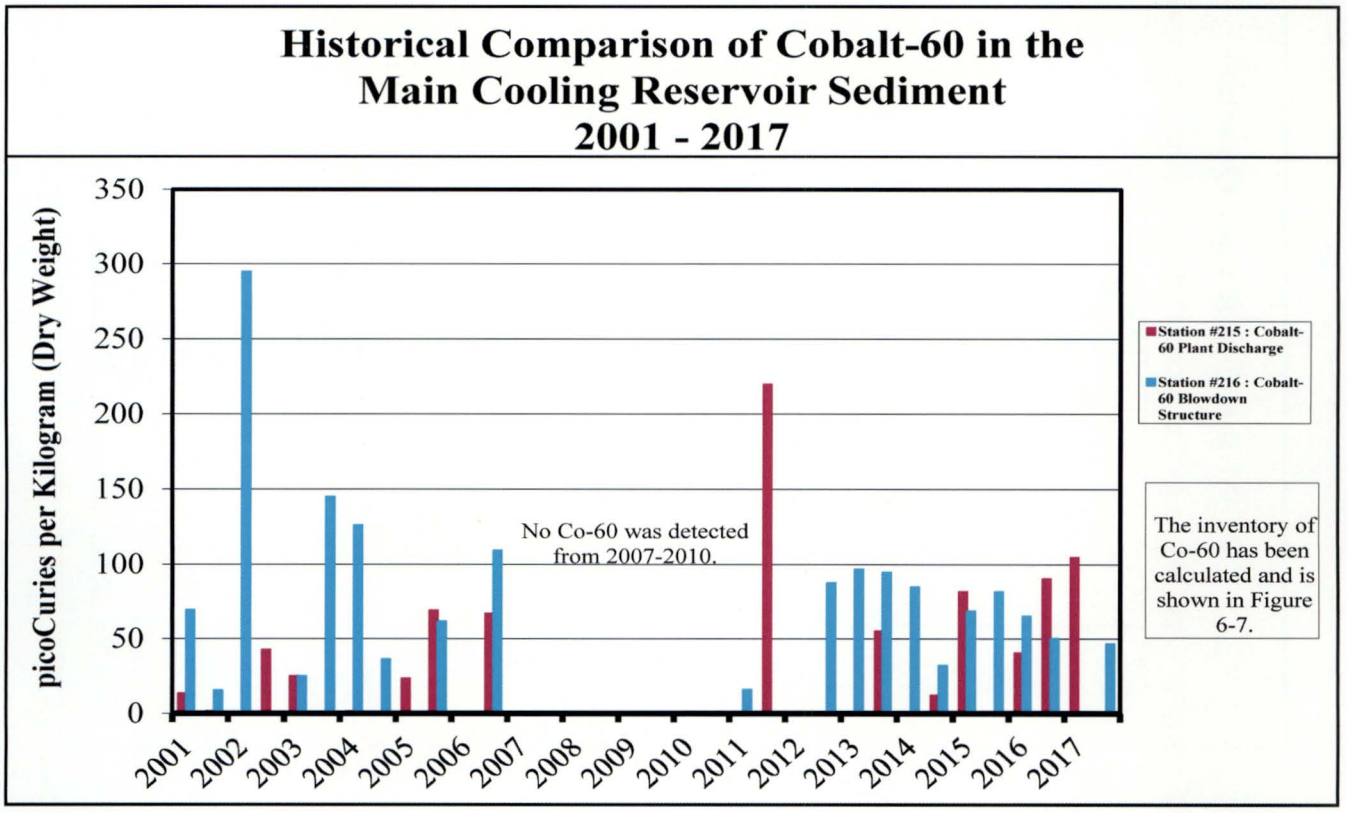



**Figure 6-6**

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION

## Waterborne Pathway

Tritium has been detected in the shallow aquifer since 1997 on the south side of the Main Cooling Reservoir. Models used when licensing the site predicted tritium in the shallow aquifer. These models were validated with additional studies in 2013. A site conceptual model, developed in 2008 and updated in 2014, validated the original predictions of the site hydrology study. The next revision will be completed in 2018 to include Dry Cask Storage Project developments.

Tritium is a radioactive isotope of hydrogen and is produced during plant operation. Tritium produced in the reactors is a part of the water molecule. Wastewater is treated to remove impurities before release, but tritium cannot be removed because it is chemically part of the water molecule. Some of the tritium is released into the atmosphere, and the remainder is released into the Main Cooling Reservoir. The tritium escapes from the Main Cooling Reservoir by evaporation, movement into the shallow aquifer, and by percolation from the relief wells which are a part of the reservoir embankment's stabilization system. Figure 6-8 shows the amount of tritium released to the Main Cooling Reservoir each year and the amount present during the last quarter of each year.

The concentration of tritium in the Main Cooling Reservoir was relatively stable in 2017. The amount of tritium measured in the Main Cooling Reservoir was consistent with the amount usually released to the Main Cooling Reservoir. The amount of rainfall and reservoir makeup from the Colorado River influences the concentration of tritium in the Main Cooling Reservoir and the shallow aquifer surrounding it. Tritium enters the sloughs and ditches of the site as runoff from the relief wells that surround the reservoir.

