Chapter 9 Table of Contents

Table of Contents (Continued)

Chapter 9 List of Tables

Chapter 9 List of Figures

9.0 Alternatives to the Proposed Action

The proposed action is for the NRC to issue a COL to authorize construction and operation of two 1535 MWe (net) nuclear power units to address future baseload generation needs. The purpose of the proposed project is to generate baseload power for sale for a profit on the wholesale market. As described in Section 8.0, Exelon is not a utility and does not have a defined service area in Texas. In Texas, Exelon is an unregulated merchant generator.

Chapter 9 describes the alternatives to construction and operation of new nuclear units at the Victoria County Station (VCS), as well as alternative plant and transmission systems. The descriptions provide sufficient detail to assess the impacts of the alternative generation options or plant and transmission systems relative to those of the proposed action. The chapter includes four sections:

- No-Action Alternative (Section 9.1)
- Energy Alternatives (Section 9.2)
- Alternative Sites (Section 9.3)
- Alternative Plant and Transmission Systems (Section 9.4)

As described in Chapter 8, the site is located in the Electric Reliability Council of Texas (ERCOT) region. ERCOT is the reliability coordinator, balance authority, and transmission operator for 75% of the geographical area and 85% of the load in the state of Texas (ERCOT Feb 2007; ERCOT Dec 2007). The ERCOT grid is essentially separated electrically from the rest of North America and, as shown in Figure 8.1-3, has only 2 DC ties to the Southwest Power Pool and 3 to Mexico with a total capacity of approximately 1100 MW (ERCOT Dec 2007). Because the ERCOT grid is isolated from the rest of North America, Exelon defines the region of interest as the area served by ERCOT.

9.0.1 References

ERCOT Dec 2007. Electric Reliability Council of Texas, *ERCOT DC-Tie Operations: NERC Tagging, Interchange Scheduling, Normal and Emergency Operations, and Inadvertent Accounting*, Version 3.0, Revision 0, December 2007, available at http://www.ercot.com/mktrules/guides/procedures/ERCOT%20DC-Tie%20Operations_v3r0.doc.

ERCOT Feb 2007. Electric Reliability Council of Texas, *ERCOT Fact Sheet*, February 2007, available at http://www.ercot.com/news/presentations/2007/ERCOT_Fact_Sheet_2-19-07.pdf.

9.1 No-Action Alternative

The no-action alternative is assumed to be the scenario where the U.S. NRC denies the COL for Exelon's proposed two units at the VCS. Under the no-action alternative, Exelon would not construct or operate the proposed units, and the associated 3070 MWe (net) of electrical capacity provided by the proposed units would not become available. The no-action alternative presupposes that no alternative energy sources would be constructed and operated, and that no additional conservation measures would be taken to decrease the electrical demand in the ERCOT region.

As described in Chapter 8, there is a demonstrated need for additional baseload generation capacity in the ERCOT region. ERCOT's forecast of peak demand growth in the ERCOT region is approximately 2.12% on average per year for the period 2007 to 2017 (ERCOT May 2007a) The minimum target reserve necessary for ERCOT to mitigate the load requirement uncertainty that arises from unit outages, adverse weather conditions, unexpected demand, or unplanned loss in the transmission system is 12.5% (ERCOT May 2007b). Given the limited interconnections, it would not be possible to supply the need for power in ERCOT with power purchased from outside of ERCOT. Without additional generating capacity ERCOT will not be able to maintain the necessary minimum target reserve.

The addition of nuclear generation capacity from two proposed units at the VCS would address these power generation needs, as well as support national and international goals to reduce the generation of greenhouse gases as outlined in the Energy Policy Act of 2005. The no-action alternative would not serve the purpose of the proposed project; namely to generate baseload power for sale at a profit on the wholesale market. Therefore, the no-action alternative is not a reasonable alternative to the proposed project.

Under the no-action alternative, the environmental and economical impacts of construction and operation of the two units would not be incurred. These impacts are described in detail in Chapters 4, 5, and 7, and are summarized in Chapter 10. Ancillary benefits of the proposed project include the employment of workers directly involved in the construction and operation of the proposed units, the indirect workers associated with an influx of direct employees, and the additional income all of these workers would inject into the regional economy. These benefits would not become available under the no-action alternative.

In light of the benefits for the proposed project, the construction and operation of two new units at the VCS is preferable to the no-action alternative.

9.1.1 References

ERCOT May 2007a. Electric Reliability Council of Texas, *2007 ERCOT Long-Term Hourly Peak Demand and Energy Forecast*, May 8, 2007.

ERCOT May 2007b. Electric Reliability Council of Texas, *2006 Annual Report*, May 2007, available at http://www.ercot.com/news/presentations/2007/2006_Annual_Report.pdf.

9.2 Energy Alternatives

This section evaluates the energy alternatives to satisfy future baseline electrical demand. Alternatives that do not require new generation capacity are described in Subsection 9.2.1 and those that do require new capacity are considered in Subsection 9.2.2. In Subsection 9.2.2, some of the alternatives that require new generation capacity were eliminated from further consideration and discussion based on their availability in the region, overall feasibility, ability to supply baseload power, or environmental consequences. In Subsection 9.2.3, the alternatives that were not previously eliminated are investigated in further detail relative to specific criteria such as environmental impacts and reliability.

9.2.1 Alternatives That Do Not Require New Generating Capacity

This subsection is intended to provide an assessment of the technical and economic feasibility of meeting the demand for energy without construction of new generation capacity. Potential options are to:

- Purchase power from other utilities or power generators
- Reactivate or extend the service life of existing plants in the power system
- Use existing peaking facilities to provide baseload power
- Implement demand side management programs

9.2.1.1 Purchase Power from Other Utilities or Power Generators

As described in Chapter 8, the region of interest for the need for power analysis is the Electric Reliability Council of Texas (ERCOT). Chapter 8 demonstrates that in ERCOT there is a need for power from the proposed VCS Units 1 and 2 plus other new generating facilities. Chapter 8 also demonstrates that there are very limited interconnections (five asynchronous high-voltage, direct-current ties with a total capacity of approximately 1100 MWe) between ERCOT and outside areas.

The existing direct-current ties can only move small amounts of power in one direction at a time over short distances and are a different technology from the free-flowing lines required for an interconnected grid. Due to reliability considerations, synchronous interconnection cannot be accomplished in a piecemeal or gradual fashion, and a considerable level of synchronous interconnection must be placed in service simultaneously to ensure the ability of the interconnection to handle the inter-grid transfers reliably. Connecting ERCOT to neighboring power pools would be a major engineering undertaking requiring a large investment. A 1999 Public Utility Commission of Texas (PUCT) study (PUCT Jan 1999) found that fully connecting the ERCOT grid with neighbors would require new transmission circuits to be installed at six sites along the east, north, and west ends of the current system. The cost for those lines and related facilities was estimated to be at least $600 million in 1997 dollars. Commencing a project today would require a new study to consider the engineering needs and project costs.

The PUCT, unlike most other state commissions, has jurisdiction over transmission and wholesale power rates and services in ERCOT. The PUCT's jurisdiction over these rates and services is a function of both state and federal law. Synchronous interconnection of ERCOT with neighboring power pools could result in the loss of the PUCT's current jurisdiction over transmission and wholesale power rates and services in ERCOT. If the PUCT's current wholesale jurisdiction were forfeited to the Federal Energy Regulatory Commission (FERC), federal regulations pertaining to wholesale transmission and energy sales would apply as opposed to state law and PUCT rules. Substantive differences between FERC and PUCT regulations include: wholesale rate setting practices; transmission pricing terms and conditions; required approvals for the sale, transfer and/or merger of utilities and utility assets; and terms and conditions for utility recovery of stranded investment (PUCT Jan 1999). It is unlikely that the PUCT or the Texas legislature would choose to relinquish PUCT jurisdiction over wholesale rates and services in ERCOT. In addition, transitioning the ERCOT market from PUCT regulation to FERC regulation would require substantial revision of market rules and impose additional project costs.

Given the limited interconnections with neighboring power pools, as well as engineering constraints, regulatory considerations, and costs associated with developing synchronous ties, it would not be feasible to meet the need for power within ERCOT with power purchased from outside of ERCOT, and thus purchased power is not a reasonable alternative to the proposed nuclear project.

Additionally, Exelon is a merchant generator in Texas. It does not have a defined service area, and its purpose for the project is to generate baseload power for sale on the wholesale market. Therefore, purchase of power from other companies is not a reasonable alternative because it would not serve the purpose of this project.

9.2.1.2 Reactivate or Extend Service Life of Existing Plants

Reactivating or extending the service life of existing plants could reduce the need for a new nuclear power station. Exelon has three gas-fired power stations in the ERCOT region: the five-unit Handley Station, the five-unit Mountain Creek Station, and the four-unit LaPorte Station. Currently there are no plans to retire any of these existing units between now and 2023 (the sixth year of commercial operation for the proposed VCS Unit 2). Since 2002, 3819 MWe of generating capacity has been retired in the ERCOT region (PUCT Nov 2007). These units have been decommissioned by their owners and cannot be restarted. As shown in Table 9.2-1, for the current ERCOT planning cycle, only one 65.0 MWe gas-fired peaking unit has announced its planned retirement. However, ERCOT presently has 4956 MWe of mothballed capacity, including four peaking units that are owned by Exelon. The ERCOT cumulative capacity to be mothballed between 2008 and 2013 is projected to be 5125 MWe.

ERCOT projections include returning some of these mothballed units to service in order to maintain a 12.5% reserve margin (ERCOT Dec 2007). Fossil fuel plants that have been mothballed or that are slated for retirement tend to be ones that have difficulty in meeting current restrictions on air pollutant emissions. Considering increasingly stringent restrictions, delaying retirement or reactivating plants would be unreasonable because, in order to meet regulatory requirements, major construction to retrofit emission control devices, upgrade, or replace plant components would likely be required. Consequently, reactivating or extending the service life of existing plants is not considered to be a reasonable alternative to the proposed nuclear project.

Additionally, Exelon is a merchant generator in Texas. It does not have a defined service area, and its purpose for the project is to generate baseload power for sale on the wholesale market. Therefore, reactivation or extension of the service of generating facilities owned by other companies would not serve the purpose of this project.

9.2.1.3 **Use Existing Peaking Facilities to Provide Baseload Power**

Baseload facilities are normally used to satisfy all or part of the minimum (baseload) of the system and, as a consequence, operate at full power continuously throughout the year. Peaking facilities usually run for short periods when demand on the grid exceeds baseload generation capacity in the region. Continuously running an existing peaking facility to provide additional baseload power could reduce the need for a new nuclear power station. Peaking facilities are small, generally fueled by oil or natural gas, which can be quickly started and shut down depending on changes in demand. Simple cycle combustion turbines and diesel generators are the most prevalent peaking technologies because they have a relatively low installed capital cost; however, these technologies are generally less fuel-efficient and release more air pollutants than baseload technologies using similar fuels. Consequently, peaking technologies are more expensive to operate, and their impact on the environment per unit of generation is greater than that from baseload technologies using similar fuels. Therefore, using existing peaking facilities to provide baseload power is not considered to be a reasonable alternative to the proposed nuclear project.

9.2.1.4 **Implement Demand Side Management Programs**

Historically, state regulatory bodies have required regulated utilities to institute programs designed to reduce demand for electricity. These demand side management (DSM) programs include energy conservation and load modification measures. However, the role of DSM programs in a deregulated market is less clear than in a regulated market.

As described in Chapter 8, ERCOT's determination of the need for power accounts for efforts to reduce demand. Therefore, even factoring in the reductions in demand associated with DSM programs, there will be a need for power in ERCOT at the time the proposed VCS project is scheduled to begin operation, and DSM is not a reasonable alternative to new generating facilities.

Finally, as stated previously, Exelon is a merchant generator in Texas. It does not have a defined service area, and its purpose for the project is to generate baseload power for sale on the wholesale market. Therefore, conservation and DSM would not serve the purpose of this project and are not reasonable alternatives to the project.

9.2.2 Alternatives Requiring New Generating Capacity

This subsection describes possible alternative energy sources that could reasonably be expected to provide the additional generating capacity from the proposed nuclear project. The COL application is premised on the installation of a facility that would serve as a large baseload generator (3070 MWe net electric output), and, thus, any feasible alternative would need to be able to generate comparable baseload power.

NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, provides a useful analysis of alternative sources. To generate the set of alternative technologies for power generation, the NRC analysis in NUREG-1437 included commonly known generation technologies and consulted various state energy plans to identify alternative generation sources typically being considered by state authorities across the country (U.S. NRC May 1996). Although NUREG 1437 is specific to license renewal, the alternatives analysis contained there can be applied to the proposed nuclear project applying for a COL to determine if an alternative technology represents a reasonable alternative to the proposed nuclear project. Accordingly, the following energy sources were identified as alternatives to the proposed nuclear project:

- Wind (Subsection 9.2.1.1)
- Solar — Photovoltaic cells (Subsection 9.2.2.2.1)
- Solar — Solar thermal systems (Subsection 9.2.2.2.2)
- Hydropower (Subsection 9.2.2.3)
- Geothermal (Subsection 9.2.2.4)
- Fuel cells (Subsection 9.2.2.5)
- Biomass (Subsection 9.2.2.6)
- Municipal solid wastes/landfill gas (Subsection 9.2.2.7)
- Coal (Subsection 9.2.2.8)
- Natural gas (Subsection 9.2.2.9)
- Petroleum (Subsection 9.2.2.10)
- Integrated gasification combined cycle (Subsection 9.2.2.11)
- Combination of alternatives (Subsection 9.2.3.3)

The alternative technologies considered in this analysis have been determined to be consistent with national policy goals for energy use, and are not prohibited by federal, state, or local regulations.

The following information is provided for each alternative energy source listed above: an overview, a current technology status, a discussion of the ability of the alternative energy source to serve the region of interest, a summary of the environmental effects of construction and operation, and a conclusion on the reasonableness with respect to the proposed nuclear project. In order to be considered "reasonable," an alternative energy source must satisfy the following criteria:

- The alternative energy conversion technology is developed, proven, and available in the relevant region in the life of the proposed nuclear project.
- The alternative energy source provides baseload generating capacity equivalent to the capacity of the proposed nuclear project.
- The alternative energy source does not result in environmental impacts in excess of a nuclear plant.

Based on the inability to meet one or more of these criteria, several of the alternative energy sources were determined to be not reasonable and were not considered further. Alternatives that were considered to be reasonable are assessed in greater detail in Subsection 9.2.3.

9.2.2.1 **Wind**

Overview

Wind energy systems use the kinetic energy of wind to produce electricity. The wind blows on the turbine blades, causing them to turn. The rotating blades turn a shaft that is connected to a gearbox that increases the rotation speed for a generator. The generator then converts the rotational energy into electrical energy. The amount of power generated by this process depends on the average wind speed and the area swept by the turbine blades.

Current Technology Status

Wind power is a fully commercialized technology. According to the U.S. DOE, wind-powered capacity in the United States increased 27% in 2006, and it had the fastest growing wind-power capacity in the world in 2005 and 2006.Despite this rapid growth, wind energy makes up less than 1% of the country's electric generating capacity (U.S. DOE May 2007).

Wind power systems produce power intermittently because they can only be fully operational when the wind blows at sufficient velocity and duration. Although advances in technology have improved wind turbine reliability to 98%, modern utility-scale wind turbines typically operate 65% to 90% of the time and often run at less than full capacity (AWEA 2007a; NRRI Feb 2007). Therefore, the capacity factors for wind power systems generally range from 25% to 40% (AWEA 2007a). These lower capacity factors illustrate that wind power cannot be depended on for a baseload power source.

Wind power systems that combine wind turbine generation with energy storage may overcome these obstacles and provide a source of power that is functionally equivalent to a conventional baseload electric power plant. By storing the power produced from wind power systems and releasing it when the wind facilities are not generating power, energy storage in combination with the wind facilities would be able to generate electricity continuously. Energy storage technologies include batteries, flywheel storage, superconducting magnetic energy storage, compressed air, pumped hydropower, and supercapacitors. However, large-scale energy storage is either not available or would not be economically viable (Schainker Dec 2006).

The energy potential of wind is expressed by wind generation classes that range from one (least energetic) to seven (most energetic). In a Class 1 region, at a height of 164 feet (50 meters), the average wind speed is less than 12.5 miles per hour (mph) and offers a wind power of less than 200 watts per square meter. A Class 7 region has an average of more than 19.7 mph and offers a wind power of more than 800 watts per square meter at a height of 164 feet (AWEA 2007c). Wind regimes of Class 4 or higher are potentially economical for the advanced utility-scale wind turbine technology currently under development. Class 3 wind regimes may be potentially economical for future utility-scale technology (U.S. DOE Sep 2004).

Until relatively recently, the offshore wind energy potential in the United States was ignored because vast onshore wind resources have the potential to fulfill the electrical energy needs for the entire country. However, development of onshore wind resources has mainly focused on remote areas of the western United States with Class 6 or greater wind regimes and on a few ridgelines in the eastern United States. The challenge of transmitting the electricity from these remote areas to large load centers may limit wind grid penetration for land-based turbines. Offshore wind turbines can generate power closer to large coastal load centers than land-based turbines can. Reduced transmission constraints, steadier and more energetic winds, and European success have made offshore wind energy more attractive for the United States. However, U.S. waters are generally deeper than those on European coasts and will require new technology to use those resources. (NREL Jun 2004)

Environmental conditions at sea are more severe than on land, and the sea poses saltwater corrosion concerns and additional loads from waves. In the past, turbine manufacturers have taken conventional land-based turbine designs, upgraded their electrical and corrosion-control systems to facilitate a marine service environment, and placed them on concrete bases or steel monopiles to anchor them to the seabed. This type of approach is only acceptable in water depths of 15 to 40 feet. Experience with offshore wind power development in Europe indicates that the use of conventional land-based turbine designs in a marine environment leads to reliability issues and increased maintenance costs. New turbine designs would be needed to withstand harsh offshore conditions. (NREL Jun 2004)

Ability to Serve Regional Needs

Texas is the nation’s top producer of wind energy and its capacity is forecasted to grow rapidly in the next several years (U.S. DOE May 2007). As of December 2007, ERCOT has 5700 MWe of wind energy capacity with an additional 1750 MWe planned by 2010. In addition, ERCOT lists another 6100 MWe of Potential Public Wind Resources plus 14,750 MWe of Potential Nonpublic Wind Resources. Wind energy currently makes up approximately 7.3% of ERCOT's installed energy capacity (ERCOT Dec 2007).

Wind resource studies indicate that in the United States, the potential wind resources in Texas are second only to those in North Dakota (AWEA 2007d). The largest expanses of high-quality wind resources in Texas are located in the Panhandle, most of which falls outside the ERCOT region. In ERCOT, the mountainous parts of west Texas and along the lower Gulf Coast contain areas with winds presently suitable for electric power generation (SECO 2007a). AWS Truewind submitted a wind generation assessment to ERCOT in January 2007 that identifies 25 viable competitive renewable energy zones distributed across the state with an estimated 1200 potential wind project sites. The estimated wind energy potential exceeds 130,000 MWe in a typical year. Most of these are located in the north, west, and central areas of ERCOT, although viable areas are also present near the coast southwest of Galveston (AWS Truewind Jan 2007).

Environmental Impacts

Wind energy is a renewable energy source that produces electricity without releasing air or water pollutants; however, these advantages are offset by environmental impacts such as aesthetic and noise concerns, large land requirements, potential harm to birds and bats, and radar interference.

Most wind facilities are located in remote areas and generate large aesthetic concerns, particularly if sited on mountaintops. Scenic vistas are important, and considerable public resistance exists to the use of mountain ridges for wind farms. Transmission lines required to deliver power to distant distribution centers result in additional land use and visual impacts.

The land use requirement for utility-scale wind plants in open and flat terrain is about 60 acres per megawatt of installed capacity. Approximately 5% (3 acres) of this area is occupied by turbines, access roads, and other equipment. The remaining land area can be used for compatible activities such as farming or ranching (AWEA 2007b). To generate the equivalent of the proposed nuclear project's net output of 3070 MWe, a wind farm with an average capacity factor of 35% would require as much as 526,000 acres (822 square miles), with about 26,000 acres (41 square miles) occupied by turbines and support facilities.

Although wind turbine/bird collision studies seem to indicate that wind generating facilities in some locations of the United States have a minor impact on birds compared to other sources of collision mortality, one cannot assume that similar impacts would occur among birds using wind-generating sites established on the Gulf of Mexico coast. Three migratory bird corridors converge immediately north of Corpus Christi, effectively funneling millions of birds along the lower Gulf Coast to wintering grounds in south Texas and Latin America. More than 200 species migrate along the lower Texas Gulf Coast annually, and several species on the federal threatened and endangered lists are included among these. Moreover, a diverse and abundant resident bird community potentially composed of federally and state-listed threatened and endangered species will likely occur on any proposed lower Gulf Coast wind-generating facility site. (NREL Jun 2006)

There are two potential sources of noise associated with wind plants: the turbine blades passing through the air as the hub rotates and the gearbox and generator. Noise from the blades is minimized by careful attention to the design and manufacture of the blades. The noise from the gearbox and generator is contained in the nacelle by sound insulation and isolation materials. Standing next to the turbine, it is usually possible to hear a swishing sound as the blades rotate and the whirl of the gearbox and generator may also be audible. However, as distance from the turbine increases, these effects are reduced. Well-designed wind turbines are generally quiet in operation and, compared to the noise of road traffic, trains, aircraft, and construction activities, the noise from wind turbines is very low. At 130 feet, the indicative noise level from a wind turbine is 50 dB to 60 dB, or about as noisy as a conversational speech or a busy office. A wind farm at 1150 feet would have a noise level of 35 dB to 45 dB (the level of a quiet bedroom) (BWEA 2007).

Experience has shown that wind turbines can degrade performance of air traffic control or air defense radar. The phenomenon can include sudden or intermittent appearance of radar contacts at the location of the wind turbine caused by blade motion or rotation of the turbine to face the wind. Air traffic control radar interference is generally limited to wind turbines that are in the radar line of sight. Studies indicate that this problem may be minimal for turbines more than 5 nautical miles (5.75 miles) from the radar. In September of 2006, the Department of Defense report titled, *The Effect of Windmill Farms on Military Readiness*, identified similar conflicts with air defense radar. According to this report, these conflicts can extend for tens of miles from the radar facility due to atmospheric refraction. (MTC 2007)

Conclusions

Based on this analysis, offshore wind technology has not matured sufficiently to support production for a baseload facility. Although land-based wind energy is developed and proven and would be available in the ERCOT region at the start of commercial operation of the proposed nuclear project, the capacity factor for wind energy is inadequate to provide baseload power. In addition, land-based wind energy has large land use requirements and associated ecological impacts. For these reasons, wind power alone is not environmentally preferable to nuclear power. Furthermore, because wind power alone cannot generate baseload power, it cannot serve the purpose of the proposed project and therefore is not a reasonable alternative. However, land-based wind power could be included in a combination of alternatives to the proposed nuclear project. Combinations of alternatives, including wind, are described in Subsection 9.2.3.3.

9.2.2.2 **Solar**

There are two basic types of solar technologies that produce electrical power: photovoltaics and solar thermal systems, evaluated in Subsection 9.2.2.2.1 and Subsection 9.2.2.2.2, respectively.

9.2.2.2.1 **Photovoltaics**

Overview

Photovoltaic cells convert sunlight directly into electricity. Light particles called photons penetrate the solar cell and knock electrons free from a semiconductor material to create an electric current. As long as an adequate amount of light flows into the cell, electrons flow out of the cell. Individual photovoltaic cells are typically combined into modules that hold about 40 cells, and modules are then mounted into photovoltaic arrays. A large number of arrays can be combined to create a power generation plant. (U.S. DOS Apr 2005)

Current Technology Status

Electric power generation from photovoltaic cells has been commercially demonstrated. However, only sunlight of certain energies will work efficiently to create electricity, and much of it is reflected or absorbed by the material that makes up the cell. Consequently, a typical commercial solar cell has an energy conversion efficiency of 15%. Low efficiencies mean that larger arrays are required, resulting in higher capital costs (NREL Oct 2007). Additional research is needed in semiconductor materials, device properties, and fabrication processes to improve the efficiency, stability, and cost of photovoltaic solar energy conversion (NREL May 2007).

Because photovoltaic cells rely on a fuel source that is intermittent, capacity factors are relatively low. The average annual capacity factor for photovoltaic systems is 24%, much lower than the 90% or better for a baseload plant, such as a nuclear plant (Leitner Jul 2002). Systems that combine solar power generation with energy storage may overcome these obstacles to provide a source of power that is functionally equivalent to a conventional baseload power plant. Energy storage technologies include batteries, flywheel storage, superconducting magnetic energy storage, compressed air, pumped hydropower, and supercapacitors. However, large-scale energy storage is either not available or would not be economically viable for these different technologies (Schainker Dec 2006).

Ability to Serve Regional Needs

When sunlight passes through the earth's atmosphere, a portion of the light is scattered or absorbed by haze, particles, or clouds (Leitner and Owens Jan 2003). Sunlight can therefore be categorized as either direct or diffused. Photovoltaic cells can use any form of sunlight, direct or diffused, to generate power. Photovoltaic systems typically use flat-plate collectors fixed in a tilted position correlated to the latitude of the location. This allows the collector to best capture the available sunlight. The annual average solar radiation for a flat-plate collector located in the ERCOT region ranges from 4.5 kWh to 6.5 kWh of solar radiation per square meter per day. Areas in the western portion of the ERCOT region receive considerably more solar radiation than the areas in the eastern portion of the ERCOT region. Therefore, it would require substantially more photovoltaic cells to produce the same amount of electricity in the eastern part of ERCOT, where the major load centers are located, as it would in the western part of the region.

Environmental Impacts

The environmental advantages of photovoltaic cells are that they have near-zero emissions and have available an unlimited supply of free fuel. Water use is much less than other technologies that require cooling water and is reduced to minimal amounts used to wash dust from panel faces. Environmental disadvantages of photovoltaic cells are sizeable land use requirements, aesthetic intrusion, and potential use of hazardous materials (lead) to store energy.

The amount of land required depends on the available solar insolation and ranges from about 3.8 to 7.6 acres per MW for photovoltaic systems (Leitner Jul 2002). Assuming an average capacity factor of 24%, a photovoltaic facility generating a net output equivalent to the proposed nuclear project of 3070 MWe is estimated to require at least 48,600 acres (76 square miles). Because of the relatively large land area requirements, a large photovoltaic facility could pose aesthetic concerns. In addition, retired system components (e.g., batteries) would likely require disposal as hazardous waste.

Conclusions

Based on this analysis, photovoltaic technology is developed and proven, and viable sites with adequate insolation levels are available in the ERCOT region at the start of commercial operation of the proposed nuclear project. However, due to its intermittent nature, the capacity factor for photovoltaic technology is inadequate to provide baseload power. In addition, photovoltaic systems have large land use requirements along with the environmental impacts associated with the disposal of retired components. For these reasons, photovoltaics alone are not environmentally preferable to nuclear power. Furthermore, because photovoltaics alone cannot generate baseload power, it cannot serve the purpose of the proposed project and therefore is not a reasonable alternative.

9.2.2.2.2 **Solar Thermal**

Overview

Solar thermal systems capture the sun's heat and transform it into electricity. Solar thermal systems include lenses or mirrors that concentrate the thermal power of sunlight into a fluid system to induce motion. The fluid is then routed through a turbine to generate electricity (WGA Jan 2006). This is basically the same type of system that is used to generate electricity from combustion of coal, except the thermal energy comes from the sun instead of from coal combustion. For this reason, solar thermal systems provide easy integration into the transmission grid. Solar thermal systems can also be equipped with a thermal storage tank to store the energy in the heat transfer fluid. This allows a solar thermal plant to provide dispatchable electric power—power available during periods of peak demand, even when the sun is not shining (WGA Jan 2006).

Current Technology Status

There are three types of solar thermal systems: parabolic trough, dish-Stirling, and power tower. Parabolic trough systems have been deployed in major commercial installations. The other solar thermal technologies have less commercial experience, but all have seen significant pre-commercial development in the past two decades. Parabolic trough plants 30 MWe to 80 MWe in size are in commercial operation, with a total of 354 MWe in the California Mojave Desert demonstrating reliable operation and excellent performance since 1985. Additional trough systems are under development in Arizona, Nevada, and Spain. Dish-Stirling systems are currently in an aggressive commercialization program by industry centered on a 25 kWe dish system unit for modular production of over-100 MWe plants. Recently, two California utilities signed power purchase agreements for dish-Stirling projects that could provide as much as 1750 MWe capacity by 2014. A prototype 10 MWe power tower that was successfully operated in California demonstrated efficient thermal energy storage and 24-hour-per-day electric production. (WGA Jan 2006)

Generating capacities and capacity factors for solar thermal are too low to meet baseload requirements. Current solar thermal systems are as large as 200 MW, with capacity factors that range from 30% to 50% (NRRI Feb 2007). This range is relatively low compared to capacity factors of 90% or better for a baseload plant, such as a nuclear plant.

Ability to Serve Regional Needs

Solar thermal plants can only use the direct component of the sunlight but focus the energy to achieve higher temperatures. Solar thermal technologies produce more electricity on clear, sunny days with more intense sunlight and when the sunlight is at a more direct angle (i.e., when the sun is perpendicular to the collector). To work effectively, solar thermal installations require consistent levels of sunlight (solar insolation).

The average amount of solar energy reaching the ground needs to be at least 6.0 kWh per square meter per day for solar thermal systems (Leitner Jul 2002). Solar thermal systems use tracking, concentrating collectors so they always face the sun. The annual average solar radiation for a concentrating collector located in the ERCOT region ranges from 3.5 kWh to 7.0 kWh of direct solar radiation per square meter per day (U.S. DOE Oct 2006). Only the very western tip of the ERCOT region would be suitable for solar thermal development (U.S. DOE Oct 2006).

Environmental Impacts

The environmental advantages of solar thermal technology are that it has near-zero emissions and it uses an unlimited supply of free fuel. Cooling water requirements for solar thermal systems that use wet cooling towers is similar to that of conventional boiler power technology. Parabolic trough plants and power towers use approximately 740 gallons of water per megawatt-hour. Dish-Stirling plants are air-cooled and do not use any water for cooling. All solar thermal technologies require a minimal amount of water to wash dust from mirror surfaces (NREL Apr 2006). Environmental disadvantages of solar thermal technologies are sizeable land use requirements and the associated aesthetic intrusion.

Land use requirements, and associated construction and ecological impacts, are greater for solar technologies than for a nuclear plant. The land area required depends on the available solar insolation and, based on a report from the Western Governors Association, the nominal land area required for a solar thermal system in a region receiving at least 6.0 kWh per square meter per day, is around 5.0 acres per megawatt (WGA Jan 2006). To generate the equivalent of the proposed nuclear project's net output of 3070 MWe, a solar thermal facility with an average capacity factor of 40% would require 38,400 acres (60 square miles).

Conclusions

Based on this analysis, solar thermal technology is developed and proven, and viable sites with adequate insolation levels are currently available in the ERCOT region; however, due to its intermittent nature, the capacity factor for solar thermal technology is inadequate to provide baseload power. In addition, solar thermal systems have large land use requirements along with the associated environmental impacts. For these reasons, solar thermal alone is not environmentally preferable to nuclear power. Furthermore, because solar thermal alone cannot generate baseload power, it cannot serve the purpose of the proposed project and therefore is not a reasonable alternative.

9.2.2.3 Hydropower

Overview

Hydroelectric power plants (also called hydropower plants) use the kinetic energy of falling water to produce electricity. The flowing water turns a turbine that is connected to a generator. The amount of power generated by this process depends on several variables: the volume of water, the flow rate, and the distance the water is falling. Hydropower is a proven energy source that can be used to provide baseload power, but its use is limited to locations that have both a large volume of flowing water and a change in elevation.

Current Technology Status

Hydropower is a fully commercialized technology that has provided baseload power for more than a century. Hydropower is currently the leading renewable energy source used by electric utilities to generate electric power (U.S. DOE EIA Mar 2007b). In 2005, hydroelectric power plants accounted for 7.9% of the nation's power capacity and 6.7% of the power generated (U.S. DOE EIA Mar 2007a). However, hydropower's estimated capacity factor of 40% to 50% is below the nominal nuclear power facilities' capacity factors of 90% or better (INL Jul 2005), and the National Hydropower Association forecasts a decline in large-scale hydropower use through 2020 as a result of increased environmental regulation (U.S. DOE Sep 2005).

There are two types of hydropower facilities: impoundment and diversion. The most common types are impoundment facilities where river water is contained behind a dam to form a reservoir. The water can be released to meet changing demands for electricity or to maintain the reservoir level. These systems can be very efficient with as much as 90% of the energy being converted to electrical power (MDNR Jul 2007). In some cases, impoundment systems are used specifically to store energy. This is done at pumped storage facilities with two separate reservoirs, one positioned at a much higher elevation than the other. As in impoundment facilities, water is released from the upper reservoir to flow through a turbine to produce electricity during peak demand. During off-peak periods, the water is pumped back to the upper reservoir using a different source of power. Pumped storage serves as a load management tool by lowering the amount of power that other generation units must provide during the periods of highest demand (and highest cost) for electricity (NRRI Feb 2007).

Diversion facilities use the flow of a fast-moving river, often near waterfalls, and do not require a dam. A portion of the water is diverted through a canal or penstock to a turbine positioned in or to the side of the river. Electricity generation, therefore, varies depending on the flow of the river. These systems cannot store power in the way a dam does and are best applied for smaller scale local power applications or in remote locations away from main utility power grids (MDNR Jul 2007).

Ability to Serve Regional Needs

In the ERCOT region, hydropower accounts for 545 MWe of power capacity representing about 0.7% of the region's electric power capacity (Drew 2007). A recent DOE study indicates that there is approximately 328 MWe of undeveloped hydropower in Texas (U.S. DOE Jan 2006). Thus, the available hydropower in the entire state of Texas is well below the 3070 MWe capacity of the proposed nuclear project.

Environmental Impacts

Land use for a large-scale hydropower facility using impoundments is likely to be substantial. NUREG-1437 estimates land use of 1600 square miles per 1000 MWe generated by hydropower (U.S. NRC May 1996). Based on this estimate, a 3070 MWe hydroelectric plant would require 4900 square miles to be flooded.Associated with this large land loss would be some erosion, sedimentation, dust, potential loss of cultural artifacts, aesthetic impacts, and equipment exhaust from land clearing and excavation. Alterations to terrestrial habitats could increase the risks to threatened and endangered species. The original land uses would be replaced by electricity generation and recreation, and perhaps, residential and business developments that take advantage of the lake environment. (U.S. NRC May 1996)

Hydropower facilities can have a substantial effect on the surrounding environment's ecology. Diverting water out of the stream channel (or storing water for future electrical generation) can dry out streamside vegetation. Insufficient stream flow degrades habitat for fish and other aquatic organisms in the affected river reach below the dam. Water in the reservoir is stagnant compared to a free-flowing river, so waterborne sediments and nutrients can be trapped, resulting in the undesirable growth and spread of algae and aquatic weeds. In some cases, water spilled from high dams may become supersaturated with nitrogen gas and cause gas-bubble disease in aquatic organisms inhabiting the tailwaters below the hydropower plant. (U.S. DOE Aug 2005a)

Additionally, changes in water temperature, currents, and amount of sedimentation produce a different aquatic environment above and below the dam (U.S. NRC May 1996). Alterations to aquatic habitats could change the risks to threatened and endangered species (U.S. NRC May 1996). The dam can block upstream movements of migratory fish. Downstream-moving fish may be drawn into the power plant intake flow and pass through the turbine. These fish are exposed to physical stresses (pressure changes, shear, turbulence, strike) that may cause disorientation, physiological stress, injury, or death (U.S. DOE Aug 2005a).

Conclusions

Based on this analysis, although hydropower is developed and proven, the potential for future hydropower development in the ERCOT region is inadequate to supply the power of the proposed nuclear project. In addition, hydropower has large land use requirements along with the associated environmental impacts. For these reasons, hydropower is not environmentally preferable to nuclear power. Furthermore, because hydropower in Texas is not available in sufficient quantities to supply the power to be provided by the proposed project, it cannot serve the purpose of the proposed project and therefore is not a reasonable alternative.

9.2.2.4 Geothermal

Overview

Geothermal power plants use naturally heated fluids in underground reservoirs as an energy source for electricity production. Electricity production using geothermal energy is based on conventional steam turbine and generator equipment, in which expanding steam powers the turbine/generator to produce electricity. Geothermal energy is tapped by drilling wells into the reservoirs and piping the hot water or steam into a power plant for electricity production. Geothermal is a proven energy source that can be used to provide baseload power, but its use is currently limited to near-surface hydrothermal resources.

Current Technology Status

Geothermal energy has provided commercial baseload power around the world for more than a century (MIT 2006). Geothermal plants have high availabilities and can achieve capacity factors of 97% (Erdlac Jan 2007). The United States is the world leader in online capacity of geothermal energy and the generation of electric power from geothermal energy. In 2005, geothermal energy provided approximately 16 billion kWh), nearly 0.4% of the electricity consumed in the nation. As of May 2007, the United States had about 2850 MWe of geothermal generating capacity (GEA May 2007).

There are four types of geothermal resources: hydrothermal (hot water or steam at moderate depths of 330 feet to 14,800 feet), geopressured (hot water aquifers containing dissolved methane under high pressure in sedimentary formations at depths of 9800 feet to 19,700 feet), hot dry rock (abnormally hot geologic formations with little or no water), and magma (molten rock at temperatures of 1200ºF to 2370ºF). (Bronicki 2002; Druffield 2003)

At present, only high-grade (shallow, hot, and permeable) hydrothermal reservoirs are used for the generation of electricity. However, recent research indicates that it may be feasible to extract geothermal electric power from hot dry rock systems and geopressured reservoirs using enhanced geothermal systems (EGS). EGS is a process where geothermal aquifers with low permeability can be stimulated to create a conductive fracture network where the reservoir operates like a conventional hydrothermal reservoir (MIT 2006). EGS is currently in the early stages of development. The U.S. DOE Geothermal Technologies Program is conducting research on EGS with the goals of demonstrating the feasibility of creating EGS reservoirs capable of producing hot fluids at the high rates needed for commercial development by 2011 and demonstrating the economic feasibility of EGS by 2018 (U.S. DOE Aug 2005b).

