6.2 Radiological Monitoring

The purpose of the Radiological Environmental Monitoring Program (REMP) is to verify that STP is operating within its design parameters and to ensure that offsite doses are as low as reasonably achievable (ALARA). The REMP confirms that radioactive materials released in effluents are not reconcentrated in the environment and that the concentrations, if observed, are as modeled in the Offsite Dose Calculation Manual (ODCM). Addition of STP 3 & 4 will not require changes to the monitoring requirements in the existing REMP for STP 1 & 2. This section presents the basis, contents, reporting, and quality assurance aspects of the REMP.

6.2.1 Radiological Environmental Monitoring Program Basis

Preoperational data obtained before the construction and operation of STP 1 & 2 provided a baseline for STP 1 & 2. The current REMP data will provide a baseline for STP 3 & 4.

The following radiation exposure pathways are currently monitored (References 6.2-1 and 6.2-2):

- Direct (exposure pathways measured by thermoluminescence dosimeters)
- Airborne (including iodine canisters and particulate filters)
- Waterborne (including surface water, groundwater, drinking water, and sediment)
- Ingestion (including milk if available, broadleaf vegetation, fish and invertebrates, and meat)

Figures 6.2-1 and 6.2-2 show existing radiological sampling locations near the site on a local and regional level, respectively. Table 6.2-1 summarizes the REMP sample media codes. Table 6.2-2 summarizes the media code, station code, vector, and sample location description. Table 6.2-3 provides details of the radiation exposure pathways monitored and the frequency of monitoring. REMP results indicate that operation of STP 1 & 2 has not resulted in adverse effects to human health or the environment. The maximum annual radiation exposure calculated for a hypothetical person living at the STP site boundary has consistently been less than 1 millirem (Reference 6.2-3).

Trending and comparison reviews performed as part of the program are used to identify changes in background levels when compared to baseline measurements. Changes in program implementation (including sampling techniques, frequencies, and locations) may occur based on monitoring results, the adequacy of analytical technique, and changes in technology.

The preoperational and operational radiological monitoring program will include measurements to evaluate the possible effects from STP 3 & 4 operations and to ensure that changes in environmental radioactivity can be detected.

6.2.2 Existing Radiological Environmental Monitoring Program Contents

The emphasis of the operational REMP is to verify source control at the plant. In meeting this objective, certain findings have been considered in formulating the operational REMP. Among these, the most important in relation to critical exposure paths and population groups, are the following:

- As of the most recent land use census conducted beyond a 5 mile radius (2006; Reference 6.2-1), no commercial dairy exists within 10 miles of the plant. However, there are ranches with beef cattle within a 10-mile radius. As verified by annual 0-5 mile ODCM Land Use Census results, there are no cows or goats within 5 miles whose milk is consumed by humans.

- There are extensive commercial crops grown—mainly rice, soybeans, grain sorghum, and cotton—in the region immediately surrounding the plant. The major portion of irrigation in this region is from the canal and levee systems with water controlled by the Lower Colorado River Authority in Bay City. Alternate irrigation comes from deep water wells 300 feet or greater in depth. Although three irrigation permits have been issued by the Lower Colorado River Authority for irrigation with Colorado River water taken downstream from the plant, these permits have not been exercised due to the brackish quality of the river in this area.

- Local towns derive their drinking water from groundwater wells; there is no population consumption of water from the Colorado River below the plant.

- There is substantial commercial harvesting of shellfish in Matagorda Bay, with the potential of harvesting fin fish as well depending on state controls. The Colorado River estuary is limited to sport fishing for human consumption and commercial fishing for bait species.

- Prevailing winds are from the south to east-southeast.

6.2.2.1 Program Summary

The design and implementation of the REMP, related surveillance activities, sample analysis, and reporting is performed by STPNOC. The monitoring program is a tiered system in which the level of surveillance is, in part, determined by effluent releases. The minimum program is outlined in the following sections and in Table 6.2-3.

The program is modeled after the minimum REMP described in the 1979 NRC Branch Technical Position (Reference 6.2-4). This program was approved by the NRC and was included in the original Technical Specifications for each STP 1 & 2 unit. The approved program was later relocated based on NRC guidance from the Technical Specifications to the STP ODCM. The **bold faced type** appearing in Table 6.2-2 highlights the requirements of the minimum REMP approved by the NRC for STP 1 & 2.