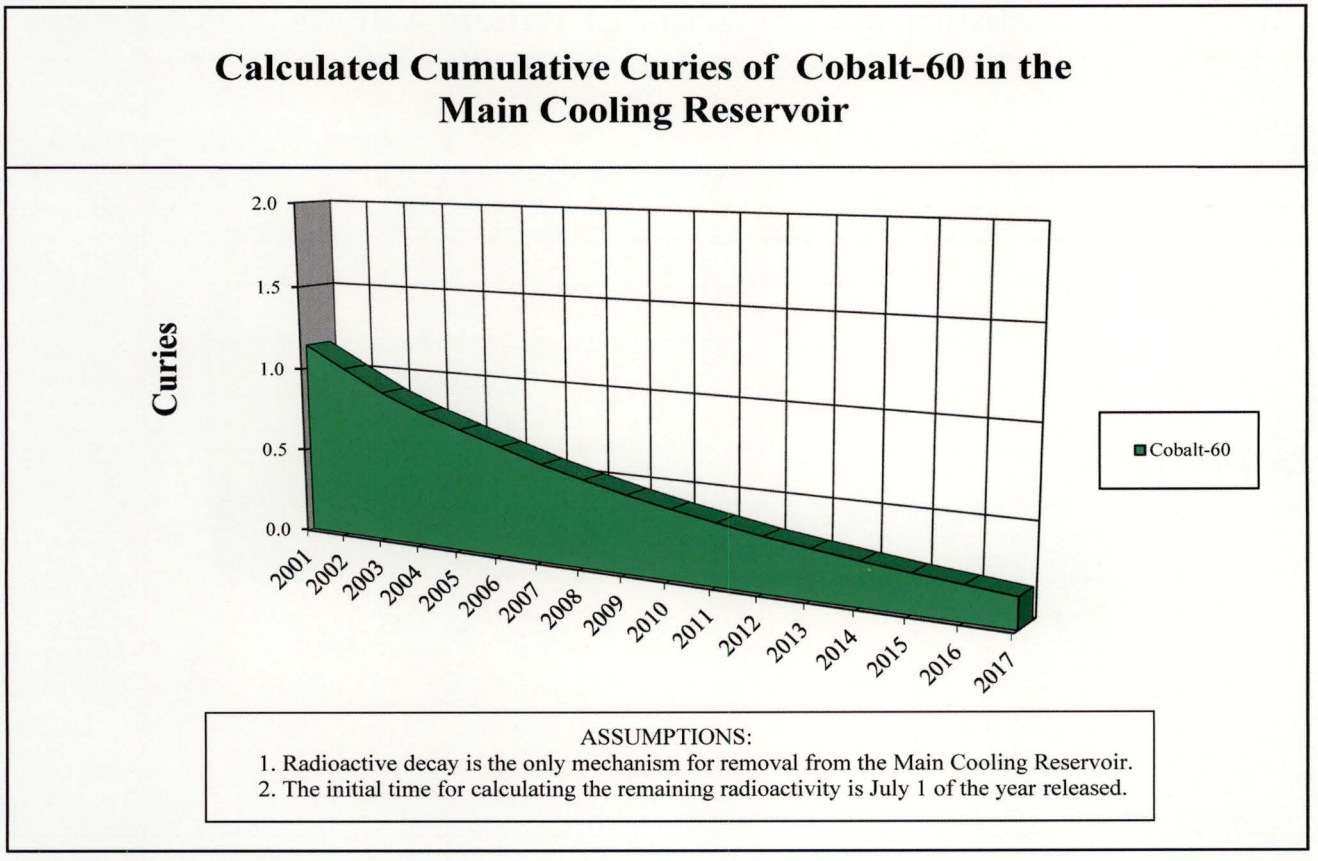



**Figure 6-7**

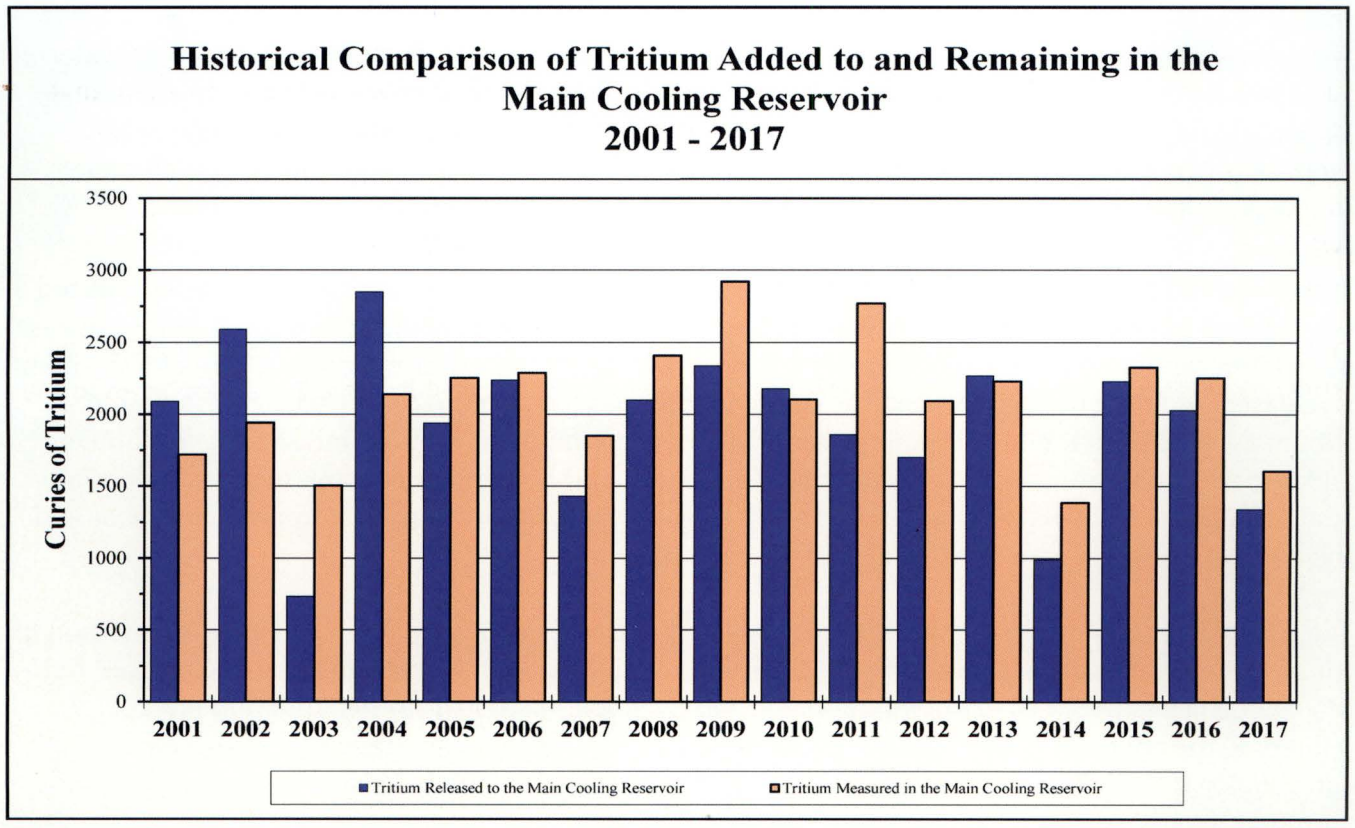



Figure 6-8

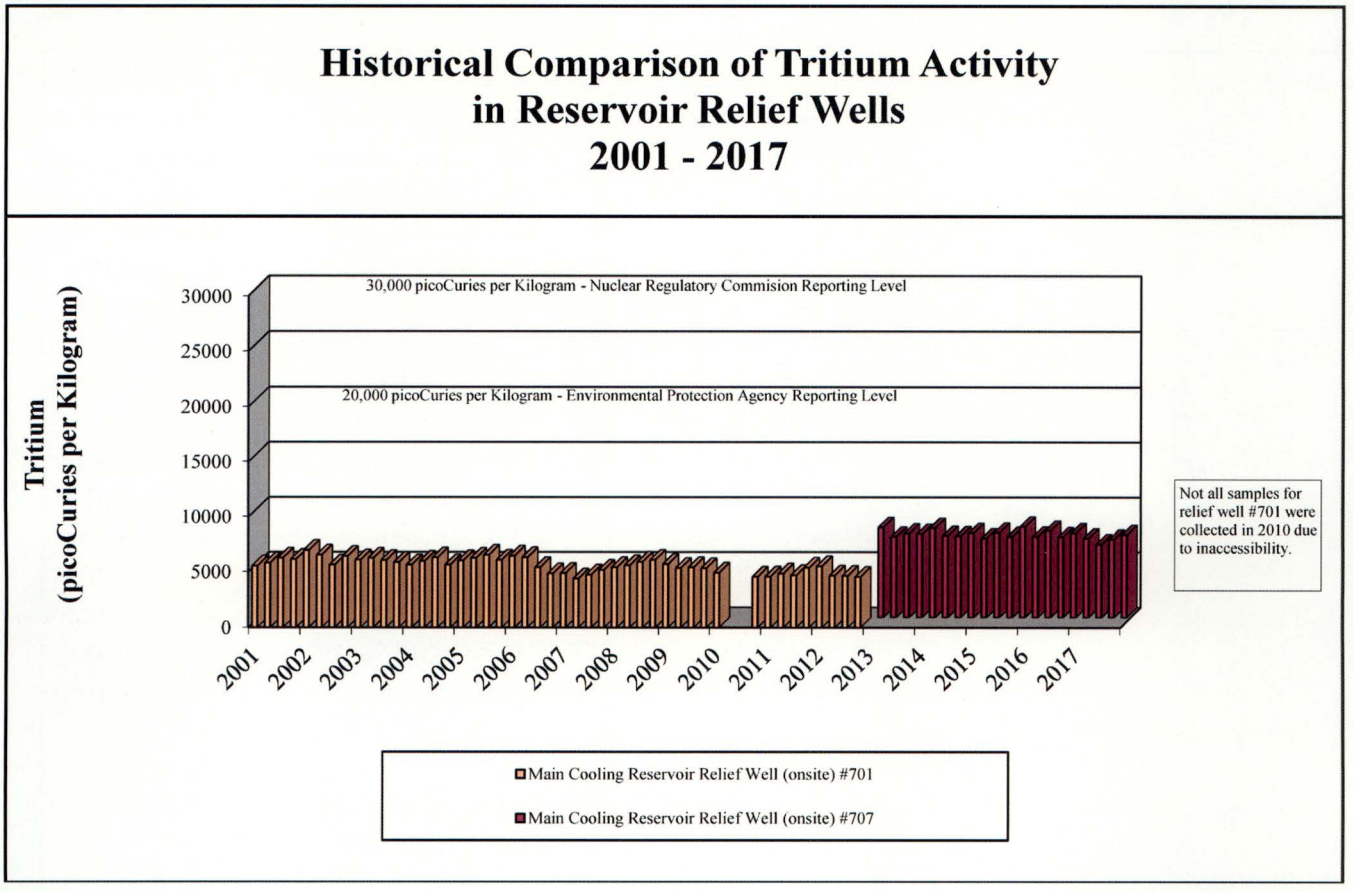



Figure 6-9

In 2017, tritium levels remained consistent with historical values in the relief wells as shown in Figure 6-9. Sampling of the Main Cooling Reservoir relief well #701 has been discontinued due to no water flow at that location. A new Main Cooling Reservoir relief well #707, is now used as a representative substitute for sampling the relief well water from the Main Cooling Reservoir. Station #707 is just west of the discontinued relief well #701 on the south side of the Main Cooling Reservoir. Due to different flow rates of water through the relief wells, the base concentration is slightly higher at relief well #707 compared to #701. The highest 2017 sample from relief well #707 indicated approximately 7,462 pCi/kg, which is less than required reporting levels.

The tritium concentrations in eight surface water sample locations from 2001 through 2017 are shown in Figure 6-10. The specific sample point locations can be found in Table 2. Tritium levels in the onsite sloughs and ditches vary with the concentration in the reservoir and the amount of rainfall received. The average tritium concentration in the relief wells, sloughs, and ditches are less than the reservoir because the water is diluted as it migrates through the reservoir relief well system. In 2017, nine out of ten surface water sample locations tested positive for tritium. All test results were below the United States Environmental Protection Agency drinking water limit of 20,000 pCi/kg. Two surface water samples were taken on March 27, 2017 located just outside the protected area fence at Stations #246 and #248 that are part of the storm drain path. These samples indicated tritium for the first time at 4470 pCi/kg. The samples were resampled on May 1, 2017 and did not have any radioactive material present. Rainwater was collected and analyzed during 2017 to determine if the tritium from the reservoir precipitated in the local area. Tritium was not measured in any of the rainwater samples offsite.

*Photo courtesy of: Aubrey Passafuma*

Tritium was identified in the shallow (i.e. ten to thirty feet deep) aquifer test wells at Station #235 approximately seventy-five yards south of the reservoir embankment base during 1999. Starting in 2000, samples were collected from the shallow aquifer well at Station #251 south of the Main Cooling Reservoir. The tritium results from these two shallow aquifer wells are shown in Figure 6-11. In 2017, the concentration of tritium at Station #235 was consistent with values over the past five years. Shallow aquifer tritium concentrations have remained near the concentrations found in the relief wells. Wells at Stations #258 and #259 on the west side of the site boundary have been sampled since 2006. Wells at Stations #270 and #271 were installed during the last quarter of 2008. The sample results are shown in Figure 6-12. The well at Station #271, located adjacent to site property on a county road easement directly west of the Main Cooling Reservoir, indicated its highest concentration in 2017 at 1,289 pCi/kg. In 2017, a maximum value of 7,394 pCi/ kg was identified for onsite test wells. Tritium levels continued to remain below the United States Environmental Protection Agency drinking water limit (20,000 pCi/kg).

Tritium has not been detected in the deep aquifer that is the source of drinking water for the local communities and homes. These measurements follow the hydrological model described in the original license basis and the updated site conceptual model discussed earlier in this section.