Commercially available geothermal generating technologies include dry steam, flash steam, and binary-cycle power plants. The type of power plant depends on the temperature and pressure of the geothermal reservoir. (Erdlac Jan 2007)

Dry steam power plants are used with vapor-dominated hydrothermal resources. Dry steam power plants use pressurized steam at temperatures above 455°F. Steam from the geothermal reservoir is routed directly through turbine-generator units to produce electricity. Dry steam units are available in the 35 MWe to 120 MWe range. (Erdlac Jan 2007)

Flash steam power plants are used with liquid-dominated hydrothermal resources of 360°F or higher. In these plants, the pressurized geothermal fluid is brought to the surface by wells and piped to a central power plant. The hot fluid is partially depressurized, causing it to rapidly vaporize (flash) to steam. The steam is then used to drive a steam turbine-generator. Hot water and condensed steam are injected back into the reservoir. Flash steam units are available in the 10 MWe to 55 MWe range. (Erdlac Jan 2007)

Binary-cycle power plants are used with liquid-dominated hydrothermal resources of moderate temperature (225°F to 360°F), or where too many impurities are contained in the geothermal fluid to allow flashing. In binary-cycle systems, hot geothermal fluids are brought to the surface using wells, and passed through one side of a heat exchanger to heat a working fluid in a separate adjacent pipe. The working fluid, a compound with a low boiling point such as isobutane, pentane, or ammonia, is vaporized. The vaporized working fluid is used to drive a turbine-generator, condensed, and recycled to the heat exchanger. The cooled geothermal fluid is re-injected to the geothermal reservoir. Binary-cycle units are available in the 1 MWe to 3 MWe range. (Erdlac Jan 2007)

Ability to Serve Regional Needs

Use of geothermal resources for the generation of electricity is currently limited to shallow, high-temperature convective hydrothermal reservoirs. While Texas does not have sufficiently hot, shallow geothermal resources of the type mentioned above, the state does have geothermal resources that could potentially support energy development. One promising opportunity is to use the state's extensive network of oil and gas wells to access geopressured resources. More than 600,000 oil and gas wells have been drilled in Texas, most of which are located in the ERCOT region. High-temperature fluid (250°F or higher) has been encountered in many of the wells that are 16,000 feet or deeper, with the highest temperatures above 400°F.More than 12 billion barrels of water are currently produced each year from oil and gas wells in Texas. Heat from this water could be used to generate electricity using binary power systems. Researchers have estimated that electric power production potential from Texas oil and gas wells ranges from 400 MW in the near-term to more than 2000 MW once the technology is demonstrated (GEA Jan 2007).

In the ERCOT region, extensive geopressured resources are located in east Texas, the Gulf Coast, and the Delaware-Val Verde Basin. East Texas also has hot dry rock resources (Erdlac Jan 2007). However, as described above, the EGS technologies needed to use these resources are in the early stages of development.

Environmental Impacts

Geothermal power generation facilities require between 1 and 8 acres per MWe (U.S. DOE Nov 2004). Based on a 95% capacity factor, a geothermal power plant with a net output of 3070 MWe would require at least 3232 acres (5 square miles).

The major environmental concerns associated with geothermal development are the release of small quantities of carbon dioxide and hydrogen sulfide, and disposal of sludge and spent geothermal fluids. Subsidence and reservoir depletion is also a concern when withdrawal of geothermal fluids exceeds natural recharge or injection. Induced seismicity can be a concern when large amounts of geothermal fluids are injected back into the hydrothermal reservoir. (U.S. DOE Nov 2004)

Conclusions

Based on this analysis, geothermal power using high-grade (shallow, hot, and permeable) hydrothermal reservoirs is developed and proven; however, because there are no known shallow, high-temperature hydrothermal resources in the ERCOT region, the potential for future geothermal power using currently available technology is inadequate to supply the equivalent power of the proposed nuclear facility. The generation of electricity from geopressured reservoirs and hot dry rock resources (the type available in the ERCOT region) is in the early stages of development, and thus this technology has not matured sufficiently to support production for a baseload facility. For these reasons, geothermal power is not a reasonable alternative for baseload power in the ERCOT region.

9.2.2.5 **Fuel Cells**

Overview

Fuel cells are similar to common batteries. Both have a positive end and a negative end, rely on chemical reaction, and produce electricity when the circuit is closed. In hydrogen fuel cells, hydrogen passes through an anode catalyst where it is ionized into a positively charged hydrogen ion and a negatively charged electron. The hydrogen ions then pass through a conductive medium and combine with oxygen to form water. The electrons formed by the ionization process create an electrical current (NRRI Feb 2007). Hydrogen fuel can come from a variety of hydrocarbon resources that are gasified by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Current Technology Status

Fuel cell power plants are in the initial stages of commercialization. Although nearly 900 large (greater than 10 kW) stationary fuel cell systems have been built and operated worldwide, the global stationary fuel cell electricity generation capacity in 2007 was approximately 150 MWe (FCT Sep 2007). The largest stationary fuel cell power plant built is the 11 MWe Goi Power Station in Ichihara, Japan (FC2000 2007), but plants typically generate 2 MWe of power (NRRI Feb 2007). Replacement of the power capacity of the proposed nuclear units would require construction and operation of more than 20 times the generating capacity worldwide.

Ability to Serve Regional Needs

According to the Fuel Cells 2000 Worldwide Stationary Fuel Cell Installation database (FC2000 2007), 21 fuel cell power plants have been installed in the ERCOT region and one small residential system is planned.

Texas is the top producer of natural gas in the United States, extracting 5.3 trillion cubic feet and exporting more than 3.2 trillion cubic feet (U.S. DOE EIA 2007a; U.S. DOE EIA Nov 2006). Therefore, ERCOT has an extensive infrastructure for distribution and abundant natural gas resources available for a large fuel cell power plant.

Environmental Impacts

Fuel cells work without combustion and therefore do not produce the environmental side effects associated with combustion. The only byproducts of the fuel cell generation process are heat, water, and carbon dioxide. The impacts of the end-of-life phase of fuel cells are small, in part, because of the large motivation to recover precious metals components.

Conclusions

Due to production limitations, fuel cell technology is not a reasonable alternative for baseload capacity.

9.2.2.6 **Biomass**

Overview

The term “biomass” means any plant-derived organic matter available on a renewable basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, aquatic plants, animal wastes, and other waste materials (U.S. DOE Sep 2006, U.S. DOE EIA 2007g). Biomass power plants use biomass feedstock to produce electric power through direct combustion or through gasification and then combustion of the resultant gas (U.S. DOE Sep 2006). Because biomass technologies employ combustion processes to produce electricity, they can generate electricity at any time.

Current Technology Status

Biomass-fired facilities generate electricity using commercially available equipment and well-established technology. Biomass is the largest source of renewable electricity generation among the non-hydropower renewable fuels, and consumption in electric utilities is expected to nearly double by 2030 (U.S. DOE EIA Feb 2007a). In 2006, the United States had about 6800 MWe of biomass generating capacity, and U.S. biomass power plants provided approximately 41.4 billion kWh of electrical power (U.S. DOE EIA Aug 2007).

Wood (i.e., forestry residues and urban wood waste) is the primary biomass feedstock used in the generation of electricity. In 2006, the United States had about 6200 MWe of wood-fired generating capacity, about 92% of the nation's biomass generating capacity. That same year, wood-fired power plants provided approximately 39.4 billion kWh, approximately 95% of the U.S. electrical power generated from biomass feedstocks (U.S. DOE EIA Aug 2007).

There are three primary classes of utility-scale biomass power systems: direct-fired, co-fired, and gasification. Nearly all of the biomass-energy-using electricity generation facilities in the United States use direct-fired steam turbine conversion technology. The technology is relatively simple to operate and it can accept a wide variety of biomass fuels. However, at the scale appropriate for biomass (the largest biomass power plants are 40 to 50 MW in size) the technology is expensive and inefficient (U.S. DOE Sep 2006).

Co-firing involves substituting biomass for a portion of coal in an existing power plant furnace. It is the most economic near-term option for introducing new biomass power generation. Because much of the existing power plant equipment can be used without major modifications, co-firing is far less expensive than building a new biopower plant. Compared to the coal it replaces, biomass reduces sulfur dioxide (SO_2), nitrogen oxides (NO_x), and other air emissions. After "tuning" the boiler for peak performance, there is little or no loss in efficiency from adding biomass (U.S. DOE Sep 2006). While biomass can be successfully co-fired with coal, it is not without technical challenges. Biomass is much less dense than coal, requiring a large volume of fuel to be handled. Larger areas of biomass storage and additional handling are required to accommodate the lower-density materials. Moreover, the ash residue left from combusting biomass contains alkali and alkaline earth elements, such as sodium, potassium, and calcium. These compounds bind irreversibly with the catalysts used in selective catalytic reduction (SCR) reactors that have been installed on coal-fired generating plants. These compounds can lead to increased catalyst plugging and cause deactivation of SCR catalysts, thus reducing or eliminating the ability of this technology to reduce NO_x emissions (Bowers Mar 2005).

Biomass can be used in integrated gasification combined-cycle (IGCC) systems in which gasifiers heat the biomass in an environment where the solid biomass breaks down to form a flammable gas. The biogas is then cleaned and filtered to remove problem chemical compounds before being burned in a combined-cycle unit (U.S. DOE Sep 2006). IGCC systems are described in Subsection 9.2.2.11.

Ability to Serve Regional Needs

As one of the nation's leading agricultural states with a large forest and cattle industry, Texas has the potential to become a major biomass producer. The availability and type of biomass differs from region to region, but most biomass opportunities are located in rural areas. The state's very large urban base also contributes to the energy pool with substantial amounts of biomass-derived wastes. If just half of Texas' available biomass resources were used for electricity production, they could supply 10% of the state's needs (SECO 2007b).

Permitting has been completed for a 100 MW biomass-fired power plant in East Texas. It will be the first major biomass-fired electric generating plant in Texas and the largest such plant in the United States. The facility will burn about one million tons of wood fuel a year (U.S. DOE Jun 2007).

In the year 2002, 1.07 billion kWh were produced in Texas by burning wood and wood waste, making up 21% of the energy provided by renewables (U.S. DOE Sep 2006). Wood wastes are used in east Texas to generate steam and electricity for local use or occasionally for resale to the grid (SECO 2007b). The entire state's wood energy electrical production for 2002 represents about 5% of the estimated 24.2 billion kWh that the proposed nuclear project would provide.

The cost-effectiveness of energy production is sensitive to the nearby availability of the energy crop. Therefore, products such as switchgrass and sugarcane that are available in the ERCOT region are the most promising. Immediate economic benefits are in the rural areas that grow and harvest these crops. Potential energy crops are geographically distributed. East Texas is ideal for cultivating short-rotation, wood energy crops like hybrid poplars and hybrid willow trees that can reach a height of 15 to 25 feet in 3 years. There are federal funds available for the study of biomass derived from hybrid poplars and hybrid willows, and the technology exists. The predominant energy crops in the high plains of Texas, situated in the northwestern part of the panhandle, are cotton, sorghum, corn, and wheat. Without irrigation, the nature of agriculture in the region's dry climate would change significantly. The Gulf Coast and the Rio Grande Delta are in the ERCOT region, unlike most of east Texas and the Texas panhandle. These areas have extensive sugarcane resources that are also being studied as feedstock for the production of ethanol. Switchgrass, a tall native grass, is a proposed energy crop that can flourish in this area. North Texas and central Texas are also in the ERCOT region and have extensive mesquite cover that is being studied to determine the feasibility of developing a bioenergy industry in the area. (SECO 2007b)

As discussed in NUREG-1437, the use of wood waste to generate electricity is largely limited to states with significant wood resources. The pulp, paper, and paperboard industries in states with adequate wood resources generate electric power by consuming wood and wood waste from the mills for energy. This produces a benefit from the use of waste materials that could otherwise represent a disposal problem.

A study on biomass feedstock availability (Walsh et al. 2000) reports that there are 1,050,700 tons of forest residues available annually in Texas.Because mill residues are clean, concentrated at one source, and relatively homogeneous, nearly 98% of all residues generated in the United States are currently used as fuel or to produce other fiber products. There are 4,043,000 tons of mill residues available annually in the state (Walsh et al. 2000).

Environmental Impacts

As discussed in NUREG-1437, the overall level of construction of a biomass-fired power facility would be about the same as that for a similar sized coal-fired plant (U.S. NRC May 1996). Like coal-fired facilities, biomass plants require large areas for fuel storage and processing and involve the same type of combustion equipment. Fuel processing, in most cases involving some type of grinding operation, produces emissions of dust and particulates (NREL Nov 1999).

Conversion of large tracts of land for production of energy crops would pose potentially adverse environmental impacts on wildlife habitat and biodiversity, reduce soil fertility, increase erosion, and reduce water quality. The net environmental impacts would depend on previous land use, the particular energy crop, and how the crop is managed. If the land has not previously been developed for farming or other purposes, displacement of natural land cover such as forests and wetlands with energy crops would likely have negative environmental impacts. In addition, conversion of food crops into energy crops means a reduction in food production that may need to be replaced elsewhere.

Air emissions and water consumption are usually the principal sources of environmental concern related to biomass facilities. Combustion of biomass fuels in modern power plants leads to many of the same kinds of emissions as the combustion of fossil fuels, including criteria air pollutants, greenhouse gases, and ash. While the air emissions would be likely less than a coal-fired facility, they would be substantially greater than the proposed nuclear project. The controls for limiting these emissions are similar to those used in coal-fired plants (NREL Nov 1999). Water consumption impacts would be similar to other boiler power technology.

Other operational impacts (including impacts on the aquatic environment and waste disposal) for a biomass-fired plant would also be similar to a conventional fossil-fueled unit.

Conclusions

Based on this analysis, biomass-fired technology is developed, proven, and available in the ERCOT region at the start of commercial operation of the proposed nuclear project. However, due to adverse environmental impacts, the small scale of existing plants, the large amount of fuel preparation, burning biomass to generate electricity is not considered to be a reasonable alternative.

9.2.2.7 **Municipal Solid Waste/Landfill Gas**

Overview

Municipal solid waste (MSW) refers to the stream of garbage collected through community sanitation services. MSW includes everyday items such as grass clippings, household garbage, newspapers, food scraps, clothing, bottles, paint, batteries, etc. MSW can be directly combusted to generate electricity.

Landfill gas is created when organic waste in a landfill naturally decomposes. This gas consists of about 50% methane, about 50% carbon dioxide, and a small amount of non-methane organic compounds. Instead of allowing landfill gas to escape into the air, it can be captured, converted, and used as an energy source (Santee Cooper 2007).

Current Technology Status

MSW-fired and landfill gas facilities generate electricity using commercially available equipment and well-established technology. Conventional direct combustion is presently the most common technology used in the United States for municipal solid waste-to-energy power generation. At the power plant, MSW is unloaded from collection trucks and shredded or processed to ease handling. Very large items such as refrigerators or stoves, recyclable materials, hazardous waste materials such as batteries are removed before combustion. Noncombustible materials such as metals can be removed before or after combustion but are usually separated from the ash with magnetic separators. After separation, the remaining waste is fed into a combustion chamber to be burned. The heat released from burning the MSW is used to produce steam, which turns a steam turbine to generate electricity.

Another option of converting landfill waste into electricity is using landfill gas in internal-combustion turbines that are connected to generators. The amount of gas that a particular landfill will produce depends on its age and size. Although gas is produced as soon as anaerobic conditions are established in the landfill, it may be several years before there is enough gas to fuel an electric generator. Later, as the site ages, gas production (as well as the quality of the gas) declines to the point at which power generation is no longer economical. In the case of a typical well-engineered and well-operated landfill, gas may be produced for as long as 50 to 100 years, but using this to fuel generators may be economically feasible for only 10 to 15 years. (Santee Cooper 2007)

At the end of 2006, the U.S. DOE EIA reported 95 municipal solid waste generation facilities in operation in the United States. Nameplate capacities of these plants range from 1.6 MWe to 90 MWe, and half are less than 20 MWe. The combined power capacity of the nation’s MSW facilities is about 2650 MWe. (U.S. DOE EIA 2007d) Approximately 85% of these plants are mass burn processors (FPSC&DEP Jan 2003). These power facilities are much smaller than the proposed nuclear project and it would require more than 34 municipal solid waste plants with a 90 MWe capacity to equal the proposed baseload capacity of 3070 MWe.

EPA reports that the United States has about 375 landfills currently collecting landfill gas and using it to produce electricity. The total power capacity of these plants is approximately 1260 MWe. There are an additional 52 landfill gas power plants currently under construction for an additional 185 MWe. The power capacity of these power plants ranges between 30 kWe and 20 MWe, with one facility operating at a 50 MWe capacity. (U.S. EPA 2007)

Ability to Serve Regional Needs

The nominal heat content of municipal solid waste is approximately 11.7 MBtu per ton or about 5865 Btu per pound (U.S. DOE EIA May 2007). The heat rate of a typical MSW-fired facility is around 16,000 Btu per kWh, substantially higher than other fuels used to power steam boiler plants, and capacity factors range between 60% to 80%(FPSC&DEP Jan 2003).

There are about 20 million people that live in the ERCOT service area and each person generates an average of about 7.11 pounds of municipal solid waste per day (ERCOT May 2007; TCEQ Jun 2006). This is roughly 2600 pounds of municipal solid waste each year per person. About 35% of municipal solid waste generated is recovered for recycling (TCEQ Jun 2006). If the other 65% is burned to generate electricity at an assumed 30% efficiency, the total annual energy potential in the ERCOT region from municipal solid waste would be about 1590 MW. This is substantially less than the 3070 MW from the proposed nuclear project.

In ERCOT, there are 15 landfill gas power plants currently operating with a total power capacity of 65 MWe. Three more are under construction for an additional 30 MWe. Forty-five other landfills are candidate sites for landfill gas-fired power plants (U.S. EPA 2007; PUCT Aug 2006). The scale of these power plants is a great deal smaller than the proposed nuclear project. It would require more than 150 landfill gas power plants to equal the proposed 3070 MWe, conservatively assuming landfill gas power plants with a capacity of 20 MWe.Currently, there are 134 landfills in the ERCOT region (TCEQ Jun 2006; PUCT Aug 2006),and the U.S. EPA regards only 45 of them as candidates for landfill gas-to-energy development and an additional 26 others as potential candidate sites (U.S. EPA 2007; PUCT Aug 2006). Assuming the landfills identified by the EPA as candidates or potential candidates produce enough gas to generate 20 MWe each annually, the energy production is still less than half of proposed nuclear project's power capacity. Additionally, as landfill gas generators can only be economically used for 10 to 15 years, even if future landfills are constructed that provide additional candidate sites, the fuel source will likely be depleted before the end of the proposed nuclear project's operating life.

Environmental Impacts

The decision to burn municipal solid waste to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations (U.S. NRC May 1996). Combusting waste usually reduces its volume by approximately 90% and the remaining ash is buried in landfills (FPSC&DEP Jan 2003). However, it is unlikely that many landfills will begin converting waste to energy due to the factors that may limit the growth in MSW power generation. Chief among these reasons are environmental regulations and public opposition to siting MSW facilities near feedstock supplies.

The overall level of land use impacts from construction of a MSW-fired plant would be approximately the same as that for a conventional coal-fired plant (U.S. NRC May 1996). The air emission profile and other operational impacts (including impacts on the aquatic environment, air, and waste disposal) for a MSW plant would also be similar to a conventional fossil fuel unit. Some of these impacts would be moderate, but still larger than the proposed nuclear project.

Burning landfill gas is beneficial to the environment by preventing methane, a greenhouse gas, from entering the atmosphere directly (Santee Cooper 2007). The air emission profile and other operational impacts (including impacts on the aquatic environment, air, and waste disposal) for a landfill gas plant would also be similar to a conventional fossil fuel unit. The overall level of land use impacts from construction of a landfill gas-fired plant should be approximately the same as for similar sized conventional gas-fired plant.

Conclusions

Based on this analysis, municipal solid waste- and landfill gas-fired technology is developed, proven, and would be available in the ERCOT region at the start of commercial operation of the proposed nuclear project. However, due to adverse environmental impacts, the small scale of existing plants, the large amount of fuel preparation required in the case of MSW-fired plants, the relatively short operating life in the case of landfill gas-fired plants, and because the full potential of municipal solid waste and landfill gas in the ERCOT region is less than the proposed 3070 MWe, burning municipal solid waste and landfill gas to generate electricity is not a reasonable alternative.

9.2.2.8 Coal

Overview

Coal-fired electric plants provide most of the electricity generated in the United States, accounting for about 50% of the electricity generated and about 32% of the available electric power capacity in 2005 (U.S. DOE EIA Mar 2007a).

The United States has abundant low-cost coal reserves, and the price of coal for electric generation is likely to increase at a relatively slow rate (U.S. DOE EIA Feb 2007a). Coal-fired plants are likely to continue to be a reliable energy source well into the future, assuming environmental constraints do not cause the gradual substitution of other fuels. Even with recent environmental legislation, new coal capacity is expected to be an affordable technology for reliable, near-term development (U.S. DOE EIA Jun 2006).

Current Technology Status

There are two primary technologies identified for generating electrical energy from coal: pulverized coal boiler and circulating fluidized bed boiler.

Pulverized Coal Boiler

In pulverized coal boilers, coal is ground up finely and blown into the combustion chamber of a boiler where it is combusted. The hot gases and heat energy from the incineration process convert water into high-pressure steam. The steam is then passed through a turbine to produce electricity. Flue gases are routed through a reducer (SCR) for NO_x reduction, and into a heat exchanger to salvage any residual heat. After this, the flue gas flows to an SO_2 scrubber system and a particulate removal system.

The steam systems used in the current generation of pulverized coal boilers are generally designated as subcritical (or conventional), supercritical, or ultra-supercritical. This designation is based on the pressure and temperature of the steam. Subcritical units operate at a nominal pressure of 2400 psi and a peak temperature of 1050°F. Supercritical units would operate at a similar peak temperature but at a nominal pressure of 3500 psi. Ultra-supercritical units operate at a nominal pressure of 4500 psi and a minimum temperature of 1100°F. As the temperature and pressure of the steam at the generator turbine inlet increases, so does the efficiency of the power steam cycle. As the efficiency of the steam cycle is increased, the amount of fuel necessary to produce the same amount of energy is reduced, in turn reducing plant emissions (NRRI Feb 2007). Therefore, ultra-supercritical units are the most effective steam systems available and have efficiencies as high as 46% to 48% (EPRI May 2007). This is compared to subcritical and supercritical net efficiencies of 36% to 37.5% and 40% to 42%, respectively (EPRI May 2007).

The subcritical pulverized coal technologies are commercially mature and widely used throughout the world. In 2005, 346 of the operating coal plants in the United States have been in operation more than 50 years. Supercritical pulverized coal plants are a highly proven and reliable technology with installations dating back to 1957 (NRRI Feb 2007).

As development of ultra-supercritical technology progresses, the unit's operating temperature increases. Units that operate at 1100°F are considered a mature technology, while units that operate at 1400°F are still in the developmental stage (EPRI May 2007).While ultra-supercritical technology has limited commercial experience in the United States, it does not depart far from the more widely used subcritical and supercritical boiler technologies (NRDC Feb 2006). There are announcements for plans to build several facilities in the United States (EPRI May 2007). In addition, MidAmerican Energy Company's ultra-supercritical Council Bluffs Unit 4 went online in June 2007, Wisconsin Public Service Corporation's Weston Unit 4 is scheduled to go online in June 2008, and 24 ultra-supercritical units are operating elsewhere worldwide(WCI 2007).

Circulating Fluidized Bed Boiler

Fluidized bed is an advanced electric power generation process that minimizes the formation of gaseous pollutants by controlling coal combustion parameters and by injecting a sorbent (such as crushed limestone) into the combustion chamber along with the fuel. Crushed fuel mixed with the sorbent is fluidized on jets of air in the combustion chamber to enhance combustion and heat transfer. Sulfur released from the fuel as SO_2 is captured by the sorbent in the bed to form a solid compound that is removed with the ash. The resultant byproduct is a dry, benign solid that is potentially a marketable byproduct for agricultural and construction applications. More than 90% of the sulfur in the fuel is captured in this process. NO_x formation in fluidized bed power plants is about 70% to 80% lower than that for conventional pulverized coal boilers because the operating temperature range of 1400ºF to 1600ºF is below the temperature at which thermal NO_x is formed. However, due to this lower operating temperature, fluidized bed systems do not achieve the higher efficiency levels achieved by conventional pulverized coal boilers. (U.S. DOE Mar 2003)

Circulating fluidized bed combustion boilers use a relatively high fluidization velocity that entrains the bed material, in conjunction with hot cyclones, to separate and recirculate the bed material from the flue gas before it passes to a heat exchanger (U.S. DOE Mar 2003). This improves operating characteristics and performance and simplifies design, making it easier to scale up (Ghosh Sep 2005). In terms of environmental performance, 'circulating beds' have better sulfur capture, carbon burnout, and NO_x control characteristics than 'noncirculating beds' (Ghosh Sep 2005).

To improve the thermal efficiency of the fluidized bed technology, a new type of fluidized bed boiler has been proposed that encases the entire boiler inside a large pressure vessel pressurized 6 to 16 times greater than atmospheric pressure. Combustion of coal in a pressurized fluidized bed boiler results in a high-pressure stream of combustion gases that can spin a gas turbine to make electricity and boil water for a steam turbine. It is estimated that pressurized fluidized bed plants could generate 50% more electricity from coal than a regular power plant from the same amount of coal. The pressurized fluidized bed technology is currently in the demonstration phase and is not a feasible alternative for the proposed nuclear project. (U.S. DOE Mar 2003)

The atmospheric fluidized bed combustion technology is a commercially mature technology that has been used for more than 50 years and has more than 600 units operating worldwide in the size range of 80 MWe to 460 MWe (Ghosh Sep 2005, NRRI Feb 2007). Designs are being developed for units as large as 600 MWe. The technology's total capacity represents approximately 2% of the overall coal-fired generation capacity in the world. In the United States, there are 185 atmospheric fluidized bed combustion boilers with a total capacity of 6000 MWe(Ghosh Sep 2005).

Atmospheric fluidized bed combustion boilers can be designed to burn a range of fuels including bituminous and sub-bituminous coal, coal waste, lignite, petroleum coke, biomass, and a variety of waste fuels (Ghosh Sep 2005). Hence, this technology is used for burning low-grade, high ash, or high sulfur coals that are more difficult to pulverize and may have variable combustion characteristics (Ghosh Sep 2005). The United States has abundant low-cost coal reserves, and the price of coal for electric generation is projected to remain steady for the next 20 years (U.S. DOE EIA Feb 2007a).

Although a multiunit facility could be built, it would not benefit from the economies of scale associated with a 3070 MW project. Because of the lower operating temperature of the fluidized bed system, it does not achieve the higher efficiency levels attained by conventional pulverized coal boilers. Due to the limited size of available units and their lower thermal efficiency, fluidized bed is not a reasonable alternative for the proposed nuclear project.

Ability to Serve Regional Needs

The United States has abundant low-cost coal reserves, and the price of coal for electric generation is projected to remain steady for the next 20 years. By 2030, coal consumption is projected to increase by 50% over 2005 levels due, in part, to significant additions of new coal-fired generation capacity over the last decade of the projection period. Projections for coal consumption are based, however, on the assumption that current energy and environmental policies remain unchanged throughout the projection period. (U.S. DOE EIA Feb 2007a)

Texas ranks fifth nationally among states with coal production and is the largest producer of lignite. Lignite constitutes approximately 97% of the near-surface coal resources in Texas. The most significant bituminous resources are in the north-central and southern parts of the state. Recoverable coal reserves in Texas are estimated to be 673 million tons, about 3% of U.S. recoverable coal reserves. (TEPC Mar 2004) Almost all (99%) of the 48.18 million tons of lignite mined in Texas is used to generate electricity for the Texas market. The balance of Texas coal consumption, which is about 55%, or 51.14 million tons, is imported, primarily from the Powder River Basin in Wyoming (GCCTCT Mar 2005). Wyoming is the largest coal-producing state in the nation and, in 2006, they produced 446.7 million tons of coal. Recoverable coal reserves in Wyoming are estimated to be 7890 million tons (U.S. DOE EIA Oct 2007).

In Texas, coal-fired plants provide about 37% of the electricity generated and about 20% of its electric power capacity (U.S. DOE EIA Mar 2007a). Similarly, ERCOT reports that coal power represents 19.5% of the region's electric power capacity (Drew 2007), and the Energy Information Administration estimates that coal-fired plants provide about 38% of the electricity generated (U.S. DOE EIA Feb 2007b).

Environmental Impacts

The environmental impacts of construction of a typical pulverized coal-fired steam plant are well known because coal-fired steam plants represent about half of the electrical generation in the United States (U.S. DOE EIA Mar 2007a). The combustion of coal creates several byproducts damaging to the air quality of the environment, including SO_2, NO_x, carbon dioxide CO_2, mercury and other trace metals, ash, and volatile organic compounds (NRRI Feb 2007). These byproducts are linked to environmental consequences such as acid rain, smog, increased public health risk, and global climate change. Although pulverized coal plants are able to meet current emission limits with existing control technologies, changes in environmental policies could alter economic advantages and process efficiency. There is about a 5% CO_2 emission reduction per 2% efficiency gain (EPRI May 2007). Therefore, ultra-supercritical facilities produce about 20% to 30% less CO_2 emissions than subcritical power facilities and 10% to 20% less than supercritical power facilities (EPRI May 2007).

Coal-fired power plants use large quantities of water for producing steam and for cooling (U.S. EPA Jul 2006b). A coal-fired plant uses approximately 600 gallons of water per megawatt-hour of generation (EPRI Mar 2002). While much of the water is ultimately returned to the source, pollutants build up in the water used in the power plant boiler and cooling system. When the water used in the power plant is discharged to a lake or river, the pollutants in the water can harm fish and plants (U.S. EPA Jul 2006b). This water may contain trace levels of metals or chemicals and may be at a higher temperature than the source water into which it is discharged (NRRI Feb 2007).

The construction of a new coal plant is likely to face community opposition. The perceptions of aesthetic and environmental impacts are typically the most significant topics of opposition. Potential large land use impacts exist from facility buildings, coal storage, cooling pond, and landfill disposal of combustion ash and process byproducts. The power block and coal storage area for a coal-fired facility of comparable size as the proposed 3070 MWe is estimated to occupy about 420 acres.

Conclusions

Based on the analysis, ultra-supercritical pulverized coal boiler technology is a reasonable alternative to the proposed nuclear plant. Although ultra-supercritical technology has limited commercial experience, several are planned in the United States, and it is an established technology in Europe and Japan (EPRI May 2007). Based on ample fuel availability, generally understood environmental impacts associated with constructing and operating a coal-fired power generation plant, and good plant efficiencies, an ultra-supercritical coal-fired power plant is considered a reasonable alternative and is therefore examined further in Subsection 9.2.3.

9.2.2.9 Natural Gas

Overview

There are several commercially mature generation technologies that use natural gas as fuel. Gas-fired steam generator technology uses combustion to heat water to produce pressurized steam, which rotates a generator to produce electricity. In simple-cycle combustion turbine technology, fuel is burned in a combustion turbine and the resulting hot gases rotate the turbine to generate electricity before being emitted to the air. Combined-cycle technology uses a combination of combustion turbine technology and steam generator technology. In the combined-cycle unit, hot combustion gases in the turbine rotate the turbine to generate electricity and waste combustion heat from the turbine is routed through a heat recovery steam generator. There, water is turned to steam that rotates a steam turbine to generate additional electricity. Combining two cycles in the generation of electricity improves the overall thermal efficiency by as much as 50% over simpler, straight combustion gas turbines. Simple combustion gas turbine systems are not efficient enough to be economically viable for baseload applications (NRRI Feb 2007).

Current Technology Status

Since the early 1990s, gas-fired power plants have comprised more than 90% of new generation capacity in the United States (NRRI Feb 2007). Natural gas-fired electric plants now account for most of the U.S. electric power capacity at 39.2%, but generated only 18.7% of the nation's electricity in 2005 (U.S. DOE EIA Mar 2007a). This low use is caused by the high prices in recent years for natural gas, making it more economical to produce electricity using other fuels and using gas-fired plants during periods of high demand. Recent studies indicate that when natural gas prices exceed $6 per million cubic feet, gas-fired combined cycle units lose their competitiveness with other technologies, particularly pulverized coal units (NRRI Feb 2007). In 2006, the average annual price of natural gas used for electric power generation was $7.09 per million cubic feet (U.S. DOE EIA 2007a).

Ability to Serve Regional Needs

Texas is the top producer of natural gas in the United States, extracting 5.3 trillion cubic feet and exporting more than 3.2 trillion cubic feet (U.S. DOE EIA 2007a; U.S. DOE EIA Nov 2006). Therefore, there is an extensive infrastructure for distribution and abundant resources available for a large baseload combined cycle gas-fired power plant.

In Texas, gas-fired plants provide about 72.0% of the electric power capacity and generate 49.4% of the state's electric power (U.S. DOE EIA Mar 2007a). In ERCOT, gas-fired power represents 68.2% of the region's electric power capacity (Drew 2007).

Environmental Impacts

As with the burning of any fossil fuel, burning of natural gas produces NO_x, SO_2, carbon monoxide, and carbon dioxide, but in lower quantities than burning coal or oil (U.S. EPA Jul 2006c).

The burning of natural gas in combustion turbines requires very little water and does not produce any water discharges. However, in combined-cycle units, water is used in the heat recovery system and the impacts of heat and pollutants in the discharge water raises concerns similar to those associated with other types of thermal power plants. (U.S. EPA Jul 2006c)

Gas-fired plants occupy about one-tenth the space of nuclear and pulverized supercritical coal plants (NRRI Feb 2007). This partially explains the relatively low level of public opposition to combined cycle gas turbine plants relative to other baseload technologies (NRRI Feb 2007). A gas-fired power plant of comparable size as the proposed 3070 MWe is estimated to occupy about 100 acres.

Conclusions

Because gas-fired generation, using combined-cycle turbines, is based on its use of well-known technology and generally has well-understood environmental impacts associated with construction and operation, it is a reasonable alternative to the proposed nuclear plant. However, the volatility of natural gas prices has made combined-cycle turbines less economically attractive. Gas-fired generation is examined further in Subsection 9.2.3.

9.2.2.10 Petroleum

Overview

Petroleum (oil) consumption in the electric power sector uses three main types of oil derivatives: distillate fuel oil, residual fuel oil, and petroleum coke.

Current Technology Status

There are several commercially mature generation technologies that use petroleum as fuel. Oil can be burned in a boiler to produce steam that is used by a steam turbine to generate electricity. A more common method is to burn the petroleum in combustion turbines, similar to simple combustion gas turbine systems. The two systems can be united and the hot exhaust from the combustion turbine can be used to create steam to run a steam turbine. (USEPA Jul 2006d)

Petroleum-fired power plants provided 3% of electricity generated in the United States in 2005 and accounted for 6% of the electric power capacity (U.S. DOE EIA Mar 2007a). The high cost of petroleum has prompted a steady decline in its use for electricity generation in recent decades. Reliance on foreign sources of petroleum, future increases in petroleum prices, and competition for petroleum resources by the transportation and petrochemical industry are expected to make petroleum-fired generation less attractive than other power alternatives.For these reasons, liquid petroleum is not considered a viable fuel source for new baseload power plants.

Ability to Serve Regional Needs

Texas is the second largest producer of crude oil in the United States, extracting almost 400 million barrels in 2006 (U.S. DOE EIA 2007e). Additionally, Texas is the nation’s leading oil refining state and has more than one-fourth of the country's refining capacity. Most Texas refineries are clustered near major ports along the Gulf Coast, including Corpus Christi (U.S. DOE EIA 2007f).

Therefore, an extensive infrastructure for distribution exists in the ERCOT region and potentially more abundant resources could be available for a large baseload petroleum-fired power plant.

Based on the ERCOT Unit Data Report for August of 2007, diesel and petroleum coke-fired power generation facilities in the ERCOT region accounted for 38 and 143 MWe of power capacity, respectively (Drew 2007).

Environmental Impacts

Construction and operation of a petroleum-fired plant would have environmental impacts. For example, NUREG-1437 estimates that construction of a 1000 MWe petroleum-fired plant would require about 120 acres (U.S. NRC May 1996). The power block and fuel storage area of an oil-fired facility of comparable size as the proposed 3070 MWe is estimated to occupy about 433 acres. Construction and operation of a petroleum-fired plant would have comparable impacts on regional air quality and the aquatic environment as would a similar sized coal-fired plant (U.S. NRC May 1996).

Conclusions

Based on this analysis, petroleum energy technology is developed, proven, and would be available in the ERCOT region at the start of commercial operation of the proposed nuclear project. Although the land use requirements are relatively small, concerns related to fuel availability, coupled with the national policy to reduce foreign oil dependence, and the adverse environmental impacts to air and water quality led to the conclusion that petroleum energy technology is not a reasonable alternative.

9.2.2.11 Integrated Gasification Combined Cycle

Overview

IGCC is an electric power generation process that combines modern gasification technology with both gas turbine and steam turbine power generation (combined cycle). IGCC plants can be powered by many carbon-based fuels such as coal, petroleum coke, and biomass. Gasification uses steam and oxygen to convert the fuel into synthesis gas (syngas) in a high-temperature, high-pressure chamber. Syngas is a mixture of carbon dioxide, carbon monoxide, and hydrogen, of which the last two are the primary combustible components. The syngas is burned in a combustion turbine and the hot exhaust gas from the turbine is routed to a heat recovery steam generator, where it produces steam to power a steam turbine. Electricity is produced in both cycles via generators, powered by the gas turbine and the steam turbine, thus the term combined cycle. IGCC plants are suitable for baseload operation because they combine low cost fuels and high output. (NRRI Feb 2007)

Current Technology Status

IGCC power plants are in the early stages of commercialization. There are currently two commercial-size, coal-based IGCC plants in the United States. Both were supported initially under the

U.S. DOE Clean Coal Technology demonstration program, but now operate commercially without U.S. DOE support (CEUS Jul 2006). The nameplate capacity of existing and planned units typically ranges from 250 to 630 MWe (NRRI Feb 2007).

Experience has been gained with the chemical processes of gasification, fuel properties, and their impact on the IGCC design, efficiency, and economics. However, system reliability is still relatively lower than conventional carbon-based-fired power plants, and the major reliability problem is related to the gasification section. There are also problems with the combination of gasification and power production systems. For example, if the gases are not adequately cleaned, they can cause various types of damage to the gas turbine. (PERMG Jun 2005)

Ability to Serve Regional Needs

As mentioned in Subsection 9.2.2.8, the United States has abundant low-cost coal reserves, and the price of coal for electric generation is projected to remain steady for the next 20 years (U.S. DOE EIA Feb 2007a). As described in Subsection 9.2.2.6, there is insufficient biomass feedstock available in the ERCOT region to power a large baseload facility. Subsection 9.2.2.10 describes that petroleum coke sources are likely to be available economically in ERCOT. This feedstock will likely have high sulfur content (2.5% to 5.5%) and low residual hydrocarbons (9% to 12%) (API Mar 2000). Due to IGCC's ability to capture the sulfur in the fuel economically, the process can be used to burn cheaper high-sulfur coal feeds and petroleum-coke with less environmental impacts.