The sampling frequencies given in Table 6.2-3 were selected to conform to the 1979 NRC Branch Technical Position on environmental monitoring. In some cases, the sampling frequency is determined by inherent characteristics of the medium; e.g., air filters can be run only 7–10 days before excessive pressure-drop arises. The frequency terms used in Table 6.2-3 generally mean once during the time period specified. Hence, annually means "some time during the year," not 365 days from the previous sample collection time. Likewise, monthly means "during the calendar month," not 30 days from the previous sample date. An effort is made to space the samples reasonably, but sample media availability, other scheduled activities, and equipment availability largely control the precise sample dates.

Typically, reporting units are pCi/m^3 for air pCi/l for liquid, and pCi/kg for solid samples. The standard deviation of the net counting rate is computed using the gross counting rate and the background rate.

6.2.3 Existing Radiological Environmental Monitoring Program Reporting

An Annual Radioactive Effluent Release Report (Reference 6.2-3) for the STP site is prepared in accordance with the ODCM and its implementing procedures. Results from REMP implementation are evaluated and compared to previous years' results to identify measurement trends, methodological consistency, and indications that program changes may be required.

An Inter-Laboratory Comparison Program exists to verify accuracy of sample results that are evaluated in the annual Radiological Environmental Operating Report.

A land-use census is conducted annually in accordance with the ODCM. Currently, the census is limited to an area within five miles of the STP units and is used to identify if revisions to the REMP are required. Parameters investigated include locations of nearest residence, milk production, and garden producing broad leaf vegetation.

In the event plant releases result in environmental measurements exceeding regulatory values or the results of an analysis indicate unexpected concentrations of radionuclides in the environment, a more vigorous sampling program may be instituted. In the event of an incident involving large releases of radioactivity from STP, an intensive sampling program would be initiated. This program would include special studies as appropriate for the particular incident and might include special reporting.

6.2.4 Existing Quality Assurance Program

The existing REMP is consistent with Regulatory Guide 4.15 (Reference 6.2-5). Quality assurance is provided in the existing NRC-approved REMP through quality training, a measurement assurance program that includes Inter-Laboratory Comparison Program tests, and administrative and technical procedures.

Control checks and tests are applied to the analytical operations by means of duplicate and/or split analyses of selected samples, and by the introduction of environmental samples with known nuclide concentrations. Calibrations are confirmed by participation in the Nuclear Energy Institute/National Institute of Standards and Technology Measurement Assurance Program.

6.2.5 Preoperational and Operational Radiological Monitoring Programs

The existing STP 1 & 2 REMP will serve as the preoperational radiological monitoring program and is already being implemented. The REMP for STP 3 & 4 will be based on NUREG 1302 and the NRC's Branch Technical Position Paper, "Acceptable Radiological Environmental Monitoring Program," Revision 1, 1979 (Reference 6.2-4).

The STP 1 & 2 ODCM will be modified, as necessary, to comply with STP 3 & 4 Technical Specifications and will address the requirements of 10 CFR 50 Appendix I. An Annual Radiological Environmental Operating Report as required by the ODCM will be prepared covering all four STP units.

The ODCM contains a detailed description of the proposed monitoring program including (1) number and location of sample collection points and the pathways sampled or measured, (2) sample collection frequency, and sampling duration, (3) type and frequency of analysis, (4) general types of sample collection and monitoring equipment, (5) lower limit of detection for each analysis, and (6) quality-assurance program for radiological environmental monitoring programs (Reference 6.2-1).

As described in Section 5.4, no new exposure pathways will result from the addition of STP 3 & 4. Based on the current radiological sample locations at the Exclusion Area Boundary (EAB), as shown on Figure 6.2-1, and the dose assessment provided in Section 5.4, no additional radiological sampling at the EAB is proposed for STP 3 & 4. Additionally, based on the effluent release points for gaseous and liquid effluent discussed in Section 3.5 and the regional dose analysis provided in Section 5.4, no additional regional monitoring points are proposed. However, it is proposed that the centroid for the regional monitoring be moved to the midpoint between STP 2 & 3.