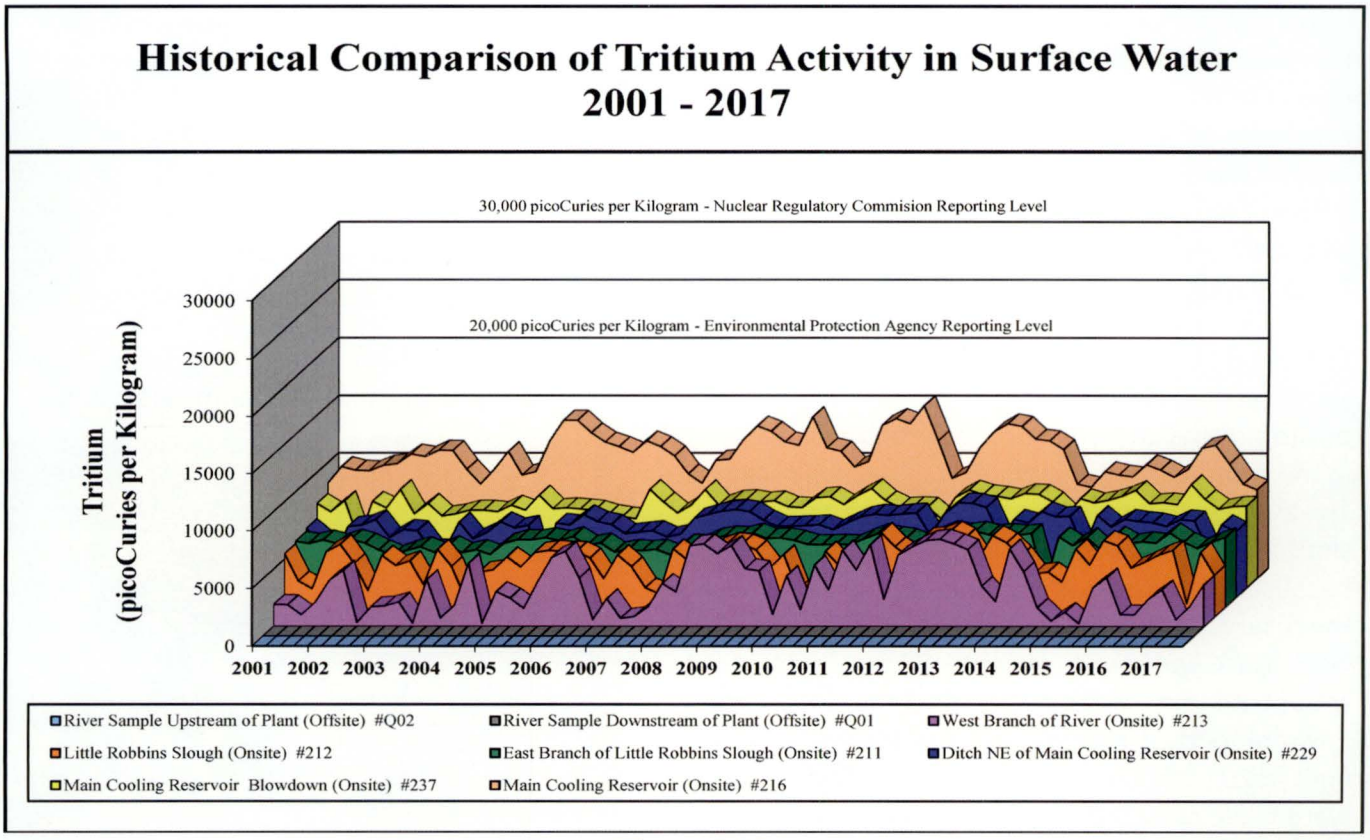



**Figure 6-10**

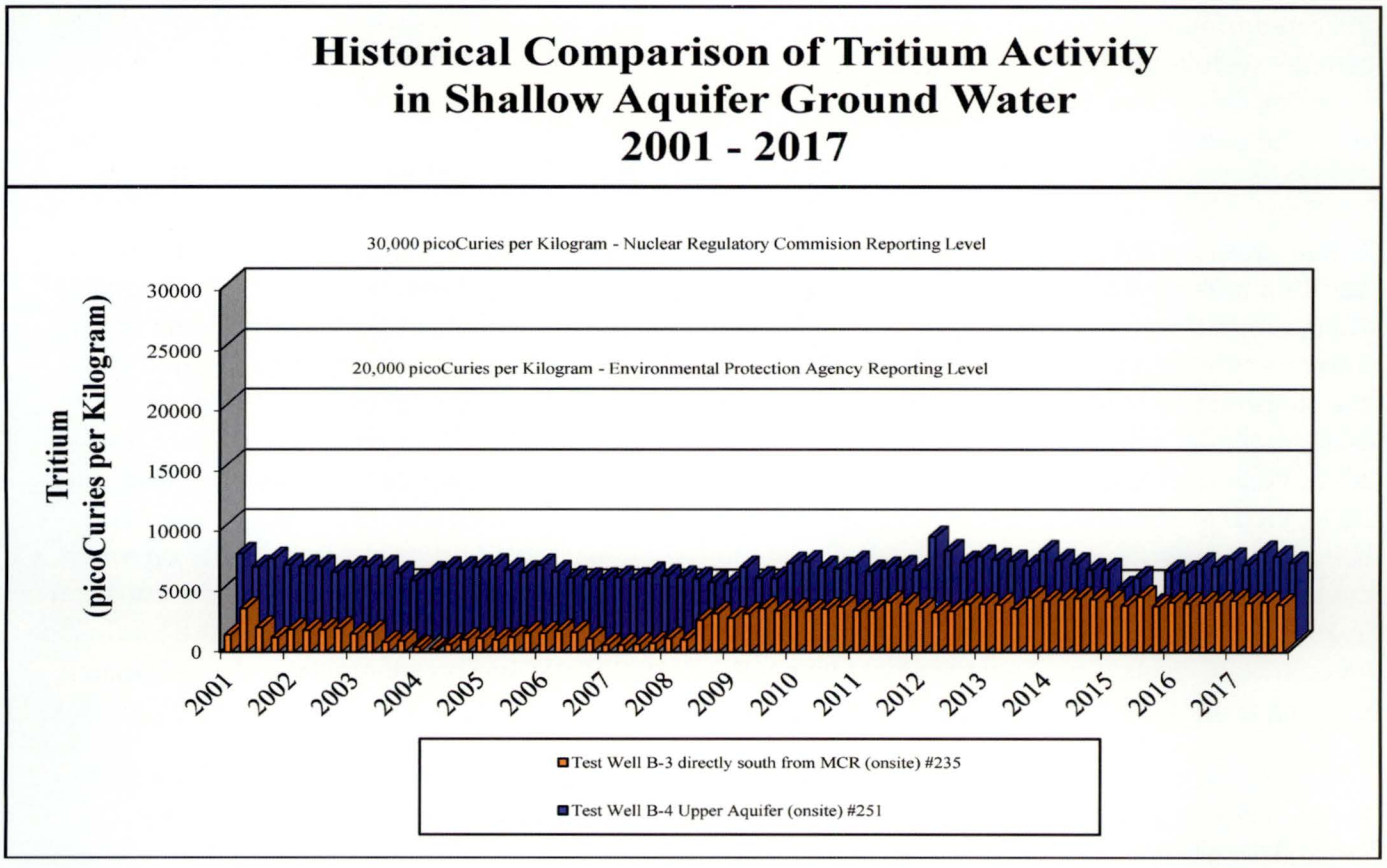



**Figure 6-11**

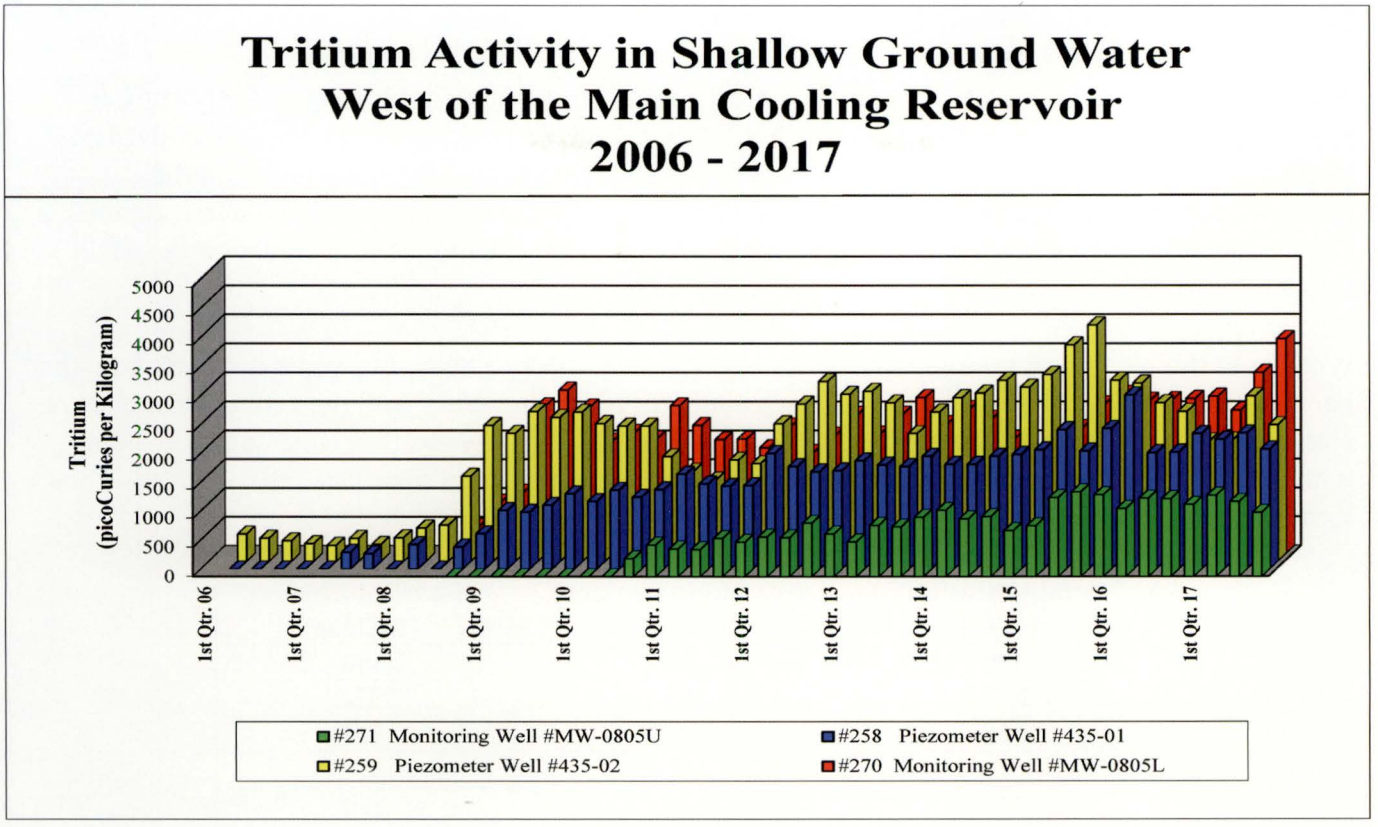



**Figure 6-12**

A windmill-powered groundwater well, sample station #267, indicated tritium activity at 315 pCi/kg in 2017. This onsite ground water sample station is the most distant location from the Main Cooling Reservoir that tritium has been detected. This well is not used for human consumption.

The drinking water onsite is pumped from deep aquifer wells and is tested monthly and composited quarterly to verify tritium is not present. The South Texas Project uses no water from the reservoir, shallow aquifers or other surface water for drinking. If the water with the highest tritium concentration that leaves the site (Little Robbins Slough) was used for drinking, the maximum dose to an individual would be less than one millirem in a year. This dose is insignificant compared to the approximately 620 millirem the public receives a year from natural radioactivity in the environment and the radiation received from medical procedures.[4]

Other samples are collected and analyzed in addition to those required by our licensing documents or internal procedures. These samples are collected to give additional assurance that the public and the environment are protected from any adverse effects from the plant. These samples include pasture grass, sediment samples, rain water, shallow aquifer well, water from various ditches and sloughs onsite, direct radiation, and air samples near communities or other areas of interest. The results of these analyses indicate that plant operation has no health impact offsite and is well within state and federal regulations and guidelines.

[4] NCRP (2006). National Council on Radiation Protection and Measurements, Ionizing Radiation Exposure of the Population of the United States, (Bethesda, Maryland), NCRP Report No. 160.

## NEI GROUNDWATER PROTECTION INITIATIVE

In 2007, the Nuclear Energy Institute (NEI) established a standard for monitoring and reporting radioactive isotopes in groundwater entitled NEI Groundwater Protection Initiative, NEI 07-07. The station implemented the recommendations of this industry standard and has broadened the groundwater monitoring program to include additional samples collected near the plants. Some of the positive results of this broadened monitoring program reflect tritium associated with the Main Cooling Reservoir.

Wells near the plants are sampled semi-annually, annually, or once every five years depending on the concentration of tritium anticipated and the location of the wells. Wells with high concentrations are sampled more frequently. Figure 6-13 contains the 2017 results for wells that were sampled along with the historical highs measured prior to 2017 for each station since sampling began in 2006. Their locations are shown in Figure 6-14.

| Sample station (WELL) | 2017 Measurements (pCi/kg) | Historical Interest (pCi/kg) |
|---|---|---|
| 809 | 900 | 590 |
| 801 | 689 | 1150 |
| 815 | 533 | 533 |
| 816 | 485 | 971 |
| 844 | 361 | 920 |
| 807 | Less than 300 | 15300 |
| 808 | Less than 300 | 2858 |
| 825 | Less than 300 | Less than 300 |
| 826 | Less than 300 | Less than 300 |
| 827 | Less than 300 | Less than 300 |
| 828 | Less than 300 | 387 |
| 835 | Less than 300 | Less than 300 |
| 838 | Less than 300 | Less than 300 |
| 842 | Less than 300 | Less than 300 |
| 843 | Less than 300 | Less than 300 |

**Figure 6-13**

Two wells sampled semi-annually (Stations #807 and #808) are adjacent to where a pipe was damaged and repaired several years ago. The tritium concentration at these two wells continued to decrease as expected in 2017. Station #809 tritium concentrations were related to the previously referenced pipe and subsequent repair. Station #844 tritium had a concentration of 361 pCi/kilogram and the source of that tritium is influenced by the Main Cooling Reservoir. All the other wells sampled in 2017 that had detectable tritium are influenced by groundwater originating in the Main Cooling Reservoir. Their concentrations remain in the range of groundwater tritium concentrations associated with the Main Cooling Reservoir. All of the 2017 measurements of tritium in groundwater are a small fraction of the United States Environmental Protection Agency drinking water limit (20,000 pCi/kg).