Environmental Impacts

IGCC technology is cleaner than any other coal-based fuel combustion technology because major pollutants can be removed from the gas stream before combustion (NRRI Feb 2007; Ghosh Sep 2005). For example, the sulfur in the fuel is captured and removed as hydrogen sulfide in the gasifier via a conventional acid-gas removal system. The concentrated hydrogen sulfide can be recovered as elemental sulfur or sulfuric acid and sold as commercial byproduct. The largest solid waste stream produced by IGCC installations is slag, a black, glassy, sand-like material that is potentially a marketable byproduct. Slag production is a function of the fuel's ash content. In this way, IGCC units do not produce ash or scrubber wastes. As much as 50% of the mercury in a feedstock is removed in IGCC systems, much of it bound in the slag and sulfur byproducts. (NCC 2001)

Land use concerns would be similar to conventional pulverized coal-fired power plants of the same capacity. The power block and coal storage area for of an IGCC power facility of comparable size as the proposed 3070 MWe is estimated to occupy about 430 acres.

Conclusions

Based on the analysis, IGCC technology has not matured sufficiently to support production for a large baseload facility. Both of the IGCC facilities that presently operate in the United States were supported federally with federal funds that would be unavailable for this IGCC alternative. Additionally, the system reliability associated with IGCC technology is considerably less than other carbon-based fuel-fired technologies. Thus, IGGC is not considered to be a reasonable alternative.

9.2.3 **Assessment of Reasonable Alternative Energy Sources and Systems**

This subsection compares the environmental impacts of reasonable alternatives to those associated with the proposed nuclear project. The reasonable alternatives addressed are: pulverized coal-fired generation and gas-fired generation. Additionally, combinations of alternatives are evaluated. The significance of the impacts associated with each issue is identified as SMALL, MODERATE, or LARGE. This characterization is consistent with the U.S. NRC-established criteria in 10 CFR 51, Appendix B, Table B-1, Footnote 3, and presented as follows:

- SMALL — Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purpose of radiological impacts assessment, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
- MODERATE — Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
- LARGE — Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.

Consideration is given to ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are SMALL receive less mitigative consideration than impacts that are LARGE).

9.2.3.1 **Pulverized Coal Boiler**

Subsection 9.2.2.8 states that ultra-supercritical, pulverized-coal-boiler technology is a reasonable alternative to the proposed nuclear plant. The comparable coal-fired alternative consists of four boiler units, each with a net capacity of 758 MWe for a combined capacity of 3033 MWe. This configuration was chosen to be equivalent to the gas-fired alternative described below in Subsection 9.2.3.2. This equivalency makes impact characteristics more comparable, facilitating impact analysis. Table 9.2-2 describes assumed basic operational characteristics of the coal-fired units. The emission control technology and percent-control assumptions were based on alternatives that the EPA has identified as being the best available control technology for minimizing emissions (U.S. EPA Sep 1998). For the purposes of analysis, coal and limestone were assumed to be delivered by rail to the site by a similar arrangement planned for the proposed nuclear project.

9.2.3.1.1 **Environmental Impacts**

The NRC analysis of environmental impacts from operation of coal-fired generation alternatives in NUREG-1437 was found to be a reasonable description of the impacts associated with the coal-fired alternative. Construction impacts could be appreciable, due in part to the large land area required (which can result in natural habitat loss) and the workforce needed. The NRC identified impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges. The NRC also identified socioeconomic benefits in the form of hundreds of jobs, substantial tax revenues, and plant spending.

Air Quality

The air quality impacts of coal-fired generation are considerably different from those of nuclear power generation. A coal-fired plant would emit sulfur dioxide (SO_2, as SO_x surrogate), oxides of nitrogen (NO_x), particulate matter (PM), carbon monoxide (CO), and mercury (Hg), all of which are regulated pollutants. A coal-fired plant would also emit carbon dioxide (CO_2) that has been linked to global climate change. As indicated in Subsection 9.2.2.8, a plant design was assumed that would minimize air emissions through a combination of boiler technology and post combustion pollutant removal. The coal-fired alternative is estimated to burn approximately 12.86 million tons of coal per year and produce the following emissions:

- SO_2 = 8325 tons per year
- NO_x = 2314 tons per year
- CO = 3214 tons per year
- CO_2 = 30.9 million tons per year
- Hg = 0.53 tons per year
- PM_{10} (particulates having a diameter of less than 10 microns) = 152 tons per year
- $PM_{2.5}$ (particulates having a diameter of less than 2.5 microns) = 40 tons per year

The acid rain requirements of the Clean Air Act Amendments capped the nation's SO_2 emissions from power plants. Each company with fossil fuel-fired units was allocated SO_2 allowances. To be in compliance with the Act, the companies must hold enough allowances to cover their annual SO_2 emissions. In 2005, emissions of SO_2 and NO_x from Texas' generators ranked fifth and first highest in the nation, respectively (U.S. DOE EIA Mar 2007a). Both SO_2 and NO_x emissions would increase if a new coal-fired plant were operated at the site for the proposed nuclear project. To operate a fossil-fuel burning plant, SO_2 allowances would have to be purchased from the open market or existing fossil-fired capacity would have to be shut down and the credits from that plant applied to the new one.

In March 2005, EPA issued the final Clean Air Interstate Rule that addresses power plant SO_2 and NOx emissions that contribute to nonattainment of the 8-hour ozone and fine particulate matter standards in downwind states. Twenty-eight eastern states, including Texas, are subject to the requirements of the rule. The rule calls for further reductions of NO_x and SO_2 emissions from power plants. These reductions can be accomplished by the installation of additional emission controls at existing coal-fired facilities or by the purchase of emission allowances from a cap-and-trade program. (USEPA Apr 2007)

In March 2005, EPA finalized the Clean Air Mercury Rule that sets emissions limits on mercury to be met in two phases beginning in 2010 and 2018, and encourages a cap and trade approach to achieving those caps. NO_x and SO_2 controls also are effective in reducing mercury emissions. However, according to the EPA, the second phase cap reflects a level of mercury emissions reduction that exceeds the level that would be achieved solely as a co-benefit of controlling NO_x and SO_2 under the Clean Air Interstate Rule. Each new coal-fired electrical generating unit in Texas will need to acquire enough mercury allowances to cover its annual mercury emissions. Compliance with EPA mercury standards must be achieved by January 1, 2010 (TCEQ Jan 2007).

Texas has regions that are designated as nonattainment with respect to the National Ambient Air Quality Standards for one or more criteria pollutants. Therefore, the state of Texas was required to submit a State Implementation Plan to the EPA (1) to establish control strategies to reduce criteria pollutant emissions, and (2) to identify the technical and regulatory processes to demonstrate compliance with the State Implementation Plan. The Texas State Implementation Plan includes a cap and trade program for NO_x, SO_x, and Hg emissions. New stationary fossil fuel facilities in Texas must acquire trade credits to cover the new potential emissions. Compliance with the NO_x and SO_x standards identified in the State Implementation Plan must be achieved by January 1, 2009 and January 1, 2010, respectively (TCEQ Jan 2007).

The region of nonattainment nearest to the proposed nuclear project location is the Houston-Galveston-Brazoria region (TCEQ Jan 2007). This region is designated as moderate nonattainment with respect to the 8-hour ozone standard (40 CFR 81.344). Brazoria County is east of Victoria County and separated from it by Jackson and Matagorda Counties. Victoria County and Corpus Christi are areas of concern and occasionally exceed the 8-hour ozone standard and are undergoing monitoring for attainment of that standard (TCEQ Jan 2007).

Emission credit trading (for NO_x and SO_2) generally applies to nonattainment areas. The proposed site is located in an attainment area, making emission credit trading not effective as a mitigation technique.

Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations. One estimate indicates that a 1000 MWe coal-fired plant would have an annual release of approximately 5.2 tons of uranium and 12.8 tons of thorium. The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be substantially higher than that from nuclear power plants (ORNL 2003).

Air impacts from fossil fuel generation would be substantial. Adverse human health effects from coal combustion have led to important federal legislation in recent years. Public health risks, such as cancer and emphysema, have been associated with coal combustion. Global climate change and acid rain are also potential impacts. Recent changes in air quality regulations indicate that the U.S. EPA and the federal government recognize the importance of stability for air resources. SO_2 and mercury emission allowances, NO_x emission offsets, low NO_x burners, overfire air, fabric filters or electrostatic precipitators, and scrubbers are regulatory-imposed mitigation measures. As such, for purposes of this alternatives analysis, the coal-fired alternative would have MODERATE impacts on air quality.

The impacts would be noticeable, but would not destabilize air quality in the area due to the use of mitigating technologies.

Waste Management

The coal-fired alternative would generate substantial solid waste in the form of ash from coal combustion and scrubber sludge from air pollution controls. The 3070 MWe coal-fired alternative would annually consume approximately 12.86 million tons of coal with an ash content of approximately 10.3%. Particulate control equipment would collect most (99.9%) of this ash. According to the American Coal Ash Association, approximately 45% of the ash produced by coal-fired power plants in the United States is recycled (ACAA Aug 2007). Assuming this amount of waste mitigation measure, Exelon would recycle approximately 593,000 tons of coal ash byproduct per year under the coal-fired alternative.

SO_x-control equipment (wet scrubbers) would use approximately 296,700 tons of limestone annually to mitigate SO_x emissions and would generate approximately 353,000 tons of scrubber sludge per year. The American Coal Ash Association estimates that approximately 37% of the sludge produced by wet scrubbers at U.S. coal-fired power plants is recycled (ACAA Aug 2007). Assuming this amount of waste mitigation measure, Exelon would recycle approximately 130,000 tons of scrubber sludge per year under the coal-fired alternative. Over a 40-year plant life, the coal-fired alternative would generate approximately 953,000 tons of waste ash and scrubber sludge per year, requiring approximately 581 acres for solid waste disposal.

With proper placement of the facility, coupled with waste management and monitoring practices, waste disposal would not destabilize any resources. There would be land space at the VCS site for this disposal. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, waste disposal for the coal-fired alternative would have MODERATE impacts, and the impacts of waste disposal would be noticeable, but would not destabilize any important resource and further mitigation of the impact would be unwarranted.

Land Use

The construction of the power block and coal storage area would impact approximately 420 acres of land and associated terrestrial habitat. Construction of the cooling pond would disturb an additional 6443 acres of land and associated terrestrial habitat. A new railroad spur for delivery of coal and limestone and shipment of coal ash byproduct would need to be constructed from an existing railroad located approximately 9.1 miles southeast of the site for the proposed nuclear project. Assuming a 100-foot easement, a minimum of 110 acres would need to be graded to permit the installation of the railroad. Construction of the coal-fired alternative would result in the loss of primarily agriculture land at the VCS site. Construction impacts would be minimized through the application of best management practices that minimize soil loss and restore vegetation after construction.

The only additional land to be used during operations would be approximately 581 acres for solid waste management. Thus, land use impacts from construction and operation of the coal-fired alternative would be MODERATE.

Water Use and Quality

Construction activities would disturb the land surface, which may temporarily affect surface water quality. Potential water quality impacts would consist of suspended solids from disturbed soils, biochemical oxygen demand, nutrient loading from disturbed vegetation, and oil and grease from construction equipment. Construction would require a National Pollutant Discharge Elimination System (NPDES) permit for storm water discharges from the site. Provisions of the NPDES permit would ensure implementation of best management practices to minimize impacts to surface waters during construction. Runoff detention ponds would be designed to detain runoff within the containment areas to allow for settling and to reduce peak discharges. A Spill Prevention, Control, and Countermeasures Plan would be implemented to minimize water quality impacts from minor spills of fuel, hydraulic fluid, lubricants, paint, and other liquids. Although this plan would be primarily intended to prevent spills from reaching navigable waters, it would also mitigate impacts on local groundwater because any spills would be quickly attended to and not allowed to penetrate to groundwater. Construction would cause no appreciable consumption of surface water resources.

Based on Electric Power Research Institute estimates, cooling pond makeup water flow during operation of the coal-fired alternative would be approximately 32,270 gpm and consumptive water use through evaporation would be approximately 25,820 gpm (EPRI Mar 2002). This amount of water consumption would be taken from the Guadalupe-Blanco River Authority Calhoun Canal with little impact on water availability downstream or in the vicinity of the plant. Cooling water for the main condensers and miscellaneous components would be circulated through the cooling pond, with the blowdown (i.e., the fraction of circulated water that is discharged to prevent the buildup of dissolved salts and minerals) and other plant operational wastewater streams subsequently discharged through diffusers to the Guadalupe River.

Onsite wells would be used to supply 400 gpm (normal operations) to 842 gpm (maximum operations) of groundwater from the Chicot Aquifer for the demineralized water, potable water, and fire protection systems and other miscellaneous plant needs. As shown in Table 2.3-2, Victoria County has substantially more unallocated groundwater supplies from the Chicot Aquifer than would be required for the coal-fired alternative.

Plant wastewater outfalls would also require an NPDES permit, with established treatment standards and discharge limits. To prevent leachate in storm water runoff from entering the surficial aquifer, the coal storage area and the runoff basin would be lined with low-permeability materials. Runoff streams from the coal pile, fly ash and bottom ash piles, and scrubber waste storage area would be collected in the lined recycle basin for reuse, with no direct discharge to the surface water. A Spill Prevention, Control, and Countermeasures Plan would be implemented to minimize water quality impacts from minor spills.

Overall, water use and quality impacts can be considered SMALL.

Aesthetics

The coal-fired power block would be as much as 200 feet tall and would be visible offsite during daylight hours. The exhaust stack could be as high as 650 feet. The stack and associated plume would likely be highly visible in daylight hours for distances greater than 10 miles. These structures would also be visible at night because of outside lighting. The Federal Aviation Administration generally requires that structures exceeding an overall height of 200 feet above ground level have markings and/or lighting so as not to impair aviation safety. Visual effects of a new coal-fired plant are mitigated by landscaping and color selection for buildings that are consistent with the environment. Visual effects at night are mitigated by reduced use of lighting (provided the lighting meets Federal Aviation Administration requirements) and appropriate use of shielding.

Coal-fired generation introduces mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid waste disposal, transportation related to coal and limestone delivery, use of outside loudspeakers, and the commuting of plant employees.

Coal delivery would add noise and transportation impacts associated with unit train traffic. Based on a unit train capacity of 15,000 tons, about 877 unit trains per year (about 17 trains per week) would be needed to deliver coal and limestone to the coal-fired plant. Noise effects associated with rail delivery of coal and limestone would be most noticeable for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail line, the short duration of the noise reduces the effect. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail route, the effects of noise on residents in the vicinity of the facility and the rail line would be noticeable.

Noise and light from the pulverized coal-fired power plants could be detectable offsite. Aesthetic effects at the plant site would mitigated by the location of the VCS site in a relatively unpopulated area. Thus, the aesthetic impacts associated with the coal-fired alternative are considered SMALL to MODERATE.

Socioeconomics

Construction of the coal-fired alternative would require an average workforce of about 2500 workers, peaking at approximately 4770 workers. Operation of the coal-fired facility would require about 415 people.

During construction, the communities immediately surrounding the plant site would experience demands on housing and public services that could have noticeable impacts. NUREG-1437 states that socioeconomic impacts at a rural site would be greater than at an urban site, because more of the peak construction workforce would need to move to the area to work. New construction could have a negative impact on availability and cost of housing and after construction, the communities would be affected by the loss of jobs (U.S. NRC May 1996).

Victoria County would benefit from tax payments for the new coal-fired plant and, depending on how these are distributed, could help address socioeconomic impacts.

Transportation impacts would be temporary, noticeable, but not destabilizing during plant construction and small during plant operation.

Socioeconomic impacts associated with constructing and operating the coal-fired alternative would be considered SMALL to LARGE (adverse) to SMALL to LARGE (beneficial).

Ecological Resources and Threatened and Endangered Species

The coal-fired generation alternative would introduce construction impacts and operational impacts, which would alter the ecology of the surrounding environment. Ecological impacts to the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss, reduced wildlife reproduction, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from the Guadalupe-Blanco River Authority Calhoun Canal could have adverse aquatic resource impacts. Construction and maintenance of transmission lines and a rail spur would have ecological impacts. Due to the loss of habitat for smaller resident species, the impact on terrestrial biota would be MODERATE. Potential impacts to aquatic biota and threatened and/or endangered species would be SMALL.

Cultural Resources

As described in Subsection 4.1.3, the VCS site is part of an NRHP-eligible historic landscape. Construction of a coal-fired plant at the VCS site would have a LARGE visual effect on the historic landscape as well as the 29 properties listed in Table 4.1-2 and would require mitigation. Surveys are being conducted to identify historic and archeological resources at the Victoria County site. Surveys would also be conducted in areas affected by the installation of offsite infrastructure associated with construction and operation of the plant. Upon completion of the surveys, the Texas State Historic Preservation Office would be consulted to identify measures for avoidance, minimization, or mitigation of any adverse effects per Section 106 of the National Historic Preservation Act. The protection and documentation of inadvertently discovered archaeological resources or human remains would be coordinated with the Texas Historical Commission. Based on this discussion, Exelon concludes that impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

Environmental Justice

Environmental justice effects depend upon the nearby population distribution. Figures 2.5.4-1 through 2.5.4-6 (Subsection 2.5.4) locate the minority and low income populations within 50 miles of the VCS site. Minority populations lie directly east of the VCS site near Bloomington as well as in the city of Victoria. The closest low-income block groups are located within the city of Refugio in Refugio County (approximately 26 miles from the site), and within the City of Cuero in Dewitt County (approximately 36 miles from the site). As described in Subsection 4.4.3.2, no subsistence agriculture, hunting or fishing dependencies or practices have been reported in the area. Construction activities offer new employment possibilities, but have negative effects on the availability and cost of housing, which could disproportionately affect low-income populations. However, as described in Section 4.4, there is ample housing available in the area to accommodate the in-migrating workforce. Overall, environmental justice effects are likely to be SMALL.

9.2.3.1.2 **Health Effects**

Coal-fired power generation introduces worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from inhalation of stack emissions.

Emission impacts can be widespread and health risks are difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks. The staff stated in NUREG-1437 that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but did not identify the significance of these impacts (U.S. NRC May 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations. Studies are presently being done to determine the extent of the impacts of PM2.5, transition metals, inorganic compounds, and mercury emissions from coal-combustion power plants to human health (NETL 2007).

Concerns over adverse human health effects from coal combustion have led to federal legislation in recent years (U.S. NRC May 1996). Regulatory agencies, including EPA and state agencies, set air emission standards and requirements based on human health and environment impacts. These agencies also impose site-specific emission limits as needed to meet the health standards. EPA has recently concluded that mercury emissions of power plants should be controlled (under the Clean Air Mercury Rule). Certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at risk of adverse health impacts because of mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, and with the limits imposed for the regulated constituents of air emissions, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal at a newly constructed coal-fired plant are considered SMALL.

9.2.3.1.3 **Design Alternatives**

The location of the VCS site lends itself to coal delivery by rail. The alternatives to railroads are trucking, barging, and pipeline slurry. However, trucks cannot deliver more than 60 tons per load. This is compared to more than 15,000 tons per load for a western coal train. Furthermore, trucking costs approximately 100 times more than rail transportation for long distances. Barging is not a viable alternative in Texas due to the limited number of navigable waterways, and coal slurry pipelines are not commercially practical at this time (GCCTCT Mar 2005). Therefore, it is assumed that coal would be delivered to the VCS site by rail.

Subsection 9.4.1 analyzes alternative designs for the proposed nuclear project heat dissipation systems. Based on this analysis, a cooling pond was assumed to be used for the coal-fired alternative.

The analysis of air quality impacts in Subsection 9.2.3.1.1 is based on use of best available control technology; therefore, there are no reasonable alternates for reducing those impacts.

9.2.3.1.4 Summary

The impacts of coal-fired alternative are compared to the proposed nuclear project in Tables 9.2-4 and 9.2-5. As these tables demonstrate, the coal-fired alternative is not environmentally preferable to the proposed nuclear project.

9.2.3.2 Natural Gas Combined Cycle

Gas-fired generation, using combined-cycle turbines, has been evaluated because it has been determined that the technology is mature and feasible. The gas-fired alternative defined in Subsection 9.2.2.9 would be located at the site for the proposed nuclear project. It would comprise existing manufacturers' standard-sized units including a gas-fired combined-cycle plant of 1011 MWe net capacity, consisting of four natural gas combustion turbine generators, four heat recovery steam generators, and a steam turbine generator. Three 1011 MWe units, with a total capacity of 3033 MWe, were assumed in evaluated the gas-fired alternative at the site. Although this provides slightly less capacity than two ESBWR units, it ensures against overestimating environmental impacts from the alternatives. The shortfall in capacity could be replaced by other methods, such as purchasing power or scaling up the steam turbine of the combined cycle. Table 9.2-3 describes the assumed basic operational characteristics of the gas-fired units. The emission control technology and percent-control assumptions were based on alternatives that the EPA has identified as being the best available control technology for minimizing emissions (U.S. EPA Apr 2000). For the purposes of analysis, it is assumed that there would be sufficient natural gas availability.

9.2.3.2.1 Environmental Impacts

The NRC analysis of environmental impacts from construction and operation of natural-gas-fired generation alternatives in NUREG-1437 that focused on combined-cycle plants were found to be reasonable. The NRC identified major adverse impacts from operations as human health concerns associated with air emissions and losses of aquatic biota due to cooling water withdrawals and discharges. Socioeconomic benefits produce positive impacts in the form of hundreds of jobs, substantial tax revenues, and plant spending.

Air Quality

Natural gas is a relatively clean-burning fuel. Also, because the heat recovery steam generator does not receive supplemental fuel, the combined-cycle operation is more efficient than coal-fired technology (58% vs. 42% for the coal-fired alternative). Therefore, the gas-fired alternative would release similar types of emissions, but in quantities less than the coal-fired alternative. Control technology for gas-fired turbines focuses on the reduction of NO_X emissions. The gas-fired alternative would use about 161 billion standard cubic feet of natural gas per year and would generate these emissions:

- SO_2 = 55 tons per year
- NO_x = 903 tons per year
- CO = 187 tons per year
- CO_2 = 9.1 million tons per year
- PM = 157 tons per year (all particulates are $PM_{2.5}$)

These emission totals are calculated based on the parameters and assumptions identified in Table 9.2-3 and emission factors published in AP-42 (U.S. EPA Apr 2000).

The Subsection 9.2.3.1.2 description of regional air quality, Clean Air Act requirements, and the Clean Air Interstate Rule also applies to the gas-fired generation alternative. SO_2 allowances, NO_X effects on ozone levels, and NO_X emission offsets would be issues of concern for gas-fired combustion. Based on the analysis, emissions from a gas-fired alternative would noticeably alter local air quality, but would not destabilize regional resources. Air quality impacts would, therefore, be MODERATE.

Waste Management

In NUREG-1437, NRC concluded that waste generation from gas-fired plants would be minimal. The only significant solid waste generated at a new gas-fired plant would be spent SCR catalyst used to control NO_X emissions. The SCR process for the gas-fired alternative would generate approximately 3140 cubic feet of spent catalyst per year (DEC 2001). The spent catalyst would be regenerated or disposed of offsite. Other than spent SCR catalyst, waste generation at an operating natural gas-fired plant would be largely limited to typical office wastes; impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities.

Overall, the solid waste impacts associated with natural gas-fired alternative would likely be SMALL

Land Use

Construction of the gas-fired alternative would impact approximately 100 acres of land and associated terrestrial habitat. Construction of the gas-fired alternative would result in the loss of primarily agriculture land at the VCS site. Construction impacts would be minimized through the application of best management practices that minimize soil loss and restore vegetation after construction.

A 26- to 30-inch diameter pipeline would need to be constructed from an existing natural gas transmission pipeline located approximately 0.75 miles northwest of the VCS site (RRCT 2007). Upgrades to the existing pipeline and gas storage facilities might also be required. To the extent practicable, the new gas supply pipeline would be routed in existing rights-of-way to minimize impacts. Assuming a 75-foot easement, about 7 acres would need to be graded to permit the installation of the pipeline. Construction impacts would be minimized through the application of best management practices that minimize soil loss and restore vegetation immediately after the excavation is backfilled.

Overall, land use impacts for construction and operation of the natural gas-fired alternative plant are considered SMALL.

Water Use and Quality

Construction activities would disturb the land surface, which may temporarily affect surface water quality. Potential water quality impacts would consist of suspended solids from disturbed soils, biochemical oxygen demand, nutrient loading from disturbed vegetation, and oil and grease from construction equipment. Construction would require a NPDES permit for storm water discharges from the site. Provisions of the NPDES permit would ensure implementation of best management practices to minimize impacts to surface waters during construction. Runoff detention ponds would be designed to detain runoff within the containment areas to allow for settling and to reduce peak discharges. Application of best management practices to control erosion during construction should mitigate construction impacts of pipelines (natural gas supply, potable water supply, process water supply, and wastewater discharge).

A Spill Prevention, Control, and Countermeasures Plan would be implemented to minimize water quality impacts from minor spills of fuel, hydraulic fluid, lubricants, paint, and other liquids. Although this plan would be primarily intended to prevent spills from reaching navigable waters, it would also mitigate impacts on local groundwater because any spills would be quickly attended to and not allowed to penetrate to groundwater. Construction would cause no appreciable consumption of surface water resources.

Based on Electric Power Research Institute estimates, cooling tower makeup water flow during operation of the gas-fired alternative would be approximately 12,110 gpm and consumptive water use through evaporation would be approximately 9480 gpm (EPRI Mar 2002). This amount of water consumption would be taken from the Guadalupe-Blanco River Authority Calhoun Canal with little impact on water availability downstream or in the vicinity of the plant. Cooling water for the main condensers and miscellaneous components would be circulated through the cooling tower, with the blowdown (i.e., the fraction of circulated water that is discharged to prevent the buildup of dissolved salts and minerals) and other plant operational wastewater streams subsequently being discharged through diffusers to the Guadelupe River.

Onsite wells would be used to supply 375 gpm (normal operations) to 540 gpm (maximum operations) of groundwater from the Chicot Aquifer for the demineralized water, potable water, and fire protection systems and other miscellaneous plant needs. As shown in Table 2.3-2, Victoria County has substantially more unallocated groundwater supplies from the Chicot Aquifer than would be required for the gas-fired alternative.

Plant wastewater outfalls would also require an NPDES permit, with established treatment standards and discharge limits. A Spill Prevention, Control, and Countermeasures Plan would be implemented to minimize water quality impacts from minor spills.

Overall, water use and quality impacts can be considered SMALL.

Aesthetics

The gas-fired units would alter the visual landscape character at the VCS site. The gas-fired steam turbine building would be approximately 100 feet high. The tallest structures would be the 150-feet-high auxiliary boilers and heat recovery steam generator stacks. Some portion of these structures would likely be visible for a mile or more during daylight hours. These structures would also be visible at night because of outside lighting. Condensation plumes from the mechanical draft cooling towers and the offsite gas pipeline compressors would also be visible during daylight hours.

Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to transportation related to use of outside loudspeakers and the commuting of plant employees. Noise from the plant may be detectable offsite, depending on the location.

Aesthetic impacts at the plant site would mitigated by the location of the VCS site in relatively unpopulated area and its proximity to other industrial facilities. Thus, the aesthetic impacts associated with the gas-fired alternative can be categorized as SMALL.

Socioeconomics

Construction of the gas-fired alternative would require an average workforce of about 1365 workers, peaking at approximately 2425 workers. Operation of the gas-fired facility would require about 130 people.

During construction, the communities immediately surrounding the plant site would experience demands on housing and public services that could have noticeable impacts. NUREG-1437 states that socioeconomic impacts at a rural site would be greater than at an urban site, because more of the peak construction workforce would need to move to the area to work. New construction could have a negative impact on availability and cost of housing and after construction, the communities would be affected by the loss of jobs (U.S. NRC May 1996). Victoria County would benefit from Exelon's tax payments for the new gas-fired plant and, depending on how these are distributed, could help address socioeconomic impacts. Jobs related to pipeline construction would not be centralized at one location for any appreciable period of time and, therefore, would have no important impact on the local economy or on community and government services.

For transportation related to commuting of plant operating personnel for the gas-fired alternative, the impacts are considered negligible. Impacts related to the commuting of plant construction personnel would be noticeable, temporary, but not destabilizing.

Overall, socioeconomic impacts resulting from construction and operation of natural gas-fired plants can be considered SMALL to MODERATE (Adverse) to SMALL (Beneficial).

Ecological Resources and Threatened and Endangered Species

The gas-fired alternative would introduce construction impacts and new incremental operational impacts, which would alter the ecology of the surrounding environment. Ecological impacts to a plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss, reduced wildlife reproduction, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts. Construction and maintenance of transmission lines and a gas pipeline would have ecological impacts. Due to the loss of habitat for smaller resident species, the impact on terrestrial biota would be MODERATE. Potential impacts to aquatic biota and threatened and/or endangered species would be SMALL.

Cultural Resources

As described in Subsection 4.1.3, the VCS site is part of an NRHP-eligible rural historic landscape. Construction of a gas-fired power plant at the VCS site would have a LARGE visual effect on the historic landscape as well as the 29 properties listed in Table 4.1-2 and would warrant mitigation. Surveys are being conducted to identify historic and archeological resources at the VCS. Surveys would also be conducted in areas affected by the installation of offsite infrastructure associated with construction and operation of the plant. Upon completion of the surveys, the Texas State Historic Preservation Office would be consulted to identify measures for avoidance, minimization, or mitigation of any adverse effects in accordance with Section 106 of the National Historic Preservation Act. The protection and documentation of inadvertently discovered archaeological resources or human remains would be coordinated with the Texas Historical Commission. Based on this discussion, impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

Environmental Justice

Environmental justice effects depend on the nearby population distribution. Figures 2.5.4-1 through 2.5.4-6 (Subsection 2.5.4) locate the minority and low income populations within 50 miles of the VCS. Minority populations lie directly east of the VCS near Bloomington as well as in the city of Victoria. The closest low-income block groups are located within the city of Refugio in Refugio County (approximately 26 miles from the site), and within the city of Cuero in Dewitt County (approximately 36 miles from the site). As described in Subsection 4.4.3.2, no subsistence agriculture, hunting, or fishing dependencies or practices have been reported in the area. Construction activities offer new employment possibilities, but have negative effects on the availability and cost of housing, which could disproportionately affect low-income populations. However, as described in Subsection 4.4, there is ample housing available in area to accommodate the in-migrating workforce. Overall, environmental justice effects are likely to be SMALL.

9.2.3.2.2 Health Effects

In the NUREG-1437, NRC identified cancer and emphysema as potential health risks from gas-fired plants. NO_X emissions contribute to ozone formation, which in turn contributes to health risks. NO_X emissions from any plant would be regulated by the state or EPA. For a plant sited in Texas, NO_X emissions would be regulated by the Texas Department of Environmental Quality. Human health impacts are not expected to be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of the resource. The human health impacts of the gas-fired alternative would be SMALL.

9.2.3.2.3 Design Alternatives

Combined-cycle plants use a combination of combustion turbine and heat recovery steam generators to generate power. Therefore, their heat rejection rates are substantially lower than comparably sized nuclear- and coal-fired steam generators. Consequently, combined-cycle plants with recirculated cooling systems generally use cooling towers rather than ponds. A mechanical draft cooling tower was conservatively assumed to be used for the gas-fired alternative.

The analysis of air quality impacts in Subsection 9.2.3.2.1 is based on use of best available control technology; therefore, there are no reasonable alternatives for reducing those impacts.

9.2.3.2.4 Summary

The impacts of gas-fired generation are compared to the proposed nuclear project in Tables 9.2-4 and 9.2-5. As these tables demonstrate, the gas-fired alternative is not environmentally preferable to the proposed nuclear project.

9.2.3.3 Combination of Alternatives

This subsection reviews possible combinations of alternatives that could generate replacement baseload power in lieu of the proposed nuclear project. As stated in the beginning of Section 9.2, the nuclear project has a capacity of 3070 MW of electrical generation and is expected to supply baseload power to the ERCOT region.

As a stand-alone technology, wind energy (Subsection 9.2.1.1) is not a feasible alternative for baseload power because of its intermittent capacity. Solar power (Subsection 9.2.2.2) has a similar issue with intermittent capacity. As shown above, fossil and/or carbon fuel-fired combustion technologies can produce baseload capacity generation, but not at environmental impact levels smaller or equal to the proposed project. Of the fossil and/or carbon-fuel alternatives evaluated, only coal and natural gas are in full commercial use at this time for electrical generation. Because of the lack of clear environmental advantages of the other fossil and/or carbon fuel-fired technologies, those technologies are not as environmentally preferable.

A complex analysis would be necessary to correctly assess the best combination of alternative sources of power. This would consider optimum size, local applicability of technology, effective combination methods, etc., to arrive at the optimum solutions. For the renewal of licenses pursuant to 10 CFR

Part 54, NRC determined that comprehensive consideration of all possible combinations would be too unwieldy, given the purposes of the alternative analysis. However, the analysis of combinations of alternatives should be sufficiently complete to aid the NRC in its analysis of alternative sources of energy pursuant to the National Environmental Policy Act. The following provides the basis for an evaluation of a reasonable number of combinations of alternative energy sources to the proposed nuclear project.

Combinations of alternatives were developed, as reasonable alternatives to the proposed project, based on technological maturity, economics, and other factors. Although some alternatives by themselves may not be able to provide the capacity needed, a mix of these alternatives could be sufficient. Representative and bounding sets of these combination alternatives are addressed below.

9.2.3.3.1 **Determination of Alternatives**

A possible alternative combination is a baseload-capable source coupled with a renewable non-baseload capable source. The proposed nuclear project will provide baseload capacity, providing power in a predictable, consistent manner. The alternative combination would provide the full dependability of a consistent baseload supply, but could reduce environmental impacts. For this portion of this analysis, wind and solar are considered as renewable power sources that can supplement the baseload capable source.

Any combination of alternative sources that includes a variable renewable source of energy (offering all or part of the proposed nuclear project capacity) must be combined with a 100% load capacity, fossil fuel-fired source. This allows the fossil fuel-fired portion to manage the entire load during times when the output of the renewable source of energy is reduced or unavailable. When available, the output of the renewable source displaces the baseload supply, and the output of the fossil fuel-fired portion can be reduced to accommodate the increase in renewable generation. For example, if the renewable resource is wind, when the wind blows and wind-driven power becomes available, the fossil fuel-fired power output can be reduced, so that the sum of the two sources continues to match the baseload capacity expected. The result is that the overall performance of the combination meets the demand with the same dependability as a fossil fuel-fired plant.

Both coal- and natural gas-fired generation were evaluated above (Subsections 9.2.3.1 and 9.2.3.2) and were shown to have environmental impacts that are greater than the proposed nuclear project. Of the two, natural gas-fired generation has a smaller environmental impact. In addition, natural gas is a better effective partner to a variable source because it can better tolerate the ramping up and down of the power level. Even cleaner burning technologies for coal do not approach the small environmental impact of natural gas. For this reason, in the environmental comparison portion of this alternative study, natural gas is used as the fossil fuel for baseload capacity. This review examines the reduction in environmental impacts from a natural gas-fired facility when generation from the facility is displaced by the renewable resource. The impacts of natural gas considered are those shown in Subsection 9.2.3.2. Also, the renewable part of the alternative combination is any combination of renewable technologies that could produce power equal to or less than the proposed nuclear project, when that resource is available.

9.2.3.3.2 **Environmental Impacts**

The overall environmental impacts associated with the construction and operation of the gas-fired alternative using a closed-cycle cooling system are described in Subsection 9.2.3.2 and are summarized in Table 9.2-4. Depending on the amount of renewable output included in the combination alternative, the level of environmental impacts of the gas-fired portion would be comparatively lower. If 100% of the power level of the gas-fired portion was not available from the renewable alternative, some level of environmental impact associated with the gas portion remains. When 100% of the load is carried by the renewable portion, the environmental impact of the operation of the gas-fired portion is eliminated.

A determination of the environmental impacts that a combination of these alternatives would have can be made from the statistics previously evaluated. The environmental impacts associated with a gas-fired facility and equivalent renewable facilities are summarized in Table 9.2-4. The gas-fired facility alone has impacts that are greater than the project. Some of the environmental impacts of the renewable energy sources are equal to or greater than those of the proposed nuclear project. Therefore, the combination of a gas-fired plant and wind or solar facilities would have environmental impacts that are equal to or greater than those of a nuclear facility.

Impacts from wind and solar facilities are described in Subsections 9.2.2.1 and 9.2.2.2, respectively. Land use impacts from wind and/or solar facilities could be SMALL to LARGE, and the aesthetic impacts of wind could be SMALL to LARGE, depending on the size of the facilities (the smaller the size of the wind/solar facilities, the larger the air impacts from the gas-fired plant). Similarly, impacts of wind/solar facilities on ecological resources and threatened and endangered species could be SMALL to MODERATE, and impacts on cultural resources could be SMALL to LARGE, depending on facility sizes and locations. The environmental impacts from the use of wind and/or solar facilities in combination with a gas-fired facility would be SMALL, except for land use and aesthetic impacts from wind and solar facilities that range from SMALL to LARGE, the ecological resource and threatened and endangered species impacts from wind and solar facilities that range from SMALL to MODERATE, the air quality impacts from the gas-fired facility that would be MODERATE, and the socioeconomic impacts from the gas-fired facility would be SMALL to MODERATE. In comparison, the environmental impacts of a new nuclear plant at the proposed nuclear project would be SMALL, except socioeconomics and cultural resources, which would be SMALL to LARGE. Therefore, a combination of alternatives would not be environmentally preferable to the proposed nuclear project and should not be considered further.

9.2.3.3.3 **Summary**

Although other combinations of the various alternatives are not described here, the lower capacity factors, higher environmental impacts, and immature technologies have not been found to assemble into a viable, reasonable alternative that is either environmentally equivalent or preferable. Wind and solar generation in combination with fossil fuel-fired facilities could be used to generate baseload power and would serve the equivalent purpose of the proposed project. However, wind and solar generation in combination with fossil fuel-fired facilities would have equivalent or greater environmental impacts when compared to a new nuclear facility at the VCS. Therefore, wind and solar generation in combination with fossil fuel-fired facilities are not preferable to the proposed project.

9.2.4 **Conclusion**

Based on environmental impacts evaluated, neither a coal-fired nor a gas-fired plant would result in appreciably fewer environmental impacts than the proposed nuclear project. This conclusion is shown in detail in Tables 9.2-4 and 9.2-5. Furthermore, both types of plants would result in substantially greater environmental impacts on air quality relative to the proposed nuclear project. In addition, a combination of either of these two types of generation with renewable sources of energy, such as wind or solar, could achieve a smaller impact on the air quality but only with an accompanying moderate to large impact on land use. Therefore, the coal-fired alternative, gas-fired alternative, and combination of alternatives would not be environmentally preferable to the proposed nuclear project.

9.2.5 **References**

ACAA Aug 2007. American Coal Ash Association. *2006 Coal Combustion Product (CCP) Production and Use Survey Results*. August 24, available at http://www.acaa-usa.org/associations/8003/files/2006_CCP_Survey_(Final-8-24-07).pdf, accessed May 22, 2008.

AEI Sep 2004. Altera Energy, Inc., *A Guidebook to Expanding the Role of Renewables in a Power Supply Portfolio*, September 2004, available at http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/power_ supply_ guidebook.pdf, accessed September 11, 2007.