6.2.6 Tritium Monitoring

Tritium is a radioactive isotope of hydrogen that is produced in the reactor. During the licensing of STP 1 & 2, the presence of tritium was anticipated and accounted for in the Main Cooling Reservoir (MCR), the shallow aquifer and in discharge from relief wells from the MCR to surface water drainage pathways.

Tritium monitoring of surface water, drinking water, and groundwater is currently performed as part of the REMP, as summarized in Table 6.2-3. Supplemental samples are also collected from several other locations on site. Table 6.2-4 summarizes the additional tritium sampling locations. Figure 6.2-3 depicts the tritium monitoring locations. Precise sample station locations and frequencies may change based on sample availability and the need to better define the subsurface migration of tritium. The sampling locations listed in Table 6.2-2 are not part of the required REMP, however, these sample stations, and potentially others, will be used by STP for additional studies to monitor for tritium in groundwater. Although tritium has been identified and analyzed in groundwater and surface water samples, the average annual tritium concentrations observed in the MCR have remained below United States Nuclear Regulatory Commission reporting limits (30,000 pCi/l) and within United States Environmental Protection Agency (40CFR141.66[d]) and State of Texas (30 Texas Administrative Code 290.108) drinking water standards (20,000 pCi/l).

In addition, several additional investigatory monitoring points (G901–G912) were sampled during the STP 3 & 4 site investigation performed in the fall 2006. Figure 6.2-3 depicts the additional tritium monitoring locations that have been used in the additional tritium studies.

6.2.6 References

6.2-1 South Texas Project Offsite Dose Calculation Manual, Revision 14, January 2007.

6.2-2 South Texas Project 2006 Annual Environmental Operating Report, April 2007.

6.2-3 South Texas Project 2006 Annual Radioactive Effluent Release Report, April 2007.

6.2-4 "An Acceptable Radiological Environmental Monitoring Program," U.S. Nuclear Regulatory Commission, Radiological Assessment Branch Technical Position, Revision 1, November 1979.

6.2-5 "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) -- Effluent Streams and the Environment," Regulatory Guide 4.15, Interim Rev. 2, March 2007.

6.2-6 "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors," NUREG-1302, April 1991.

Table 6.2-1 Radiological Environmental Monitoring Program Sample Media Codes

Code	Sample Type	Code	Sample Type
AI	Airborne Radioiodine	L5	Cabbage
AP	Airborne Particulate	L6	Collard Greens
B1	Resident Dabbler Duck	M1	Beef Meat
B2	Resident Diver Duck	M2	Poultry Meat
B3	Migratory Dabbler Duck	M3	Wild Swine
B4	Migratory Diver Duck	M4	Domestic Swine
B5	Goose	M5	Eggs
B6	Dove	M6	Game Deer
B7	Quail	M7	Alligator
B8	Pigeon	M8	Rabbit
CC	Crustacean Crab	OY	Oyster
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 L Samples
F3	Fish - Herbivore & Detritus Feeders	VP	Pasture Grass
L1	Banana Leaves	Wd	Drinking Water
L2	Cana Leaves	Wg	Groundwater
L4	Turnip Greens	Ws	Surface Water
		WW	(Relief) Well Water

Table 6.2-2 Radiological Environmental Monitoring Program Sample Submission Code (Pre-Application, Construction, Preoperation, & Operation)

Media Code	Station Code	Vector (Approximate)	Location Description
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	Buckeye - FM 1468
DR AI AP SO	**018**	5.5 miles NNE	Celanese Plant - 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

Table 6.2-2 Radiological Environmental Monitoring Program Sample Submission Code (Pre-Application, Construction, Preoperation, & Operation) (Continued)