## STP PROTECTED AREA GROUND WATER MONITORING WELLS

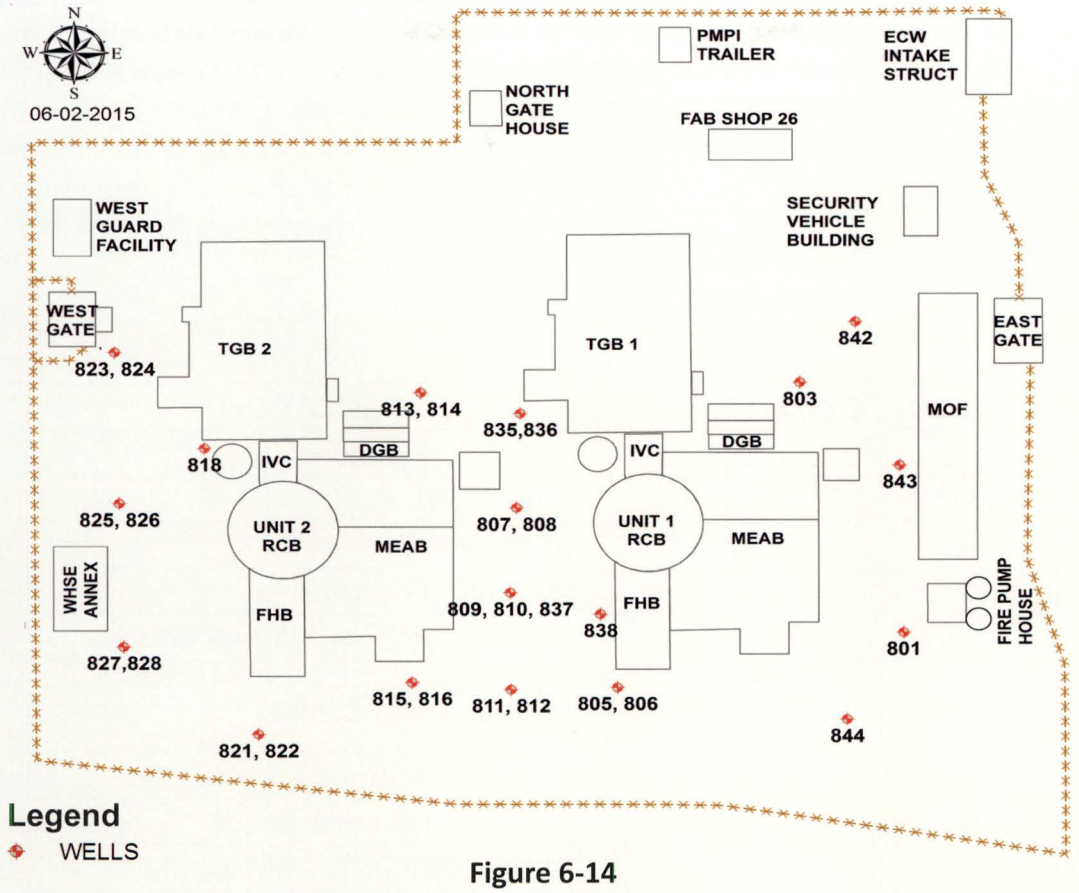



**Figure 6-14**

During 2012, steam traps for the auxiliary steam system that could potentially contain trace amounts of tritium were modified to re-direct the condensed steam or liquid water to the Main Cooling Reservoir. Information regarding the steam traps and subsequent response was documented in the station's condition reporting process. This evaluation identified no new effluent release pathways and no impact to the drinking water or the health and safety of the public.

By the end of 2014, the majority of the protected area wells had undergone a modification to enhance the protection of the structural integrity of the water well casing used for sampling the upper aquifer. The modifications were completed in 2015 with continued improvements into 2016.

In 2017, there were five occurrences where condensed steam or water contacted the ground onsite. One of these occurrences included water from an open-loop cooling water supply header rupture that contacted the ground onsite but was quickly recovered and returned to the Main Cooling Reservoir. None of these occurrences resulted in dose impact to the public or the environment. No discharge occurred offsite or to groundwater that may be used as a source of drinking water. Where applicable, the water was quickly recovered, recaptured, and clean up completed with no impact to groundwater.

## LAND USE CENSUS

The Annual Land Use Census is performed to determine if any changes have occurred in the location of residents and the use of the land within five miles of the South Texas Project generating units. The information is used to determine whether any changes are needed in the Radiological Environmental Monitoring Program. The census is performed by contacting area residents and local government agencies that provide the information. In addition, a survey is performed to verify the nearest residents within five miles of the South Texas Project generating units in each of 16 sectors. The results of the survey indicated no changes for 2017. The eleven sectors that have residents within five miles and the distance to the nearest residence in each sector are listed below.

| SECTOR | DISTANCE (MILES) | LOCATION |
|---|---|---|
| ENE | 4.5 | CR 232 (Ryman Rd.) |
| ESE | 3.5 | Selkirk Dr. |
| SE | 3.5 | Selkirk Dr. |
| SW | 4.5 | CR 386 (Corporon Rd.) |
| SSW | 4.5 | CR 391 (Robbins Slough Rd.) |
| WSW | 2.5 | CR 358 |
| W | 4.5 | FM 1095 |
| WNW | 4.5 | CR 356 (Ashby-Buckeye Road) |
| NW | 4.5 | CR 354 (Mondrik Road) |
| NNW | 3.0 | Runnells Ranch – RM 1468 |
| N | 3.0 | Runnells Ranch – RM 1468 |

The following items of interest were noted during the census:

- No commercial dairies operate within Matagorda County.
- There were no identified animals producing milk for human consumption located within five miles of STP.
- A commercial olive tree orchard is located approximately 4.9 miles WSW of the plant.
- Two commercial fish farms continue to operate. One is two miles west of the plant near FM 521 and the second is approximately four to five miles southwest of the plant located in the area north of Robbins Slough Road and east of South Citrus Grove Road. The water supply for the ponds is not affected by the operations of the South Texas Project.
- Colorado River water from below the Bay City Dam has not been used to irrigate crops.
- There were no identified commercial vegetable farms located within the five mile zone.
- Broadleaf vegetation sampling is performed at the site boundary in the three most leeward sectors and at a control location in lieu of a garden census. The broadleaf vegetation samples collected also satisfy the collection requirement when milk samples are not available.

## QUALITY ASSURANCE

Quality assurance encompasses planned and systematic actions to ensure that an item or facility will perform satisfactorily. Reviews, surveillances, and audits have determined that the programs, procedures and personnel are performing at a satisfactory level.

Quality audits and independent technical reviews help to determine areas that need attention. These areas are addressed in accordance with the station's Condition Reporting Process.

The measurement capabilities of the Radiological Laboratory are demonstrated by participating in an interlaboratory measurement assurance program as well as performing duplicate and split sample analyses. Approximately 11 percent of the analyses performed are quality control samples. These consist of interlaboratory measurement assurance program samples, duplicate samples, and split samples. Approximately 21 percent of the analyses include National Institute of Standards and Technology samples, blanks, intercomparison testing, duplicates and splits out of a total of 1136 samples.

*Photo courtesy of: Michael Simons*

The interlaboratory measurement assurance program provides samples that are similar in matrix and size to those measured by the Radiological Environmental Monitoring Program. This program assures that equipment calibrations and sample preparation methods accurately measure radioactive material in samples. Figure 6-15 summarizes the results of the interlaboratory comparison programs.

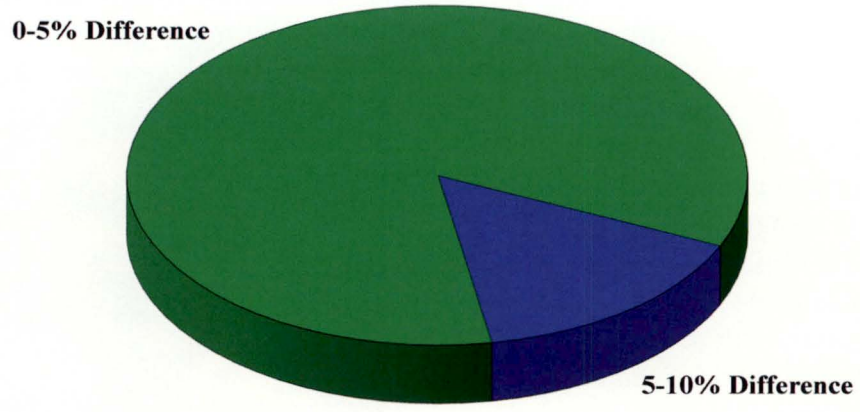
Duplicate sampling of the environment allows the South Texas Project to estimate the repeatability of the sample collection, preparation, and analysis process. Splitting samples allows estimation of the precision and bias trends of the method of analysis without the added variables introduced by sampling. Generally, two samples split from the same original sample material should agree better than two separate samples collected in the same area and time period. The 2017 variances for duplicates and splits are shown in Figure 6-16

## PROGRAM DEVIATIONS

In addition to measurement accuracy, radiochemical measurements must meet sensitivity requirements at the Lower Level of Detection for environmental samples. Deviations from the sampling program or sensitivity requirements must be acknowledged and explained in this report. The loss of a small fraction of the total samples collected in 2017 did not impact the ability to demonstrate that the South Texas Project continues to operate with no negative effect on the population or the environment. During 2017, the following samples were not collected or were unacceptable for analysis:

- Eight out of 265 air samples were not continuously collected for the full time interval because of loss of power as a result of Hurricane Harvey.