API Mar 2000. The American Petroleum Institute, *Petroleum Coke Test Plan*, Submitted to U.S. EPA, Consortium Registration # 1100997, March 31, 2000.

AWEA 2007a. American Wind Energy Association, *Wind Web Tutorial: Wind Energy Basics*, available at http://www.awea.org/faq/wwt_basics.html, accessed September 7, 2007.

AWEA 2007b. American Wind Energy Association, *Wind Web Tutorial: Wind Energy and the Environment*, available at http://www.awea.org/faq/wwt_environment.html, accessed September 7, 2007.

AWEA 2007c. American Wind Energy Association, *Basic Principles of Wind Resource Evaluation*, available at http://www.awea.org/faq/basicwr.html, accessed September 11, 2007.

AWEA 2007d. American Wind Energy Association, *Wind Energy: An Untapped Resource*, Wind Energy Fact Sheet, available at http://www.awea.org/pubs/factsheets/Wind_Energy_An_Untapped_Resource.pdf, accessed September 11, 2007.

AWS Truewind Jan 2007. AWS Truewind, *Wind Generation Assessment—A Report to the Electric Reliability Council of Texas*, January 2007.

Bowers Mar 2005. Bowers, K. W., *Renewable Energy Options for the Southeastern United States*, Prepared testimony of Kerry W. Bowers, Technology Manager, Southern Company. Senate Energy and Natural Resources Committee Hearing on Renewable Resources, March 8, 2005.

Bronicki 2002. Bronicki, L.Y.,*Geothermal Power Stations. Encyclopedia of Physical Science and Technology*, Third Edition, Volume 6: pages 709-719, Academic Press.

BWEA 2007. British Wind Energy Association, *Noise from Wind Turbines — The Facts*, available at http://www.britishwindenergy.co.uk/ref/noise.html, accessed September 13, 2007.

CEUS Jul 2006. Clean Energy U.S., *About IGCC Power*, July 5, 2006, available at http://www.clean-energy.us/facts/igcc.htm, accessed September 16, 2007.

DEC 2001. Duke Energy Corporation, *Applicant's Environmental Report Operating License Renewal Stage, McGuire Nuclear Station*. Section 8.0 Comparison of Impacts, Page 8-10.

Drew 2007. Electric Reliability Council of Texas, Drew, R., *ERCOT Unit Data Report August 2007*, August 22, 2007, available upon request from info@ercot.com.

Duffield, Wendell A. and Sass, John H., 2003. *Geothermal Energy—Clean Power From the Earth's Heat*. U.S. Geological Survey Circular C1249. Available at http://pubs.usgs.gov/circ/2004/c1249/c1249.pdf, accessed September 7, 2007.

EPRI Mar 2002. Electric Power Research Institute, *Water & Sustainability (Volume 3): U.S. Water Consumption for Power Production — The Next Half Century*, March 2002.

EPRI May 2007. Electric Power Research Institute, *Advanced Clean Coal*, May 29, 2007.

ERCOT Dec 2007. Electric Reliability Council of Texas, *Report on the Capacity, Demand, and Reserves in the ERCOT Region, Summer Summary*, December 2007.

ERCOT May 2007. Electric Reliability Council of Texas, *ERCOT Quick Facts*, May 2007, available at http://www.ercot.com/news/presentations/2007/ERCOT%20Quick%20Facts%20May%202007.pdf, accessed October 11, 2007.

Erdlac Jan 2007. R.J. Erdlac, Jr., *Geopowering Texas, A Report to the Texas State Energy Conservation Office on Developing the Geothermal Energy Resource of Texas*, January 2007, The University of Texas of the Permian Basin Center for Energy and Economic Diversification.

FC2000 2007. Fuel Cells 2000, *Worldwide Stationary Fuel Cell Installation Database*, available at http://www.fuelcells.org/info/databasefront.html, accessed October 16, 2007.

FCT Sep 2007. Fuel Cell Today, K. Adamson, *2007 Large Stationary Survey*, September 2007.

FPSC&DEP Jan 2003. Florida Public Service Commission and the Department of Environmental Protection, *An Assessment of Renewable Electric Generating Technologies for Florida*, January 2003.

GCCTCT Mar 2005. Governor's Clean Coal Technology Council of Texas, *Clean Coal: The Key to Affordable Electricity in Texas*, March 2005.

GEA Jan 2007. Geothermal Energy Association, *An Assessment of Geothermal Resource Development Needs in the Western U.S.*, January 2007.

GEA May 2007. Geothermal Energy Association, *Update on U.S. Geothermal Power Production and Development*, May 10, 2007.

Ghosh Sep 2005. Harvard University John F. Kennedy School of Government, Debyani Ghosh, *Assessment of Advanced Coal-Based Electricity Generation Options for India: Potential Learning from U.S. Experiences*, September 2005.

INGAA 2000. Interstate Natural Gas Association of America, *Implications of Reduced Gas Use on Emissions from Power Generation*, F-2000-04, April 2000.

INL Jul 2005. Idaho National Laboratory, *Hydropower Program: Hydrofacts, Hydropower, Plant Costs and Production Expenses*, July 18, 2005, available at http://hydropower.id.doe.gov/hydrofacts/plant_costs.shtml, accessed September 27, 2007.

Leitner and Owens Jan 2003. National Renewable Energy Laboratory, Leitner, A. and B. Owens, *Brighter than a Hundred Suns: Solar Power for the Southwest*, NREL/SR-550-33233, January 2003.

Leitner Jul 2002. National Renewable Energy Laboratory, A. Leitner, *Fuel from the Sky: Solar Power's Potential for Western Energy Supply*, NREL/SR-550-32160, July 2002.

MDNR Jul 2007. Missouri Department of Natural Resources, *Energy for Missouri: Today and Tomorrow, Educator's Guide: Energy Producing Systems*, Hydro Power, July 18, 2007.

MIT 2006. Massachusetts Institute of Technology, *The Future of Geothermal Energy, Impact of Enhanced Geothermal Systems on the United States in the 21st Century*, available at http://geothermal.inel.gov/publications/future_of_geothermal_energy.pdf, accessed October 16, 2007.

MTC 2007. Massachusetts Technology Collaborative, *Airspace Issues in Wind Turbine Siting*, available at http://www.mtpc.org/renewableenergy/Community_Wind/faaairspace.html, accessed September 12, 2007.

NCC (National Coal Council). 2001. *Increasing Electricity Availability from Coal-fired Generation in the Near-Term*, May 2001, Washington D.C.

NETL 2007. National Energy Technology Laboratory, *EW&R-Air Quality Research, Health Effects of Coal Plant Emissions*, available at http://www.netl.doe.gov/technologies/coalpower/ewr/air_quality_research/health_effects.html, accessed October 1, 2007.

NRDC Feb 2006. Natural Resources Defense Council, *Coal Technology Options: Costs, Emissions, and Experience for Electricity Generation in a Carbon-Constrained World*, February 13, 2006.

NREL Apr 2006. National Renewable Energy Laboratory, *Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California*, NREL/SR-550-39291, April 2006.

NREL Jun 2004. National Renewable Energy Laboratory, *Future for Offshore Wind Energy in the United States*, NREL/CP-500-36313, June 2004.

NREL Jun 2006. National Renewable Energy Laboratory, *Bird Movements and Behaviors in the Gulf Coast Region: Relation to Potential Wind Energy Developments*, NREL/SR-500-39572, June 2006.

NREL May 2007. National Renewable Energy Laboratory, *Photovoltaic Research Electronic Materials and Devices*, May 2007, available at http://www.nrel.gov/pv/electronic_materials_devices.html, accessed December 6, 2007.

NREL Nov 1999. National Renewable Energy Laboratory, *The Value of the Benefits of U.S. Biomass Power*, NREL/SR-570-27541, November 1999.

NREL Oct 2007. National Renewable Energy Laboratory, *Learning About Renewable Energy and Energy Efficiency Photovoltaics*, October 2007, available at http://www.nrel.gov/learning/re_photovoltaics.html, accessed December 6, 2007.

NRRI Feb 2007. National Regulatory Research Institute, *What Generation Mix Suits Your State? Tools for Comparing Fourteen Technologies across Nine Criteria*, February 14, 2007, available at http://www.nrri.ohio-state.edu/dspace/handle/2068/1045, accessed September 7, 2007.

ORNL 2003. Oak Ridge National Laboratory, *Coal Combustion: Nuclear Resource or Danger*, Oak Ridge National Laboratory Review Volume 26 Nos. 3 and 4 Summer/Fall 1993.

PERMG Jun 2005. Purdue Energy Research Modeling Groups, *Factors that Affect the Design and Implementation of Clean Coal Technologies in Indiana*, June 6, 2005.

Powerlytix 2007. *Annual Heat Rates from CEMS*, available at http://www.powerlytix.com/frontend/, accessed September 28, 2007.

PUCT Aug 2006. Public Utility Commission of Texas, *Texas Electric Market*, August 28, 2006, available at http://www.rrc.state.tx.us/commissioners/carrillo/mexico/2006/julieparsley.pdf, accessed October 24, 2007.

PUCT Jan 1999. Public Utility Commission of Texas, *Feasibility Investigation for AC Interconnection between ERCOT and SPP/SERC*, Report to the 76th Texas Legislature, January 29, 1999, available at http://www.puc.state.tx.us/electric/projects/14894/14894.cfm, accessed February 24, 2008.

PUCT Nov 2007. Public Utility Commission of Texas, *New Generating Plants in Texas Since 1995*, November 16, 2007, available at http://www.puc.state.tx.us/electric/maps/index.cfm, accessed March 24, 2008.

RRCT 2007. Railroad Commission of Texas, *Public GIS Map Viewer*, available at http://gis2.rrc.state.tx.us/public, accessed October 1, 2007.

Santee Cooper 2007. Santee Cooper, *Green Power FAQ*, available at https://www.santeecooper.com/portal/page/portal/SanteeCooper/Environment/GreenPower/GreenPower%20FAQ, accessed October 12, 2007.

Schainker Dec 2006. R. B. Schainker, *Shaping & Firming Wind Energy with Electric Energy Storage*, December 13 2006, available online at http://cwec.ucdavis.edu/forum2006/proceedings/Schainker_CWEC2006.pdf, accessed October 13, 2007

SECO 2007a. State Energy Conservation Office, *Texas Wind Energy Resources*, available at http://www.infinitepower.org/reswind.htm, accessed September 11, 2007.

SECO 2007b. State Energy Conservation Office, *Texas Biomass: Regional Differences*, available at http://www.seco.cpa.state.tx.us/re_biomass-regional.htm, accessed October 13, 2007.

TCEQ Jan 2007. Texas Commission on Environmental Quality, *Air Quality and the State Implementation Plan: SIP 101*, January 11, 2007, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/miscdocs/SIP101revised.pdf, accessed September 26, 2007.

TCEQ Jun 2006. Texas Commission on Environmental Quality, *Municipal Solid Waste in Texas: A Year in Review, FY 2005 Data Summary and Analysis*, AS-187/06, June 2006.

TEPC Mar 2004. Texas Energy Planning Council, *Texas Energy Overview*, March 2004, available at http://www.rrc.state.tx.us/tepc/TexasEnergyOverview.pdf, accessed February 25, 2008.

U.S. DOE Aug 2005a. U.S. Department of Energy, *Wind and Hydropower Technologies Program: Hydropower Research and Development*, August 30, 2005, available at http://www1.eere.energy.gov/windandhydro/hydro_rd.html, accessed September 17, 2007.

U.S. DOE Aug 2005b. U.S. Department of Energy, *DOE Geothermal Technologies Program Multi-Year Program Plan 2006 — 2011*, August 31, 2005, available at http://www1.eere.energy.gov/geothermal/pdfs/consolidated_draft_83105_final.pdf, accessed October 16, 2007.

U.S. DOE EIA 2007a. U.S. Department of Energy, Energy Information Administration, *Frequently Asked Questions — Natural Gas*, available at http://tonto.eia.doe.gov/ask/ng_faqs.asp, accessed September 18, 2007.

U.S. DOE EIA 2007b. U.S. Department of Energy, Energy Information Administration, *United States Spot Price FOB Weighted by Estimated Import Volume (Dollars per Barrel)*, available at http://tonto.eia.doe.gov/dnav/pet/hist/wtotusaw.htm, accessed September 18, 2007.

U.S. DOE EIA 2007d. U.S. Department of Energy, Energy Information Administration, *Existing Electric Generating Units in the United States 2006*, available at http://www.eia.doe.gov/cneaf/electricity/page/capacity/capacity.html, accessed October 10, 2007.

U.S. DOE EIA 2007e. U.S. Department of Energy, Energy Information Administration, *Crude Oil Production*, available at http://tonto.eia.doe.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_a.htm, accessed October 31, 2007.

U.S. DOE EIA 2007f. U.S. Department of Energy, Energy Information Administration, *State Energy Profiles: Texas*, available at http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=TX, accessed October 31, 2007.

U.S. DOE EIA 2007g. U.S. Department of Energy, Energy Information Administration, *Biomass for Electricity Generation*, available at http://www.eia.doe.gov/oiaf/analysispaper/biomass/index.html, accessed December 2, 2007.

U.S. DOE EIA Aug 2007. U.S. Department of Energy, Energy Information Administration, *Renewable Energy Consumption and Electricity Preliminary 2006 Statistics*, August 2007, available at http://www.eia.doe.gov/cneaf/solar.renewables/page/prelim_trends/rea_prereport.html, accessed December 2, 2007.

U.S. DOE EIA Feb 2007a. U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2007 with Projections to 2030*, DOE/EIA-0383(2007), February 2007.

U.S. DOE EIA Feb 2007b. U.S. Department of Energy, Energy Information Administration, *Supplemental Tables to the Annual Energy Outlook 2007*, February 2007, available at http://www.eia.doe.gov/oiaf/aeo/supplement/index.html, accessed February 24, 2008.

U.S. DOE EIA Jun 2006. U.S. Department of Energy, Energy Information Administration, *Cost and Quality of Fuels for Electric Plants 2004 and 2005*, DOE/EIA-0191(2005), June 30, 2006.

U.S. DOE EIA Mar 2007a. U.S. Department of Energy, Energy Information Administration, *State Electricity Profiles 2005*, DOE/EIA-0348(01)/2, March 6, 2007.

U.S. DOE EIA Mar 2007b. U.S. Department of Energy, Energy Information Administration, *Table 1.13.B. Net Generation from Hydroelectric (Conventional) Power by State by Sector, Year-to-Date through June 2007 and 2006*, available at http://www.eia.doe.gov/cneaf/solar.renewables/ page/hydroelec/ hydroelec.html, accessed September 16, 2007.

U.S. DOE EIA May 2007. U.S. Department of Energy, Energy Information Administration, *Methodology for Allocating Municipal Solid Waste to Biogenic and Non-Biogenic Energy*, May 2007.

U.S. DOE EIA Nov 2006. U.S. Department of Energy, Energy Information Administration, *Natural Gas Annual 2005*, DOE/EIA-0131(05), November 16, 2006.

U.S. DOE EIA Oct 2007. U.S. Department of Energy, Energy Information Administration, *Annual Coal Report 2006*, October 2007, available at http://www.eia.doe.gov/cneaf/coal/page/acr/acr_sum.html, accessed February 24, 2008.

U.S. DOE Jan 2006. U.S. Department of Energy, *Feasibility Assessment of the Water Energy Resources of the US for New Low Power and Small Hydro Classes of Hydroelectric Plants*, DOE-ID-11263, January 2006.

U.S. DOE Jun 2007. U.S. Department of Energy, *Texas Provides Grants for Biomass Power Generation; 100-Megawatt Plant to Use Waste that Qualifies*, June 25, 2007, available at http://www.eere.energy.gov/states/news_detail.cfm/news_id=11078, accessed October 13, 2007.

U.S. DOE Mar 2003. U.S. Department of Energy, *Clean Coal Technology — The JEA Large-Scale CFB Combustion Demonstration Project*, Topical Report Number 22, March 2003.

U.S. DOE May 2007. U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, May 30, 2007, available at http://www1.eere.energy.gov/windandhydro/pdfs/wiser_data_report_summary_2006.pdf, accessed September 10, 2007.

U.S. DOE Nov 2004. U.S. Department of Energy, *Buried Treasure — The Environmental, Economic, and Employment Benefits of Geothermal Energy*, DOE/GO-102004-1985, November 2004.

U.S. DOE Oct 2006. U.S. Department of Energy, *Alternative Energy Resources in Texas*, October 24, 2006, available at http://www.eere.energy.gov/states/alternatives/resources_tx.cfm, accessed September 13, 2007.

U.S. DOE Sep 2005. U.S. Department of Energy, *Consumer's Guide to Energy Efficiency and Renewable Energy: Hydropower or Hydroelectric Power*, September 12, 2005, available at http://www.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10480?, accessed September 16, 2007.

U.S. DOE Sep 2006. U.S. Department of Energy, *Biomass Energy Data Book: Edition 1*, ORNL/TM-2006/571, September 2006, available at http://cta.ornl.gov/bedb/download.shtml, accessed October 13, 2007.

U.S. NRC May 1996. U.S. Nuclear Regulatory Commission, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Volumes 1 and 2*, NUREG-1437, May 1996.

U.S. DOS Apr 2005. U.S. Department of State, *Solar Cells Increasing Use of Electricity from Sunlight — Photovoltaic Technology a Multibillion-dollar Market Worldwide*, April 25, 2005, available at http://usinfo.state.gov/gi/Archive/2005/Apr/19-464962.html, accessed September 13, 2007.

U.S. EPA 2007. U.S. Environmental Protection Agency, *LMOP Landfill and LFG Energy Project Database*, available at http://epa.gov/landfill/proj/index.htm#1, accessed October 12, 2007.

U.S. EPA Apr 2000. U.S. Environmental Protection Agency, *AP 42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Chapter 3: Stationary Internal Combustion Sources*, April 2000, Section 3.1, Stationary Gas Turbines.

U.S. EPA Apr 2007. U.S. Environmental Protection Agency, *Clean Air Interstate Rule, April 5, 2007*, available at http://www.epa.gov/cair, accessed September 26, 2007.

U.S. EPA Jul 2006a. U.S. Environmental Protection Agency, *Electricity from Municipal Solid Waste, July 19, 2006*, available at http://www.epa.gov/solar/muni.htm, accessed September 16, 2007.

U.S. EPA Jul 2006b. U.S. Environmental Protection Agency, *Electricity from Coal*, July 19, 2006, available at http://www.epa.gov/solar/coal.htm, accessed September 16, 2007.

U.S. EPA Jul 2006c. U.S. Environmental Protection Agency, *Electricity from Natural Gas*, July 19, 2006, available at http://www.epa.gov/solar/natgas.htm, accessed September 16, 2007.

U.S. EPA Jul 2006d. U.S. Environmental Protection Agency, *Electricity from Oil*, July 19, 2006, available at http://www.epa.gov/solar/oil.htm, accessed September 16, 2007.

U.S. EPA Jul 2006e. U.S. Environmental Protection Agency, *Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies*, EPA-430/R-06/006, July 2006.

U.S. EPA Sep 1998. U.S. Environmental Protection Agency, *AP 42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*, *Chapter 1: External Combustion Sources*, September 1998, Section 1.1, Bituminous and Subbituminous Coal Combustion.

Walsh et.al. 2000. Walsh, M.E, Perlack, R.L., Turhollow, A., de la Torre Ugarte, D. G., Becker, D. A., Graham, R. L., Slinsky, S. E., and Ray, D. E. *Biomass Feedstock Availability in the United States: 1999 State Level Analysis*, updated January, 2000, available at http://bioenergy.ornl.gov/resourcedata/index.html, accessed September 28, 2007.

WCI 2007. World Coal Institute, *Coal Technologies: Supercritical & Ultra-supercritical*, available at http://www.worldcoal.org/pages/content/index.asp?PageID=421, accessed October 14, 2007.

WGA Jan 2006. Western Governors' Association, *Solar Task Force Report, Clean and Diversified Energy Initiative*, January 2006.

Zachry 2007. Zachry, *Deer Park Energy Center*, available at http://www.zachry.com/projects_deerpark.htm, accessed September 28, 2007.

Table 9.2-1
Retired and Mothballed Capacity in the ERCOT Region by Year

Unit Name	2008	2009	2010	2011	2012	2013
Leon Creek 3	0.0	0.0	65.0	65.0	65.0	65.0
Units to retire	0.0	0.0	65.0	65.0	65.0	65.0
Atkins 3	12.0	12.0	12.0	12.0	12.0	12.0
Atkins 4	22.0	22.0	22.0	22.0	22.0	22.0
Atkins 5	25.0	25.0	25.0	25.0	25.0	25.0
Atkins 6	50.0	50.0	50.0	50.0	50.0	50.0
Collin 1	138.0	138.0	138.0	138.0	138.0	138.0
Eagle Mountain 1	112.0	112.0	112.0	112.0	112.0	112.0
Eagle Mountain 2	100.0	100.0	100.0	100.0	100.0	100.0
Eagle Mountain 3	378.0	378.0	378.0	378.0	378.0	378.0
Ft. Phantom 1	157.0	157.0	157.0	157.0	157.0	157.0
Ft. Phantom 2	203.0	203.0	203.0	203.0	203.0	203.0
Handley 1	36.0	36.0	36.0	36.0	36.0	36.0
Handley 2	68.0	68.0	68.0	68.0	68.0	68.0
J L Bates 1	71.0	71.0	71.0	71.0	71.0	71.0
J L Bates 2	110.0	110.0	110.0	110.0	110.0	110.0
Laredo 1	0.0	0.0	0.0	32.0	32.0	32.0
Laredo 2	0.0	0.0	0.0	32.0	32.0	32.0
Laredo 3	0.0	0.0	0.0	105.0	105.0	105.0
Leon Creek 4	95.0	95.0	95.0	95.0	95.0	95.0
Morgan Creek 6	457.0	457.0	457.0	457.0	457.0	457.0
Mountain Creek 2	23.0	23.0	23.0	23.0	23.0	23.0
Mountain Creek 3	63.0	63.0	63.0	63.0	63.0	63.0
Nueces Bay 5	31.0	31.0	31.0	31.0	31.0	31.0
Nueces Bay 6	161.0	161.0	161.0	161.0	161.0	161.0
Nueces Bay 7	367.0	367.0	367.0	367.0	367.0	367.0
P H Robinson 1	444.0	444.0	444.0	444.0	444.0	444.0
P H Robinson 2	459.0	459.0	459.0	459.0	459.0	459.0
P H Robinson 3	551.0	551.0	551.0	551.0	551.0	551.0
P H Robinson 4	733.0	733.0	733.0	733.0	733.0	733.0
W B Tuttle 2	90.0	90.0	90.0	90.0	90.0	90.0
Total Mothballed	4956.0	4956.0	4956.0	5125.0	5125.0	5125.0

Source: ERCOT Dec 2007

Table 9.2-2
Coal-Fired Alternative

Characteristic	Basis
Unit size = 758 MWe ISO rating net[a]	Assumed
Unit size = 807 MWe ISO rating gross[a]	Calculated based on 6% onsite power
Number of units = 4	Assumed
Technology = Ultra-supercritical	—
Boiler type = PC, dry bottom, tangentially-fired, sub-bituminous, NSPS	—
Fuel type = Powder River Basin sub-bituminous coal	Typical for coal used by generators in ERCOT
Fuel heat value = 7611 Btu per lb	(U.S. DOE EIA Jun 2006)
Fuel ash content by weight = 10.3%	(U.S. DOE EIA Jun 2006)
Fuel sulfur content by weight = 0.74%	(U.S. DOE EIA Jun 2006)
Uncontrolled NO_x emission = 7.2 lb per ton	Typical for pulverized coal, tangentially fired, dry-bottom, NSPS (U.S. EPA Sep 1998)
Uncontrolled CO emission = 0.5 lb per ton	Typical for pulverized coal, tangentially fired, dry-bottom, NSPS (U.S. EPA Sep 1998)
Heat rate = 8146 Btu per kWh	Based on EPA data (U.S. EPA Jul 2006e)
Capacity factor = 85%	Typical for large coal-fired units
NO_x control = low NO_x burners, overfire air and selective catalytic reduction (95% reduction)	Best available and widely demonstrated to minimize NO_x emissions (U.S. EPA Sep 1998)
Particulate control = fabric filters (baghouse — 99.9% removal efficiency)	Best available for minimizing particulate emissions (U. S. EPA Sep 1998)
SO_x control = Wet scrubber — limestone (95% removal efficiency)	Best available for minimizing SO_x emissions (U.S. EPA Sep 1998)

a. The difference between “net” and “gross” is the electricity consumed onsite.
Btu = British thermal unit
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60% relative humidity, and 14.696 pounds per square inch of atmospheric pressure
NSPS = New Source Performance Standard
NOx = nitrogen oxides
SOx = oxides of sulfur

Table 9.2-3
Gas-Fired Alternative

Characteristic	Basis
Unit size = 1011 MWe ISO rating net[a]	Assumed
Unit size = 1053 MWe ISO rating gross[a]	Calculated based on 4% onsite power
Number of units = 3	Assumed
Fuel type = natural gas	Assumed
Fuel heating value = 1029 Btu per scf	2005 value for gas used in Texas (U.S. DOE EIA Jun 2006, Table 14.A)
Fuel sulfur content = 0.0007%	(INGAA 2000)
NO_x control = selective catalytic reduction (SCR) with steam/water injection	Best available to minimize NO_x emissions (U.S. EPA Apr 2000)
Fuel NO_x content = 0.0109 lb per MBtu	Typical for large SCR-controlled gas-fired units with water injection (U.S. EPA Apr 2000)
Fuel CO content = 0.00226 lb per MBtu	Typical for large SCR-controlled gas-fired units (U.S. EPA Apr 2000)
Fuel $PM_{2.5}$ content[b] = 0.0019 lb per MBtu	(U.S. EPA Apr 2000, Table 3.1-2a)
Heat rate = 7046 Btu per kWh	Assumption based on Deer Park Energy Center 4x1 plant configuration Powerlytix 2007; Zachry 2007)
Capacity factor = 85%	Assumed based on performance of modern plants

a. The difference between “net” and “gross” is the electricity consumed onsite.

b. All particulate matter is PM2.5.

ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60% relative humidity, and 14.696 pounds of atmospheric pressure per square inch
MBtu = million British Thermal Units
PM2.5 = particulates with a diameter of 2.5 microns or less
scf = standard cubic foot

Table 9.2-4
Summary of Environmental Impacts of New Nuclear, Coal-Fired, and Natural Gas-Fired Generating Units and a Combination of Alternatives

Impact Category	Nuclear	Coal	Natural Gas	Combination of Alternatives
Air quality	SMALL	MODERATE	MODERATE	SMALL to MODERATE
Waste management	SMALL	MODERATE	SMALL	SMALL to MODERATE
Land use	SMALL	MODERATE	SMALL	SMALL to LARGE
Water use and quality	SMALL	SMALL	SMALL	SMALL
Aesthetics	SMALL	SMALL to MODERATE	SMALL	SMALL to LARGE
Socioeconomics	SMALL to LARGE (Adverse) SMALL to LARGE (Beneficial)	SMALL to LARGE (Adverse) SMALL to LARGE (Beneficial)	SMALL to MODERATE (Adverse) SMALL (Beneficial)	SMALL to LARGE (Adverse) SMALL to LARGE (Beneficial)
Ecological resources—Aquatic	SMALL	SMALL	SMALL	SMALL to MODERATE
Ecological resources—Terrestrial	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Threatened and endangered species	SMALL	SMALL	SMALL	SMALL to MODERATE
Cultural resources	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE
Environmental justice	SMALL	SMALL	SMALL	SMALL
Human health	SMALL	SMALL	SMALL	SMALL

Table 9.2-5
Plant and Fuel-System Characteristics Summary

Characteristic	Nuclear	Coal	Natural Gas
Generation — Gross (MWe)	3200	3227	3159
— Net (MWe)	3070	3033	3033
No. of Generating Units	2	4	3
Heat Rate (Btu per kWh)	10,000	8146	7046
Cooling-Water Req.	46,500 gpm	32,270 gpm	12,110 gpm
Cooling-System type	Cooling Pond	Cooling Pond	Cooling Tower
Alternatives Fuel System			
Fuel Heating Value		7611 Btu per lb	1029 Btu per scf
Consumption	–	1.286×10^7 ton per year	1.611×10^{11} scf per year
Average Supply	–	35,225 ton per day	4.413×10^8 scf per day
Sulfur Content	–	0.74%	0.0007%
Ash Content	–	10.3%	–
Ash Disposal (cubic feet per year)	–	1.46×10^7	–
Sulfur-Removal System	–	Wet scrubber – limestone	None
Raw Materials	–	296,700 ton per year	3140 cubic feet per year
Waste Products (cubic feet per year)	–	4.37×10^6	3140
SO_2 Emissions (ton per year)	–	8325	55
NO_x Emissions (ton per year)	–	2314	903
Particulate Emissions (ton per year)	–	152	157
CO_2 Emissions (million ton per year)	–	30.92	9.12
Nuclear Fuel System			
Uranium Consumption (metric tons per year)	84.4	–	–
Initial Fuel Load (ton per year)	408	–	–
New Fuel (trucks per year)	18	–	–
Spent Fuel (trucks per year)	156	–	–
Spent Fuel (metric tons uranium per year)	77	–	–

gpm = gallons per minute
scf = standard cubic foot

9.3 Site Selection Process

This section describes the Exelon site selection process and provides an analysis of alternatives to the proposed VCS Units 1 and 2 site.

9.3.1 Introduction

The objectives of the site selection process are:

1. Compliance with National Environmental Policy Act (NEPA) requirements regarding consideration of alternative sites
2. Satisfaction of NRC site suitability requirements
3. Conformance with Exelon's business objectives for the proposed project

Process guidance was taken from NUREG-1555, Section 9.3.

Subsection 9.3.2 describes the site selection process for the Exelon COL project. A comparison of the potential environmental impacts of a new nuclear generating facility at the alternative and proposed sites is provided in Subsection 9.3.3.

9.3.2 Overview of Site Selection Process

Site selection was conducted in general accordance with the process outlined in the EPRI Siting Guide: *Site Selection and Evaluation Criteria for an Early Site Permit Application*, dated March 2002.

The site selection consisted of the following steps:

- Defining the region of interest (ROI)
- Screening the ROI to identify candidate areas
- Identifying potential sites in the candidate areas
- Screening the potential sites to identify candidate sites
- Selecting the proposed site and the alternative sites

The process for the Exelon site selection study is shown on Figure 9.3-1. Evaluations supporting the identification and screening of candidate areas and potential sites were based on publicly available data sources. Evaluations of the candidate sites also included onsite investigations and reconnaissance.

9.3.2.1 Region of Interest

Exelon operates electrical generation facilities in the midwest, northeast, mid-Atlantic regions and the Electric Reliability Council of Texas (ERCOT) region of Texas. Exelon desires to expand its base load portfolio in the Texas ERCOT market because this market has favorable load projections, market prices, and conditions. Chapter 8 provides a detailed analysis of the existing and projected loads in the ERCOT region in Texas. The projections indicate that ERCOT could need as much as 55,471 MW of new generation capacity by 2017. Based on these favorable load growth projections, Exelon has chosen to expand its base load portfolio in the ERCOT region. To that end, Exelon has defined the ROI based on a geographic boundary limited to the state of Texas and the ERCOT North American Electric Reliability Corporation (NERC) region. Figure 9.3-2 is a map that shows the major load centers and their supporting transmission infrastructure, major water bodies, and population densities for counties in the ROI.

The ERCOT region lies entirely within the state of Texas but does not include the entire state of Texas. The region excludes most of the Panhandle, the extreme west, and parts of the east (Figure 8.1-1). The ERCOT region encompasses 75% of the state of Texas and serves 85% of the Texas load (ERCOT May 2008). As discussed in Chapter 8, ERCOT's intersystem energy exchange capabilities are limited. The ERCOT region is almost entirely isolated from other transmission networks, so the power provided to the ERCOT region loads must be generated within ERCOT. The power generated by the proposed new construction would be used in the ERCOT region.

9.3.2.2 **Process for Identifying Candidate Areas**

As defined in NUREG-1555, the candidate areas are "a subset of the ROI, after unsuitable areas in the ROI are removed from consideration." Based on water availability, transmission access and electrical load, Exelon broadly identified a sub-region in the eastern portion of the ERCOT region to initiate the potential site search. Figure 9.3-3 shows the sub-region consisting of approximately 67 counties.

The next step in the Exelon site selection process was to further refine the sub-region to eliminate those areas that were unsuitable as candidate areas. Exelon performed this refinement by applying the following criteria:

- The primary load centers within the ROI are Dallas-Fort Worth, Houston, and San Antonio/Austin. The transmission systems are most robust in these areas. Consideration shall be given to identifying areas that are within reasonable proximity to these load centers and their supporting infrastructure.
- The availability of a sufficient source of water for the generating facility is a key determining factor in deciding candidate areas in Texas. Consideration should be given to identifying areas where the Gulf of Mexico (using salt water cooling) is accessible or where there is reasonable proximity to large freshwater reservoirs or rivers with sufficient excess capacity. There is greater precipitation and therefore greater availability of water in the south and eastern portions of ERCOT.
- Proximity to large population centers shall be considered when determining the candidate areas. The areas should not generally be within 50 miles of a large population center from an emergency planning perspective, but also not so far from a population center that some meaningful community infrastructure and proximity to a workforce does not exist.

Application of the above exclusionary criteria yielded two candidate areas viewed to be favorable for the COL project as shown in Figure 9.3-2.

9.3.2.3 Identification and Screening of Potential Sites

Exelon used four sources for identifying potential sites. These sources included:

- Texas Office of Economic Development and Tourism
- County economic development agencies
- Real estate brokers
- Contact with individual property owners

Exelon used the Texas Office of Economic Development and Tourism web-based solicitation system. This system allows parties considering economic development in the state of Texas to solicit interest using a central web-based system. While the solicitation was issued by the Texas Office of Economic Development (TOED) to over 300 participating county economic development corporations or entities (i.e., all participating parties in its statewide system), Exelon identified in its request that it was focusing its search on a sub-region consisting of approximately 67 counties (Figure 9.3-3). Exelon's specification in the TOED solicitation consisted of the following:

- Transportation — Adjacent barge or heavy rail access.
- Land — Approximately 850 acres if the cooling water source is a river; additional land necessary if cooling source is a lake/reservoir or other.
- Water — Approximately 75,000 gpm flow rate for continuous consumptive use.
- Transmission Infrastructure — Readily accessible to two or more major, high voltage substations capable of handling input voltages of 345 kV or 500 kV.

Exelon requested that interested parties meeting the above specification submit the following information:

- Cover letter detailing how the community site meets the preliminary site selection criteria.
- Site plot, including documentation addressing water source (river, lake/reservoir, or other) and substation locations.
- Location of rail/barge access.
- Incentives available.
- Community profile.

Nine responses to the web-based solicitation were received: one brownfield site and eight greenfield sites. The acceptability of these sites was evaluated by Exelon's site selection team (the "Team") comprised of individuals with an assortment of expertise, including environmental, water resource and site suitability experts, environmental and real property legal counsel, and individuals with land acquisition expertise such as real estate brokerage (also referred to as "Landmen"), GIS mapping, land and mineral title searches, valuation of target properties, and site surveying.

Following receipt of the responses to the solicitation issued through the governor's web-based economic-development system, The Landmen, at the Team's direction, began to engage parties or landowners who had subsequently offered their property to Exelon, collecting relevant information about the property and bringing this information to the Team for evaluation. Further, the Landmen canvassed the candidate areas searching for other properties that were for sale and that met the following three criteria:

- Contained within one of the designated candidate areas.
- Near an existing or proposed reservoir or near (i.e., approximately 10 miles) a major river such as the Guadalupe, Colorado, Brazos, Trinity, Neches, or San Antonio rivers.
- Individual or multiple parcels that total at least 5000 acres if the source of cooling water is fresh water. If the source is salt water from the Gulf of Mexico, the size of the property should be approximately 1000 acres.

The Landmen used real estate listings, discussions with other brokers, newspapers and other publications, and driving tours of the area to identify potential sites. Eleven sites were identified through the other sources listed above.

Due to the advantages to be gained by locating a new nuclear power plant at an existing commercial nuclear site rather than at a non-nuclear site, including environmental, constructability, and cost benefits, as well as a higher level of knowledge of site conditions, Exelon also considered existing commercial nuclear sites within the ROI. There are two commercial nuclear sites within the ROI: the two-unit South Texas Project and the two-unit Comanche Peak Plant. However, neither is controlled by Exelon, and the operators at both facilities have announced plans for COL applications for new units at these sites. Accordingly, it was determined that obtaining control of sites at these locations would not be feasible and therefore, both were eliminated as potential sites.

Ultimately, 22 potential sites were examined for initial suitability. Table 9.3-1 lists the 22 potential sites considered. Figure 9.3-3 presents the location of the 20 remaining potential sites, after the elimination of two existing nuclear sites.

The potential sites represent a reasonable number of alternatives reflecting the spectrum of siting trade-offs within the ROI.

9.3.2.4 Screening Process to Identify Candidate Sites

The 20 remaining potential sites were first evaluated against the following exclusionary criteria:

- Minimum consumptive water flow rate of 42,000 gpm and minimum water availability of 68,000 acre-feet per year based on average water use.
- Minimum acreage
- Cooling pond not required — 1000 acres.
- If cooling pond needed, sufficient acreage to impound adequate volume of water.

The initial exclusionary water requirement of 75,000 gpm (discussed in Subsection 9.3.2.3) was based on the maximum consumptive water use plant parameter envelope value for two ESBWRs with natural draft cooling towers used in the development of the Clinton Early Site Permit. Specifically, according to information provided by General Electric during the preparation of the ESP application and used to develop bounding cooling water requirements, the maximum make-up flow rate for natural draft cooling towers is 39,000 gpm and 78,000 gpm for a single and dual unit ESBWR, respectively. This figure was rounded down to 75,000 gpm. However, during the course of early discussions with Texas water authorities, it became apparent that Texas water authorities were not willing to negotiate water agreements based on a bounding use figure and a more realistic water use figure was requested. Detailed analyses were performed to determine actual water consumption, resulting in the revised flow rate criterion of 42,000 gpm. In addition, the initial minimum acreage requirement of 850 acres, if no cooling pond is required, was the minimum needed for the exclusion area boundary when the power block is located at the center of the site. The minimum acreage requirement was increased to 1000 acres to allow a larger margin on the exclusion area radius.