Media Code	Station Code	Vector (Approximate)	Location Description
DR	**022**	7 miles E	Equistar Chemical Plant
DR	**023 [2]**	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
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
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
DR AI AP SO	**035**	8.5 miles SSE	Matagorda
DR	**036**	9 miles WSW	College Port
DR AI AP VB VP SO	**037 [2]**	10 miles WSW	Palacios AEP Substation
DR	**038**	10.5 miles NW	AEP Substation on TX 71 near Blessing
DR AI AP SO	**039**	9 miles NW	TX 35 under high voltage power lines near Tidehaven High School
DR	**040**	4.5 miles SW	Citrus Grove
DR	041	2.0 miles ESE	MCR Dike
DR	**042**	8.5 miles NW	FM 459 at Tidehaven Intermediate School
DR	**043**	4.5 miles SE	Site boundary at blowdown outlet
WS	209	2 miles ESE	Kelly Lake

Table 6.2-2 Radiological Environmental Monitoring Program Sample Submission Code (Pre-Application, Construction, Preoperation, & Operation) (Continued)

Media Code	Station Code	Vector (Approximate)	Location Description
WD	210	On Site	Approved drinking water supply from STP
WS S1	211 [1]	3.5 miles S	Site, E. Branch Little Robbins Slough
WS S1	212 [1]	4 miles S	Little Robbins Slough
WS S1	213	4 miles SE	W. Branch Colorado River
F (1, 2, or 3) CC	214	2.5 miles SE	MCR at Makeup Water Discharge
S2	215	0.5 mile SW	MCR at Circulating Water Discharge
WS S2	216	3.5 miles SSE	MCR at blowdown structure
F (1, 2, or 3) CC CS OY	**222 [1]**	>10 miles	West Matagorda Bay
WS S(1 or 2)	**227**	5-6 miles SE	West bank of Colorado River downstream of STP across from channel marker #22
WD	**228 [2]**	14 miles NNE	Le Tulle Park public water supply
WS S1	229	2-3 miles ESE	Drainage ditch north of reservoir that empties into Colorado upstream from makeup pumping facility
S(1 or 2)	**230 [1]**	3.5 miles ESE	Colorado River at point where drainage ditch (#229) empties into it
S(1 or 2) WS	**233 [1]**	4.5 miles SE	Colorado River where MCR blowdown discharge channel empties into it
WG	235	3.8 miles S	Well B-3 directly south from MCR
B8	236	N/A	STP Protected Area
WS	237	3.7 miles SSE	Blowdown discharge channel from MCR
S(1 or 2) WS	**242 [2]**	>10 miles N	Colorado River where it intersects Highway 35
WS	**243 [2]**	>10 miles N	Colorado River upstream of Bay City Dam at the LCRA pumping station

Table 6.2-2 Radiological Environmental Monitoring Program Sample Submission Code (Pre-Application, Construction, Preoperation, & Operation) (Continued)

Media Code	Station Code	Vector (Approximate)	Location Description
WS	245	4.5 mile SSE	Water well approximately 60' deep located on private property about 0.5 miles south of the MCR
WS	247	<1 mile E	Essential Cooling Pond
F(1,2, or 3)	**249 [2]**	N/A	Control sample purchased from a local retailer
SO	250	0.75 miles NW	Sewage sludge land farming area
WG	251	4.0 miles SSE	Test Well B-4, upper aquifer
F(1, 2, or 3) CC S2	300	S	STP Main Cooling Reservoir
WW	701	4 miles S	MCR Relief Well #440
WS	**Q01**	N/A	Quarterly composite of station #227 and/or alternate #233 (1)
WS	**Q02**	N/A	Quarterly composite of station #243 and/or alternate #242 (1)

[1] This station may be used to obtain the required aquatic samples in the vicinity of STP that may be influenced by plant operations.

[2] Control Station

MCR - STP Main Cooling Reservoir

Media codes typed in bold satisfy collection requirement described in Table 6.2-3

Station codes printed in bold identify offsite locations

Table 6.2-3 Radiological Environmental Monitoring Program (Pre-Application, Construction, Preoperation, Operation)