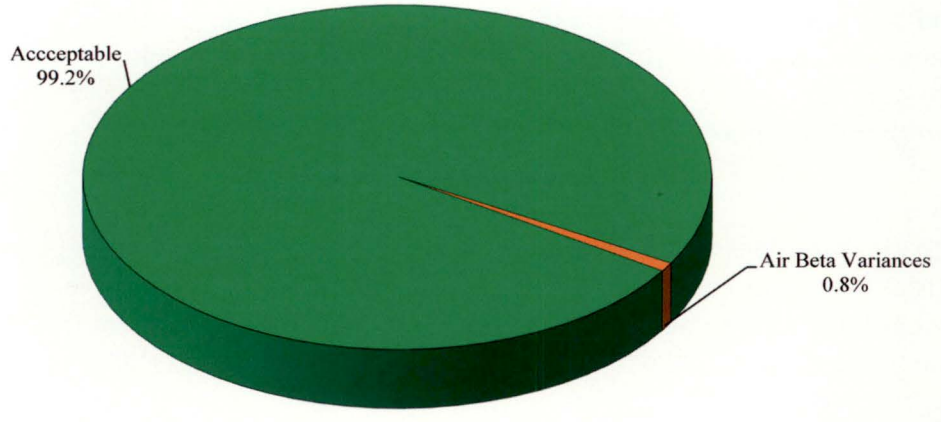
## 2017 Radiological Laboratory Quality Assurance Program Performance




**78 Total Analyses**

Figure 6-15

## Duplicate & Split Agreement of Environmental Samples in 2017




**All other variances are less than 0.01%**

Figure 6-16

# TABLE 1
# RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE: **DIRECT RADIATION** — 40 TOTAL SAMPLING STATIONS

| Sample Media, Number, Approximate Location and Distance of Sample Stations from Containment. | Routine Sampling Mode | Sampling and Collection Frequency | Analysis Type | Minimum Analysis Frequency |
|---|---|---|---|---|
| Exposure Media: TLD<br><br>16- Located in all 16 meteorological sectors, 0.2* to 4 miles.<br><br>16- Located in all 16 meteorological sectors, 2 to 7 miles.<br><br>6- Located in special interest areas (e.g. school, population centers), within 14 miles.<br><br>2- Control stations located in areas of minimal wind direction (WSW,ENE), 10-16 miles. | Continuously | Quarterly | Gamma dose | Quarterly |

* The inner ring of stations in the southern sectors are located within 1 mile because of the main cooling reservoir

EXPOSURE: **AIRBORNE** — 5 TOTAL SAMPLING STATIONS

| Sample Media, Number, Approximate Location, and Distance of Sample Stations from Containment. | Routine Sampling Mode | Nominal Collection Frequency | Analysis Type | Minimum Analysis Frequency |
|---|---|---|---|---|
| Charcoal and Particulate Filters<br><br>3- Located at the exclusion zone, N, NNW, NW Sectors, 1 mile.<br><br>1- Located in Bay City, 14 miles.<br><br>1- Control Station, located in a minimal wind direction (WSW), 10 miles. | Continuous sampler operations | Weekly or more frequently if required by dust loading | Radioiodine Canister: I-131<br><br>Particulate Sampler: Gross Beta Activity<br><br>Gamma-Isotopic of composite (by location) | Weekly<br><br>Following filter change<br><br>Quarterly |

MCR-STP Main Cooling Reservoir
STP- South Texas Project

# TABLE 1
# RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE: **WATERBORNE** 13 TOTAL SAMPLING STATIONS

| Sample Media, Number And Approximate Location of Sample Stations | Routine Sampling Mode | Nominal Collection Frequency | Analysis Type | Minimum Analysis Frequency |
|---|---|---|---|---|
| Surface | | | | |
| 1- Located in MCR at the MCR blowdown structure. | Composite sample over a 1 month period (grab if not available) | Monthly | Gamma-Isotopic | Monthly |
| 1- Located above the site on the Colorado River not influenced by plant discharge (control). | | | Tritium | Quarterly Composite |
| 1- Located downstream from blow down entrance into the Colorado River. | | | | |
| Ground | | | | |
| 5- Located in wells used to monitor tritium migration in the shallow aquifer. | Grab | Quarterly | Gamma-Isotopic & Tritium | Quarterly |
| Drinking Water | | | | |
| 1- Located on site. * | Grab | Monthly | Gross Beta & Gamma-Isotopic | Monthly |
| 1- Located at a control station. | | | Tritium | Quarterly Composites |
| Sediment | | | | |
| 1- Located above the site on the Colorado River, not influenced by plant discharge. | Grab | Semiannually | Gamma-Isotopic | Semiannually |
| 1- Located downstream from blowdown entrance into the Colorado River. | | | | |
| 1- Located in MCR. | | | | |

* No municipal water systems are affected by STP. This sample taken from deep aquifer supplying drinking water to employees while at work.

MCR-STP Main Cooling Reservoir
STP- South Texas Project

# TABLE 1
# RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (Continued)

EXPOSURE: **INGESTION**

7 TOTAL SAMPLING STATIONS

| Sample Media, Number And Approximate Location of Sample Stations | Routine Sampling Mode | Nominal Collection Frequency | Analysis Type | Minimum Analysis Frequency |
|---|---|---|---|---|
| Milk<br>* | Grab | Semi-monthly when animals are on pasture; monthly at other times. | Gamma-Isotopic And Low Level I-131 | Semi-monthly when animals are on pasture; monthly at other times. |
| Broadleaf Vegetation**<br>2- Located at the exclusion zone, N, NW, or NNW sectors.<br>1- Located in a minimal wind direction. | Grab | Monthly during growing season (When available) | Gamma-Isotopic | As collected |
| Fish and Invertebrates (edible portions)<br>1- Representing commercially or recreational important species in vicinity of STP that maybe influenced by plant operation.<br>1- Same or analogous species in area not influenced by STP.<br>1- Same or analogous species in the MCR. | Grab | Sample semi-annually | Gamma-Isotopic on edible portions | As collected |
| Agricultural Products<br>*** | Grab | At time of harvest | Gamma-Isotopic Analysis in edible portion | As collected |
| Domestic Meat<br>1- Represents domestic stock fed on crops grown exclusively within 10 miles of the plant. | Grab | Annually | Gamma-Isotopic | As collected |

* Limited source of sample in vicinity of the South Texas Project. (Attempts will be made to obtain samples when available.)

** Three different kinds of broadleaf vegetation are to be collected over the growing season, not each collection period.

*** No sample stations have been identified in the vicinity of the site. Presently no agricultural land is irrigated by water into which liquid plant wastes will be discharged. Agricultural products will be considered if these conditions change.

MCR-STP Main Cooling Reservoir
STP- South Texas Project

## TABLE 2
## SAMPLE MEDIA AND LOCATION DESCRIPTIONS

| | | | |
|---|---|---|---|
| AI | AIRBORNE RADIOIODINE | MG | GOAT MILK |
| AP | AIRBORNE PARTICULATE | M1 | BEEF MEAT |
| B1 | RESIDENT DABBLER DUCK | M2 | POULTRY MEAT |
| B2 | RESIDENT DIVER DUCK | M3 | WILD SWINE |
| B3 | MIGRATORY DABBLER DUCK | M4 | DOMESTIC SWINE |
| B4 | MIGRATORY DIVER DUCK | M5 | EGGS |
| B5 | GOOSE | M6 | GAME DEER |
| B6 | DOVE | M7 | ALLIGATOR |
| B7 | QUAIL | M8 | RABBIT |
| B8 | PIGEON | OY | OYSTER |
| CC | CRUSTACEAN CRAB | R4 | TURNIP |
| CS | CRUSTACEAN SHRIMP | SO | SOIL |
| DR | DIRECT RADIATION | S1 | SEDIMENT - SHORELINE |
| F1 | FISH - PISCIVOROUS | S2 | SEDIMENT - BOTTOM |
| F2 | FISH - CRUSTACEAN & INSECT FEEDERS | VB | ANY COMBINATION OF BROAD LEAF SAMPLES (L1 thru L7) |
| F3 | FISH - PLANKIVORES & DETRITUS FEEDERS | VP | PASTURE GRASS |
| L1 | BANANA LEAVES | WD | DRINKING WATER |
| L2 | CANA LEAVES | WG | GROUND WATER |
| L4 | TURNIP GREENS | WR | RAIN WATER |
| L5 | CABBAGE | WS | SURFACE WATER |
| L6 | COLLARD GREENS | WW | (relief) WELL WATER |
| L7 | MUSTARD GREENS | | |

## TABLE 2
## SAMPLE MEDIA AND LOCATION DESCRIPTIONS (Continued)

| Media Code | Station Code | Vector (Approximate) | Location |
|---|---|---|---|
| **DR AI AP VB** VP SO | 001 | 1 mile N | FM 521 |
| **DR** | 002 | 1 mile NNE | FM 521 |
| **DR** | 003 | 1 mile NE | FM 521 |
| **DR** | 004 | 1 mile ENE | FM 521 |
| **DR** | 005 | 1 mile E | FM 521 |
| **DR** AI AP SO | 006 | 3.5 miles ESE | Site near Reservoir Makeup Pumping Facility |
| **DR** | 007 | 3.5 miles SE | MCR Dike |
| **DR** | 008 | 0.25 mile SSE | MCR Dike |
| **DR** | 009 | 0.25 mile S | MCR Dike |
| **DR** | 010 | 0.25 mile SSW | MCR Dike |
| **DR** | 011 | 0.5 mile SW | MCR Dike |
| **DR** | 012 | 1.5 mile WSW | MCR Dike |
| **DR** | 013 | 1.5 mile W | FM 521 |
| **DR** | 014 | 1.5 mile WNW | FM 521 |
| **DR AI AP VB** SO VP | 015 | 1 mile NW | FM 521 |
| **DR AI AP VB** SO VP | 016 | 1 mile NNW | FM 521 |
| **DR** | **017** | 6.5 miles N | SE corner @ intersection of FM 1468 (Buckeye RD) and CR 306 (Brown RD) |
| **DR** AI AP SO | **018** | 5.5 miles NNE | OXEA Corp. - FM 3057 |
| **DR** | **019** | 5.5 miles NE | FM 2668 |
| **DR** | **020** | 5 miles ENE | FM 2668 & FM 2078 |
| **DR** | **021** | 5 miles E | FM 521& FM 2668 |
| **DR** | **022** | 7 miles E | Lyondellbasell Chemical Plant on SH 60 |
| **DR** | **023*** | 16 miles ENE | Intersection of FM 521 and FM 2540 |
| **DR** | 024 | 4 miles SSE | MCR Dike |
| **DR** | 025 | 4 miles S | MCR Dike |
| **DR** | 026 | 4 miles SSW | MCR Dike |
| **DR** | 027 | 2.5 miles SW | MCR Dike |
| **DR** | **028** | 5 miles WSW | FM 1095 & Ellis Road (CR 380) |
| **DR** SO | **029** | 4.5 miles W | FM 1095 |
| **DR** | **030** | 6 miles WNW | Tres Palacios Oaks, FM 2853 |
| **DR** | **031** | 5.5 miles NW | Wilson Creek Road |
| **DR** | **032** | 3.5 miles NNW | FM 1468 |

♦This station may be used to obtain the required aquatic samples in the vicinity of STP that may be influenced by plant operations.
MCR-STP Main Cooling Reservoir
STP- South Texas Project
Media codes typed in bold satisfy collection requirement described in Table 1.
Station codes typed in bold identify offsite locations.
* Control Station