Based on evaluation of the potential sites against these criteria, six sites were summarily eliminated, as follows:

- Moss Lake (Cooke County) — This 850-acre inland site on the shore of Moss Lake was eliminated because the response to the TOED solicitation indicated that it does not meet the minimum water requirement and it does not meet the acreage requirement to support development of a cooling pond.
- Red River (Cooke County) —This 1000-acre inland site on the southern bank of the Red River was eliminated because the response to the TOED solicitation indicated that it does not meet the minimum water requirement and it does not meet the acreage requirement to support development of a cooling pond.
- McGregor Industrial Park (McLennan County) — This 1000-acre site is part of a 9700-acre former naval weapons facility that has undergone extensive groundwater and surface water remediation. The site is located in close proximity to other industrial facilities including an active rocket testing facility. Additionally, the site contains hundreds of underground rocket bunkers. The McGregor Industrial Park was the single brownfield site considered.
- Hughes Farm (Williamson County) — This 484-acre site was eliminated because the response to the TOED solicitation indicated that it does not meet the minimum water and acreage requirements.
- Munson site (Grayson County) — The 850-acre site is on the Red River in the northeast corner of Grayson County. This site was eliminated because it has insufficient acreage to allow for the creation of a cooling pond. In addition, there are no existing 345-kV substations in Grayson County, and the only 345-kV line in the area is the Anna-Valley line that goes through the southwest corner of the county. The site would require a new 345-kV substation and routing of a

transmission corridor a significant distance to interconnect. Development of this transmission infrastructure would have impacts on land use and ecological resources and would require a substantial investment.

- Rusk County (Rusk County) — This 600-acre inland site is near the eastern edge of ERCOT, approximately 140 miles east of Dallas. While interconnection to ERCOT via an existing 345-kV transmission line is possible, development of the site would require extensive transmission system upgrades, including construction of an additional 95-mile 345-kV line. Also, the site is not in close proximity to port or barge facilities and extensive rails spurs would need to be built to support construction activities. Development of the transmission and rail lines would have impacts on land use and ecological resources. In addition, the site has a marginal cooling water supply and it does not have sufficient acreage for development of a cooling pond.

The Sam Rayburn Reservoir Area site was also found not to meet the minimum acreage requirement. It was not summarily eliminated but was included in the next selection step because there was potential for additional land parcels to be offered to increase the size of the final property.

Exelon next applied the below screening criteria (based on "avoidance" and "suitability" outlined in the EPRI Siting Guide) to further evaluate the 14 remaining potential sites. The intent of this evaluation was to identify the five best sites of the total population when considering each site against some or all of the below criteria. The criteria included:

- No environmentally sensitive areas in location of footprint.
- No known historic or archaeological sites in location of footprint.
- No land use restrictions (e.g., zoned for residential only).
- Generally low population density in the area immediately surrounding the exclusion area boundary.
- Minimal significant flooding potential (preferably not in a 100-year floodplain). No known or obvious impacts to water quality or aquatic species.
- No known significant geologic, seismic, or subsidence hazards.
- No known significant man-made hazard at the exclusion area boundary (e.g., site adjacent to liquefied natural gas terminal or ship channel, next to a large airport, pipelines running through property and near footprint that cannot be moved, etc.); each hazard to be examined on a case-by-case basis.
- Transmission access — Readily accessible to at least two existing, ERCOT-controlled, major, high-voltage substations capable of handling input voltages of 345 kV or 500 kV.
- Reasonably flat topography.
- Site access and surface and mineral right acquisition are compatible with project milestones.

Exelon performed reconnaissance surveys and onsite studies to obtain additional information on each of the 14 sites, and then reevaluated the sites using the above criteria. Based on the more in-depth screening, 9 of the remaining potential sites were eliminated. A summary of the general basis for their elimination is presented as follows:

- Occidental-Hardy (Matagorda County) — The 2659-acre inland site is bordered by the Colorado River Flood Control Levee along its entire western boundary and most of its southern boundary. This site was eliminated because the site acreage would not support development of a cooling pond. Also, the property behind the levee is a flood plain, so nearly all of the soils on the property have poor structural qualities. Extensive fill would be required due to geotechnical issues and the potential for flooding on the Colorado River. In addition, approximately 200 acres of wetlands exist throughout the site. Further, multiple parcels would need to be acquired, causing uncertainty regarding the ability to obtain approval to acquire the site within project time constraints.
- Douglas-Runnels (Matagorda County) — The 7212-acre inland site is just north of the South Texas Project nuclear power plant and is bordered by the Colorado River to the east. The property is divided by a creek that runs north-south. The eastern half of the site is in the Colorado River flood plain and the soils in this area have poor structural qualities. This site was eliminated due to geotechnical issues and the potential for flooding on the Colorado River that would require extensive fill and the construction of flood protection structures. In addition, approximately 1000 acres of wetlands are located throughout the site, and a large petro-chemical processing facility is located near the northeastern boundary of the site. Further, the unavailability of information regarding the landowner's desire to sell the property to Exelon caused uncertainty regarding the ability to obtain approval to acquire the site within project time constraints.
- Franzen (Matagorda County) — The 2643-acre site is located on the shore of Tres Placios Bay. This site was eliminated because the site is subject to flooding during storm surges due to its low elevation (5 to 10 feet above MSL) and nearly all of the soils have poor structural qualities. Extensive excavation and imported fill would be required to elevate the site and improve the soil structure. In addition, approximately 300 acres of freshwater wetlands and 100 acres of saltwater wetlands are located throughout the property.
- O'Connor Tract (Victoria County) — The site's shape (long and narrow) rather than acreage (1634 acres) presented exclusion area boundary control issues, and the site has insufficient acreage for development of a cooling pond. The barge canal adjoining the property was also deemed to not be a suitable source of plant cooling water. Further, shortly after the site was reviewed by Exelon, it was purchased by another party and was no longer available for Exelon’s project.

- Placedo (Victoria County) — The presence of 30-inch and 36-inch diameter natural gas transmission pipelines adjacent to the site, as well as a 6-inch natural gas pipeline and several highly volatile liquid pipelines within the site boundary, would pose hazard and relocation issues. The site is also at a low elevation above sea level, posing site suitability issues, and is bisected by Placedo Creek. Finally, the site had over 20 landowners in interest at the time of site selection, causing uncertainty regarding the ability to obtain approval to acquire the site within project time constraints.
- Navarro County (Navarro County) — The site is located on the shore of the Richland-Chambers Reservoir, which was built to provide water for Fort Worth. The Reservoir is a popular recreation area and its shoreline has been approved for extensive residential development. This site was eliminated because a new 3000-unit single-family housing development is underway, which caused the city commissioners to withdraw their proposal of this site.
- Powderhorn Ranch (Calhoun County) — The 3707-acre site is bounded by Powderhorn Lake to the north, Matagorda Bay to the east, and the Gulf Intracoastal Waterway (GIWW) to the south. The site is surrounded by the Aransas National Wildlife Refuge, which is known for its exceptional variety of nearly 400 resident and transient bird species. The site is on salt marshes and lowlands with elevations ranging from 5 to 15 feet above MSL. Approximately 2000 acres of freshwater wetlands and 300 acres of saltwater wetlands are located within the property boundary. The site also has potential external hazard issues due to potential for liquefied natural gas ship traffic in the shipping channel. Further, acquisition of this site would not be possible because the landowner was neither interested in selling nor entering into discussions with Exelon.
- Womack (Victoria County) — The 3293-acre site is located between McFaddin and Tivoli in southwestern Victoria County. Two 4-inch diameter natural gas pipelines cross the site where the power block would be located, and a 6-inch natural gas pipeline is located within the exclusion area boundary. These pipelines would require relocation. Several high volatility liquid pipelines are within 4500 feet of the site boundary and would also require relocation. In addition, 23 wells are located within the exclusion area boundary. Further, the acquisition of this site would not be possible because the landowner was not interested in entering into discussions with Exelon.
- Sam Rayburn Reservoir Area (Nacogdoches County) — The 860-acre inland site is bounded on the west and south by the Angelina River and on the east by Attoyac Bayou. The anticipated cooling water source would be the Sam Rayburn Reservoir, which is used extensively for recreational and sport fishing. Development of the site would require construction of a 20-mile pipeline to an intake structure on the reservoir, which would cross several bayous. There is minimal 345-kV transmission in Nacogdoches County, and development of the transmission

infrastructure would have impacts on land use and ecological resources. In addition, the site comprises 12 parcels with multiple owners, causing uncertainty regarding the ability to obtain approval to acquire the site within project time constraints.

Applying the avoidance and suitability criteria to these sites resulted in identifying five candidate sites. These candidate sites received detailed analysis. The sites included the Buckeye and Green sites in Matagorda County, the McCan site in Victoria County, the Alpha site in Austin County, and the Bravo site in Henderson County (Figure 9.3-3).

9.3.2.5 **Candidate Site Evaluation and Conclusion**

The process for candidate site evaluation was comprised of the following two elements:

- Develop criterion ratings for each candidate site
- Develop composite site suitability ratings

Criterion Ratings — Each candidate site was assigned a rating of 1 to 5 (1 = least suitable, 5 = most suitable) for each of the following criterion sets:

- Health and Safety
- Environmental
- Socioeconomic
- Engineering
- Transmission and Market Analysis
- Communications (Public Support)
- Local Government and Political Support
- Economic Development Incentives

Composite Suitability Ratings — Ratings reflecting the overall suitability of each site were developed by multiplying criterion ratings by the criterion weight factors and summing overall criteria for each site.

The result of the initial candidate site selection process is shown on Figure 9.3-4. All candidate sites were considered viable sites. The Matagorda County site was ranked as the primary site with all evaluation criteria, and the Buckeye and Victoria County sites following as secondary sites, with scoring too close to differentiate one site over the other.

Exelon's project plan was to initiate long lead data collection at the primary and secondary sites. However, additional analysis was needed to differentiate between Buckeye and Victoria County sites. The result of the secondary site selection analysis concluded that the Victoria County site was preferred over the Buckeye site. While the valuation of deep mineral rights at the Victoria County site had the potential for significant financial risk, the risks associated with acquiring the needed surface rights at the Buckeye site were higher.

Following selection of the Matagorda County site as the primary site, field work began to characterize subsurface conditions at both the primary and secondary (Victoria County) sites. The sites were reevaluated using original criteria but with updated and additional data collected. This resulted in the Victoria County site scoring better than the Matagorda County sitein the following areas:

- Geology/seismology
- Flooding
- Groundwater radionuclide pathway
- Transportation safety
- Dewatering effects on adjacent wetlands
- Dredging/disposal effects
- Engineering cost differential

In addition, certainty of water availability at the Victoria County site greatly improved with the successful execution of a water reservation agreement with the Guadalupe-Blanco River Authority (GBRA). Further, updated transmission and market analysis showed preference to western load centers (San Antonio, Corpus Christi, and Austin). Based on the foregoing, environmental considerations, site suitability issues, and geotechnical data, the Victoria site received a higher composite rating in the re-analysis than the Matagorda site (Figure 9.3-5). Accordingly, this re-evaluation resulted in the Victoria County site being designated as the proposed site and the Matagorda County site as the secondary site.

The Victoria County site ranked higher than the four alternative sites based on the environmental criteria ratings (health and safety, environmental, and socioeconomic). Comparison of projected construction and operational impacts at the proposed and alternative sites, as set forth in Subsection 9.3.3 below, demonstrates that there is no significant difference in environmental impact among the five candidate sites. For these reasons, there is no alternative site that is "environmentally preferable" to the Victoria County site.

9.3.3 **Alternative Site Review**

The proposed VCS site is reviewed at length throughout the environmental report. This subsection reviews the other alternative candidate sites using the selection criteria suggested in NUREG-1555.

Regulatory Guide 4.2, *Preparation of Environmental Reports for Nuclear Power Stations* (U.S. NRC Jul 1976) notes: "The applicant is not expected to conduct detailed environmental studies at alternative sites; only preliminary reconnaissance-type investigations need be conducted." The alternatives described here are compared based on recent information about existing facilities, the surrounding area, and existing environmental studies.

In accordance with 10 CFR 51, potential impacts from construction and operation of the proposed nuclear power plant at candidate sites other than the proposed site are analyzed, and a single significance level of potential impact (i.e., SMALL, MODERATE, or LARGE) is assigned to each analysis consistent with the criteria that the NRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3 as follows:

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

For some analyses, Exelon determined the criteria used by the NRC in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (USNRC May 1996), were appropriate for the analyses presented here and reviewed those criteria to assign a significance level to impacts.

Impact initiators for the alternative sites are the same as those described in Chapter 4 for construction and Chapter 5 for operation of VCS.

9.3.3.1 **Evaluation of the Matagorda County Site**

The Matagorda County site is a 1480-acre, undeveloped property in the western part of Matagorda County, Texas. It is situated about 90 miles southwest of Houston, 25 miles southwest of Bay City, and 4 miles southeast of the towns of Palacios and Collegeport. The site is approximately 3.5 miles north of the Gulf Intercoastal Waterway (GIWW), 4 miles north of Matagorda Bay, 2 miles east of Tres Palacios Bay, and 2.5 miles north of Oyster Lake (Figure 9.3-6). The site is also 11.5 miles southwest of South Texas Project (STP) Electric Generating Station.

For the purpose of analysis, it was assumed that two ESBWR units producing 3070 MWe (net) would be built at the Matagorda site. The cooling system would consist of onsite cooling towers with an intake line from the GIWW and a discharge line to Tres Palacios Bay. A transmission system consisting of new ROW would be required to connect the site to the surrounding grid. To analyze the effects of building a new nuclear plant, Exelon has assumed that the construction and operation practices described in ER Chapters 4 and 5 would generally be applied to the Matagorda site; thereby, allowing for a consistent description of the impacts.

9.3.3.1.1 **Land Use Including Site and Transmission Line Rights-of-Way**

The Matagorda County site is comprised of fairly flat, agricultural land used on a rotating basis for rice production and cattle grazing. Wetlands encompass much of the southeastern portion of the site (USFWS 2008). Construction of a power plant and transmission lines would alter land use at the site from agricultural to industrial. The footprint of a new plant would be approximately 655 acres including switchyard, parking lots, temporary facilities, cooling towers, laydown yards, and spoil storage. Because the site is undeveloped, additional acreage would be required for roads and railroad spurs. The entire

1480 acres would be excluded from future agricultural and recreational use for the estimated 60-year life of the plant.

County Road 3221 (Oyster Lake Road) passes along the western side of the Matagorda County site and County Road 3220 (Letulle Lane) runs along its northern side. These roads would require improvement (increased elevation, widening, and paving) so that sufficient access could be provided for operations and deliveries. In addition, a 0.4-mile-long paved road would be needed on the west side of the site from Oyster Lake Road to provide vehicle access. Assuming a 100-foot ROW, development of this access road would require approximately 4.8 acres.

A heavy haul road would be constructed to provide construction materials to the site during construction. This road would span about 4.1 miles southeast from the plant to a barge slip that would be constructed on the GIWW. The road would follow an existing private, gravel road providing access to the Oyster Lake Stabilization Facility and would be widened, paved, and have its turn radii increased. Development of the heavy haul road would require approximately 50 acres.

The nearest operating railroad is approximately 16 miles north of the site near Blessing, Texas. A 9-mile rail spur, currently not in use, runs south from this railroad to service the STP nuclear plant and is expected to be reconstructed in the next few years for use by STP (STPNOC Sep 2007). While no railroads currently traverse the Matagorda County site, a spur rail line would be constructed directly from the rail line mentioned above or from the reconstructed STP rail spur to serve the Matagorda County site. Assuming a 100-foot ROW, this would impact 150 to 200 acres of land.

Intake and discharge piping for the plant's circulating water system would necessarily extend off the plant property. A makeup water intake line, approximately 4.5 miles long, would be constructed from the site southeast to the GIWW near the Oyster Lake Stabilization Facility. A discharge line would be routed about 2.7 miles southwest to Tres Palacios Bay. Assuming a 400-foot ROW, construction of the water system would temporarily disturb about 344 acres.

Operations impacts to site land use would include permanent disturbance of 655 acres for the power plant facility, 4.8 acres for the access road, and 150 to 200 acres for the rail spur.

Land-use impacts associated with site-preparation and construction of the proposed nuclear power plant at the Matagorda County site would be SMALL. Site land-use impacts associated with operations of the proposed nuclear power plant would be SMALL.

Exelon estimates that four additional 345 kV transmission lines would be needed for the proposed nuclear power plant. A single new transmission ROW about 400 feet wide containing all four lines would run from the Matagorda County site switchyard to the STP nuclear plant about 11.5 miles to the northeast. Assuming a 400 foot ROW, routing these new transmission lines would require approximately 560 acres of land. Similar to Matagorda County site area, the land use where this corridor would extend is primarily agricultural land and rangeland. Although, in general, the most direct route would be used between terminations, consideration would also be given to avoiding possible conflicts with natural or man-made areas where important environmental resources are located. Route selection would also avoid populated areas and residences to the extent possible. Lands that are currently forested would be altered. Trees would be replaced by grasses and other low-growing types of ground cover. Although Exelon would not be responsible for final routing and construction, the transmission service provider is expected to comply with all applicable laws, regulations, permit requirements, and use best construction management practices. Construction impacts to offsite land use would be SMALL.

The new transmission corridor would not be expected to permanently affect agricultural areas, but it would have the potential to affect residents along the ROW. Corridor vegetation management and line maintenance procedures would be established by the transmission service provider. Given the rural setting and low population density along the transmission corridors, operational impacts to land use along the ROW would be SMALL.

From STP, the four transmission lines would continue 20 miles northwest along an existing transmission corridor to the Hillje Substation in Wharton County. Two of the lines would terminate at Hillje, while the other two lines would continue 50 miles northeast along an existing transmission corridor to the W.A. Parrish Substation in Fort Bend County. The Exelon transmission lines would most likely occupy approximately half of the 400-foot-wide STP corridors. This would lead to approximately 1700 acres of established ROW being used.

The region surrounding the Matagorda County site is in the Texas Coastal Zone, and all construction and operation activities would comply with the Texas Coastal Management Program and would require a federal consistency review.

9.3.3.1.2 **Air Quality**

The Matagorda County site is in the Metropolitan Houston-Galveston Intrastate Air Quality Control Region (40 CFR 81.38), consisting of areas designated as being in non-attainment of the National Ambient Air Quality Standards (NAAQS) (40 CFR 81.344). Matagorda County is designated as being unclassified or in attainment of the NAAQS. The nearest non-attainment areas are Brazoria and Fort Bend Counties (the Houston metropolitan area) and are so classified due to exceedance of the 8-hour ozone standard (40 CFR 81.344).

Air emissions from construction and operation of the proposed nuclear power plant at the Matagorda County site would be similar to those at the VCS site as described in Subsections 4.4.1.3 and 5.8.1.2, respectively. Construction impacts would be temporary and similar to any large-scale construction project. Particulate emissions in the form of dust from disturbed land, roads, and construction activities would be generated. Mitigation measures similar to those described in Subsection 4.4.1.3 would be taken. Air pollutants would be emitted from the exhaust systems of construction vehicles and equipment and from vehicles used by construction workers to commute to the site. The amount of pollutants emitted in this way would be small compared to total vehicular emissions in the region. It is not expected that construction-related emissions would result in any violation of the NAAQS.

The proposed nuclear power plant would have standby diesel generators and auxiliary power systems. Emissions from those sources are described in Subsection 3.6.3. It is expected that the diesel generators would see limited use and, when used, would operate for short time periods. Therefore, air emissions from the standby diesel generators and auxiliary power systems are expected to be minimal.

The closest area to the Matagorda County site designated as a mandatory Class I Federal area, in which visibility is an important value, is Big Bend National Park in western Texas (40 CFR 81.429). Because there are no mandatory Class I Federal areas within 50 miles of the site, any potential visibility impacts from the proposed nuclear power facilities on Class I areas would be negligible.

The air quality impacts from construction and operation of the proposed nuclear power plant at the Matagorda County site would be SMALL.

9.3.3.1.3 **Hydrology, Water Use, and Water Quality**

The Matagorda County site lies over the central portion of the Gulf Coast Aquifer System. The Gulf Coast Aquifer is a major aquifer that parallels the Gulf of Mexico coastline from the Louisiana border to the Mexican border. This aquifer covers 54 counties and consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers, which are composed of discontinuous sand, silt, clay, and gravel beds. The area of the aquifer is about 41,879 square miles. Seventy-three percent of the aquifer, including the area in the region of the Matagorda County site, is covered under a groundwater control district. (TWDB Nov 2006)

As discussed in Subsection 2.3.2, a local issue is the significant regional decreases in water levels in the Gulf Coast Aquifer during the 1970's and 1980's that prompted concern regarding the allocation of groundwater and forced a number of users, including municipalities, to revert to surface water as their primary source of water. New development, recent droughts, and the potential for saltwater intrusion have also heightened concerns about long-term groundwater availability in the Gulf Coast Aquifer.

Matagorda County is part of the Lower Colorado Regional Water Planning Group, which is required to plan for future water needs under drought conditions. According to the 2006 Lower Colorado Regional Water Plan, the projected groundwater supply available in the Lower Colorado Region from the Gulf Coast Aquifer during drought of record conditions is 198,425 acre-feet per year throughout the 2010 through 2060 projection period. Groundwater allocations from the Gulf Coast Aquifer are projected to decline by 50.1% from 848,782 acre-feet per year to 423,328 acre-feet per year over the same period. (LCRWPG Jan 2006)

Exelon would use groundwater during construction for the potable water system, concrete production and curing, backfill operations, dust control, cleaning and lubrication, and hydro testing and flushing. Peak well water demand during construction is estimated to be approximately 580 gpm. For normal station operations, Exelon estimates that 425 gpm of groundwater would be necessary. A maximum of 902 gpm is anticipated when one unit is operating normally and one unit is in an outage. Compared with the Lower Colorado Region projected groundwater use from the Gulf Coast Aquifer, groundwater use for construction and operations of nuclear units at the Matagorda County site would represent a very small percentage of total use (less than 1%). Therefore, construction and operations impacts to groundwater would be SMALL.

To ensure that wetlands and streams are not harmed by petroleum products or other industrial chemicals, Exelon would restrict certain activities (e.g., transfer and filling operations) that involve the use of petroleum products and solvents to designated areas, such as lay-down, fabrication, and shop areas. In addition, construction activities would be guided by a Storm Water Pollution Prevention Plan and a construction-phase Spill Prevention, Control, and Countermeasures Plan similar to those proposed for VCS as described in Subsection 4.2.4. Therefore, any impacts to surface water during plant construction would be SMALL and would not warrant mitigation beyond best management practices required by the permits.

The Matagorda Bay complex is the second largest bay in Texas (after Galveston Bay) and provides valuable habitat for resident and migratory birds and habitat for a number of important aquatic species. The complex is home to the largest shrimp fleet on the coast and is popular for recreational and commercial fishing. Typically, that portion of the Matagorda Bay complex west of the Colorado River is referred to simply as "Matagorda Bay," as distinguished from East Matagorda Bay, which lies east of the river (LCRA Apr 2007). Matagorda Bay is approximately 4.4 miles south of the Matagorda County site, and Tres Palacios Bay, which is an eastern embayment of the Matagorda Bay complex, is 2.4 miles west of the site.

The GIWW is a navigable inland waterway located 3.5 miles south of the site and extending 1200 miles from Carrabelle, Florida to Brownsville, Texas. The GIWW passes through Texas barrier islands mostly via channels that must be dredged to remain open (TSHA Jan 2008a). The GIWW provides a channel with a controlling depth of 12 feet designed primarily for barge transportation, but the waterway also provides habitat for resident and migratory birds and habitat for a number of important aquatic species.

The normal consumptive use of surface water during operations by the two ESBWR units using cooling towers would be 57,800 gpm (Table 9.4-3). The source of water for the proposed nuclear generating units at the Matagorda County site would be saltwater from the Gulf of Mexico or GIWW. Impacts to surface water use would be SMALL because of the saltwater source.

During operations, the cooling water system would withdraw from the Colorado River or GIWW and discharge into Tres Palacios Bay. The Matagorda County site would operate under a National Pollutant Discharge Elimination System (NPDES) permit issued by the Texas Commission on Environmental Quality (TCEQ). As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating discharges into waters of the United States. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. The permit contains limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality or human health. Any releases to Tres Palacios Bay, the GIWW, or onsite streams as result of construction or operation of the proposed nuclear power plant at the Matagorda County site would be regulated by the TCEQ through the NPDES permit process to ensure that water quality is protected. The impacts of discharges to surface water would be minimized by the same mitigation measures as those discussed for the proposed site in Sections 4.2 and 5.2.2. Therefore, impacts to water quality would be SMALL.

9.3.3.1.4 Terrestrial Resources Including Protected Species

The Matagorda County site is approximately 25 miles southwest of Bay City and 4 miles southeast of the towns of Palacios and Collegeport. The site encompasses approximately 1480 acres and is situated in western Matagorda County. Construction of the proposed nuclear power plant at the Matagorda County site would require at least a facility footprint of 655 acres. Additionally, a 0.4-mile entrance road from the west, 4.1 mile heavy haul road to the southeast, between 12 and 16 miles of railroad to the north, and the intake and discharge water system would all have to be constructed, requiring between 620 and 670 acres.

As mentioned in Subsection 9.3.3.1.1, Exelon estimates that four additional 345 kV transmission lines would be needed to connect the proposed nuclear power plant to the state's transmission system. The new lines would most likely run from the Matagorda County site switchyard to the STP nuclear plant, about 11.5 miles to the northeast, and then continue 20 miles northwest to Hillje substation along an existing transmission corridor. Two of the lines would terminate at Hillje, while the other two lines would continue along an existing transmission corridor 50 miles northeast to the W.A. Parrish Substation. Routing these transmission lines would require about 560 acres of virgin land disturbed in Matagorda County and approximately 1700 acres of land along established ROWs in Matagorda County, Wharton County, and Fort Bend County.

Four federally listed terrestrial species, all bird species, have the potential to occur in Matagorda County, and therefore in the vicinity of the Matagorda County site. These species include the bald eagle (*Haliaeetus leucocephalus*), the brown pelican (*Pelecamus occidentalis*), the piping plover (*Charadrius melodus*), and the whooping crane (*Grus Americana*).

The nearby Aransas National Wildlife Refuge (NWR) Complex is the wintering ground for the largest flock of whooping cranes in the United States, and specific whooping crane habitat is found in Aransas NWR (Calhoun and Refugio Counties) and in scattered locations in Matagorda County. Piping plover habitat is also scattered along the Matagorda County coastline. In Matagorda County, critical habitat for both the whooping crane and piping plover is found along county coastline, specifically on the Matagorda peninsula, in the vicinity of Matagorda/Mad Island WMA, on the Big Boggy NWR (piping plover) and San Bernard NWR (just inside Brazoria County).

In addition, Matagorda County has 14 state-protected species, including 12 bird and two mammal species.

The east coast of Texas, including Matagorda County, is at the terminus of the Central Flyway migration route, resulting in the occurrence of many different species of avifauna during the fall, winter, and spring months (TNC 2008). Thousands of migrating birds from the cooler regions of the continent visit or overwinter in the coastal zone of Texas. Other migrants traveling to or from Central and South America use this region of Texas as an important stopover point before continuing their travels.

The Matagorda County site is approximately 10 miles west of the Matagorda County-Mad Island Christmas Bird Count (CBC), a 15-mile diameter circle in which attempts are made to count all birds on one day during the winter season. The Mad Island CBC has been among the top five CBCs nationwide every year since 1993 in regards to total number of species observed (TNC 2008). In 2006, 233 bird species were observed in the 15-mile diameter circle near the Matagorda County site. Since 2000, the total number of species observed has ranged from 231–250 avian species.

Prior to clearing or construction activities at the site or along associated transmission or pipeline corridors, field surveys would be conducted for federally listed and state-protected species as part of the permitting process. Land clearing would be conducted according to federal and state regulations, permit conditions, existing Exelon procedures, good construction practices, and established best management practices (e.g., directed drainage ditches, silt fencing). With this in mind, Exelon concludes that impacts to terrestrial resources, including endangered and threatened species, from construction and operation of the proposed nuclear power plant at the Matagorda County site would be SMALL.

Although the most direct route would generally be used between transmission corridor terminations, consideration would also be given to avoiding possible conflicts with natural areas where important environmental resources are located. Given the short length of the new transmission corridor needed between the Matagorda County site and STP and the possibility of using existing transmission corridors and substations, impacts to terrestrial resources from construction and operation of transmission lines would also be SMALL.

9.3.3.1.5 **Aquatic Resources Including Protected Species**

The Matagorda County site is approximately 3.5 miles north of the GIWW, 4 miles north of Matagorda Bay, 9 miles north of the Gulf of Mexico, 2 miles east of Tres Palacios Bay, and 2.5 miles north of Oyster Lake. The surface water bodies that could potentially be affected by construction and operation of new units at the Matagorda County site are (1) nearby drainage ditches, irrigation canals, and surface streams; (2) the GIWW; and (3) Tres Palacios Bay, a secondary bay of Matagorda Bay.

Five federally listed aquatic species are found in Matagorda County. These species, all sea turtles, are found within the county boundaries, but not in the vicinity of the Matagorda County site. The species include green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), and hawksbill sea turtle (*Eretmochelys imbricate*). The green sea turtle and the loggerhead sea turtle are classified as threatened in Texas, while the remaining species are endangered. Three species are known to nest on Texas beaches (TSTNR 2007), and all five could possibly feed or occur in Matagorda Bay.

Water from the GIWW would be used to cool the proposed nuclear power plant constructed at the Matagorda County site. Although recreational sport fish and other aquatic species would be temporarily displaced during construction, they would be expected to re-colonize the area after construction is complete. Exelon is not aware of any federally listed aquatic species onsite. Field surveys would be conducted for federally listed and state-protected aquatic species as part of the permitting process before any clearing or construction activities at the site or along associated transmission corridors. Because of this fact and because construction-related land-clearing would be conducted according to federal and state regulations, permit conditions, existing Exelon procedures, good construction practices, and established best management practices as described in detail Subsection 4.3.2, impacts to aquatic resources, including endangered and threatened species from construction of nuclear power facilities at the Matagorda County site would be SMALL.

The most likely aquatic impact from nuclear operations at the Matagorda County site would be entrainment and impingement of aquatic organisms from the GIWW. Because the plant's intake structure would be designed to reduce the effects of entrainment and impingement, the potential for environmental impacts to aquatic resources, including endangered and threatened species, from nuclear power facility operations at the Matagorda County site would be SMALL.

9.3.3.1.6 **Socioeconomics**

This subsection evaluates the social and economic impacts to the surrounding region as a result of constructing and operating the proposed nuclear power plant at the Matagorda County site. The evaluation assesses impacts of construction, station operation, and demands placed by the construction and operation workforce on the surrounding region.

9.3.3.1.6.1 Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, and dust. Vibration and shock impacts would not be expected due to the strict control over construction activities. The use of public roadways and railways would be necessary to transport construction materials and equipment. Most of construction activities would occur in the boundaries of the Matagorda County site. However, a heavy haul access road, a connecting rail spur, and makeup water system would be constructed on lands adjacent to the site. These would be routed to avoid residences and populated areas. Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted, or will be permitted prior to operation. Impacts on those facilities from construction of the proposed nuclear power plant would be small, incremental impacts associated with their normal operation.

Potential impacts from station operation include noise, exhausts, thermal emissions, and visual effects. The proposed nuclear power plant would produce noise from the operation of pumps, fans, transformers, turbines, generators, and switchyard equipment. Vehicular traffic would also be a source of noise. However, noise attenuates quickly so that ambient noise levels would be minimal at the site boundary. Also, the Matagorda County site is in a rural area surrounded by pastures and agricultural land with few residents in the area. Commuter traffic would be controlled by speed limits, which could reduce the dust and noise level generated by the workforce commuting to the site.

The proposed nuclear power plant would have standby diesel generators and auxiliary power systems. This equipment would be operated infrequently, for short durations.

In summary, construction activities would be temporary and would occur mainly within the boundaries of the Matagorda County site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, ambient noise levels would be minimal at the site boundary. Diesel generators and auxiliary power systems would be operated infrequently for short durations. Therefore, the physical impacts of construction and operation of the proposed nuclear power plant at the Matagorda County site would be SMALL.

9.3.3.1.6.2 Demography

The population distribution near the site is low with typical rural characteristics.

As discussed in Subsection 4.4.2, Exelon anticipates employing 6300 construction workers during the peak construction period (Table 3.10-2). Exelon anticipates that approximately 5985 workers would relocate to the area. As described in Subsection 4.4.2, operations would overlap with peak construction activity; therefore, in addition to the construction workforce, it is estimated that 265 operations workers would relocate to the area during the peak construction period.

Based on the residential distribution of the current workforce at STP (an existing two-unit nuclear facility approximately 5 miles south of the Matagorda County site), Exelon has assumed that the new units' construction and operational workforces would reside in either Matagorda or Brazoria Counties. Of the existing STP workforce, approximately 83% reside in Matagorda and Brazoria counties; therefore, these counties comprise the ROI and are the focus of this analysis. It is assumed that approximately 60.7% would settle in Matagorda County and 22.4% in Brazoria County (STPNOC Sep 2007).

The total 2000 population of Matagorda and Brazoria counties was 279,724 people, with 241,767 residing in Brazoria County and 37,957 residing in Matagorda County (USCB 2000a). The population within 50 miles of the site was 175,059 people (40.1 people per square mile), and the population within 20 miles of the site was 14,377 people (21.3 people per square mile). The nearest population center, as defined in 10 CFR 100, is Bay City Census County Division with a 2000 population of 24,238 (USCB 2000b), north-northeast of the Matagorda County site. Based on the sparseness and proximity matrix in NUREG-1437, the Matagorda County site is in a low population area.

As discussed in Subsection 4.4.2, approximately 70% of the in-migrating construction workforce and 100% of the operations workforce are likely to bring families. Therefore, 4455 workers would bring families into the 50-mile region during peak construction. Assuming an average family household size of 3.25 people, construction would increase the population within the 50-mile region by 16,273 people, which is approximately 9.3% of the region's population in 2000. Based on the population distribution of the existing STP workforce, Exelon assumed that approximately 83% of the in-migrating construction workforce and their families (13,523 people) would settle in Matagorda (60.7%) and Brazoria (22.4%) counties. These numbers constitute 26.0% and 1.5% of the 2000 Census populations of Matagorda and

Brazoria Counties, respectively. The remaining construction employees relocating to the region would be distributed among other counties in the 50-mile region.

Exelon is adopting the NRC definition of impacts as small when plant-related population growth is less than 5% of the study area's total population and large when plant-related population growth is greater than 20% (U.S. NRC May 1996). Therefore, the potential increases in population during construction of the proposed nuclear power plant at the Matagorda County site would represent a MODERATE increase for the entire 50-mile region. However, small and large, but temporary, impacts would be seen in Brazoria and Matagorda Counties, respectively.

Exelon assumed the operations workforce would have the same residential distribution as the construction workforce. Exelon estimates that 800 workers (Subsection 3.10.3) would be required for the operation of nuclear power facilities at the Matagorda County site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating to the region would most likely be scattered throughout the counties in the region, with most choosing to live in Matagorda or Brazoria counties. The 800 employees would translate into an additional 2600 people (assuming an average family household size of 3.25 people). Based on 2000 census data, the addition of the new employees and their families would increase the population in Matagorda County by 4.2% and Brazoria County by 0.2%. Overall, the potential increase in population from operation of the proposed nuclear power plant at the Matagorda County site would represent a small increase in the total population for the 50-mile region and for the two most impacted counties, representing a SMALL impact to the population.

9.3.3.1.6.3 Economy

Based on 2000 census data, in the two most affected counties near the Matagorda County site there are 129,232 people in the civilian labor force. Of the civilian labor force, 94.2% are employed and 5.8% are unemployed (USCB 2000c). The overall unemployment rate for the two-county region is lower than that of the state, which is 6.1% (USCB 2000e). In 2000, Matagorda County had a civilian labor force of 16,434 people and an unemployment rate of 8.4%. Brazoria County had a civilian labor force of 112,798 people and an unemployment rate of 5.4%.

As described in Subsections 4.4.2.1 and 5.8.2.1, the wages and salaries of the construction and operations workforce would have a multiplier effect that could result in an increase in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses and increased job opportunities for local residents. The economic effect on the 50-mile region would be beneficial. Exelon assumes that direct jobs would be filled by an in-migrating workforce, but most indirect jobs would be service-related, not highly specialized, and would be filled by the existing workforce in the 50-mile region.

As discussed in Subsection 9.3.3.1.6.2, Exelon estimates that 5985 construction workers and 265 operations workers would in-migrate to the region during peak construction of the proposed nuclear power plant at the Matagorda County site. Assuming a multiplier of 1.63 jobs (direct and indirect) for every construction job and a multiplier of 2.59 for every operations job (BEA 2008a), an influx of 5985 construction and 265 operations workers would create 4188 indirect jobs, for a total of 10,438 new jobs in the ROI. Expenditures made by the direct and indirect workforce would strengthen the regional economy. Exelon concludes that the impacts of construction of the proposed nuclear power plant on the economy would be beneficial and SMALL in the region, beneficial and small in Brazoria County, and beneficial and moderate in Matagorda County.

As discussed in Section 9.3.3.1.6.2, about 800 workers would be required for the operation of two nuclear power facilities at the Matagorda County site. For the purpose of analysis, Exelon assumes that all the new employees would migrate into the region. Assuming a multiplier of 2.59 jobs (direct and indirect) for every operations job at the proposed nuclear power plant (BEA 2008a), an influx of 800 workers would create 1276 indirect jobs for a total of 2076 new jobs in the region. Because most indirect jobs are service-related and not highly specialized, Exelon assumes that most, if not all, indirect jobs would be filled by the existing labor force in the 50-mile region. Exelon concludes that the impacts of operation of the proposed nuclear power plant on the economy would be beneficial and SMALL everywhere in the region.

9.3.3.1.6.4 Taxes

Taxes collected as a result of constructing and operating the proposed nuclear power plant at the Matagorda County site would be of benefit to state and local taxing jurisdictions. In Texas, property tax assessments are made by the county appraisal district, which bases its appraisal on a consideration of cost, income, and market value. This appraisal is used by all taxing jurisdictions in the county, including special districts and independent school districts, which apply their individual millage rates to determine the taxes owed. Based on the analysis in Subsection 4.4.2.2.2, Exelon anticipates that additional property taxes would be paid to Matagorda County during the construction period.

In 2006, Matagorda County had property tax revenues of $9,038,864 (Combs Jan 2008). Assuming that tax payments to Matagorda County for nuclear power facilities at the Matagorda County site would be similar to those of the VCS site (Subsections 4.4.2.2.2 and 5.8.2.2.2), the tax payments would represent a large portion of the tax revenue for the county. For the operations period, Exelon estimates its total payment to all taxing entities would be approximately $24 million, annually. Table 5.8.2-12 estimates the county property tax for VCS at approximately $6.9 million. The benefits of taxes are considered small when new tax payments by the nuclear plant constitute less than 10% of total revenues for local jurisdictions and large when new tax payments represent more than 20% of total revenues. The projected operations-phase taxes for the nuclear power facilities represent more than 75% of current property tax revenues for Matagorda County. Therefore, Exelon concludes that the potential beneficial impacts of taxes collected during construction and operation during construction and operation of the proposed project would be large in the Matagorda County and SMALL in the remainder of the 50-mile region.