Sample Media, Number, Approximate Location and Distance of Sample Stations from Containment	No. Sampling Stations	Routine Sampling Mode	Sampling and Collection Frequency	Analysis Type	Minimum Analysis Frequency
Direction Radiation					
Exposure Media: TLD 16 – Located in all 16 meteorological sectors, 0.2 [1] to 4 miles 16 – Located in all 16 meteorological sectors, 2 to 7 miles 6 – Located in special interest areas (e.g., schools, population centers), within 14 miles 2 – Control stations located in areas of minimal wind direction (WSW, ENE), 10-16 miles	40	Continuously	Quarterly	Gamma Dose	Quarterly
Airborne					
Exposure Media: Charcoal and Particulate Filters	5	Continuous sampler operations	Weekly or more frequently if required by dust loading		
3 – Located at the exclusion zone, N, NNW, NW sectors, 1 mile				Radionuclide Canister: I-131	Weekly
1 – Located in Bay City, 14 miles				Particulate Sampler: Gross Beta Activity	Following filter change
1 – Control Station, located in a minimal wind direction (WSW), 10 miles				Gamma Isotopic of composite(by location)	Quarterly

Table 6.2-3 Radiological Environmental Monitoring Program (Pre-Application, Construction, Preoperation, Operation) (Continued)

Sample Media, Number, Approximate Location and Distance of Sample Stations from Containment	No. Sampling Stations	Routine Sampling Mode	Sampling and Collection Frequency	Analysis Type	Minimum Analysis Frequency
Waterborne					
Surface Water					
1 – Locatedin MCR at the MCR blowdown structure 1 – Located above the site on the Colorado River not influenced by plant discharge (control) 1 – Located downstream from blowdown entrance into the Colorado River	9	Composite sample over a 1 month period (grab if not available)	Monthly	Gamma Isotopic Tritium	Monthly Quarterly Composite
Groundwater 1 – Located at well downgradient in the shallow aquifer (B-4)		Grab	Quarterly	Gamma Isotopic and Tritium	Quarterly
Drinking Water (Tap) 1 – Located on site [2] 1 – Located at a control station		Grab	Quarterly	Gamma Isotopic and Gamma Isotopic Tritium	Monthly Quarterly Composite
Sediment 1 – Located above the site on the Colorado River, not influenced by plant discharge 1 – Located downstream from blowdown entrance into the Colorado River 1 – Located in MCR		Grab	Semiannually	Gamma Isotopic	Semiannually

Table 6.2-3 Radiological Environmental Monitoring Program (Pre-Application, Construction, Preoperation, Operation) (Continued)

Sample Media, Number, Approximate Location and Distance of Sample Stations from Containment	No. Sampling Stations	Routine Sampling Mode	Sampling and Collection Frequency	Analysis Type	Minimum Analysis Frequency
Ingestion					
Milk [3]	7	Grab	Semi-monthly when animals are on pasture; monthly at other times	Gamma-Isotopic and I-131	Semi-monthly when animals are on pasture; monthly at other times
Broadleaf Vegetation [4] 2 – Located at the exclusion zone, N, NW, or NNW sectors 1 – Located in a minimal wind direction		Grab	Monthly during growing season (when available)	Gamma-Isotopic and I-131	As collected
Fish and Invertebrates (edible portions) 1 – Representing commercially or recreational important species in vicinity of STP that may be influenced by plant operation 1 – Same or analogous species in area not influenced by STP 1 – Same or analogous species in the MCR		Grab	Sample semiannually	Gamma-Isotopic on edible portions	As collected
Agriculture Products [5]		Grab	At time of harvest	Gamma-Isotopic on edible portions	As collected
Domestic Meat 1 – Represents domestic stock fed on crops grown exclusively within 10 miles of plant		Grab	Annually	Gamma-Isotopic	As collected

Source - Reference 6.2-1

[1] The inner ring of stations in the southern sector is located within one mile due to the main cooling reservoir.

[2] No municipal water systems affected by STP. This sample taken from deep aquifer supplying drinking water to employees at work.