## TABLE 2
## SAMPLE MEDIA AND LOCATION DESCRIPTIONS (Continued)

| Media Code | Station Code | Vector (Approximate) | Location |
|---|---|---|---|
| **DR AI AP** SO | **033** | 14 miles NNE | Microwave Tower at end of Kilowatt road in Bay City |
| **DR** | **034** | 7.5 miles ENE | Wadsworth Water Supply Pump Station on Main St. |
| **DR** AI AP SO | **035** | 8.5 miles SSE | Matagorda on Fisher St. |
| **DR** | **036** | 9 miles WSW | College Port on FM 1095 |
| **DR AI AP VB** VP SO | **037*** | 10 miles WSW | Palacios AEP Substation on Harrison Rd. (CR 323) |
| DR | **038** | 10.5 miles NW | AEP Substation on SH 71 near Blessing (0.2 miles North of SH 35) |
| **DR** AI AP SO | **039** | 9 miles NW | SH 35 under High Voltage lines |
| DR | **040** | 4.5 miles SW | Citrus Grove Rd. (CR 385) |
| **DR** | 041 | 2.0 miles ESE | MCR Dike |
| **DR** | 043 | 4.5 miles SE | Site boundary just south of the spillway discharge channel |
| **WG** | 205 | 4.0 miles SE | Piezometer Well #446A. Alternate for WG is Station Code 206 |
| WG | 206 | 4.0 miles SE | Piezometer Well #446 |
| WS | 209 | 2 miles ESE | Kelly Lake |
| **WD** | 210 | On Site | Approved drinking water supply from STP |
| WS S1 F(1, 2, or 3) | 211♦ | 3.5 miles S | East Branch Little Robbins Slough |
| WS S1 F(1, 2, or 3) | 212♦ | 4 miles S | Little Robbins Slough |
| WS S1 | 213 | 4 miles SE | West Branch Colorado River |
| **F(1, 2, or 3)** CC | 214 | 2.5 miles SE | MCR at Makeup Water Discharge. Alternate for F(1, 2, or 3) in any location in the MCR |
| **S2** | 215 | 0.5 mile SW | MCR at Circulating Water Discharge (S2 Alternate is any location in MCR) |
| **WS** S2 | 216 | 3.5 miles SSE | MCR at blowdown structure |
| WS S(1 OR 2) F(1, 2 or 3) | **217♦** | 7-9 miles SSE | Mouth of Colorado River and Intracoastal Waterway (Region 1) |
| WS F(1, 2 OR 3) | **218♦** | 6-9 miles SE-SSE | Colorado River between Intracoastal Waterway and station 227 (Region 2) |
| WS F(1, 2 OR 3) | **219** | 3-6 miles E-SE | Colorado River between Station 227 and FM 521 (Region 3) |
| F(1, 2, or 3) | **220** | 3-10 miles E-N | Colorado River between FM 521 and the LCRA Dam (Region 4) |
| S(1 or 2)<br>F(1, 2 or 3) WS | **221** | >10 miles N-NE | Above the LCRA Dam (Region 5) |
| F(1, 2, or 3) CC CS OY | **222♦** | >10 miles | West Matagorda Bay |
| F(1, 2, or 3) | **224** | 9 miles SSE | West Intracoastal Canal |
| F(1, 2, or 3) | **225** | 9 miles SE | East Intracoastal Canal |
| **WS S(1 or 2)** | **227♦** | 6 miles SE | West bank of Colorado River downstream of STP. Alternate for WS or S(1 or 2) is station 233 |

♦This station may be used to obtain the required aquatic samples in the vicinity of STP that may be influenced by plant operations.
MCR-STP Main Cooling Reservoir
STP- South Texas Project
Media codes typed in bold satisfy collection requirement described in Table 1.
Station codes typed in bold identify offsite locations.
* Control Station

# TABLE 2
## SAMPLE MEDIA AND LOCATION DESCRIPTIONS (Continued)

| Media Code | Station Code | Vector (Approximate) | Location |
|---|---|---|---|
| **WD** | **228*** | 14 miles NNE | Le Tulle Park Public Water Supply on SH 35 |
| WS S1 | 229 | 2 miles ESE | Plant Area Drainage Ditch north of reservoir that empties into Colorado River |
| S(1 or 2) | **230♦** | 3.5 miles ESE | Colorado River at point where drainage ditch (#229) empties into it |
| S(1 or 2) WS | **233♦** | 4.5 miles SE | Colorado River approx. 0.5 km south of the Spillway discharge channel empties into it. |
| **WG** | 235 | 4 miles S | Well B-3 directly south from MCR |
| B8 | 236 | N/A | STP Protected Area |
| WS | 237 | 3.7 miles SSE | Spillway discharge channel from MCR |
| **S(1 or 2)** WS | **242*** | >10 miles N | Colorado River where it intersects SH 35 |
| **WS** | **243*** | >10 miles N | Colorado River upstream of dam at the Lower Colorado River Authority pumping station near Bay City. Alternate for WS is station 242 |
| WG | **245** | 4.5 mile SSE | Water well (windmill) located on private property approx. 1 mile south of the MCR |
| WS S1 | 246 | <1 mile N | Drainage ditch originating at protected area fence north of Unit 2 |
| WS | 247 | <1 mile E | Essential Cooling Pond |
| WS S1 | 248 | <1 mile N | Point in drainage ditch north of protected area downstream of Unit #1 Protected Area storm drain discharge |
| **F(1,2, or 3)** CS | **249*** | N/A | Control sample purchased from a local retailer |
| **WG** | 251 | 4.0 miles SSE | Test Well B-4, upper shallow aquifer |
| WG | 255 | 4.2 miles SE | Piezometer Well #415 110' deep |
| WG | 256 | 2.8 miles ESE | Piezometer Well #417 100' deep |
| WG | 257 | 3.9 miles SSW | Piezometer Well #421-02, 80' deep 1.1 miles down STP Road from Station Code #258 approximately 20' inside east of site boundary fence |
| WG | 258 | 2.9 miles SW | Piezometer Well #435-01, 1.5 miles down STP Road from FM 521 along east of site boundary fence |
| **WG** | 259 | 2.9 miles SW | Piezometer Well #435-02, 1.5 miles down STP Road from FM 521 20' east of fence (site boundary) WG Alternate is station 258 |
| WG | 260 | 3.7 miles S | Piezometer Well #437 74' deep |
| WG | 263 | 3.2 miles ESE | Piezometer Well #447 104' deep |
| WG | 264 | 3.2 miles ESE | Piezometer Well #447A 46' deep |
| **WG** | 266 | 0.7 miles NW | Piezometer Well #602A 40' deep |
| WG | 267 | 2.7 miles ESE | Windmill north of Heavy Haul Road |
| WG | 268 | 3.0 miles SE | Windmill east of MCR |
| WG | **269** | 4.2 miles SSE | Windmill south of STP owner controlled area on private land |
| WG | **270** | 2.9 miles SW | Monitor well MW-805L 49' deep. Across Rd from station # 258 & 259 |
| WG | **271** | 2.9 miles SW | Monitor well MW-805U Across Rd from station # 258 & 259 |
| WR | 272 | NA | Unit 1 |
| WR | 273 | NA | Unit 2 |
| WS | **278** | 1.8 WNW | First catfish pond NW of plant next to FM 521 |

♦This station may be used to obtain the required aquatic samples in the vicinity of STP that may be influenced by plant operations.
MCR-STP Main Cooling Reservoir
STP- South Texas Project
Media codes typed in bold satisfy collection requirement described in Table 1.
Station codes typed in bold identify offsite locations.
* Control Station

## TABLE 2
## SAMPLE MEDIA AND LOCATION DESCRIPTIONS (Continued)

| Media Code | Station Code | Vector (Approximate) | Location |
|---|---|---|---|
| S(1 or 2) WS | 280 | 0.2 miles ESE | Beginning at Plant Area Discharge Ditch (PADD) west of the Nuclear Support Center |
| WS | 281 | 0.2 miles ESE | Main Spill Gate, Located north of the beginning of the PADD (Protected Area Drainage Ditch) |
| WS | 282 | <1 mile N | Point in drainage ditch at the Protected Area storm drainage discharge pipe located West of station # 246 |
| WG | 283 | 1 mile NW | OW-928L depth 121 feet |
| WG | 284 | 1 mile NW | OW-928U depth 40 feet |
| WG | 285 | 1 mile W | OW-931U depth 36 feet |
| WG | 286 | 1 mile SW | OW-950 L depth 132 feet |
| WG | 287 | 1 mile SW | OW-950 U depth 42 feet |
| WG | 288 | 1 mile N | OW-954 L depth 99 feet |
| WG | 289 | 1 mile N | OW-954 U depth 46 feet |
| WG | 290 | 1 mile E | OW-956 L depth 109 feet |
| WG | 291 | 1 mile E | OW-956 U depth 29 feet |
| WG | 292 | 2.3 miles ESE | OW-961 L depth 105 feet |
| WG | 293 | 2.3 miles ESE | OW-961 U depth 25 feet |
| WG | 294 | 1 mile NE | OW-962 L depth 116 feet |
| WG | 295 | 1 mile NE | OW-962 U depth 43 feet |
| F(1, 2, or 3) CC S2 | 300 | S | STP Main Cooling Reservoir |
| F(1, 2, or 3) S2 | 301-631 | S | Grids located in Main Cooling Reservoir. |
| WW | 701 | 4 miles S | MCR Relief Well #W-440 |
| WW | 702 | 4 miles S | MCR Relief Well #W-500 |
| WW | 703 | 4 miles S | MCR Relief Well #W-505 |
| WW | 704 | 4 miles S | MCR Relief Well #W-404 |
| WW | 705 | 4 miles S | MCR Relief Well #W-497 |
| WW | 706 | 4 miles S | MCR Relief Well #W-522 |
| WW | 707 | 4 miles S | MCR Relief Well #W-455 |
| **WS** | **Q01** | N/A | Quarterly composite of station #227 and/or alternate #233 |
| **WS** | **Q02** | N/A | Quarterly composite of station #243 and/or alternate #242 |

♦This station may be used to obtain the required aquatic samples in the vicinity of STP that may be influenced by plant operations.
MCR-STP Main Cooling Reservoir
STP- South Texas Project
Media codes typed in bold satisfy collection requirement described in Table 1.
Station codes typed in bold identify offsite locations.
* Control Station

## 2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY

A summary of all required samples is given in Table 3. The table has been formatted to resemble a United States Nuclear Regulatory Commission industry standard. Modifications have been made for the sole purpose of reading ease. Only positive values are given in this table.

Media type is printed at the top left of each table, and the units of measurement are printed at the top right. The first column lists the type of radioactivity or specific radionuclide for which each sample was analyzed. The second column gives the total number of analyses performed and the total number of non-routine analyses for each indicated nuclide. A nonroutine measurement is a sample whose measured activity is greater than the reporting levels for Radioactivity Concentrations in Environmental Samples. The "LOWER LIMIT OF DETECTION" column lists the normal measurement sensitivities achieved. The sensitivities were better than required by the United States Nuclear Regulatory Commission.

A set of statistical parameters is listed for each radionuclide in the remaining columns. The parameters contain information from the indicator locations, the location having the highest annual mean, and information from the control stations. Some sample types do not have control stations. When this is the case, "no samples" is listed in the control location column. For each of these groups of data, the following is calculated:

- The mean positive values
- The number of positive measurements / the total number of analyses
- The lowest and highest values for the analysis

The data placed in Table 3 are from the samples required by the site's Offsite Dose Calculation Manual as described in Table 1. Additional thermoluminescent dosimeters were utilized each quarter for quality control purposes. The minimum samples required by Table 1 were supplemented in 2017 by eight direct radiation measurements, 32 additional surface water samples, 23 ground water samples, eight additional pasture grass, four additional rain water samples, four additional relief well water samples, and two additional sediment samples. Fish and crustacean samples vary in number according to availability, but exceeded the minimum number required by Table 1. Also, 255 additional air station samples were collected from weekly air sample stations, in addition to the minimum number of samples required by Table 1 in order to strengthen the Radiological Environmental Monitoring Program.