The Matagorda County site is in the Palacios Independent School District (ISD), which is categorized as a property-wealthy district (see Subsection 2.5.2.3.5). Increased tax revenues would therefore have only a small positive impact to the Palacios ISD. In-migrating construction and operation workers would result in larger enrollments in the ROI schools, which would not receive direct property tax revenues from the plant. Because the Texas school funding formula is based on weighted average daily attendance, increases in the number of students would lead to increased funding, but would also result in the additional expenses related to a larger student body. Fiscal impacts to the ISD from increased enrollment would be small to moderate, depending on their existing capacity, funding status, and fiscal condition. Subsection 9.3.3.1.6.9 discusses capacity and enrollment issues for the Matagorda County site ROI in detail.

9.3.3.1.6.5 Transportation

The regional and local road system is shown on Figure 9.3-6. There are no interstate highways in the 50-mile radius; however, there are two U.S. highways: U.S. 59 and U.S. 87. U.S. 59 runs northeast-southwest through Fort Bend, Wharton, Jackson, and Victoria counties and connects the cities of Victoria and Houston; U.S. 87 runs northwest-southeast and through Victoria and Calhoun counties (Figure 9.3-6). A number of county roads (CR) and farm-to-market (FM) roads intersect these highways providing access to towns in these counties and conversely providing outlying areas access to the state and U.S. highway system. CR 3221 (Oyster Lake Road) and CR 3220 (Letulle Lane) border the Matagorda County site along the west and north sides, respectively, and would provide access to the Matagorda site. Currently they are dirt roads and would be paved, elevated, and widened, providing site access for deliveries and employees.

Workers and deliveries traveling to the Matagorda County site from the north would travel to U.S. Highway 59, then south on TX 71, then east on TX 35 for 3 miles, then south on FM 1095, CR 3225, and CR 3221 to the site. Workers and deliveries originating from the east would travel to Bay City and take TX 35 from the instruction above. A small amount of traffic is expected from south and west of the site.

The average annual traffic count near the site is about 125 vehicles per day along FM 1095 and likely lower on CR 3221 (TXDOT 2006). In keeping with the analysis in Subsection 4.4.2.2.4, the maximum number of vehicles on FM 1095 in a single hour is estimated to be 10% of the daily average. Therefore, Exelon estimates the maximum number of cars on FM 1095 in a single hour to be 13. The largest impact on traffic would be during the construction period day/back shift change, with up to 6250 vehicles entering or leaving the site. FM 1095 has a threshold capacity of 2300 passenger cars per hour.

Transportation impacts are considered to be small when increases in traffic do not result in delays or other operational problems; impacts are moderate when increases in traffic begin to cause delays or other operational problems.

Assuming construction shifts as described in Subsection 4.4.2.2.4, the additional traffic that could be on the road during shift changes could cause potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could bring additional congestion during certain times of the day. Shift changes for the proposed nuclear power plant at the Matagorda County site could be staggered to mitigate the impact on traffic. Impacts of construction on transportation would be MODERATE to LARGE on the surrounding roads and some mitigating actions, such as those described in Subsection 4.4.2.2.4 would be needed.

With respect to the facility operations, the addition of 800 cars (assuming a single occupant per car) to the existing traffic on FM 1095 could congest the surrounding roadways. Shift changes for the proposed nuclear power plant at the Matagorda County site would be staggered resulting in a limited traffic increase that would not cause congestion. Impacts of the operations workforce on transportation would be SMALL to MODERATE and some mitigating actions, such as those described in Subsection 4.4.2.2.4, could be warranted.

9.3.3.1.6.6 Aesthetics and Recreation

The Matagorda County site is approximately 4 miles north of Matagorda Bay, 2.5 miles north of Oyster Lake, and 9 miles due north of the Gulf of Mexico. Landscapes with water as a major element are generally considered aesthetically pleasing, and this is the case along the southern coast and barrier islands as well as the numerous parks along Matagorda Bay. The marshes, lakes, bays, and other natural amenities found in the project area have historically attracted residents and tourists to the Matagorda Bay System.

The Matagorda County site is in the coastal prairie ecosystem of east Texas, the southernmost tip of the tallgrass prairie system prevalent in the Midwest (USGS Jun 2000). This area is typified by low elevation with native, open prairie, grasses interspersed with post oak savannahs or live oak groves. The larger drainages often have bottomland forests. Much of the original coastal prairie in Matagorda County has been converted to croplands or is now in pasture (USGS Jun 2000). Throughout the general area, the landscape consists of agricultural fields, including inundated rice fields, fallow fields/pasture, and irrigation ditches, with the margins of these features being lined with small trees and shrubs and herbaceous vegetation common to disturbed soils.

CR 3221, or Oyster Lake Road, is the closest major roadway from which the public can see the site (within 1 mile). In addition, FM 1095 is approximately 4 miles from the site, and FM 521 is within 9 miles. Because the topography surrounding the construction site is relatively flat with sparse trees, there is little to no screen for the reactors from area roadways. The tallest facility would be turbine buildings at approximately 160 feet. The above ground facilities would be located along rural farm roads primarily traveled by local farmers or rural residents. No sensitive visual resources, such as schools, residential subdivisions, or public lands were identified in the project area or in the vicinity of the Matagorda County site.

The Matagorda Island Wildlife Management Area (WMA), an offshore barrier island and bay side marsh, is jointly owned by the Texas General Land Office and the U.S. Fish and Wildlife Service

(USFWS). A portion of the island is operated as a park for year-round recreational activities. Approximately 26 miles of Matagorda Island is within 50 miles of the site (TPWD Sep 2007).

The Mad Island WMA is fresh-to-brackish marsh with sparse brush and flat coastal prairie. It is approximately 9 miles east of Collegeport in Matagorda County and approximately 6 miles from the Matagorda County site (TPWD Sep 2007).

The Peach Point/Justin Hurst WMA is west of Freeport near Jones Creek in Brazoria County, approximately 46 miles from the Matagorda County site. It is part of the Central Coast Wetlands Ecosystem Project. Their mission is to provide for sound biological conservation of all wildlife resources in the central coast of Texas for the public's common benefit (TPWD Sep 2007).

The D.R. Wintermann WMA is in Wharton County near Egypt, approximately 47 miles from the Matagorda County site with 246 acres. A former rice farm, a section of the WMA was used to develop a wetlands area with water from the Colorado River. The land is a flat, coastal prairie and is used as a laboratory for students and land owners to observe wetlands management. This environment attracts winter migratory waterfowl including bald eagles, sandhill cranes, a variety of geese, teal, doves, ducks, and a variety of ibis, Neotropical migrants, and many other birds (TPWD Sep 2007).

The Nannie M. Stringfellow WMA has approximately 3664 acres in Brazoria County, approximately 37 miles from the Matagorda County site. This WMA primarily consists of coastal, bottomland, hardwood forest in the San Bernard River floodplain. It is part of the Coastal Bottomlands Mitigation Bank, established to increase wetland functions by preserving, enhancing, restoring, creating, and properly managing threatened, functioning biologically diverse ecosystems of waters of the United States, including special aquatic sites and associated uplands (TPWD Sep 2007).

The Guadalupe Delta WMA consists of freshwater marshes in the delta of the Guadalupe River. It is in Victoria, Refugio, and Calhoun Counties northeast of Tivoli, approximately 43 miles from the Matagorda County site. Lands in the Guadalupe Delta WMA have traditionally provided important habitat for wetland dependent wildlife, especially migratory waterfowl. Public hunting is permitted for waterfowl and migratory shore birds, alligators, and other wetland wildlife (TPWD Sep 2007).

The Welder Flats WMA is southwest of Seadrift in San Antonio Bay, which is in Calhoun County, approximately 45 miles from the Matagorda County site. It has 1480 acres of submerged coastal wetlands used to stock the bay with red drum and spotted sea trout (TPWD Sep 2007).

The Mad Island Marsh Preserve is southeast of Collegeport in Matagorda County. The preserve's upland prairies represent a portion of the remaining 2% of the original tallgrass coastal prairies once found across Texas. The Nature Conservancy forged a partnership with Ducks Unlimited in 1990 to restore the wetlands and tallgrass coastal prairies through four habitat management programs. (TNC 2008)

The Big Boggy NWR is near Wadsworth in Brazoria County, bordering Matagorda Bay. Approximately 21 miles from the Matagorda County site, it consists of flat, coastal prairies, salt marshes, and two large saltwater lakes. Established to provide habitat for migratory waterfowl and other bird species, this NWR is generally closed to visitors; however, waterfowl hunting is allowed in season. (USFWS 2007)

The San Bernard NWR is in Matagorda and Brazoria Counties, about 12 miles west of Freeport and 35 miles from the Matagorda County site. The refuge is a stop on the Great Texas Coastal Birding Trail and includes trails for hikers and auto tour loops. San Bernard NWR also allows fishing and waterfowl hunting. (USFWS 2007)

The Aransas NWR is near Fulton in Refugio County. Approximately 45 miles from the Matagorda County site, Aransas NWR consists of more than 115,000 acres including the Blackjack Peninsula (Aransas proper), Matagorda Island, Myrtle Foester Whitmire, Tatton, and Lamar units. These areas provide vital resting, feeding, wintering, and nesting grounds for migratory birds and native Texas wildlife. The refuge is world-renowned for hosting the largest wild flock of endangered whooping cranes each winter. (USFWS 2007)

Birding is a major tourist activity in the areas surrounding the Matagorda County site. The Coastal Birding Trail is a 500-mile trail that is jointly sponsored by the Texas Parks and Wildlife Department (TPWD) and the Texas Department of Transportation, stretching along the Texas Gulf Coast from north of Beaumont to the Rio Grande Valley. The trail establishes viewing areas at feeding, roosting, and nesting points, thereby encouraging the preservation of woods and wetlands for both migrating and endemic bird species. Launched in October 1994, the Central Texas Coast section of the trail encompasses 95 of the total 308 distinct wildlife-viewing sites throughout communities on the Central Texas Gulf Coast. The Great Texas Coastal Birding Trail goes through many areas within 50 miles of the Matagorda County site. Approximately 40 state-recognized sites are located in the 50 mile vicinity, nine of which are in and around the immediate Palacios area (TPWD Feb 2007a).

The impacts to recreational facilities within 50 miles of the Matagorda County site would be minimal. During construction of the plant, they would be affected by increased traffic on area roads during peak travel periods. During the operating period, it is expected that some employees and their families would use the recreational facilities in the region. However, the increase attributable to plant operations would be small compared to overall use of these facilities. The construction and operation of the proposed nuclear power plant on the Matagorda County site would exclude the entire 1480 acres from private recreational use for the life of the plant. The attractiveness of the Tres Palacios Bay and GIWW for sport fishing and other recreational uses could be impacted during construction of intake and discharge structures. Impacts on tourism and recreation are considered small if current facilities are adequate to handle local levels of demand. Therefore, impacts of facility construction and operation on tourism and recreation would be SMALL.

The construction and operation of the proposed nuclear power plant at the Matagorda County site would have minimal impacts on aesthetic and scenic resources. The developed areas at the site would be located near the center of the property. The intake structure would be located on the north bank of the GIWW, approximately 4 miles south of the Matagorda County site. The outfall would be located on the east side of Tres Palacios Bay about 3 miles southwest of the site. From the GIWW, Tres Palacios Bay, and Matagorda WMA, the plant (including the intake and outfall) would potentially be visible from certain angles. The upper portions of facility structures would potentially be visible from areas near the site. There would be occassional visible plumes associated with the PSWS and circulating water system cooling towers. The visibility of the plumes would be dependent upon the weather and wind patterns and the location of the viewer in the general topography of the area.

Impacts on aesthetic resources are considered to be moderate if there are some complaints about diminution in the enjoyment of the physical environment and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. Construction and operation of an industrial facility on a previously undeveloped site would likely result in some complaints from the affected public regarding diminution in the enjoyment of the physical environment. Therefore, impacts of construction and operation of the proposed nuclear power plant on aesthetics would be MODERATE and could warrant mitigation.

9.3.3.1.6.7 Housing

Impacts on housing from the construction labor force depend on the number of workers already residing in the 50-mile region and the number that would relocate and require housing.

As discussed in Subsection 9.3.3.1.6.2, Exelon estimates that approximately 5985 construction and 265 operations workers would in-migrate to the region during construction of the proposed nuclear power plant at the Matagorda County site. Of these, approximately 3794 (60.7%) would settle in Matagorda County and 1400 (22.4%) would settle in Brazoria County.

Based on 2000 census data, a total of 13,384 vacant housing units were available for sale or rent in Matagorda and Brazoria Counties. Exelon estimates that, in absolute numbers, the available housing would be sufficient to house the workforce. However, there may not be enough housing of the type desired by the movers in each county, especially in Matagorda County. The median price of housing in Matagorda County in 2000 was $61,500. The median price of housing in Brazoria County was $88,500 for the same year (USCB 2000d). If pricing is too high, workers would relocate to other areas in the 50-mile region, have new homes constructed, bring their own housing, or live in hotels and motels. Given this increased demand for housing, prices of existing housing could rise to some degree. Matagorda and Brazoria Counties (and other counties to a lesser extent) would benefit from increased property values and the addition of new houses to the tax rolls. Increasing the demand for homes could increase rental rates and housing prices. It is unlikely, but possible, that some low-income populations could be priced out of their rental housing due to upward pressure on rents. However, the construction workforce would increase over time. The gradual influx of new residents would give the housing market time to adjust to the additional demands.

In summary, Matagorda and Brazoria counties, where most of the construction workforce would seek housing, have adequate housing resources for the entire workforce. Impacts on housing are considered to be small when a small and not easily discernable change in housing availability occurs, and impacts are considered to be moderate when there is a discernable but short-lived reduction in the availability of housing units. Exelon concludes that the potential impacts of construction on housing could be MODERATE to LARGE in Matagorda and Brazoria Counties and would be SMALL in the remainder of the 50-mile region. Mitigation would not be warranted where the impacts were small. Mitigation of the moderate to large impacts would most likely be market-driven, but may take some time. Additional mitigation measures similar to those discussed in Subsection 4.4.2 could also be implemented.

Exelon estimates that about 800 workers would be needed for operation of two nuclear power facilities at the Matagorda County site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating to the region would most likely be scattered throughout the counties in the region, with most choosing to live in Matagorda and Brazoria counties. If all 800 employees and their families were to come from outside the region, it is likely that adequate housing would be available in the region, especially in the larger metropolitan areas. In the two most affected counties, the average income of the new workforce would be expected to be higher than the median or average income in the county; therefore, the new workforce could exhaust the high-end housing market and some new construction could result.

Exelon concludes that the potential impacts of operations on housing in Matagorda and Brazoria Counties would be SMALL to MODERATE and SMALL elsewhere in the 50-mile region. Market forces could result in more housing being built in the two-county region, eventually mitigating any housing shortages. Additional mitigation would not be warranted.

9.3.3.1.6.8 Public Services

Public services include water supply and wastewater treatment facilities; police, fire, and medical facilities; and social services. As discussed in Subsection 9.3.3.1.6.2, construction of the proposed nuclear power plant at the Matagorda County site would increase the population in the 50-mile region by 16,273 people (9.3% of the population in the region). Approximately 83% of the in-migrating construction workforce and their families would settle in Matagorda and Brazoria counties. The new construction employees and their families would increase the total population in Matagorda County by 26.0% and in Brazoria County by 1.5%. Operation of the proposed nuclear power plant at the Matagorda County site would increase the population in the 50-mile region by 2600 (0.9% of the population in the region). The new operations employees and their families would increase the total population in Matagorda County by 4.2% and Brazoria County by 0.2%.

New construction or operations employees relocating from outside the region would most likely live in residentially developed areas where adequate water supply and wastewater treatment facilities already exist. Small increases in the regional population would not materially impact the availability of medical services. The total number of in-migrating workers and their families would only increase the 50-mile regional population by 9.3% for construction and 1.5% for operations.

The proposed nuclear power plant and the associated population influx would likely economically benefit the disadvantaged population. The additional direct jobs would increase indirect jobs that could be filled by currently unemployed workers, thus removing them from social services client lists.

In 2002, Matagorda and Brazoria counties' persons per law enforcement officer ratios were 380:1 and 418:1, respectively (USCB Sep 2004). The persons per officer ratio for Texas was 490:1 (USCB Sep 2004). The 2002 persons per firefighter ratios in Matagorda and Brazoria counties were 234:1 and 447:1, respectively (USFA Dec 2007). The persons per firefighter ratio for Texas is 342:1 (USFA Dec 2007). Ratios are in part, dependent on population density. Fewer public safety officers are necessary for the same population if the population resides in a smaller area. The population increase in the four counties from construction or operations employees relocating from outside the region could result in the need to hire additional emergency personnel. This is most likely to happen in Matagorda County. However, increased tax revenues would be adequate to pay the salaries of any additional emergency personnel hired.

As discussed above, it is not expected that public services would be materially impacted by new construction or operations employees relocating from outside the region. Impacts on public services are considered to be small if there is little or no need for changes in the level of service provided to the community. Therefore, impacts of construction and operation of the proposed nuclear power plant at the Matagorda County site on public services would be SMALL and mitigation would not be warranted.

9.3.3.1.6.9 Education

As discussed in Subsection 9.3.3.1.6.2, Exelon anticipates that most of in-migrating workers in the construction and operation workforces would settle in Matagorda and Brazoria counties. Therefore, this analysis is restricted to the two counties that would be most affected by the new workforce.

Based on data for the 2005-2006 school year, Matagorda County had 25 pre-kindergarten through 12 (PK-12) schools with a total enrollment of 7686 students. Brazoria County had 91 PK-12 schools with a total enrollment of 54,578 students (NCES 2007).

As discussed in Subsection 9.3.3.1.6.2, Exelon assumed that 70% of the 5985 in-migrating nuclear plant construction workers were likely to bring families: 4190 would bring families and 1796 would not. However, Exelon assumed that 100% of the overlapping operations workforce (265 people) would bring families. As in Subsection 4.4.2.8, Exelon assumes that the average number of school-aged children per worker who relocated his or her family was 0.8 (BMI Apr 1981). This would increase the school-aged population in the ROI by approximately 3564 students. The student populations in Matagorda and Brazoria counties would increase by 28.1% and 1.5%, respectively. Small impacts are generally associated with project-related enrollment increases of up to 3%, and large impacts on local school systems are generally associated with project-related enrollment increases greater than 8%. Therefore, projected increases in the student population of Brazoria County would have a SMALL impact on the education system and mitigation would not be warranted. In Matagorda County, the projected increase in the student population would constitute a large impact. Mitigation measures similar to those discussed in Subsection 4.4.2 could be implemented if the proposed nuclear power plant were constructed at the Matagorda County site. The quickest mitigation would be to hire additional teachers and move modular classrooms to existing schools. Increased property tax revenues as a result of the increased population would fund additional teachers and facilities. No additional mitigation would be warranted.

Most of the operations workforce is assumed to come from outside the ROI. As such, the school system in the ROI could potentially experience an influx of students from operation of the proposed nuclear power plant at the Matagorda County site. If all 800 employees and their families were to come from outside the region, the school-aged population in the ROI of the Matagorda County site would increase by about 640 students. The student populations in Matagorda and Brazoria counties would increase by 5.1% and 0.3%, respectively. These increases in student population would constitute a SMALL impact on the education system in Brazoria County and mitigation would not be warranted. Impacts would be MODERATE in Matagorda County. As with construction, the quickest mitigation would be to hire additional teachers.

9.3.3.1.7 **Historic and Cultural Resources**

Exelon conducted historical and archaeological record searches on the National Park Service National Register of Historic Places (NRHP). A search of the NRHP identified 53 sites in the six counties surrounding the Matagorda County site including four sites in Matagorda County and 10 in Brazoria County (NPS 2008a). None are within 10 miles of the Matagorda County site.

Building the proposed nuclear power plant at the Matagorda County site would require a formal cultural resources survey to be conducted before construction. Mitigation measures would be coordinated with the Texas Historical Commission (THC) so that any impacts to cultural resources from construction or operation of the proposed nuclear power plant at the Matagorda County site would be SMALL.

9.3.3.1.8 **Environmental Justice**

Environmental justice refers to a federal policy under which each federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. The NRC has a policy on the treatment of environmental justice matters in licensing actions (69 FR 52040) and guidance (USNRC May 2004). Subsection 2.5.4.1 describes the methodology Exelon used to establish locations of minority and low-income populations.

The 2000 Census block groups were used for ascertaining minority and low-income in the area. There are 170 block groups within 50 miles of the Matagorda County site. The Census Bureau data for Texas characterizes 11.5% of the population as black races, 0.6% as American Indian or Alaskan Native, 2.7% as Asian, 0.07% as native Hawaiian or other Pacific Islander, 11.7% as all other single minorities, 2.5% as multi-racial, 29.0% as an aggregate of minority races, and 32.0% as Hispanic ethnicity. If any block group percentage exceeded its corresponding state percentage by more than 20% or was greater than 50%, then the block group was identified as having a significant minority population. Black minority populations exist in 15 block groups, Asian minority populations exist in one block group, "aggregate of minority races" populations exist in 18 block groups, "Hispanic ethnicity" populations exist in 30 block groups, and populations of other races exist in eight blocks. The locations of the minority populations within the 50-mile radius are shown in Figure 9.3-7.

The Census Bureau data characterizes 14.0% of Texas households as low-income. Based on the "more than 20%" criterion, five block groups out of a possible 170 contain a low-income population. The locations of the low-income populations within 50 miles of the Matagorda County site are shown in Figure 9.3-8.

Construction activities (noise, fugitive dust, air emissions, traffic) would not impact minority populations, because of their distance from the Matagorda County site. In fact, minority and low-income populations would most likely benefit from construction activities through an increase in construction-related jobs. Operation of the proposed nuclear power plant at the Matagorda County site is unlikely to have a disproportionate impact on minority or low-income populations.

9.3.3.2 **Evaluation of the Buckeye Site**

The Buckeye site is a 5000-acre undeveloped site in Matagorda County, approximately 9 miles southwest of Bay City and 5 miles north of STP along the Colorado River. Houston is approximately 60 miles northeast of the site, and Matagorda Bay is approximately 16 miles south of the site (Figure 9.3-9).

For the purpose of analysis, it was assumed that two ESBWR units producing 3070 MWe (net) would be built at the Buckeye site. The cooling system would consist of an onsite cooling pond with an intake line from the Colorado River. A transmission system consisting of new ROW would be required to connect the site to the surrounding grid. To analyze the effects of building a new nuclear plant, Exelon has assumed that the construction and operation practices described in ER Chapters 4 and 5 would generally be applied to the Buckeye site thereby allowing for a consistent description of the impacts.

9.3.3.2.1 **Land Use Including Site and Transmission Line Rights-of-Way**

The Buckeye site is comprised of flat, agricultural land along the Colorado River. Construction of a power plant and transmission lines would alter land use at the site from agricultural to industrial. The site contains freshwater emergent wetlands on the eastern side of Wilson Creek and freshwater forested/shrub wetlands in the southeastern portion of the site (USFWS 2008). The footprint of the new plant would require approximately 5000 acres, including a switchyard, parking lots, temporary facilities, cooling pond, laydown areas, and spoil storage. Because the site is undeveloped, additional acreage would be required for roads and railroad spurs. The entire 5000 acres would be excluded from future agricultural and recreational use for the estimated 60-year life of the plant, with most of the property being used for a cooling pond. Wetlands near Wilson Creek would be impacted by construction of the cooling pond.

Local road FM 1468 is approximately 0.8 mile east of the Buckeye site. Construction of local road access would be minimal (less than 2 miles in length and 24 acres), but some local area roads may require upgrades (increased elevation, widening, paving) so proper access could be provided for operations and deliveries.

The site is approximately 3.1 miles west of the Port of Bay City. The Port of Bay City is accessed via the Colorado River Channel, which is approximately 200 feet wide and 12 feet deep. Rail connectivity is immediately accessible at the port. The nearest rail line is approximately 1.4 miles north of the site and operated by Union Pacific Railroad; however, Burlington Northern Santa Fe has track usage rights. Construction of rail access from the Union Pacific line to the site would necessitate crossing small canals/levees located in the area, and would require approximately 17 acres (assuming a 100-foot ROW.

A makeup water intake line, approximately 5 miles long, would be constructed from the site east to the Colorado River. Construction of the pipeline would temporarily disturb approximately 30 acres, assuming a 50-foot ROW. As mentioned, the Buckeye site would necessitate construction of a cooling pond on the site property (included in the 5000-acre footprint.

Operations impacts to site land use would include permanent disturbance of most of the 5000-acre site, plus local road (24 acres) and rail (17 acres) access.

Land use impacts associated with site preparation and construction of the proposed nuclear power plant at the Buckeye site would be SMALL. Site land use impacts associated with operations would be SMALL.

The proposed site is in the South Zone of ERCOT in the proximity of strong transmission infrastructure and would utilize a similar interconnection arrangement to the Matagorda County site. Four new 345 kV transmission lines would be required; two would be routed to STP (10 miles), and two would be routed to Hillje (10 miles). From Hillje, the two lines would continue to WA Parrish (50 miles). A total of 70 miles of new ROW would be required. No residential areas or major obstacles lie in the path of a ROW for new transmission lines. Assuming a 200-foot-wide transmission corridor, the new transmission lines would require about 1700 acres. The new transmission corridor would not be expected to permanently affect agricultural areas, but it would have the potential to affect residents along the ROW. Although Exelon would not be responsible for final routing and construction, the transmission service provider is expected to comply with all applicable laws, regulations, permit requirements, and use best construction management practices. Construction impacts to offsite land use would be SMALL.

The new transmission corridor would not be expected to permanently affect agricultural areas, but it would have the potential to affect residents along the ROW. Corridor vegetation management and line maintenance procedures would be established by the transmission service provider. Given the rural setting and low population density along the transmission corridors, operational impacts to land use along the ROW would be SMALL.

Most of the Buckeye site is not in the Texas Coastal Zone, and the route for the new transmission lines would not pass through the Texas Coastal Zone. However, the Colorado River lies east of the plant. This portion of the Colorado River, along with a 1-mile buffer area, is contained in the Coastal Zone. Portions of the plant infrastructure (cooling pond) may fall in the Coastal Zone. The intake line would be constructed through the portion of the Texas Coastal Zone surrounding the Colorado River. Therefore, all construction and operation activities at the Buckeye site would comply with the Texas Coastal Management Program, and the Buckeye site would require a federal consistency review.

9.3.3.2.2 **Air Quality**

The Buckeye site is in the Metropolitan Houston-Galveston Intrastate Air Quality Control Region (40 CFR 81.38), which consists of NAAQS (40 CFR 81.344) non-attainment areas. Matagorda County is designated as unclassified or in attainment of all NAAQS. The nearest non-attainment areas are Brazoria and Fort Bend Counties (the Houston metropolitan area) and are so classified due to their exceedance of the 8-hour ozone standard (40 CFR 81.344). These counties are approximately 20 miles east and 30 miles northeast of the Buckeye site, respectively.

Air emissions from construction and operation of the proposed nuclear power plant at the Buckeye site would be similar to those at the proposed site as described in Subsections 4.4.1.3 and 5.8.1.2, respectively. Construction impacts would be temporary and similar to any large-scale construction project. Particulate emissions in the form of dust from disturbed land, roads, and construction activities would be generated. Mitigation measures similar to those described in Subsection 4.4.1.3 would be taken. Air pollutants would be emitted from the exhaust systems of construction vehicles and equipment and from vehicles used by construction workers to commute to the site. The amount of pollutants emitted in this way would be small compared to total vehicular emissions in the region. It is not expected that construction-related emissions would result in any violation of the NAAQS.

The proposed nuclear power plant would have standby diesel generators and auxiliary power systems. Emissions from those sources are described in Subsection 3.6.3. It is expected that diesel generators would see limited use and, when used, would operate for short time periods. Therefore, air emissions from the standby diesel generators and auxiliary power systems are expected to be minimal and would not result in any violation of TCEQ standards.

The closest area to the Buckeye site designated as a mandatory Class I Federal area, in which visibility is an important value, is Big Bend National Park in western Texas (40 CFR 81.429). Because there are no mandatory Class I Federal areas within 50 miles of the site, any potential visibility impacts from the proposed nuclear power facilities on Class I areas would be negligible.

The air quality impacts from construction and operation of the proposed nuclear power plant at the Buckeye site would be SMALL.

9.3.3.2.3 Hydrology, Water Use, and Water Quality

The Buckeye site lies over the central portion of the Gulf Coast Aquifer System. The Gulf Coast Aquifer is a major aquifer that parallels the Gulf of Mexico coastline from the Louisiana border to the Mexican border. This aquifer covers 54 counties and consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers, which are composed of discontinuous sand, silt, clay, and gravel beds. The area of the aquifer is about 41,879 square miles. Seventy-three percent of the aquifer, including the area in the region of the Buckeye site, is covered under a groundwater control district. (TWDB Nov 2006)

As discussed in Subsection 2.3.2, a local issue is the significant regional decreases in water levels in the Gulf Coast Aquifer during the 1970s and 1980s that prompted concern regarding the allocation of groundwater and forced a number of users, including municipalities, to revert to surface water as their primary source of water. New development, recent droughts, and the potential for saltwater intrusion have also heightened concerns about long-term groundwater availability in the Gulf Coast Aquifer.

Matagorda County is part of the Lower Colorado Regional Water Planning Group, which is required to plan for future water needs under drought conditions. According to the 2006 Lower Colorado Regional Water Plan, the projected groundwater supply available in the Lower Colorado Region from the Gulf Coast Aquifer during drought of record conditions is 198,425 acre-feet per year throughout the 2010 through 2060 projection period. Groundwater allocations from the Gulf Coast Aquifer are projected to decline by 50.1% from 848,782 acre-feet per year to 423,328 acre-feet per year over the same period. (LCRWPG Jan 2006)

Exelon would use groundwater during construction for the potable water system, concrete production and curing, backfill operations, dust control, cleaning and lubrication, and hydro testing and flushing. Peak well water demand during construction is estimated to be approximately 580 gpm. For normal station operations, Exelon estimates that 425 gpm of groundwater would be necessary. A maximum of 902 gpm is anticipated when one unit is operating normally and one unit is in an outage. Compared with the Lower Colorado Region projected groundwater use from the Gulf Coast Aquifer, groundwater use for construction and operations of nuclear units at the Buckeye site would represent a very small percentage of total use (less than 1%). Therefore, construction and operations impacts to groundwater would be SMALL.

To ensure that wetlands and streams are not harmed by petroleum products or other industrial chemicals, Exelon would restrict certain activities (e.g., transfer and filling operations) that involve the use of petroleum products and solvents to designated areas, such as lay-down, fabrication, and shop areas. In addition, construction activities would be guided by a Storm Water Pollution Prevention Plan and a construction-phase Spill Prevention, Control, and Countermeasures Plan similar to those proposed for VCS as described in Subsection 4.2.4. Therefore, any impacts to surface water during plant construction would be SMALL and would not warrant mitigation beyond best management practices required by the permits.

The Gulf of Mexico is approximately 20 miles south of the Buckeye site. The GIWW is about 17 miles south of the site and extends 1200 miles from Carrabelle, Florida to Brownsville, Texas. The GIWW passes through Texas barrier islands mostly via channels that must be dredged to remain open (TSHA Jan 2008a). The Colorado River is approximately 2 miles east of the Buckeye site and drains into Matagorda Bay and the Gulf of Mexico. The portion of the Colorado River east of the site, along with a 1-mile buffer area, is contained in the Coastal Zone.

As discussed in Subsection 5.2.1.1, the consumptive use of surface water during operations by the two ESBWR units using an onsite cooling pond is 43,200 gpm (normal use) to 64,500 gpm (maximum use). Water for the proposed nuclear generating units at the Buckeye site would be provided by the Colorado River through a water supply contact with the LCRA. The LCRA can provide as much as 945,000 acre-feet per year (585,000 gpm). Surface water use for operations of nuclear units at the Buckeye site would represent a small percentage of total water available (less than 11%). Therefore, impacts to surface water use would be SMALL.

The Buckeye site would operate under a NPDES permit issued by the TCEQ. As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating discharges into waters of the United States. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. The permit contains limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality or human health. Any releases from the cooling pond into the Colorado River or onsite streams as result of construction or operation would be regulated by the TCEQ through the NPDES permit process to ensure that water quality is protected. The impacts of discharges to surface water would be minimized by the same mitigation measures as those discussed for the proposed site in Section 4.2 and Subsection 5.2.2. Therefore, impacts to water quality would be SMALL.

9.3.3.2.4 **Terrestrial Resources Including Protected Species**

The Buckeye site is approximately 9 miles southwest of Bay City, 6 miles south of Markham, and 8 miles east of Blessing. The site encompasses approximately 5000 acres, and is situated in western Matagorda County. Less than 2 miles of entrance road from FM 1468 east of the proposed site would be constructed, along with 1.4 miles of rail line to access the railroad to the north, and intake and discharge water pipelines to the proposed site, a distance of approximately 5 miles.

As mentioned in Subsection 9.3.3.2.1, the proposed site is in the South Zone of ERCOT in the proximity of strong transmission infrastructure. No residential areas or major obstacles lie in the path of a ROW for new transmission lines. Assuming a 200-foot-wide transmission corridor, the new transmission lines would require about 1700 acres of transmission corridor. The new transmission corridor would run from the Buckeye site switchyard to the Hillje, STP and WA Parrish substations.

The topography of the site consists of a relatively flat area between Wilson Creek and the Colorado River, with an elevation of 35 feet. The site is protected from Colorado River flooding by a series of levees west of the river. However, construction of flood protection structures or fill to elevate the site would likely be necessary. The planned footprint (including the 3200-acre cooling pond) would impact wetlands on the east side of Wilson Creek.

Agricultural land represents 87% of Matagorda County land; 41% is planted in crops. The predominant crops are sorghum, cotton, rice, soybeans, hay, and orchards. Other farmland is used for cattle, hogs, pigs, sheep, and poultry. Aerial imagery indicates that the agricultural crop operations in the vicinity of the Buckeye site are focused near Tres Palacios Bay and along the Colorado River.

Four federally listed terrestrial species, all bird species, have the potential to occur in Matagorda County, and therefore in the vicinity of the Buckeye site. These species include the bald eagle (Haliaeetus leucocephalus), the brown pelican (*Pelecamus occidentalis*), the piping plover (C*haradrius melodus*), and the whooping crane (*Grus Americana*).

The nearby Aransas NWR Complex is the wintering ground for the largest flock of whooping cranes in the United States, and specific whooping crane habitat is found in Aransas NWR (Calhoun and Refugio Counties) and in scattered locations in Matagorda County. Piping plover habitat is also scattered along the Matagorda County coastline. In Matagorda County, critical habitat for both the whooping crane and piping plover is found along county coastline, specifically on the Matagorda peninsula, in the vicinity of Matagorda/Mad Island Wildlife Management Area (WMA), on the Big Boggy NWR (piping plover), and San Bernard NWR (just inside Brazoria County).

In addition, Matagorda County has 14 state-protected species, including 12 bird and two mammal species.

The east coast of Texas, including Matagorda County, is at the terminus of the Central Flyway migration route—one of four principal North American migratory bird routes (TNC 2008). The Buckeye site is approximately 15 miles northwest of the Matagorda County-Mad Island CBC, an early-winter bird census where volunteers follow specified routes through a designated 15-mile diameter circle, counting every bird they see or hear all day (NAS Undated). The Mad Island CBC has been among the top five CBCs nationwide every year since 1993 in regards to total number of species observed (TNC 2008). In 2007, 235 bird species were observed in the 15-mile-diameter circle near the Buckeye site (NAS 2008).

Before clearing or construction activities at the site or along associated transmission or pipeline corridors, field surveys would be conducted for federally listed and state-protected species as part of the permitting process. Land clearing would be conducted according to federal and state regulations, permit conditions, existing Exelon procedures, good construction practices, and established best management practices (e.g., directed drainage ditches, silt fencing). With this in mind, Exelon concludes that impacts to terrestrial resources from construction and operation of the proposed nuclear power plant at the Buckeye site would be MODERATE. Impacts to threatened and endangered species would be SMALL.

9.3.3.2.5 **Aquatic Resources Including Protected Species**

Five federally listed aquatic species are found in Matagorda County. These species, all sea turtles, are found in county boundaries but not in the vicinity of the Buckeye site. The species include green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), and hawksbill sea turtle (*Eretmochelys imbricate*). The green sea turtle and the loggerhead sea turtle are classified as threatened in Texas, while the remaining species are endangered. Sea turtles are not present in the Colorado River, and therefore would not be impacted by construction or operation activities at the Buckeye site.

Water from the Colorado River would be used for cooling at the Buckeye site. Although aquatic biota would be temporarily displaced during construction of new intake and discharge structures, they would be expected to re-colonize the area after construction is complete. Any disturbance to aquatic resources from construction would be localized and of relatively short duration. Construction-related land clearing would be conducted according to federal and state regulations, permit conditions, existing Exelon procedures, good construction practices, and established best management practices as described in detail in Subsection 4.3.2. Any impacts of construction on aquatic resources, including federally listed threatened and endangered species would be SMALL.

The most likely aquatic impact from nuclear operations at the Buckeye site would be entrainment and impingement of aquatic organisms at the intake in the Colorado River. Because the plant's intake structure would be designed and operated to reduce the effects of entrainment and impingement, the potential for environmental impacts to aquatic resources from nuclear power facility operations at the Buckeye site would be SMALL.

9.3.3.2.6 **Socioeconomics**

This subsection evaluates the social and economic impacts to the surrounding region as a result of constructing and operating the proposed nuclear power plant at the Buckeye site. The evaluation assesses impacts of construction, station operation, and demands placed by the construction and operation workforce on the surrounding region.

9.3.3.2.6.1 Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, and dust. Vibration and shock impacts would not be expected due to the strict control over construction activities. It is assumed that all construction activities would occur within the existing Buckeye site boundary. The use of public roadways and railways would be necessary to transport construction materials and equipment. Commuter traffic would be controlled by speed limits that, in connection with good road conditions, would minimize the noise level and dust generated by the workforce commuting to the site. Some existing public roads would require upgrades, but no new offsite routes would be required. Offsite areas that would support construction activities (e.g., borrow pits, quarries, and disposal sites) are expected to be already permitted or will be permitted prior to operation. Impacts on those facilities from construction of the proposed nuclear power plant would be small, incremental impacts associated with their normal operation.

Potential impacts from station operation include noise, exhausts, thermal emissions, and visual intrusions. The proposed nuclear power plant would produce noise from the operation of pumps, fans, transformers, turbines, generators, and switchyard equipment. Vehicular traffic would also be a source of noise. However, noise attenuates quickly, so noise levels would be minimal at the project boundary. Commuter traffic would be controlled by speed limits, which could reduce the noise level and dust generated by the workforce commuting to the site.

The proposed nuclear power plant would have standby diesel generators and auxiliary power systems. This equipment would be operated infrequently, for short durations.

In summary, construction activities would be temporary and would occur mainly within the boundaries of the Buckeye site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, ambient noise levels would be minimal at the site boundary. Diesel generators and auxiliary power systems would be operated infrequently, for short durations. Therefore, the physical impacts of construction and operation would be SMALL.