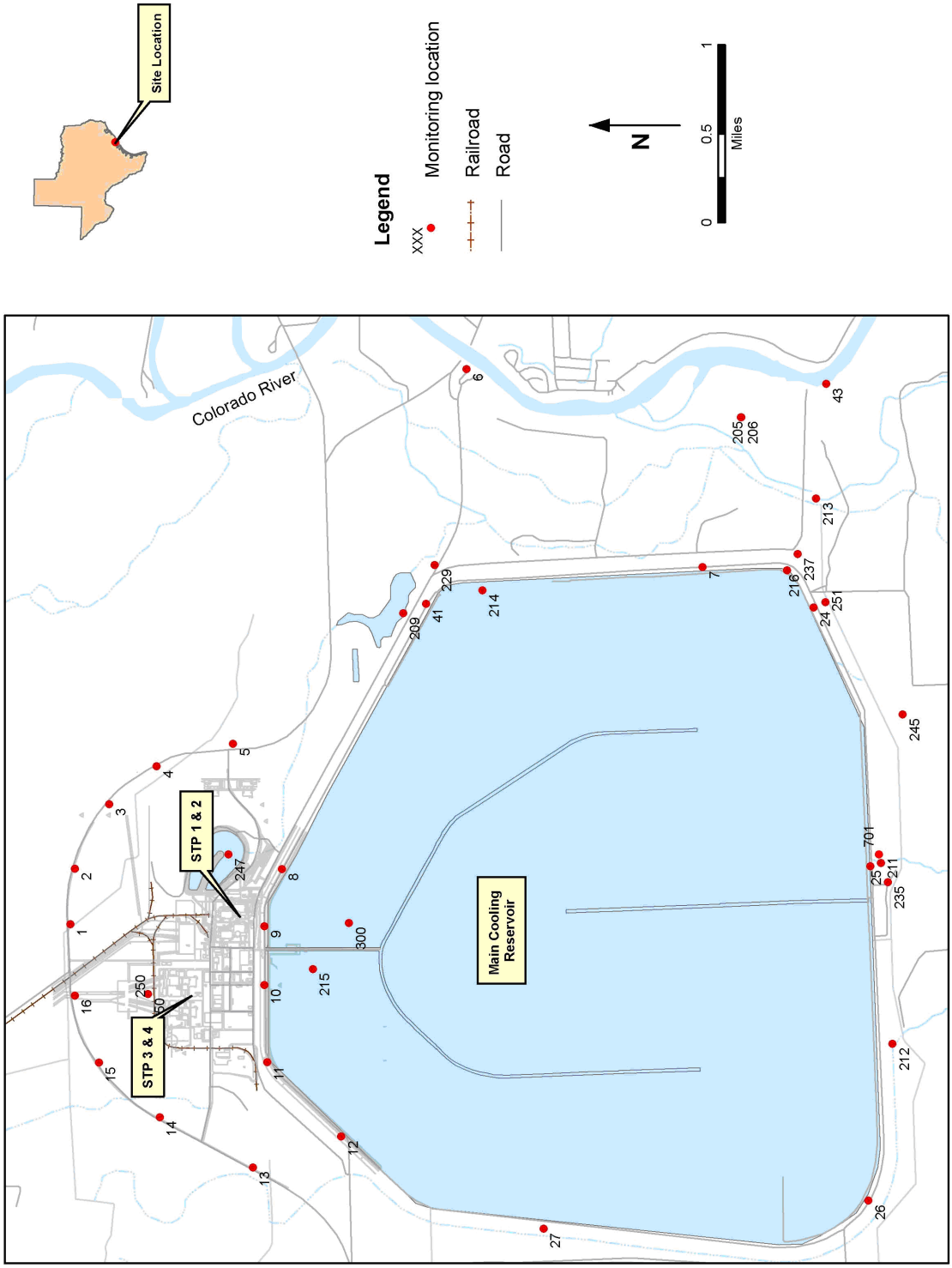
[3] Limited source of sample in the vicinity of STP.

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

[5] 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.