The minimum required Radiological Environmental Monitoring Program is presented in Table 1. The table is organized by exposure pathway. Specific requirements such as location, sampling method, collection frequency, and analyses are given for each pathway.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Direct Radiation — Units: MilliRoentgen/Standard Quarter

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Gamma | 176/ 0 | 5.0E+00 | 1.3E+01 ( 163/ 163 ) ( 9.0E+00 - 1.7E+01 ) | 1.5 miles W (#013) | 1.6E+01 ( 8 / 8) (1.4E+01 - 1.7E+01) | 1.4E+01 ( 12 / 12) ( 1.2E+01 - 1.5E+01 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Airborne Particulate & Radioiodine — Units: PicoCuries per cubic meter

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Gross Beta | 255/ 0 | 1.4E-03 | 1.8E-02 ( 203 / 204 ) ( 5.0E-03 - 3.6E-02 ) | 1 mile NW (#015) | 1.9E-02 ( 50 / 51 ) ( 5.0E-03 - 3.5E-02 ) | 1.8E-02 ( 51 / 51 ) ( 5.1E-03 - 3.6E-02 ) |
| Iodine-131 | 255/ 0 | 1.3E-02 | --- ( 0 / 204 ) | --- | --- | --- ( 0 / 51 ) |
| Cesium-134 | 20/ 0 | 4.7E-04 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Cesium-137 | 20/ 0 | 4.4E-04 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Manganese-54 | 20/ 0 | 5.0E-04 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Iron-59 | 20/ 0 | 2.2E-03 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Cobalt-58 | 20/ 0 | 7.2E-04 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Cobalt-60 | 20/ 0 | 5.1E-04 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Zinc-65 | 20/ 0 | 1.4E-03 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Zirconium-95 | 20/ 0 | 1.3E-03 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Niobium-95 | 20/ 0 | 8.1E-04 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |
| Lanthanum-140 Barium-140 | 20/ 0 | 7.3E-03 | --- ( 0 / 16 ) | --- | --- | --- ( 0 / 4 ) |

† Number of positive measurements / total measurements at specified locations.

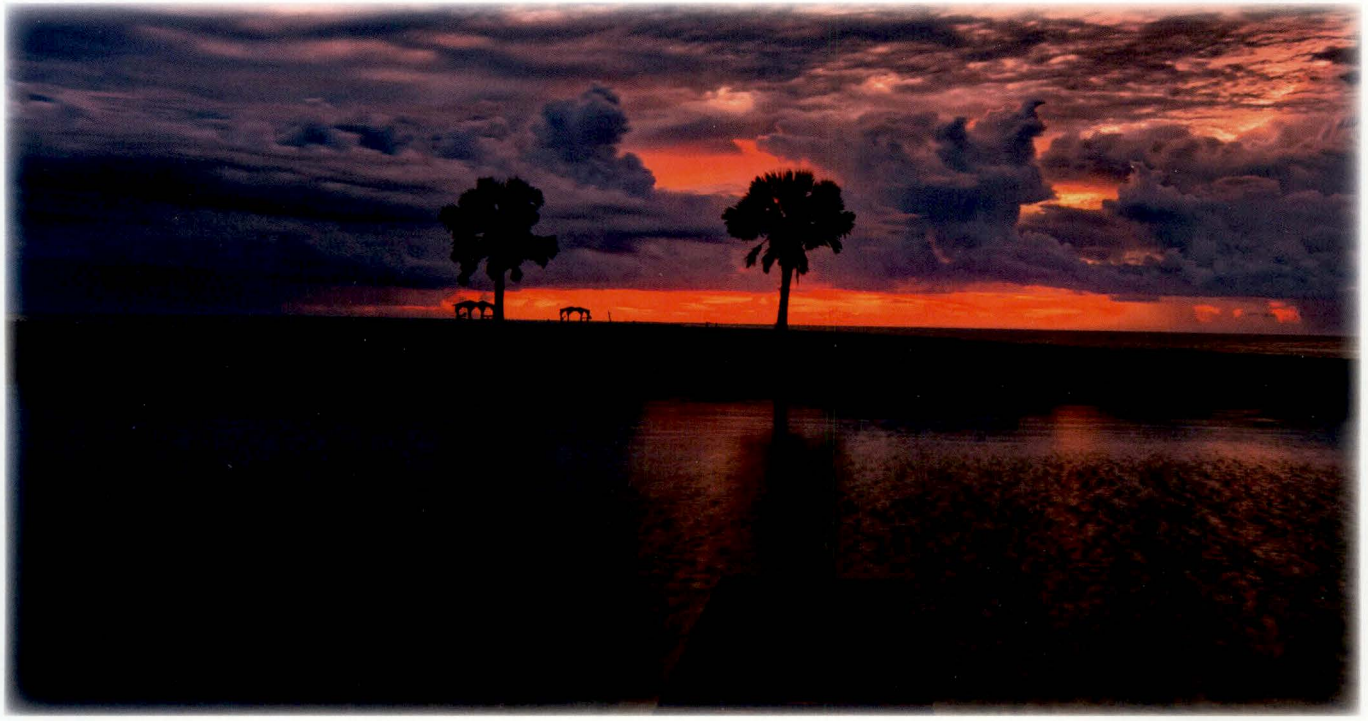


*Photo courtesy of: Mark Cunningham*

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Surface Water — Units: PicoCuries per Kilogram

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Hydrogen-3 | 12/ 0 | 2.9E+02 | 9.3E+03 ( 4/ 8) ( 7.7E+03 - 1.2E+04 ) | 3 miles SSE (#216) | 9.3E+03 ( 4/ 4) ( 7.7E+03 - 1.2E+04 ) | --- ( 0/ 4 ) |
| Iodine-131 | 42/ 0 | 4.8E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Cesium-134 | 42/ 0 | 1.9E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Cesium-137 | 42/ 0 | 2.0E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Manganese-54 | 42/ 0 | 1.9E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Iron-59 | 42/ 0 | 4.8E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Cobalt-58 | 42/ 0 | 2.1E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Cobalt-60 | 42/ 0 | 2.2E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Zinc-65 | 42/ 0 | 4.8E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Zirconium-95 | 42/ 0 | 3.8E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Niobium-95 | 42/ 0 | 2.2E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |
| Lanthanum-140 Barium-140 | 42/ 0 | 4.7E+00 | --- ( 0/ 27 ) | --- | --- | --- ( 0/ 15 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Ground Water *(On site test well)* — Units: PicoCuries per Kilogram

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Hydrogen-3 | 22/ 0 | 2.9E+02 | 4.4E+03 ( 14/ 22 ) ( 2.1E+03 - 7.4E+03 ) | 4.0 miles SSE (#251) | 6.7E+03 ( 5/ 5 ) ( 6.2E+03 - 7.4E+03 ) | no samples |
| Iodine-131 | 22/ 0 | 3.4E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Cesium-134 | 22/ 0 | 2.5E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Cesium-137 | 22/ 0 | 2.6E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Manganese-54 | 22/ 0 | 2.4E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Iron-59 | 22/ 0 | 5.5E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Cobalt-58 | 22/ 0 | 2.5E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Cobalt-60 | 22/ 0 | 2.8E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Zinc-65 | 22/ 0 | 7.6E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Zirconium-95 | 22/ 0 | 4.2E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Niobium-95 | 22/ 0 | 2.7E+00 | --- ( 0/ 22 ) | --- | --- | no samples |
| Lanthanum-140 Barium-140 | 22/ 0 | 4.2E+00 | --- ( 0/ 22 ) | --- | --- | no samples |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Drinking Water — Units: PicoCuries per Kilogram

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Gross Beta | 25/ 0 | 1.2E+00 | 2.5E+00 ( 12 / 13 ) ( 1.6E+00 - 3.3E+00 ) | 14 miles NNE (#228) | 8.3E+00 ( 12 / 12 ) ( 4.7E+00 - 1.2E+01 ) | 8.3E+00 ( 12 / 12 ) ( 4.7E+00 - 1.2E+01 ) |
| Hydrogen-3 | 8/ 0 | 2.9E+02 | --- ( 0 / 4 ) | --- | --- | --- ( 0 / 4 ) |
| Iodine-131 | 25/ 0 | 3.6E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Cesium-134 | 25/ 0 | 2.6E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Cesium-137 | 25/ 0 | 2.8E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Manganese-54 | 25/ 0 | 2.6E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Iron-59 | 25/ 0 | 5.8E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Cobalt-58 | 25/ 0 | 2.7E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Cobalt-60 | 25/ 0 | 2.9E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Zinc-65 | 25/ 0 | 7.6E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Zirconium-95 | 25/ 0 | 4.6E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Niobium-95 | 25/ 0 | 2.9E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |
| Lanthanum-140 Barium-140 | 25/ 0 | 4.3E+00 | --- ( 0 / 13 ) | --- | --- | --- ( 0 / 12 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Rain Water — Units: PicoCuries per Kilogram

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Hydrogen-3 | 4/ 0 | 2.9E+02 | --- ( 0 / 4 ) | --- | --- | no samples |
| Iodine-131 | 4/ 0 | 3.2E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Cesium-134 | 4/ 0 | 2.7E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Cesium-137 | 4/ 0 | 2.8E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Manganese-54 | 4/ 0 | 2.7E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Iron-59 | 4/ 0 | 5.8E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Cobalt-58 | 4/ 0 | 2.7E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Cobalt-60 | 4/ 0 | 3.0E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Zinc-65 | 4/ 0 | 7.2E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Zirconium-95 | 4/ 0 | 4.6E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Niobium-95 | 4/ 0 | 2.9E+00 | --- ( 0 / 4 ) | --- | --- | no samples |
| Lanthanum-140 Barium-140 | 4/ 0 | 4.2E+00 | --- ( 0 / 4 ) | --- | --- | no samples |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Sediment-Shoreline — Units: PicoCuries per Kilogram dry weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 4/ 0 | 2.2E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Cesium-137 | 4/ 0 | 2.2E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Manganese-54 | 4/ 0 | 2.4E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Iron-59 | 4/ 0 | 1.2E+02 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Cobalt-58 | 4/ 0 | 3.4E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Cobalt-60 | 4/ 0 | 2.3E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Zinc-65 | 4/ 0 | 8.1E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Zirconium-95 | 4/ 0 | 7.0E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Niobium-95 | 4/ 0 | 4.2E+01 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |
| Lanthanum-140 Barium-140 | 4/ 0 | 8.9E+02 | --- ( 0/ 2 ) | --- | --- | --- ( 0/ 2 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Sediment-Bottom — Units: PicoCuries per Kilogram dry weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 6/ 0 | 2.4E+01 | --- ( 0/ 6 ) | --- | --- | no samples |
| Cesium-137 | 6/ 0 | 2.5E+01 | 6.2E+01 ( 5/ 6 ) ( 2.0E+01 - 1.2E+02 ) | 3 miles SSE (#216) | 7.0E+01 ( 2/ 2 ) ( 2.0E+01 - 1.2E+02 ) | no samples |
| Manganese-54 | 6/ 0 | 2.6E+01 | --- ( 0/ 6 ) | --- | --- | no samples |
| Iron-59 | 6/ 0 | 1.1E+02 | --- ( 0/ 6 ) | --- | --- | no samples |
| Cobalt-58 | 6/ 0 | 3.4E+01 | --- ( 0/ 6 ) | --- | --- | no samples |
| Cobalt-60 | 6/ 0 | 2.5E+01 | 8.5E+01 ( 3/ 6 ) ( 4.6E+01 - 1.1E+02 ) | 1 mile SW (#215) | 1.0E+02 ( 2/ 4 ) ( 9.8E+01 - 1.1E+02 ) | no samples |
| Zinc-65 | 6/ 0 | 8.6E+01 | --- ( 0/ 6 ) | --- | --- | no samples |
| Zirconium-95 | 6/ 0 | 6.7E+01 | --- ( 0/ 6 ) | --- | --- | no samples |
| Niobium-95 | 6/ 0 | 4.2E+01 | --- ( 0/ 6 ) | --- | --- | no samples |
| Lanthanum-140 Barium-140 | 6/ 0 | 4.0E+02 | --- ( 0/ 6 ) | --- | --- | no samples |

† Number of positive measurements / total measurements at specified locations.