9.3.3.2.6.2 Demography

The Buckeye site is in western Matagorda County, Texas within 10 miles of Markham, Blessing, and Bay City, and within 20 miles of Palacios and Matagorda.

As discussed in Subsection 4.4.2, Exelon anticipates employing 6300 construction workers during the peak construction period (Table 3.10-2). Exelon anticipates that approximately 5985 workers would relocate to the area. As described in Subsection 4.4.2, operations would overlap with peak construction activity; therefore, in addition to the construction workforce, it is estimated that 265 operations workers would relocate to the area during the peak construciton period.

Based on the residential distribution of the current workforce at STP (an existing 2-unit nuclear facility located approximately 5 miles south of the proposed location for the new units), Exelon has assumed that the new units' construction and operational workforces would reside in either Matagorda or Brazoria Counties. Of the existing STP workforce approximately 83% reside in Matagorda and Brazoria counties, therefore, these counties comprise the ROI and are the focus of this analysis. Approximately 60.7% would settle in Matagorda County and 22.4% in Brazoria County (STPNOC Sep 2007).

The 2000 population of the two most affected counties is 279,724 people. The 2000 population in the counties was 241,767 in Brazoria County and 37,957 in Matagorda County (USCB 2000a). The 2000 population within 50 miles of the site was 287,616 (53.4 people per square mile), and the population within 20 miles of the site was 36,948 people (32.1 people per square mile). The nearest population center, as defined in 10 CFR 100, is Bay City Census County Division with a 2000 population of 24,238 (USCB 2000b), northeast of the Buckeye site. Based on the sparseness and proximity matrix in NUREG-1437, the Buckeye site is in a low population area.

As discussed in Subsection 4.4.2, approximately 70% of the in-migrating construction workers and 100% of the operations workers are likely to bring families. Therefore, 4455 workers would bring families into the 50-mile region during peak construction. Assuming an average family household size of 3.25 people, construction would increase the population in the 50-mile region by 16,273 people, which is about 5.7% of the 50-mile radius population in 2000. Exelon assumed that approximately 83% of the in-migrating construction workforce and their families (13,523 people) would settle in Matagorda (60.7%) and Brazoria (22.4%) counties. The remaining construction employees relocating to the region would be distributed among other counties in the 50-mile region. Based on 2000 census data, the addition of the new employees and their families would increase the population in Matagorda County by 26.0% and in Brazoria County by 1.5%. Exelon is adopting the NRC definition of impacts as small if plant-related population growth is less than 5% of the study area's total population and large if plant-related population growth is more than 20% of the study area's total population. Therefore, the potential increases in population during construction of the proposed nuclear power plant at the Buckeye site would represent a MODERATE increase for the entire 50-mile region. However, small and large, but temporary, impacts would be seen in Brazoria and Matagorda Counties, respectively.

Exelon estimates that 800 workers would be required for the operation of nuclear power facilities at the Buckeye site (Subsection 3.10.3). For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating would most likely be scattered throughout other counties in the region, with most choosing to live in Matagorda or Brazoria counties. However, if all 800 employees and their families were to come from outside the region, the potential increase in population in the most affected counties would not be substantial. For example, the 800 employees would translate into an additional 2600 people (assuming an average household size of 3.25 people). Based on 2000 census data, the addition of the new employees and their families would increase the population in Matagorda County by 4.2% and in Brazoria County by 0.2%. Overall, the potential increase in population from operation of the proposed nuclear power plant at the Buckeye site would represent a small increase in the total population for the 50-mile region and for Matagorda and Brazoria counties, representing a SMALL impact to the population.

9.3.3.2.6.3 Economy

Based on 2000 census data, in the two most affected counties near the Buckeye site there are 129,232 people in the civilian labor force. Of the civilian labor force, 94.2% are employed and 5.8% are unemployed. The overall unemployment rate for the two-county region is lower than that of the state, which is 6.1%.In 2000, Matagorda County had a civilian labor force of 16,434 people and an unemployment rate of 8.4%. Brazoria County had a civilian labor force of 112,798 people and an unemployment rate of 5.4%.

As described in Subsections 4.4.2.1 and 5.8.2.1, the wages and salaries of the construction and operations workforce would have a multiplier effect that could result in an increase in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses, and increased job opportunities for local residents. The economic effect on the 50-mile region would be beneficial. Exelon assumes that direct jobs would be filled by an in-migrating workforce, but most indirect jobs would be service-related, not highly specialized, and would be filled by the existing workforce in the 50-mile region.

As discussed in Subsection 9.3.3.2.6.2, Exelon estimates that 5985 construction and 265 operations workers would in-migrate to the region during the peak employment of construction. Assuming a multiplier of 1.63 jobs (direct and indirect) for every construction job and a multiplier of 2.59 for every operations job (BEA 2008a), an influx of 5985 construction workers and 265 operations workers would create 4188 indirect jobs, for a total of 10,438 new jobs in the region of influence. Expenditures made by the direct and indirect workforce would strengthen the regional economy. Exelon concludes that the impacts of construction of the proposed nuclear power plant on the economy would be beneficial and SMALL in the region, and beneficial and moderate in Matagorda County.

As discussed in Subsection 9.3.3.2.6.2, about 800 workers would be required for the operation of two nuclear power facilities at the Buckeye site. For the purpose of analysis, Exelon assumes that all the new employees would migrate into the region. Assuming a multiplier of 2.59 jobs (direct and indirect) for every operations job at the proposed nuclear power plant (BEA 2008a), an influx of 800 workers would create 1276 indirect jobs for a total of 2076 new jobs in the region. Because most indirect jobs are service-related and not highly specialized, Exelon assumes that most, if not all, indirect jobs would be filled by the existing labor force in the 50-mile region. Exelon concludes that the impacts of operation of the proposed nuclear power plant on the economy would be beneficial and SMALL everywhere in the region.

9.3.3.2.6.4 Taxes

Taxes collected as a result of constructing and operating the proposed nuclear power plant at the Buckeye site would be of benefit to state and local taxing jurisdictions. In Texas, property tax assessments are made by the county appraisal district, which bases its appraisal on a consideration of cost, income, and market value. This appraisal is used by all taxing jurisdictions in the county, including special districts and independent school districts, which apply their individual millage rates to determine the taxes owed. Based on the analysis in Subsection 4.4.2.2.2, Exelon anticipates that additional property taxes would be paid to Matagorda County during the construction period.

In 2006, Matagorda County had property tax revenues of $9,038,864 (Combs Jan 2008). Assuming that tax payments to Matagorda County for nuclear power facilities at the Buckeye site would be similar to those of the VCS site (Subsections 4.4.2.2.2 and 5.8.2.2.2), the tax payments would represent a large portion of the tax revenue for the county. For the operations period, Exelon estimates its total payment to all taxing entities would be approximately $24 million, annually. Table 5.8.2-12 estimates the county property tax for VCS at approximately $6.9 million. The benefits of taxes are considered small when new tax payments by the nuclear plan constitute less than 10% of total revenues for local jurisdictions and large when new tax payments represent more than 20% of total revenues. The projected operations-phase taxes for the nuclear power facilities represent more than 75% of current property tax revenues for Matagorda County. Therefore, Exelon concludes that the potential beneficial impacts of taxes collected during construction and operation of the proposed project woud be LARGE in Matagorda County and small in the remainder of the 50-mile region.

The Buckeye site is in the Tidehaven ISD, which is categorized as a property-wealthy district (see Subsection 2.5.2.3.5). Increased tax revenues would therefore have only a small positive impact to the Tidehaven ISD. In-migrating construction and operation workers would result in larger enrollments in the ROI schools, which would not receive direct property tax revenues from the plant. Because the Texas school funding formula is based on weighted average daily attendance, increases in the number of students would lead to increased funding, but would also result in the additional expenses related to a larger student body. Fiscal impacts to the ISD from increased enrollment would be small to moderate, depending on their existing capacity, funding status, and fiscal condition. Subsection 9.3.3.2.6.9 discusses capacity and enrollment issues for the Buckeye site ROI in detail.

9.3.3.2.6.5 Transportation

The regional and local road system is shown on Figure 9.3-9. Highway access to the Buckeye site is provided by FM 1468, a two-lane paved road. There are no interstate highways in the 50-mile radius; however, there are two U.S. highways: U.S, Highway 59 and U.S. Highway 87. U.S. Highway 59 runs northeast-southwest through Fort Bend, Wharton, Jackson, and Victoria counties and connects the cities of Victoria and Houston; U.S. Highway 87 runs northwest-southeast through Victoria and Calhoun counties. A number of county roads and farm-to-market roads intersect these highways, providing access to towns in these counties and conversely providing outlying areas access to the state and U.S. highway system.

Workers and deliveries traveling to the Buckeye site from the north would travel to U.S. Highway 59, then south on TX 60 to Bay City, then east on TX 35 for 6.5 miles, and then south on FM 1468 to the site. Workers and deliveries originating from the east or west would travel to TX 35 and take FM 1468 south to the site. A small amount of traffic is expected from south of the site.

The average annual traffic count near the site is about 750 vehicles per day along FM 1468 and about 6700 along TX 35 (TXDOT 2006). In keeping with the analysis in Subsection 4.4.2.2.4, the maximum number of vehicles on a highway in a single hour is estimated to be 10% of the daily average. Therefore, Exelon estimates the maximum number of cars on FM 1468 and TX 35 in a single hour to be 75 and 670, respectively. The largest impact on traffic would be during the construction period day/back shift change, with up to 6250 vehicles entering or leaving the site. FM 1468 and TX 31, respectively, have threshold capacities of 2300 and 4200 passenger cars per hour.

Transportation impacts are considered small when increases in traffic do not result in delays or other operational problems and moderate when increases in traffic begin to cause delays or other operational problems.

Assuming construction shifts as described in Subsection 4.4.2.2.4, an additional traffic that could be on the road during construction shift changes could cause potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could bring additional congestion during certain times of the day. Shift changes for the proposed nuclear power plant at the Buckeye site could be staggered to mitigate the impact on traffic. Impacts of construction on transportation would be

MODERATE to LARGE on the surrounding roads and some mitigating actions such as those described in Subsection 4.4.2.2.4 would be needed.

With respect to the facility operations, the addition of 800 cars (assuming a single occupant per car) the existing traffic on FM 1468 and TX 31 would not materially congest the roadways. Shift changes for the proposed nuclear power plant at the Buckeye site would be staggered, resulting in a limited traffic increase that would not cause congestion. Impacts of the operations workforce on transportation would be SMALL and mitigation would not be warranted.

9.3.3.2.6.6 Aesthetics and Recreation

The Buckeye site is in Matagorda County, which is adjacent to the Gulf of Mexico. Landscapes with water as a major element are generally considered aesthetically pleasing, and this is the case along the southern coast and barrier islands as well as the numerous parks along Matagorda Bay. The marshes, lakes, bays, and other natural amenities found in the project area have historically attracted residents and tourists to the Matagorda Bay System.

Multiple recreational facilities are within 50 miles of the Buckeye site. The Matagorda Island WMA, an offshore barrier island and bayside marsh, is jointly owned by the Texas General Land Office and the USFWS. The TPWD manages the area for public use, and the USFWS has the main responsibility for managing the wildlife and habitat on the island (TPWD Sep 2007).

The Peach Point/Justin Hurst WMA is west of Freeport near Jones Creek in Brazoria County. It is part of the Central Coast Wetlands Ecosystem Project. Their mission is to provide for sound biological conservation of all wildlife resources in the central coast of Texas for the public's common benefit (TPWD Sep 2007).

The D.R. Wintermann WMA is in Wharton County near Egypt, encompassing 246 acres. A former rice farm, a section of this WMA was used to develop a wetlands area with water from the Colorado River. The land is a flat, coastal prairie and is used as a laboratory for students and land owners to observe wetlands management. This environment attracts winter migratory waterfowl including bald eagles, sandhill cranes, a variety of geese, teal, doves, ducks, and a variety of ibis, Neotropical migrants, and many other birds (TPWD Sep 2007).

The Nannie M. Stringfellow WMA has approximately 3664 acres in Brazoria County. This WMA consists primarily of coastal bottomland hardwood forest which lies in the San Bernard River floodplain. It is part of the Coastal Bottomlands Mitigation Bank, which was set up to increase wetland functions by preserving, enhancing, restoring, creating, and properly managing threatened, functioning, biologically diverse ecosystems of waters of the United States, including special aquatic sites, and associated uplands (TPWD Sep 2007).

The Guadalupe Delta WMA consists of freshwater marshes in the delta of the Guadalupe River. It is in Victoria, Refugio, and Calhoun Counties along the Texas Coast between Houston and Corpus Christi. Lands in the Guadalupe Delta WMA have traditionally provided important habitat for wetland dependent wildlife, especially migratory waterfowl. Public hunting is permitted for waterfowl and migratory shore birds, alligators, and other wetland wildlife (TPWD Sep 2007).

The Welder Flats WMA is in the San Antonio Bay area in Calhoun County. It has 1480 acres of submerged coastal wetlands used to stock the bay with red drum and spotted sea trout (TPWD Sep 2007).

The Mad Island Marsh Preserve is southeast of Collegeport in Matagorda County. The preserve's upland prairies represent a portion of the remaining 2% of the original tallgrass coastal prairies once found across Texas. The Nature Conservancy forged a partnership with Ducks Unlimited in 1990 to restore the wetlands and tallgrass coastal prairies through four habitat management programs. (TNC 2008).

The Big Boggy NWR is near Wadsworth in Brazoria County, bordering Matagorda Bay. Big Boggy NWR consists of flat coastal prairies, salt marshes, and two large saltwater lakes. Established to provide habitat for migratory waterfowl and other bird species, this NWR is generally closed to visitors; however, waterfowl hunting is allowed in season (USFWS 2007).

The San Bernard NWR is in Matagorda and Brazoria Counties, about 12 miles west of Freeport. The refuge is a stop on the Great Texas Coastal Birding Trail and includes trails for hikers and auto tour loops. San Bernard NWR also allows fishing and waterfowl hunting (USFWS 2007)

The Aransas NWR is near Fulton in Refugio County. Aransas NWR consists of more than 115,000 acres including the Blackjack Peninsula (Aransas proper), Matagorda Island, Myrtle Foester Whitmire, Tatton, and Lamar units. These areas provide vital resting, feeding, wintering, and nesting grounds for migratory birds and native Texas wildlife. The refuge is world-renowned for hosting the largest wild flock of endangered whooping cranes each winter (USFWS 2007).

Birding is a major tourist activity in Matagorda County. The Great Texas Coastal Birding Trail stretches along the Texas Gulf Coast from the Louisiana Border, encompassing the southern tip of Texas along the border with Mexico, and extending west towards Laredo. The trail has 308 established viewing areas at feeding, roosting, and nesting points, thereby encouraging the preservation of woods and wetlands for both migrating and endemic bird species. The Great Texas Coastal Birding Trail goes through many areas within 50 miles of the Buckeye site, with several sites in the immediate vicinity of Bay City and Palacios (TPWD Feb 2007a).

The impacts on recreational facilities within 50 miles of the Buckeye site would be minimal. During construction of the plant, some may be affected by increased traffic on area roads during peak travel periods. During the operating period, it is expected that some employees and their families would use the recreational facilities in the region. However, the increase attributable to plant operations would be small compared to overall use of these facilities. The construction and operation of the proposed nuclear power plant on the Buckeye site would exclude the entire 5000 acres from recreational use for the life of the plant. The attractiveness of the Colorado River for sport fishing and other recreational uses could be impacted during construction of intake and discharge structures. Impacts on tourism and recreation are considered small if current facilities are adequate to handle local levels of demand. Therefore, impacts of facility construction and operation on tourism and recreation would be SMALL.

The construction and operation of the proposed nuclear power plant at the Buckeye site would have minimal impacts on aesthetic and scenic resources. The developed areas at the site would be located near the center of the property. The intake structure would be located on the west bank of the Colorado, approximately 5 miles east of the Buckeye site. There would be occasional visible plumes associated with the PSWS cooling towers. The visibility of the plumes would be dependent upon the weather and wind patterns and the location of the viewer in the general topography of the area.

Impacts on aesthetic resources are considered to be moderate if there are some complaints about diminution in the enjoyment of the physical environment and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. Construction and operation of an industrial facility on a previously undeveloped site would likely result in some complaints from the affected public regarding diminution in the enjoyment of the physical environment. Therefore, impacts of construction and operation of the proposed nuclear power plant on aesthetics would be MODERATE and could warrant mitigation.

9.3.3.2.6.7 Housing

Impacts on housing from the construction labor force depend on the number of workers already residing in the 50-mile region and the number that would relocate and require housing.

As discussed in Subsection 9.3.3.2.6.2, Exelon estimates that approximately 5985 construction and 265 operations workers would in-migrate to the region during construction of the proposed nuclear power plant at the Buckeye site. Of these, approximately 3794 (60.7%) would settle in Matagorda County and 1400 (22.4%) would settle in Brazoria County.

Based on 2000 census data, a total of 13,384 vacant housing units were available for sale or rent in Matagorda and Brazoria Counties. Exelon estimates that, in absolute numbers, the available housing would be sufficient to house the workforce. However, there may not be enough housing of the type desired by the movers in each county, especially in Matagorda County. The median price of housing in Matagorda County in 2000 was $61,500. The median price of housing in Brazoria County was $88,500 for the same year (USCB 2000d). If pricing is too high, workers would relocate to other areas in the 50-mile region, have new homes constructed, bring their own housing, or live in hotels and motels. Given this increased demand for housing, prices of existing housing could rise to some degree. Matagorda and Brazoria Counties (and other counties to a lesser extent) would benefit from increased property values and the addition of new houses to the tax rolls. Increasing the demand for homes could increase rental rates and housing prices. It is unlikely, but possible, that some low-income populations could be priced out of their rental housing due to upward pressure on rents. However, the construction workforce would increase over time. The gradual influx of new residents would give the housing market time to adjust to the additional demands.

In summary, Matagorda and Brazoria counties, where most of the construction workforce would seek housing, have adequate housing resources for the entire workforce. Impacts on housing are considered to be small when a small and not easily discernable change in housing availability occurs, and impacts are considered to be moderate when there is a discernable but short-lived reduction in the availability of housing units. Exelon concludes that the potential impacts of construction on housing could be MODERATE to LARGE in Matagorda and Brazoria Counties and would be SMALL in the remainder of the 50-mile region. Mitigation would not be warranted where the impacts were small. Mitigation of the moderate-to-large impacts would most likely be market-driven, but may take some time. Additional mitigation measures similar to those discussed in Subsection 4.4.2 could also be implemented.

Exelon estimates that about 800 workers would be needed for operation of two nuclear power facilities at the Buckeye site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating to the region would most likely be scattered throughout the counties in the region, with most choosing to live in Matagorda and Brazoria counties. If all 800 employees and their families were to come from outside the region, it is likely that adequate housing would be available in the region, especially in the larger metropolitan areas. In the two most affected counties, the average income of the new workforce would be expected to be higher than the median or average income in the county; therefore, the new workforce could exhaust the high-end housing market and some new construction could result.

Exelon concludes that the potential impacts of operations on housing in Matagorda and Brazoria Counties would be SMALL to MODERATE and SMALL elsewhere in the 50-mile region. Market forces could result in more housing being built in the two-county region, eventually mitigating any housing shortages. Additional mitigation would not be warranted.

9.3.3.2.6.8 Public Services

Public services include water supply and wastewater treatment facilities; police, fire, and medical facilities; and social services. As discussed in Subsection 9.3.3.2.6.2, construction of the proposed nuclear power plant at the Buckeye site would increase the population in the 50-mile region by 16,273 people (9.3% of the population in the region). Approximately 83% of the in-migrating construction workforce and their families would settle in Matagorda and Brazoria counties. The new construction employees and their families would increase the total population in Matagorda County by 26.0% and in Brazoria County by 1.5%. Operation of the proposed nuclear power plant at the Buckeye site would increase the population in the 50-mile region by 2600 (0.9% of the population in the region). The new operations employees and their families would increase the total population in Matagorda County by 4.2% and Brazoria County by 0.2%.

New construction or operations employees relocating from outside the region would most likely live in residentially developed areas where adequate water supply and waste treatment facilities already exist. Small increases in the regional population would not materially impact the availability of medical services.

The proposed nuclear power plant and the associated population influx would likely economically benefit the disadvantaged population. The additional direct jobs would increase indirect jobs that could be filled by currently unemployed workers, thus removing them from social services client lists.

In 2002, Matagorda and Brazoria persons per law enforcement officer ratios were 380:1 and 418:1, respectively (USCB Sep 2004). The persons per officer ratio for Texas was 490:1 (USCB Sep 2004). The 2002 persons per firefighter ratios in Matagorda and Brazoria counties were 234:1 and 447:1, respectively (USFA Dec 2007). The persons per firefighter ratio for Texas is 342:1 (USFA Dec 2007). Ratios are partly dependent on population density. Fewer public safety officers are necessary for the same population if the population resides in a smaller area. The population increase in the two counties from construction or operations employees relocating from outside the region could result in the need to hire additional emergency personnel. This is most likely to happen in Matagorda County. However, increased tax revenues would be adequate to pay the salaries of any additional emergency personnel hired.

As discussed above, it is not expected that public services would be materially impacted by new construction or operations employees relocating from outside the region. Impacts on public services are considered to be small if there is little or no need for changes in the level of service provided to the community. Therefore, impacts of construction and operation of the proposed nuclear power plant on public services would be SMALL and mitigation would not be warranted.

9.3.3.2.6.9 Education

As discussed in Subsection 9.3.3.2.6.2, Exelon anticipates that most of in-migrating workers in the construction and operation workforces would settle in Matagorda and Brazoria counties. Therefore, this analysis is restricted to the two counties that would be most affected by the new workforce.

Based on data for the 2005-2006 school year, Matagorda County has 25 pre-kindergarten through 12 (PK-12) schools with a total enrollment of 7686 students; Brazoria County has 91 PK-12 schools with a total enrollment of 54,578 students (NCES 2007).

As discussed in Subsection 9.3.3.2.6.2, Exelon assumed that 70% of the 5985 in-migrating nuclear plant construction workers were likely to bring families: 4190 would bring families and 1796 would not. However, Exelon assumed that 100% of the overlapping operations workforce (265 people) would bring families. As in Subsection 4.4.2.8, Exelon assumes that the average number of school age children per worker who relocated his or her family was 0.8 (BMI Apr 1981). This would increase the school-aged population in the ROI by approximately 3564 students. The student populations in Matagorda and Brazoria counties would increase by 28.1% and 1.5%, respectively. Small impacts are generally associated with project-related enrollment increases of up to 3%, and moderate impacts on local school systems are generally associated with project-related enrollment increases of 3% to 8%. Therefore, projected increases in the student population of Brazoria would have a SMALL impact on the education system and mitigation would not be warranted. In Matagorda County, the projected increase in the student population would constitute a LARGE impact. Mitigation measures similar to those discussed in

Subsection 4.4.2 could be implemented if the proposed nuclear power plant were constructed at the Buckeye site. The quickest mitigation would be to hire additional teachers and move modular classrooms to existing schools. Increased property tax revenues as a result of the increased population would fund additional teachers and facilities. No additional mitigation would be warranted.

Most of the operations workforce would be expected to come from outside the ROI. As such, the school system in the ROI could potentially experience an influx of students from operation of the proposed nuclear power plant at the Buckeye site. If all 800 employees and their families were to come from outside the region, the school-aged population in the ROI of the Buckeye site would increase by about 640 students. The student populations in Matagorda and Brazoria counties would increase by 5.1% and 0.3%, respectively. These increases in student population would constitute a SMALL impact on the education system in Brazoria County and mitigation would not be warranted. Impacts would be MODERATE in Matagorda County. As with construction, the quickest mitigation would be to hire additional teachers.

9.3.3.2.7 **Historic and Cultural Resources**

Exelon conducted historical and archaeological record searches on the National Park Service NRHP. A search of the NRHP identified 53 sites in the six counties surrounding the Buckeye site including four sites in Matagorda County and 10 in Brazoria County. (NPS 2008a). None are within 10 miles of the Buckeye site.

Building the proposed nuclear power plant at the Buckeye site would require a formal cultural resources survey to be conducted prior to construction. Mitigation measures would be coordinated with the THC so that any impacts to cultural resources from construction or operation of the proposed nuclear power plant at the Buckeye site would be SMALL.

9.3.3.2.8 **Environmental Justice**

Environmental justice refers to a federal policy under which each federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. The NRC has a policy on the treatment of environmental justice matters in licensing actions (69 FR 52040) and guidance (U.S. NRC May 2004). Subsection 2.5.4.1 describes the methodology Exelon used to establish locations of minority and low-income populations.

The 2000 Census block groups were used for ascertaining minority and low-income in the area. There are 255 block groups within 50 miles of the Buckeye site. The Census Bureau data for Texas characterizes 11.5% of the population as black races, 0.6% as American Indian or Alaskan native, 2.7% as Asian, 0.1% as native Hawaiian or other Pacific Islander, 11.7% as all other single minorities, 2.5% as multi-racial, 29.0% as an aggregate of minority races, and 32.0% as Hispanic ethnicity. If any block group percentage exceeded its corresponding state percentage by more than 20% or was greater than 50%, then the block group was identified as having a significant minority population. Black minority populations exist in 19 block groups, Asian minority populations exist in one block group, "aggregate of minority races" populations exist in 25 block groups, "Hispanic ethnicity" populations exist in 38 block groups, and populations of other races exist in 10 block groups. The locations of the minority populations in the ROI are shown in Figure 9.3-10.

The Census Bureau data characterizes 14.0% of Texas households as low-income. Based on the "more than 20%" criterion, six block groups out of a possible 255 contain a significant low-income population. The locations of the low-income populations within 50 miles of the Buckeye site are shown in Figure 9.3-11.

Construction activities (noise, fugitive dust, air emissions, traffic) would not impact minority populations, because of their distance from the Buckeye site. In fact, minority and low-income populations would most likely benefit from construction activities through an increase in construction-related jobs. Operation of the proposed nuclear power plant at the Buckeye site is unlikely to have a disproportionate impact on minority or low-income populations.

9.3.3.3 **Evaluation of the Alpha Site**

The Alpha site is located in southwestern Austin County, just west of the Brazos River and about 45 miles west of Houston, about 4 miles northwest of Wallis, and 7 miles south-southeast of Sealy, between TX 36 and the Brazos River floodplain. The counties conterminous with Austin County include Colorado County to the west, Wharton County to the south, Fort Bend County to the southeast, and Waller County to the east. The terrain rolls gently with elevations that range from 98 to 146 feet above MSL (HL&P 1973). Farms currently occupy about 367,497 of 417,278 acres in Austin County (88%).

For the purpose of analysis, it was assumed that two ESBWR units producing 3070 MWe (net) would be built at the Alpha site. The cooling system would consist of onsite cooling towers with intake and discharge lines to the yet to be built Allen's Creek Reservoir. A transmission system consisting of new ROW would be required to connect the site to the surrounding grid. To analyze the effects of building a new nuclear plant, Exelon has assumed that the construction and operation practices described in ER Chapters 4 and 5 would generally be applied to the Alpha site; thereby allowing for a consistent description of the impacts.

9.3.3.3.1 **Land Use Including Site and Transmission Line Rights-of-Way**

The 2000-acre Alpha site is comprised of mostly flat agricultural land used to farm row crops. Uncleared and partially cleared land is used to graze cattle (HL&P 1973). A proposed reservoir would be located near the Alpha site, and would provide a 145,500 acre-feet off-channel surface water storage to hold peak flows diverted from the Brazos River. The reservoir would provide an annual volume of 99,650 acre-feet of water to meet demand in Austin County and five other counties in the region and would also be the primary source of cooling water for the proposed nuclear power plant.

Construction of the power plant would alter land use at the site from agricultural to industrial use. It is expected that the footprint of the new units at the Alpha site would be approximately 300 acres. A paved road, less than 2 miles long (100-foot ROW), would be constructed to provide vehicle access from State

Highway 36 to the Alpha site. Development of the access road would require about 24 acres. Rail access would also need to be constructed, requiring approximately 0.8 miles of new railroad.

Operations impacts to site land use would include permanent disturbance of the 300-acre powerblock area, plus local road (24 acres) and rail (10 acres) access.

Because most of the site has been previously cleared and is now used for farm activities, land-use impacts associated with site-preparation and construction of the proposed nuclear power plant at the Alpha site would be SMALL. Site land use impacts from the proposed nuclear power plant at the Alpha Site would be SMALL.

Four new 345 kV transmission lines, divided between two ROWs, would be required to connect the proposed nuclear power plant to ERCOT transmission system, and both ROWs would be 200-feet wide. Two transmission lines would connect to the O'Brien Substation, about 24 miles from the site, and the other two would connect to the Fayette Substation, about 32 miles from the site. New ROWs would be required. Based on 56 total miles of corridor and a 200-foot ROW, installation of these transmission lines would impact around 1360 acres. Although the most direct route would, in general, be used between terminations, efforts would be applied to avoid conflicts with any natural or man-made areas where important environmental resources are located. Route selection would also seek to avoid populated areas and residences to the extent possible. The use of lands that are currently used for forests or timber production would be altered. Trees would be replaced by grasses and other low-growth ground cover. Although Exelon would not be responsible for final routing and construction, the transmission service provider is expected to comply with all applicable laws, regulations, permit requirements, and use best construction management practices. Construction impacts to offsite land use would be SMALL.

The new transmission corridor would not be expected to permanently affect agricultural areas, but it would have the potential to affect residents along the ROW. Corridor vegetation management and line maintenance procedures would be established by the transmission service provider. Given the rural setting and low population density along the transmission corridors, operational impacts to land use along the ROWs would be SMALL.

9.3.3.3.2 **Air Quality**

The Alpha site is in the Metropolitan Houston-Galveston Intrastate Air Quality Control Region (AQCR) (40 CFR 81.38). The Austin County portion of this AQCR is either designated as attainment or unclassifiable with respect to the NAAQS (40 CFR 81.344). The nearest non-attainment areas are the conterminous counties of Fort Bend and Waller, also located in the Metropolitan Houston-Galveston Intrastate AQCR. Both of these counties are designated as non-attainment with respect to the 1-hour and 8-hour ozone standards (40 CFR 81.344).

Air quality impacts from construction and operation of the proposed nuclear power plant at the Alpha site would be similar to those at the VCS site. Construction impacts would be temporary and would be similar to any large-scale construction project. Construction emissions would primarily include fugitive dust from disturbed land and roads and tailpipe emissions from construction equipment. Mitigation measures similar to those described for the VCS site would be applied. During station operation, standby diesel generators would be used for auxiliary power. It is expected that these diesel generators would see limited use and, when they are used, they would operate for short time periods, and annual emission levels would be low. Air emissions from the standby diesel generators and auxiliary power systems are expected to be minimal and would not result in any violation of NAAQS.

The nearest Class I area is the Wichita Mountains Wilderness in Oklahoma, more than 300 miles from the Alpha site. Therefore, there is no potential for the project to impose visibility impacts to Class I areas. The air quality impacts from construction and operation of the proposed nuclear power plant at the Alpha site would be SMALL.

9.3.3.3.3 **Hydrology, Water Use, and Water Quality**

The Alpha site lies over the northern portion of the Gulf Coast Aquifer System. The Gulf Coast Aquifer is a major aquifer that parallels the Gulf of Mexico coastline from the Louisiana border to the Mexican border. This aquifer covers 54 counties and consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers, which are composed of discontinuous sand, silt, clay, and gravel beds. The area of the aquifer is about 41,879 square miles. The area of the aquifer is about 41,879 square miles. Seventy-three percent of the aquifer, including the area in the region of the Alpha site, is covered under a groundwater control district. (TWDB Nov 2006)

As discussed in Subsection 2.3.2, a local issue is the significant regional decreases in water levels in the Gulf Coast Aquifer during the 1970s and 1980s that prompted concern regarding the allocation of groundwater and forced a number of users, including municipalities, to revert to surface water as their primary source of water. New development, recent droughts, and the potential for saltwater intrusion have also heightened concerns about long-term groundwater availability in the Gulf Coast Aquifer.

Austin County is part of the Region H Water Planning Group, which is required to plan for future water needs under drought conditions. According to the 2006 Region H Water Plan, the projected groundwater supply available in Region H from the Gulf Coast Aquifer would decline from 803,271 acre-feet per year to 616,648 in 2060 (RHWPG Jan 2006). In 2004, Austin County pumped approximately 11,156 acre-feet of groundwater from the Gulf Coast Aquifer (TWDB 2008).

Exelon would use groundwater during construction for the potable water system, concrete production and curing, backfill operations, dust control, cleaning and lubrication, and hydro testing and flushing. Peak well water demand during construction is estimated to be approximately 580 gpm. For normal station operations, Exelon estimates that 425 gpm of groundwater would be necessary. A maximum of 902 gpm is anticipated when one unit is operating normally and one unit is in an outage. Compared with the Lower Colorado Region projected groundwater supply from the Gulf Coast Aquifer, groundwater use for construction and operations of nuclear units at the Alpha site would represent a very small percentage of total supply (less than 1%). Therefore, construction and operations impacts to groundwater would be SMALL.

To ensure that wetlands and streams are not harmed by petroleum products or other industrial chemicals, Exelon would restrict certain activities (e.g., transfer and filling operations) that involve the use of petroleum products and solvents to designated areas, such as lay-down, fabrication, and shop areas. In addition, construction activities would be guided by a Storm Water Pollution Prevention Plan and a construction-phase Spill Prevention, Control, and Countermeasures Plan similar to those proposed for VCS as described in Subsection 4.2.4. Therefore, any impacts to surface water during plant construction would be SMALL and would not warrant mitigation beyond best management practices required by the permits.

The normal consumptive use of surface water during operations by the two ESBWR units using cooling towers would 57,800 gpm (Table 9.4-3). Water for the proposed nuclear generating units at Alpha site would be provided by future development of the Allen's Creek Reservoir. Water Rights Permit 2925 is held by the City of Houston (70% of 69,750 acre-feet per year), the Brazos River Authority (30% of 29,900 acre-feet per year), and the Texas Water Development Board to allow diversion of water from Allen's Creek and the Brazos River into this new reservoir.

The reservoir would be constructed in the southern portion of Austin County. It would be bounded by U.S. Interstate 10 to the north, Highway 1458 to the east, Highway 1093 to the south, and State Highway 36 to the west. The reservoir would cover about 9500 acres of land, have a capacity of 145,500 acre-feet, and would yield nearly 100,000 acre-feet of water availability per year (61,700 gpm) (BRA Undated). Surface water use for operations of nuclear units at the Alpha site would represent most of the total water available. Currently, the water is designated to meet future municipal, industrial, and irrigation needs within Austin County and five other counties in the region; however, no contracts for this yield have been executed by the Houston or Brazos River Authority. It is expected that the reservoir could be constructed and filled to support plant operation. However, this would require that reservoir construction be completed much sooner than currently anticipated. For this reason, impacts on surface water supplies would be LARGE.

An NPDES permit from the TCEQ would be required. As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating water discharges. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. The permit contains limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality or human health. Any releases of contaminants to the Brazos River, Allen's Creek, or other Texas waters as result of construction or operation of the proposed nuclear power plant at the Alpha site would be regulated by the TCEQ through the NPDES permit process to ensure that water quality is protected. The impacts of discharges to surface water would be minimized by the same mitigation measures as those discussed for the proposed site in Section 4.2 and . Therefore, impacts to water quality would be SMALL.

9.3.3.3.4 **Terrestrial Resources Including Protected Species**

Two federally listed terrestrial species are found in Austin County and have the potential to occur in the vicinity of the Alpha site. These include the Attwater's greater prairie chicken (*Tympanuchus cupido attwateri*) and the Houston toad (*Bufo houstonensis*). The Attwater's greater prairie chicken was once widely distributed but has declined dramatically from historic population levels. The endangered species is now found only in two counties, including Austin County. The Attwater Prairie Chicken NWR has been established largely for the purpose of preserving prairie habitat that supports this prairie chicken. The refuge is about 8 miles west of the Alpha site. Other suitable habitat may be scattered throughout the county.

The Houston toad is an endangered species that is found in nine counties in Texas. The toad lives primarily on land and requires loose, deep sands supporting woodland savannah and still or slow-flowing waters that persist for at least 30 days for breeding.

Austin County also has 13 state-listed species, including one amphibian, nine birds, two mammals, and one reptile.

As mentioned in Subsection 9.3.3.3.1, it is assumed that four new 345 kV transmission lines requiring two 200-foot wide transmission corridors would be needed to connect the proposed nuclear power plant to the ERCOT transmission system. The new lines would connect to the Fayette and O'Brien substations. Routing the new transmission lines would require about 1360 acres of transmission corridor. Land clearing associated with construction of plant facilities and transmission lines would be conducted according to federal and state regulations, permit conditions, existing procedures, good construction practices, and established best management practices (e.g., directed drainage ditches, silt fencing). With this in mind, impacts to terrestrial resources, including endangered and threatened species, from construction and operation of a plant at the Alpha site would be SMALL. Given the relatively short length of the transmission corridor needed to the substations and the low number of sensitive species in Austin County, impacts to terrestrial resources would be SMALL. Impacts would be MODERATE when construction of the Allen’s Creek reservoir is considered.

9.3.3.3.5 **Aquatic Resources Including Endangered Species**

Allen's Creek originates southeast of Sealy, Texas (Austin County) and flows south for about 10 miles before making a strong turn to the east, emptying into the Brazos River after another 3.7 miles. As discussed in Subsection 9.3.3.3.3, water for the proposed nuclear generating units at Alpha site would be provided by future development of the Allen's Creek Reservoir. The reservoir would be constructed along Allen's Creek. As planned, the Allen's Creek Reservoir would be a 145,500 acre-feet off-channel reservoir. The reservoir site would be located 2 miles north of the town of Wallis, Texas. The project would impound water available from the Allen's Creek watershed, as well as water diverted and pumped from the Brazos River during periods of flow in excess of downstream needs. The location for the proposed reservoir lies directly above the confluence of Allen's Creek and the Brazos River. A spillway from the reservoir would continue the flow from Allen's Creek into the Brazos River.

One federally listed aquatic species is found in Austin County and has the potential to occur in the vicinity of the Alpha site: the sharpnose shiner (*Notropis oxygrhynchus*). The sharpnose shiner is endemic to the Brazos River Basin. The species is an obligate riverine fish that typically occurs in fairly shallow water. This shiner is found in waters that have a relatively high current velocity and high turbidity. Reservoir construction on the Brazos River appears to have had a substantial impact on the distribution of the shiner, with apparent population declines in many parts of the river system.

The aquatic environment would be impacted during the construction of the reservoir. However, impacts to the aquatic environment during construction and operation of the plant would be minimal. The construction of a cooling water intake structure would be necessary if a nuclear power plant were built at the Alpha site. The plant's intake structure would be designed and operated to reduce the effects of entrainment and impingement to sensitive species.