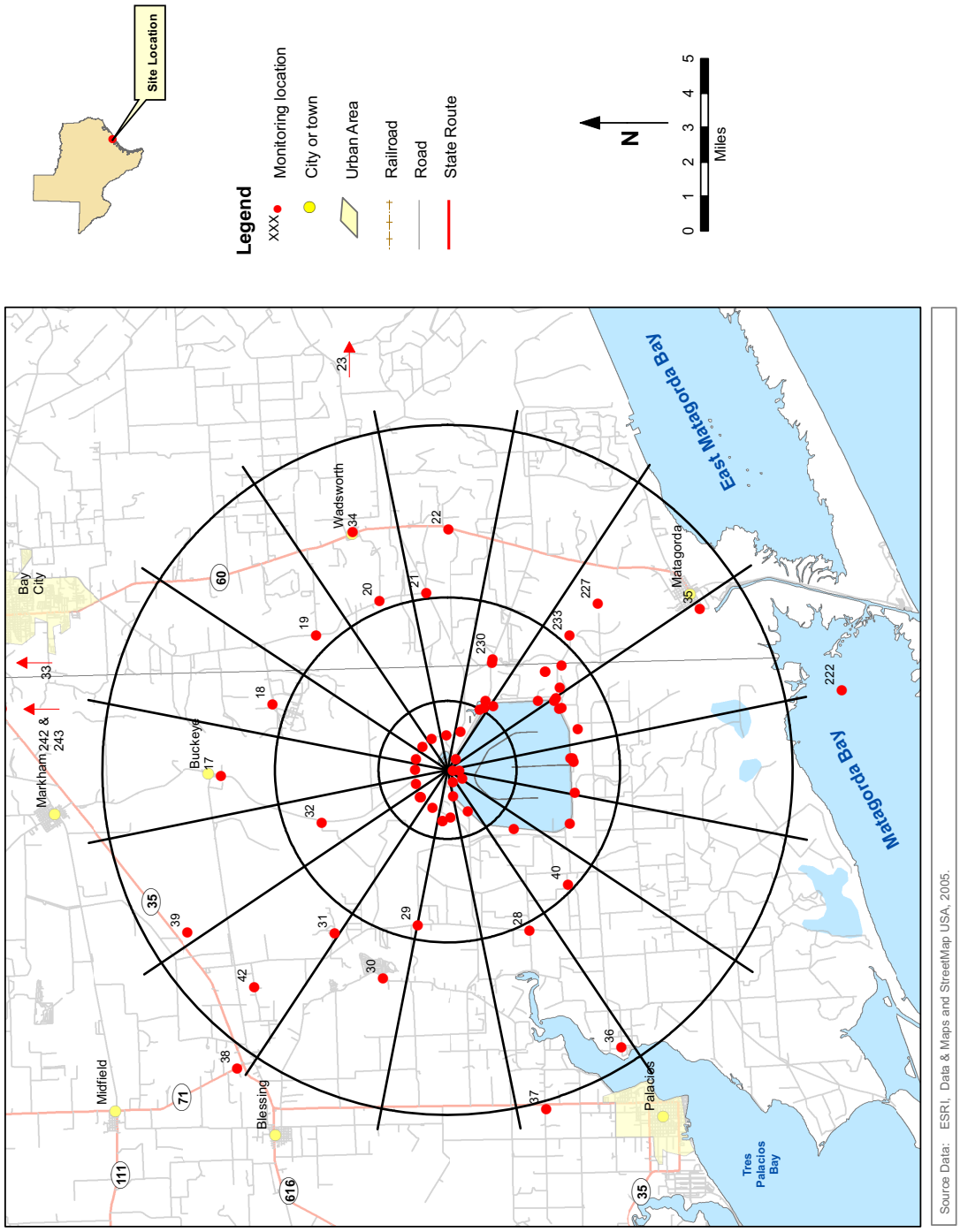
Table 6.2-4 Tritium Monitoring Program

Well Number	Sample ID	Depth, ft below ground surface
Piezometer Well # 415	255	110
Piezometer Well # 417	256	100
Piezometer Well # 421-02	257	80
Piezometer Well # 435-01	258	50
Piezometer Well # 435-02	259	50
Piezometer Well # 437	260	74
Piezometer Well # 446	205	78
Piezometer Well # 446A	206	40
Piezometer Well # 447	263	104
Piezometer Well # 447A	264	46
Piezometer Well # 602A	266	40
Windmill north of heavy haul road near Well #417	267	NA
Windmill east of MCR	268	NA
Water well located on private property approx.1/4 mile south of MCR reservoir	245	NA
Windmill south of the east corner of STP MCR on private land	269	NA
G-901	NA	Various
G-902	NA	
G-903	NA	
G-904	NA	
G-905	NA	
G-906	NA	
G-907	NA	
G-908	NA	
G-909	NA	
G-910	NA	
G-911	NA	
G-912	NA	



Source Data: ESRI, Data & Maps and StreetMap USA, 2005.