*Photo courtesy of: Mark Cunningham*

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Banana Leaves — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Iodine-131 | 18/ 0 | 1.7E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Cesium-134 | 18/ 0 | 1.2E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Cesium-137 | 18/ 0 | 1.2E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Manganese-54 | 18/ 0 | 1.1E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Iron-59 | 18/ 0 | 3.0E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Cobalt-58 | 18/ 0 | 1.2E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Cobalt-60 | 18/ 0 | 1.4E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Zinc-65 | 18/ 0 | 3.7E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Zirconium-95 | 18/ 0 | 2.1E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Niobium-95 | 18/ 0 | 1.3E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |
| Lanthanum-140 Barium-140 | 18/ 0 | 1.7E+01 | --- ( 0/ 12 ) | --- | --- | --- ( 0/ 6 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Cana Leaves — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Iodine-131 | 11/ 0 | 1.7E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Cesium-134 | 11/ 0 | 1.3E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Cesium-137 | 11/ 0 | 1.3E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Manganese-54 | 11/ 0 | 1.3E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Iron-59 | 11/ 0 | 3.6E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Cobalt-58 | 11/ 0 | 1.4E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Cobalt-60 | 11/ 0 | 1.7E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Zinc-65 | 11/ 0 | 4.2E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Zirconium-95 | 11/ 0 | 2.4E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Niobium-95 | 11/ 0 | 1.4E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |
| Lanthanum-140 Barium-140 | 11/ 0 | 1.8E+01 | --- ( 0/ 6 ) | --- | --- | --- ( 0/ 5 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Mustard Greens — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Iodine-131 | 7/ 0 | 1.2E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Cesium-134 | 7/ 0 | 1.2E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Cesium-137 | 7/ 0 | 1.2E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Manganese-54 | 7/ 0 | 1.2E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Iron-59 | 7/ 0 | 3.0E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Cobalt-58 | 7/ 0 | 1.2E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Cobalt-60 | 7/ 0 | 1.5E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Zinc-65 | 7/ 0 | 3.7E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Zirconium-95 | 7/ 0 | 2.1E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Niobium-95 | 7/ 0 | 1.3E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |
| Lanthanum-140 Barium-140 | 7/ 0 | 1.5E+01 | --- ( 0/ 6) | --- | --- | --- ( 0/ 1) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Fish - Piscivorous — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 11/ 0 | 3.1E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Cesium-137 | 11/ 0 | 2.9E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Manganese-54 | 11/ 0 | 3.1E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Iron-59 | 11/ 0 | 1.0E+02 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Cobalt-58 | 11/ 0 | 3.7E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Cobalt-60 | 11/ 0 | 3.5E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Zinc-65 | 11/ 0 | 7.9E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Zirconium-95 | 11/ 0 | 6.7E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Niobium-95 | 11/ 0 | 3.9E+01 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |
| Lanthanum-140 Barium-140 | 11/ 0 | 2.8E+02 | --- ( 0/ 10) | --- | --- | --- ( 0/ 1) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Fish - Crustacean & Insect Feeders — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 6/ 0 | 2.8E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Cesium-137 | 6/ 0 | 2.9E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Manganese-54 | 6/ 0 | 2.9E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Iron-59 | 6/ 0 | 9.5E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Cobalt-58 | 6/ 0 | 3.5E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Cobalt-60 | 6/ 0 | 3.4E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Zinc-65 | 6/ 0 | 7.7E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Zirconium-95 | 6/ 0 | 6.2E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Niobium-95 | 6/ 0 | 3.6E+01 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |
| Lanthanum-140 Barium-140 | 6/ 0 | 2.4E+02 | --- ( 0/ 5) | --- | --- | --- ( 0/ 1) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Fish - Plankivores & Detritus Feeders — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | LOCATION WITH HIGHEST ANNUAL MEAN MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 1/ 0 | 2.9E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Cesium-137 | 1/ 0 | 2.9E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Manganese-54 | 1/ 0 | 2.9E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Iron-59 | 1/ 0 | 1.2E+02 | --- ( 0/ 1) | --- | --- | no samples |
| Cobalt-58 | 1/ 0 | 3.6E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Cobalt-60 | 1/ 0 | 3.7E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Zinc-65 | 1/ 0 | 8.2E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Zirconium-95 | 1/ 0 | 6.7E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Niobium-95 | 1/ 0 | 4.0E+01 | --- ( 0/ 1) | --- | --- | no samples |
| Lanthanum-140 Barium-140 | 1/ 0 | 3.1E+02 | --- ( 0/ 1) | --- | --- | no samples |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Crustacean Shrimp — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 6/ 0 | 3.3E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Cesium-137 | 6/ 0 | 3.3E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Manganese-54 | 6/ 0 | 3.3E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Iron-59 | 6/ 0 | 8.6E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Cobalt-58 | 6/ 0 | 3.4E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Cobalt-60 | 6/ 0 | 3.7E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Zinc-65 | 6/ 0 | 8.3E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Zirconium-95 | 6/ 0 | 6.3E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Niobium-95 | 6/ 0 | 3.6E+01 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |
| Lanthanum-140 Barium-140 | 6/ 0 | 1.5E+02 | --- ( 0/ 4 ) | --- | --- | --- ( 0/ 2 ) |

† Number of positive measurements / total measurements at specified locations.

**TABLE 3**

**2017 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSIS SUMMARY**

Medium: Beef Meat — Units: PicoCuries per Kilogram wet weight

| ANALYSIS TYPE | TOTAL ANALYSES /NONROUTINE MEASUREMENTS | LOWER LIMIT OF DETECTION | INDICATOR LOCATIONS MEAN † RANGE | LOCATION WITH HIGHEST ANNUAL MEAN LOCATION INFORMATION | MEAN † RANGE | CONTROL LOCATIONS MEAN † RANGE |
|---|---|---|---|---|---|---|
| Cesium-134 | 2/ 0 | 1.8E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Cesium-137 | 2/ 0 | 1.6E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Manganese-54 | 2/ 0 | 1.9E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Iron-59 | 2/ 0 | 1.6E+02 | --- ( 0/ 2 ) | --- | --- | no samples |
| Cobalt-58 | 2/ 0 | 4.1E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Cobalt-60 | 2/ 0 | 1.9E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Zinc-65 | 2/ 0 | 5.0E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Zirconium-95 | 2/ 0 | 7.8E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Niobium-95 | 2/ 0 | 4.6E+01 | --- ( 0/ 2 ) | --- | --- | no samples |
| Lanthanum-140 Barium-140 | 2/ 0 | 5.4E+03 | --- ( 0/ 2 ) | --- | --- | no samples |

*Photo courtesy of: Mark Cunningham*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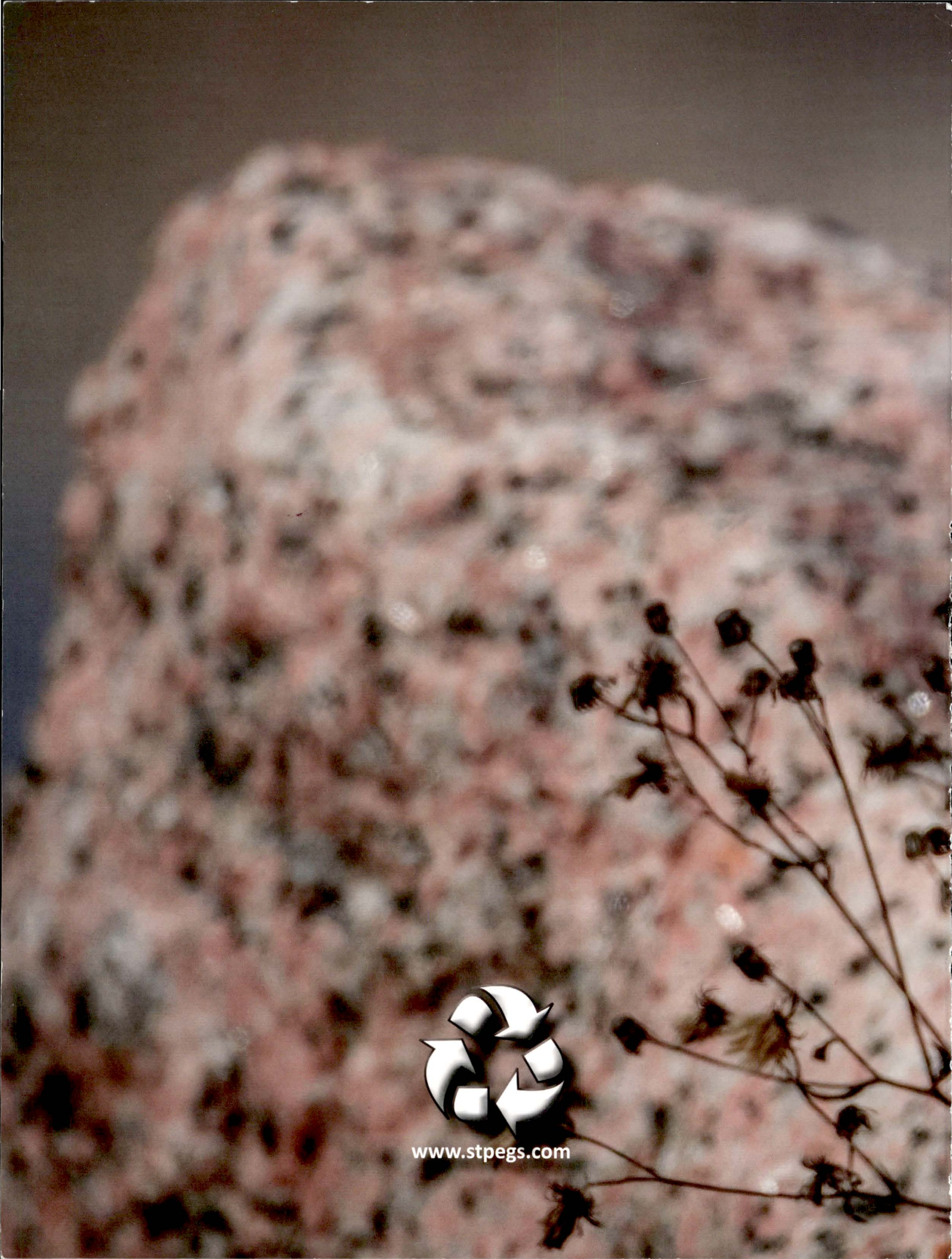
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