Figure 6.2-1 Radiological Monitoring Designated Sample Locations – Onsite Locations



Source Data: ESRI, Data & Maps and StreetMap USA, 2005.

Figure 6.2-2 Current Radiological Monitoring Designated Sample Locations – Regional

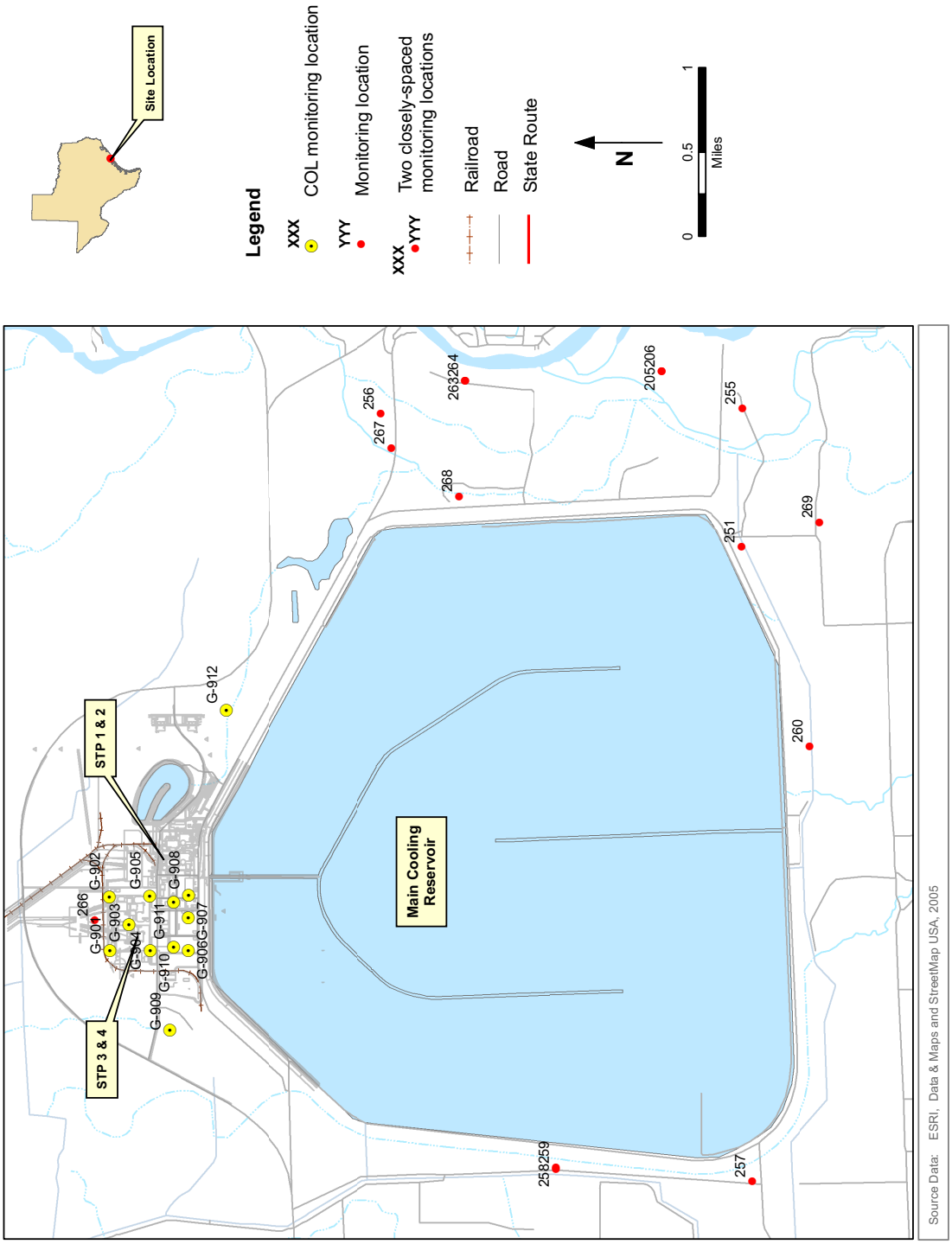


Figure 6.2-3 Tritium Monitoring Locations - Groundwater