Based on a review of the available information, impacts during construction of the Allen's Creek Reservoir would be MODERATE to LARGE. Impacts to the aquatic environment during construction of the power plant would be SMALL. Impacts during operation at the Alpha site would be SMALL to both Allen's Creek and the Brazos River.

9.3.3.3.6 **Socioeconomics**

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating the proposed nuclear power plant at the Alpha site. The evaluation assesses impacts of construction, station operation, and demands placed by the construction and operation workforce on the surrounding region.

9.3.3.3.6.1 Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, and dust. Vibration and shock impacts would not be expected due to the strict control over construction activities. The use of public roadways and railways would be necessary to transport construction materials and equipment. Most construction activities would occur within the boundaries of the Alpha site. However, an access road and a connecting rail spur (requiring about 34 acres) would be constructed on lands adjacent to the site. These new transportation rights-of-way would be routed to avoid residences and populated areas. Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted or would be permitted prior to operation. Impacts on those facilities from construction of the proposed nuclear power plant would be small incremental impacts associated with their normal operation.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions. The proposed nuclear power plant would produce noise from the operation of pumps, fans, transformers, turbines, generators, and switchyard equipment, and traffic at the site would also be a source of noise. However, noise attenuates quickly, so ambient noise levels would be minimal at the site boundary. Also, the Alpha site is in a rural area surrounded by agricultural land with few residents in the area. Commuter traffic would be controlled by speed limits, which could reduce the dust and noise level generated by the workforce commuting to the site.

The proposed nuclear power plant would have standby diesel generators and auxiliary power systems. This equipment would be operated infrequently, for short durations.

In summary, construction activities would be temporary and would occur mainly in the boundaries of the Alpha site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, ambient noise levels would be minimal at the site boundary. Diesel generators and auxiliary power systems would be operated infrequently, for short durations. Therefore, the physical impacts of construction and operation of the proposed nuclear power plant at the Alpha site would be SMALL.

9.3.3.3.6.2 Demography

The Alpha site is in Austin County, Texas. The population distribution near the site is low with typical rural characteristics.

As discussed in Subsection 4.4.2, Exelon anticipates employing 6300 construction workers during the peak construction period (Table 3.10-2). Exelon anticipates that approximately 5985 workers would relocate to the area. As described in Subsection 4.4.2, operations would overlap with peak construction activity; therefore, in addition to the construction workforce, it is estimated that 265 operations workers during the peak construction period.

Exelon estimates that most of construction workers would locate in Austin, Fort Bend, and Waller counties, based on the counties' distance from the Alpha site. About 60% would settle in Austin County, primarily in the town of Sealy; 10% would settle in Fort Bend County, primarily along County Highway 1093; and 30% would settle in Waller County, primarily along the Interstate-10 corridor. In reality, some workers could locate to one of the other counties within 50 miles of the site.

Based on the 2000 Census, the total population of the three most affected counties is 410,705 people. The 2000 population was 23,590 in Austin County, 354,452 in Fort Bend County, and 32,663 in Waller County (USCB 2000a). In 2000, the population within 50 miles of the site was 3,169,740 people (403.8 people per square mile), and the population within 20 miles of the site was 67,654 people (53.9 people per square mile). The nearest population center, as defined in 10 CFR 100 is Houston, Texas (population 4,669,571), about 45 miles east of the Alpha site (USCB 2000b). Based on the sparseness and proximity matrix in NUREG-1437, the Alpha site is in a high population area.

As discussed in Subsection 4.4.2, approximately 70% of the in-migrating construction workers and 100% of the operations workers are likely to bring families. Therefore, 4455 workers would bring families into the 50-mile region during peak construction. Assuming an average family household size of 3.25 people, construction would increase the population in the 50-mile region by 16,273 people, which is about 0.5% of the 50-mile radius population in 2000. Based on the counties' distance to the Alpha site, Exelon assumed that the workers would relocate in one of three counties: approximately 9764

(60%) people would locate to Austin County, 1627 (10%) people would locate to Fort Bend County, and 4882 (30%) people would locate to Waller County. These numbers constitute 41.4%, 0.5%, and 14.9% of the 2000 Census populations of Austin, Fort Bend, and Waller Counties, respectively.

Exelon is adopting the NRC definition of impacts as small if plant-related population growth is less than 5% of the study area's total population and large if plant-related population growth is greater than 20%. Therefore, the potential increases in population during construction of the proposed nuclear power plant at the Alpha site would represent a large impact to the population in Austin County, a moderate impact to the population in Waller County, and a SMALL impact to the total population elsewhere in the 50-mile region. Mitigation methods would be similar to those described in Subsection 4.4.2.

Exelon assumed the operations workforce would have the same residential distribution as the construction workforce. Exelon estimates that 800 workers (Subsection 3.10.3) would be required for the operation of two nuclear power facilities at the Alpha site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating to the region would most likely choose to live in Austin, Fort Bend, or Waller counties. The 800 employees would translate into an additional 2600 people (assuming an average family household size of 3.25 people). Based on the counties' distance to the Alpha site, Exelon assumed that the workers would relocate in one of three counties: approximately 1560 (60%) people would locate to Austin County, 260 (10%) people would locate to Fort Bend County, and 780 (30%) people would locate to Waller County. These numbers constitute 6.6%, 0.1%, and 2.4% of the 2000 Census populations of Austin, Fort Bend, and Waller Counties, respectively. Overall, the potential increase in population from operation of the proposed nuclear power plant at the Alpha site would represent a SMALL impact to the total population throughout the 50-mile region, except Austin County, where the impact could be moderate and mitigation would be warranted. Mitigation methods would be similar to those described in Subsection 4.4.2.

9.3.3.3.6.3 Economy

Based on 2000 census data, in the three most affected counties near the Alpha site, there are 201,806 people in the civilian labor force. Of the civilian labor force, 94.5% are employed and 5.5% are unemployed. In 2000, Austin County had a civilian labor force of 11,265 people and an unemployment rate of 4.4%. Fort Bend County had a civilian labor force of 174,654 people and an unemployment rate of 4.9%. Waller County had a civilian labor force of 15,887 people and an unemployment rate of 13.8%. (USCB 2000c)

As described in Subsections 4.4.2.1 and 5.8.2.1, the wages and salaries of the construction and operations workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses and increased job opportunities for local residents. The economic effect on the 50-mile region would be beneficial. For the purpose of analysis, Exelon conservatively assumes that direct jobs would be filled by an in-migrating workforce, but most indirect jobs would be service-related, not highly specialized, and would be filled by the existing workforce in the 50-mile region. Expenditures made by the direct and indirect workforce would strengthen the regional economy. This would be considered a positive impact.

As discussed in Subsection 9.3.3.3.6.2, Exelon estimates that 5985 construction workers and 265 operations workers would in-migrate to the region during construction of the proposed nuclear power plant at the Alpha site. Assuming a multiplier of 1.68 jobs (direct and indirect) for every construction job and a multiplier of 2.62 for every operations job (BEA 2008b), an influx of 6250 workers would create 4470 indirect jobs, permanent or temporary, for a total of 10,720 new jobs in the 50-mile region. The number of new jobs would represent about 57.1% of the employment in Austin County, 0.6% of the employment in Fort Bend County, and 20.2% of the employment in Waller County.

Exelon is adopting the NRC definition of impacts as small if plant-related employment is less than 5% of the study area's total employment and large if plant-related employment is greater than 10%. Exelon concludes that the impacts of construction on the economy would be beneficial and SMALL everywhere in the region except Austin and Waller counties, where the impacts could be LARGE.

As discussed in Subsection 9.3.3.3.6.2, about 800 workers would be required for the operation of two nuclear power facilities at the Alpha site, and Exelon assumes that all the new employees would migrate into the region. Assuming a multiplier of 2.62 jobs (direct and indirect) for every operations job at the new units (BEA 2008b), an influx of 800 workers would create 1294 indirect jobs for a total of about 2094 new jobs in the region. The number of new jobs would represent about 11.2% of the employment in Austin County, 0.1% of the employment in Fort Bend County, and 4.0% of the employment in Waller County. Because most indirect jobs are service-related and not highly specialized, Exelon assumes that most, if not all, indirect jobs would be filled by the existing labor force in the 50-mile region. Exelon concludes that the impacts of operation of two nuclear power facilities on the economy would be beneficial and SMALL everywhere in the region except Austin County, where the impact could be beneficial and MODERATE.

9.3.3.3.6.4 Taxes

Taxes collected as a result of constructing and operating the proposed nuclear power plant at the Alpha site would benefit state and local taxing jurisdictions. In Texas, property tax assessments are made by the county appraisal district, which bases its appraisal on a consideration of cost, income, and market value. This appraisal is used by all taxing jurisdictions in the county, including special districts and independent school districts, which apply their individual millage rates to determine the taxes owed. Based on the analysis in Subsection 4.4.2.2.2, Exelon anticipates that additional property taxes would be paid to Austin County during the construction period.

In 2006, Austin County had property tax revenues of $8,604,832 (Combs Jan 2008).Assuming that tax payments to Austin County for nuclear power facilities at the Alpha site would be similar to those of the VCS site (Subsections 4.4.2.2.2 and 5.8.2.2.2), the tax payment would represent a large portion of the tax revenue for the county. For the operations phase, Exelon estimates its total payment to all taxing entities would be approximately $24 million, annually. Table 5.8.2-12 estimates the county property tax for VCS at approximately $6.9 million. The benefits of taxes are considered small when new tax payments by the nuclear plant constitute less than 10% of total revenues for local jurisdictions and large when new tax payments represent more than 20% of total revenues. The projected operations-phase property taxes for the nuclear power facilities represent almost 80% of current property tax revenues for Austin County. Therefore, Exelon concludes that the potential beneficial impacts of taxes collected during construction and operation of the proposed project would be LARGE in Austin County.

The Alpha site is located in the Brazos ISD, which is categorized as a property-poor district (see Subsection 2.5.2.3.5). The substantially increased tax revenues from the plant would likely change the district's status to property-wealthy. In that case, more of the district's funding would come from local taxpayers, with less funding from the state. Overall revenues would not change very much unless there was a large increase in enrollment from the in-migrating families, and there would be a small positive impact to the Brazos ISD. In-migrating construction and operation workers could lead to larger enrollments in other ROI schools that would not receive direct property tax revenues from the plant. Because the Texas school funding formula is based on weighted average daily attendance, increases in the number of students would lead to increased funding, but would also result in the additional expenses related to a larger student body. Fiscal impacts to the ISD from increased enrollment would be small to moderate, depending on their existing capacity, funding status, and fiscal condition. Subsection 9.3.3.3.6.9 discusses capacity and enrollment issues for the Alpha site ROI in detail.

9.3.3.3.6.5 Transportation

The regional and local road system is shown on Figure 9.3-12. Highway access to the Alpha site is provided by State Highway 36, a two-lane road that connects Wallis and Sealy, the only two communities with more than 1000 residents within 10 miles of the site. TX 36 passes the site just west of the restricted area, and the Santa Fe Railway crosses Interstate 10 north of the Alpha site. South of the site in Wallis, TX 36 intersects with TX 60, which further south of Wallis intersects with U.S. 90. U.S. 90 runs east-west connecting many smaller communities to Houston. The road is a two-lane road at its intersection with TX 60 but becomes a four-lane road closer to Houston.

Workers and deliveries traveling to the Alpha site from the north would travel to TX 36 and then travel south to the site. Those originating from the south would travel to TX 60 to Wallis and then north on TX 36 to the site. Workers and deliveries originating from the east or west (Houston area) would travel to Interstate 10 and take Exit 720, the TX 36 exit, and then travel south to the site. Alternately, the workers or deliveries could travel to U.S. 90 and take TX 60 north to Wallis to intersect with TX 36 and then go north to the site.

The average annual traffic count near the site along TX 36 is 14,000 vehicles per day north of the site near Sealy and Interstate 10 and 6300 vehicles per day south of the site near Wallis (TXDOT 2006). In keeping with the analysis in Subsection 4.4.2.2.4, the maximum number of vehicles on TX 36 in a single hour is estimated to be 10% of the daily average. Therefore, Exelon estimates the maximum number of cars on TX 36 in a single hour to be 1400. The largest impact on traffic would be during the construction period day/back shift change, with up to 6250 vehicles entering or leaving the site. TX 36 has a threshold capacity of 5200 passenger cars per hour.

Transportation impacts are considered to be small when increases in traffic do not result in delays or other operational problems; impacts are moderate when increases in traffic begin to cause delays or other operational problems.

Assuming construction shifts as described in Subsection 4.4.2.2.4, the additional traffic that could be on the road during shift changes could cause potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could bring additional congestion during certain times of the day. Shift changes for the proposed nuclear power plant at the Alpha site could be staggered so that the traffic increase would not cause congestion. Impacts of construction on transportation would be SMALL to MODERATE on two-lane roads in Austin County, particularly on TX 36 near the site, and some mitigating actions such as those described in Subsection 4.4.2.2.4 would be needed.

With respect to facility operations, the addition of 800 cars (assuming a single occupant per car) to the existing traffic on TX 36 would not materially congest the roadways. Shift changes for the proposed nuclear power plant at the Alpha site would be staggered resulting in a limited traffic increase that would not cause congestion. Impacts of the operations workforce on transportation would be SMALL and mitigation would not be warranted.

9.3.3.3.6.6 Aesthetics and Recreation

The Alpha site is an undeveloped property in southern Austin County and is surrounded by rural agricultural land. The plant would be located about 4 miles northwest of Wallis, and 7 miles south-southeast of Sealy between Highway 36 and the floodplain of the Brazos River. The site is situated approximately 5 miles east of Allen's Creek and 3 miles west of the Brazos River. Approximately 9500 acres would be dedicated for a reservoir located on a portion of the Brazos River floodplain. The attractiveness of the area for hunting, sport fishing, and other recreational uses could be increased by construction of the reservoir, and additional recreation facilities would be built to use this demand (HL&P 1973). Present recreational facilities might be affected by increased traffic on area roads during peak travel periods, but impacts would be minimal. The only nearby recreational areas are the 663-acre Stephen F. Austin State Park 10.5 miles to the north and Eagle Lake 15 miles southwest (TPWD Feb 2007b). During the operating period, it is expected that some employees and their families would use the recreational facilities in the region. However, the increase attributable to plant operations would be small compared to overall use of these facilities. Impacts on tourism and recreation are considered small if current facilities are adequate to handle local levels of demand. Therefore, impacts of facility construction and operation on tourism and recreation would be SMALL.

The construction and operation of the proposed nuclear power plant at the Alpha site would have small impacts on aesthetic and scenic resources. The developed areas at the site would be located near the center of the property, with the area immediately adjacent to the Alpha site mostly undeveloped. The remainder of the site would consist of open fields. Due to the flat nature of the land, facility structures would be visible from roadways near the site. There would be occassional visible plumes associated with the PSWS and circulating water system cooling towers. The visibility of the plumes would be dependent upon the weather and wind patterns and the location of the viewer in the general topography of the area. Impacts on aesthetic resources are considered to be moderate if there are some complaints about diminution in the enjoyment of the physical environment and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. Construction and operation of an industrial facility on a previously undeveloped site would likely result in some complaints from the affected public regarding diminution in the enjoyment of the physical environment. Therefore, impacts of construction and operation of the proposed nuclear power plant on aesthetics would be MODERATE and could warrant mitigation.

9.3.3.3.6.7 Housing

Impacts on housing from the construction labor force depend on the number of workers already residing in the 50-mile region and the number that would relocate and require housing.

As discussed in Subsection 9.3.3.2.6.2, Exelon estimates that 5985 construction and 265 operations workers would in-migrate to the region during construction of the proposed nuclear power plant at the Alpha site. Of these, approximately 3750 (60%) would settle in Austin County, 625 (10%) would settle in Fort Bend County, and 1875 (30%) would settle in Waller County.

In 2000, a total of 7932 vacant housing units were available for sale or rent in Austin, Fort Bend, and Waller Counties. Exelon estimates that, in absolute numbers, the available housing would be sufficient to house the in-migrating workforce. However, there may not be enough housing of the type desired by the workers in each of the three counties, especially in Austin and Waller Counties. The median price of housing in Austin County in 2000 was $85,000. The median price of housing in Fort Bend and Waller Counties was $115,100 and $84,700, respectively, for the same year (USCB 2000d). In this event, workers would relocate to other areas in the 50-mile region, have new homes constructed, bring their own housing, or live in hotels and motels. Given this increased demand for housing, prices of existing housing could rise to some degree.

Austin and Waller Counties (and other counties to a lesser extent) would benefit from increased property values and the addition of new houses to the tax rolls. Increasing the demand for homes could increase rental rates and housing prices. It is unlikely, but possible, that some low-income populations could be priced out of their rental housing due to upward pressure on rents. However, the construction workforce would increase over time and any actual housing shortage is unlikely to be as severe as a comparison of maximum workforce to available housing would indicate. The gradual influx of new residents would give the housing market time to adjust to the additional demands.

In summary, the three counties where most of the construction workforce would seek housing have adequate housing resources for the entire workforce. Impacts on housing are considered to be small when a small and not easily discernable change in housing availability occurs, and impacts are considered to be moderate when there is a discernable but short-lived reduction in the availability of housing units. Exelon concludes that the potential impacts of construction on housing could be MODERATE to LARGE in Austin and Waller Counties and would be SMALL in the remainder of the 50-mile region. Mitigation would not be warranted where the impacts were small. Mitigation of the moderate to large impacts would most likely be market-driven but may take some time. Additional mitigation measures similar to those discussed in Subsection 4.4.2 could also be implemented.

Exelon estimates that about 800 workers would be needed for operations at the Alpha site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating to the region would most likely be scattered throughout the counties in the region, with most choosing to live in Austin, Fort Bend, or Waller counties. If all 800 employees and their families were to come from outside the region, it is likely that adequate housing would be available in the region, especially in the larger metropolitan areas.

Exelon concludes that the potential impacts of operations on housing in Austin and Waller counties would be MODERATE and SMALL elsewhere in the 50-mile region. Market forces could result in more housing being built in the three-county region, eventually mitigating any housing shortages. Additional mitigation would not be warranted.

9.3.3.3.6.8 Public Services

Public services include water supply and waste water treatment facilities; police, fire, and medical facilities; and social services. As discussed in Subsection 9.3.3.2.6.2, construction of the proposed nuclear power plant at the Alpha site would increase the population in the 50-mile region by 16,273 people (0.5% of the population in the region). The new construction employees and their families would increase the total population in Austin County by 41.4%, Fort Bend County by 0.5%, and Waller County by 14.9%. Operation of the proposed nuclear power plant at the Alpha site would increase the population in the 50-mile region by 2600 people (0.1% of the population in the region). The new operations employees and their families would increase the total population in Austin County by 6.6%, Fort Bend County by 0.1%, and Waller County by 2.4%.

New construction or operations employees relocating from outside the region would most likely live in residentially developed areas where adequate water supply and waste treatment facilities already exist. The medical facilities in the Houston area provide medical care to much of the population in the 50-mile region, and the small increases in the regional population would not materially impact the availability of medical services.

The proposed nuclear power plant and the associated population influx would likely economically benefit the disadvantaged population served by the Texas Department of Human Resources. The additional direct jobs would increase indirect jobs that could be filled by currently unemployed workers, thus removing them from social services client lists.

In 2002, Austin, Fort Bend, and Waller Counties' persons per law enforcement officer ratios were 347:1, 512:1, and 311:1, respectively (USCB Sep 2004). The persons per officer ratio for Texas was 490:1

(USCB Sep 2004). The 2002 persons per firefighter ratios in Austin, Fort Bend, and Waller counties were 167:1, 748:1, and 268:1, respectively (USFA Dec 2007). The persons per firefighter ratio for Texas was 342:1 (USFA Dec 2007). Ratios are partly dependent on population density. Fewer public safety officers are necessary for the same population if the population resides in a smaller area. The population increase in the three most affected counties from construction or operations employees relocating from outside the region could result in the need to hire additional emergency personnel. This is most likely to happen in Austin and Waller Counties. However, increased tax revenues would be adequate to pay the salaries of any additional emergency personnel hired.

As discussed above, it is not expected that public services would be materially impacted by new construction or operations employees relocating from outside the region. Impacts on public services are considered to be small if there is little or no need for changes in the level of service provided to the community. Therefore, impacts of construction and operation of the proposed nuclear power plant on public services would be SMALL and mitigation would not be warranted.

9.3.3.3.6.9 Education

As discussed in Subsection 9.3.3.2.6.2, Exelon anticipates that most of the in-migrating workers in the construction and operation workforce would settle in Austin, Fort Bend, and Waller counties. Therefore, this analysis is restricted to the three counties that would be most affected by the new workforce.

Based on data for the 2005-2006 school year, Austin County has 13 pre-kindergarten through 12 (PK-12) schools with a total enrollment of 5620 students; Fort Bend County has 113 PK-12 schools with a total enrollment of 91,559 students; and Waller County has 17 PK-12 schools with a total enrollment of 8210 students (NCES 2007).

As discussed in Subsection 9.3.3.1.6.2, Exelon assumed that 70% of the 5985 in-migrating nuclear plant construction workers were likely to bring families: 4190 would bring families and 1796 would not. However, Exelon assumed that 100% of the overlapping operations workforce (265 people) would bring families. As in Subsection 4.4.2.8, Exelon assumes that the average number of school-aged children per worker who relocated his or her family was 0.8 (BMI Apr 1981). This would increase the school-aged population within 50 miles of the Alpha site by about 3564 students. About 60% would settle in Austin County, 10% in Fort Bend County, and 30% in Waller County. The student populations in Austin, Fort Bend, and Waller counties would increase by 38.0%, 0.4%, and 13.0%, respectively. Small impacts are generally associated with project-related enrollment increases below 4% and large impacts on local school systems are generally associated with project-related enrollment increases above 8%. Therefore, the projected increase in the student population of Fort Bend County would have a SMALL impact on the education system and mitigation would not be warranted. Projected increases in the student populations of Austin and Waller Counties would constitute LARGE impacts. Mitigation measures similar to those discussed in Subsection 4.4.2 could be implemented if the proposed nuclear power plant were constructed at the Alpha site. The quickest mitigation would be to hire additional teachers and move modular classrooms to existing schools. Increased property tax revenues as a result of the increased population would fund additional teachers and facilities. No additional mitigation would be warranted.

For the purpose of analysis, Exelon conservatively assumes that all the operations employees would migrate to the region. If all 2600 employees and their families were to come from outside the region, the school-aged population in Austin, Fort Bend, and Waller counties would increase by about 640 students, or by 6.8%, 0.1%, and 2.3%, respectively. Therefore, the projected increase in the student populations of Fort Bend and Waller Counties would have a SMALL impact on the education system and mitigation would not be warranted. Projected increases in the student population of Austin County would constitute a MODERATE impact. Mitigation measures similar to those discussed in Subsection 4.4.2 could be implemented if the proposed nuclear power plant were constructed at the Alpha site. As with construction, the quickest mitigation would be to hire additional teachers.

9.3.3.3.7 **Historic and Cultural Resources**

Exelon conducted historical and archaeological records searches on the National Park Service NRHP and reviewed information in the Allen's Creek Safety Analysis Report prepared in 1973.

A search of the NRHP identified 54 sites in the five counties surrounding the Alpha site. There are seven sites in Austin County (4 to 42 miles from the site), which encompasses the Alpha site. Two of these properties, the Allen's Creek Ossuary Site and the Church of the Guardian Angel, are in Willis, approximately 4 miles northwest of the Alpha site. There are five sites in Colorado County (27 miles from the site), 31 sites in Wharton County (25 miles from the site), five sites in Fort Bend County (17 to 22 miles from the site), and six sites in Waller County (28 miles from the site) (NPS 2008b).

Building the proposed nuclear power plant at the Alpha site would require a formal cultural resources survey to be conducted prior to construction. Mitigation measures similar to those described in Subsection 4.4.2 would be coordinated with the THC so that any impacts to cultural resources from construction or operation of the proposed nuclear power plant at the Alpha site would be SMALL.

9.3.3.3.8 **Environmental Justice**

Environmental justice refers to a federal policy under which each federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. The NRC has a policy on the treatment of environmental justice matters in licensing actions (69 FR 52040) and guidance (U.S. NRC May 2004). Subsection 2.5.4.1 describes the methodology Exelon used to establish locations of minority and low-income populations.

The 2000 Census block groups were used for ascertaining minority and low-income populations in the area. There are 1816 block groups within 50 miles of the Alpha site. The Census Bureau data for Texas characterizes 11.5% of the population as black races, 0.6% as American Indian or Alaskan native, 2.7% as Asian, 0.1% as native Hawaiian or other Pacific Islander; 11.7% as all other races; 2.5% as multiracial, 29.0% as an aggregate of minority races, and 32.0% as Hispanic ethnicity. If any block group minority percentage exceeded 50%, then the block group was identified as containing a minority population. If any block group percentage exceeded its corresponding state percentage by more than 20%, then the block group was identified as having minority population. There are 388 block groups with significant black races populations, 68 block groups with significant Asian populations, 196 block groups with significant "other" race populations, 634 block groups with “aggregate of minority races,” and 367 block groups with significant Hispanic populations. The locations of the minority populations within 50 miles of the Alpha site are shown in Figure 9.3-13.

The Census Bureau data characterizes 13.98% of Texas households as low-income. Based on the "more than 20%" criterion, 151 block groups contain a low-income population. The locations of the low-income populations within 50 miles of the Alpha site are shown in Figure 9.3-14.

Construction activities (noise, fugitive dust, air emissions, traffic) would not impact minority populations because of their distance from the Alpha site. In fact, minority and low-income populations would most likely benefit from construction activities through an increase in construction-related jobs. Operation of the proposed nuclear power plant at the Alpha site is unlikely to have disproportionate impacts on minority or low-income populations.

9.3.3.4 **Evaluation of the Bravo Site**

The 5000-acre Bravo site is on the west side of Henderson County 1 mile southwest of the town of Malakoff. State Highway 31 spans an east-west path about 0.5 mile north of the Bravo site; Cedar Creek defines the western boundary of the site; and the rest of the site is bordered by the former Trinity Lignite Mine site. Farmland occupies about 61% of the land in Henderson County.

For the purpose of analysis, it was assumed that two ESBWR units producing 3070 MWe (net) would be built at the Bravo site. The cooling system would consist of onsite cooling towers with an intake line to the Cedar Creek Reservoir, an onsite makeup water retention basin, and a discharge line to Walnut Creek. A transmission system consisting of new ROW would be required to connect the site to the surrounding grid. To analyze the effects of building a new nuclear plant, Exelon has assumed that the construction and operation practices described in ER Chapters 4 and 5 would generally be applied to the Bravo site; thereby, allowing for a consistent description of the impacts.

9.3.3.4.1 **Land Use Including Site and Transmission Line Rights-of-Way**

In the early 1980s, HL&P began construction of a coal-fired generation plant at the Bravo site; however, the project was cancelled and construction activities were discontinued. Today, based on aerial photography, about half the site is wooded and half is cleared for agricultural use. Construction of the power plant would alter land use at the site from agricultural and wooded to industrial use. The footprint of the plant would be approximately 3500 acres including switchyard, parking lots, temporary facilities, makeup water storage basin, cooling towers, laydown yards, and spoil storage. A paved road, less than 2 miles long (100-foot ROW), would be constructed to provide vehicle access from State Highway 31 to the Bravo Site. Development of the access road would require about 24 acres. Rail access is approximately 1.3 miles from the site (100-foot ROW), requiring approximately 16 acres.

A 3.8-mile water pipeline corridor would be required to transfer water south from Cedar Creek Reservoir to the site. Although the pipeline corridor would be installed underground, it is assumed that a 100-foot wide pipeline ROW would be required. This would impact approximately 46 acres of land.

Operations impacts to site land use would include permanent disturbance of the 3500-acre site area plus local road (24 acres) and rail (16 acres) access.

Because approximately half the site has been previously cleared and is now used for farm activities, land-use impacts associated with site preparation and construction of the proposed nuclear power plant at the Bravo site would be SMALL. Site land-use impacts from operations of the proposed nuclear power plant would be SMALL.

Four new transmission lines would be required to connect the proposed nuclear power plant with the Trinidad substation. Assuming a 400-foot wide ROW, the land affected would be approximately 390 acres. Two of these transmission lines would continue to the Venus substation. Sixty-five miles of power transmission would be needed to join to the 345 kV Venus substation, which serves as the primary path into Dallas and Fort Worth. New ROW would be required for some or all of the new transmission lines. For a 200-foot wide ROW and 65 miles of new transmission line, the land area affected would be around 1575 acres. The maximum land area affected would be approximately 1965 acres. Although Exelon would not be responsible for final routing and construction, the transmission service provider would be expected to comply with all applicable laws, regulations, and permit requirements, and use best management practices. Construction impacts of new transmission lines on offsite land use would be SMALL.

The new transmission line would not be expected to permanently affect agricultural areas, but it would have the potential to affect residents along the ROW. Corridor vegetation management and line maintenance procedures would be established by the transmission service provider. Operational impacts to land use along the ROWs would be SMALL.

9.3.3.4.2 **Air Quality**

The Bravo site is in western Henderson County in the Shreveport-Texarkana-Tyler Interstate AQCR (40 CFR 81.94). This AQCR is designated as unclassifiable/attainment with respect to the NAAQS (40 CFR 81.344). The nearest non-attainment area is Kaufman County which is designated as a Subpart 2 Moderate non-attainment area with respect to the 8-hour ozone standard (40 CFR 81.344). The southern boundary of Kaufman County is about 14 miles northwest of the Bravo site.

Air quality impacts from construction and operation of the proposed nuclear power plant at the Bravo site would be similar to those at the VCS site. Construction impacts would be temporary, and would be similar to any large-scale construction project. Construction emissions would primarily include fugitive dust from disturbed land and roads, and tailpipe emissions from construction equipment. Mitigation measures similar to those described for the VCS site would be applied. During station operation, standby diesel generators would be used for auxiliary power. It is expected that these diesel generators would see limited use and, when they are used, they would operate for short time periods, and annual emission levels would be low. Air emissions from the standby diesel generators and auxiliary power systems are expected to be minimal and would not violate NAAQS.

The nearest Class I area to the Bravo site is the Wichita Mountains Wilderness Area in Oklahoma (40 CFR 81.424), more than 180 miles from the Bravo site; therefore, there is little potential for the project to impose visibility impacts to Class I areas. Overall, impacts to regional air quality would be SMALL.

9.3.3.4.3 **Hydrology, Water Use, and Water Quality**

The Bravo site lies over the Carrizo-Wilcox Aquifer. The Carrizo-Wilcox Aquifer is a major aquifer that extends across much of eastern Texas and covers 66 counties. The outcrop of the aquifer covers about 11,186 square miles, and the area in subsurface covers about 25,409 square miles. Sixty-three percent of the aquifer, including the area in the region of the Bravo site, is covered under a groundwater control district (TWDB Nov 2006).

Significant decreases in water levels have developed in the semiarid Winter Garden portion of the Carrizo-Wilcox Aquifer in south Texas because the region is heavily dependent on groundwater for irrigation. Significant water level declines resulting from extensive municipal and industrial use also have occurred in Northeast Texas around Tyler and the Lufkin-Nacogdoches area.

Henderson County is part of the Region C Water Planning Group, which is required to plan for future water needs under drought conditions. According to the 2006 Region C Water Plan, the projected groundwater supply available in Region C from the Carrizo-Wilcox Aquifer is 12,203 acre-feet per year throughout the 2010 through 2060 projection period (RCWPG Jan 2006). In 2004, Henderson County pumped approximately 5870 acre-feet of groundwater from the Carrizo-Wilcox Aquifer (TDWB 2008).

Exelon would use groundwater during construction for the potable water system, concrete production and curing, backfill operations, dust control, cleaning and lubrication, and hydro testing and flushing. Peak well water demand during construction is estimated to be approximately 580 gpm. For normal station operations, Exelon estimates that 425 gpm of groundwater would be necessary. A maximum of 902 gpm is anticipated when one unit is operating normally and one unit is in an outage. Compared with the projected groundwater supply from the Carrizo-Wilcox aquifer, groundwater use for construction and operations of nuclear units at the Bravo site would represent a very small percentage of total supply (less than 12%). Therefore, construction and operations impacts to groundwater would be SMALL.

To ensure that wetlands and streams are not harmed by petroleum products or other industrial chemicals, Exelon would restrict certain activities (e.g., transfer and filling operations) that involve the use of petroleum products and solvents to designated areas, such as laydown, fabrication, and shop areas. In addition, construction activities would be guided by a Storm Water Pollution Prevention Plan and a construction-phase Spill Prevention, Control, and Countermeasures Plan similar to those proposed for VCS as described in Subsection 4.2.4. Therefore, any impacts to surface water during plant construction would be SMALL and would not warrant mitigation beyond best management practices required by the permits.

The normal consumptive water use during operations by the two ESBWR units using cooling towers would be 57,800 gpm (Table 9.4-3). {Water for the proposed cooling system at Bravo site could be provided by a number of available water sources.

Richland Chambers Reservoir, owned and operated by Tarrant Regional Water District (TRWD), is approximately 13.5 miles southwest of Bravo site. It was completed in 1987 with a firm yield of approximately 210,000 acre-feet per year (130,000 gpm). This yield is expected to decline from 188,000 acre-foot per year (116,000 gpm) in 2010 to 153,000 acre-foot per year (95,000 gpm) in 2060 due to sedimentation in the reservoir.

Cedar Creek Reservoir, also operated by the TRWD, is about 3.8 miles north of the site. Cedar Creek is estimated to have a firm yield of about 153,000 acre-feet per year (95,000 gpm) reducing to 139,000 acre-feet per year (86,000 gpm) in 2060 due to sedimentation.

While much of the supply in this reservoir system has been allocated to existing users, firm supplies remain. Additionally, other surface water supplies are available. For example, Lake Palestine, the Upper Neches River, and the Trinity River have both obtainable water and water potentially available under water supply contracts to support plant operation. Although ample surface water is available in the region (1.5 million acre-feet according to 2006 region C Plan), construction of the nuclear generation units at the Bravo site would require modifications to the existing long-range water management plans for the region and would therefore have a MODERATE impact on regional surface water supplies.

During operation, the cooling water system would likely withdraw water from the Cedar Creek Reservoir or Richland Chambers Reservoir and discharge water to the Trinity River via Walnut Creek. Construction of cooling towers would be required. The Bravo site would operate under a NPDES permit issued by the TCEQ. As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating discharges into waters of the United States. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. The permit contains limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality or human health. Any releases of contaminants to the Trinity River or other Texas waters as result of construction or operation of the proposed nuclear power plant at the Bravo site would be regulated by the TDEQ through the NPDES permit process to ensure that water quality is protected. The impacts of discharges to surface water would be minimized by the same mitigation measures as those discussed for the proposed site in Section 4.2 and Subsection 5.2.2. Therefore, impacts to water quality would be SMALL.

9.3.3.4.4 **Terrestrial Resources Including Protected Species**

The plant site is southeast of Dallas, Texas, immediately east of the Trinity River, and is situated in southwestern Henderson County. The terrain at the site is relatively flat, being in the Trinity River flood plain. Much of the site is open cropland and pasture, but some hardwood riparian areas exist along the Trinity River and Cedar Creek. The vegetation in the area surrounding this proposed site consists of mixed pine and hardwoods, including oak, elm, hackberry, and pecan. Along the Trinity River, the western border of the county, lie the bottomlands of the floodplain, where the vegetation features mixed hardwoods and a dense undergrowth of scrubs and vines typical of the East Texas mixed forests (TSHA 2008). Some land would have to be cleared for the construction of site facilities. Also, a makeup water intake line from the site to Cedar Creek Reservoir would have to be constructed. This line would be approximately 3.8 miles long and would require about 46 acres of corridor.

One federally listed terrestrial species has the potential to occur in Henderson County and therefore in the vicinity of the Bravo site. This species is the Bald Eagle (recently federally de-listed). In addition, Henderson County has 10 state-protected species, including seven birds, two mammals, and one reptile.

As mentioned in Subsection 9.3.3.4.1, it is assumed that four 345 kV transmission lines requiring a 400-foot wide ROW (8 miles long) would be needed to connect the proposed nuclear power plant to the Trinidad substation. Two new lines, requiring a 200-foot ROW, would continue to the Venus substation. Land clearing associated with construction of plant facilities and transmission lines would be conducted according to federal and state regulations, permit conditions, existing Exelon procedures, good construction practices, and established best management practices (e.g., directed drainage ditches, silt fencing). With this in mind, impacts to terrestrial resources, including endangered and threatened species, from operation of the Bravo site plant and transmission lines would probably be SMALL.

9.3.3.4.5 **Aquatic Resources Including Endangered Species**

The Bravo site is near the city of Malakoff in Henderson County. Water for the proposed plant would be withdrawn from the Cedar Creek Reservoir north of the site. The reservoir is estimated to have a firm yield of about 153,000 acre-feet reducing to 139,000 acre-feet in 2060 due to sedimentation. There are no known federally listed aquatic species in Henderson County.

Discharge from the facility would go to Walnut Creek. This creek is part of the Trinity River watershed. Impacts to the aquatic environment during construction of the plant would be minimal. The construction of cooling water intake and discharge structures would be necessary if a nuclear power plant were constructed at the Bravo site. The design of the intake structure would comply with the requirements of Section 316(b) of the Clean Water Act, thereby reducing the potential impacts of entrainment and impingement to sensitive species. The design of the new discharge system would comply with the requirements of the Clean Water Act thereby reducing the potential impacts of increased thermal discharge temperatures on sensitive species. The discharge to Walnut Creek would also comply with NPDES guidelines.

Based on a review of the available information construction impacts to aquatic biota would be SMALL. Impacts due to plant operations would also be SMALL.

9.3.3.4.6 **Socioeconomics**

This subsection evaluates the social and economic impacts to the surrounding region as a result of constructing and operating the proposed nuclear power plant at the Bravo site. The evaluation assesses impacts of construction, station operation, and demands placed by the construction and operation workforce on the surrounding region.

9.3.3.4.6.1 Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, and dust. Vibration and shock impacts would not be expected due to the strict control over construction activities. The use of public roadways and railways would be necessary to transport construction materials and equipment. Most construction activities would occur in the boundaries of the Bravo site. However, an access road and a connecting rail spur (requiring about 30 acres) would be constructed on lands adjacent to the site. These new transportation ROW would be routed to avoid residences and populated areas. Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted or would be permitted prior to operation. Impacts on those facilities from construction of the proposed nuclear power plant would be small incremental impacts associated with their normal operation.

Potential impacts from station operation include noise, exhausts, thermal emissions, and visual intrusions. The proposed nuclear power plant would produce noise from the operation of pumps, fans, transformers, turbines, generators, and switchyard equipment, and traffic at the site would also be a source of noise. However, noise attenuates quickly so ambient noise levels would be minimal at the site boundary. Also, the Bravo site is in a rural area surrounded by forests and agricultural land, with few residents in the area. Commuter traffic would be controlled by speed limits, which could reduce the dust and noise level generated by the workforce commuting to the site.

The proposed nuclear power plant would have standby diesel generators and auxiliary power systems. This equipment would be operated infrequently, for short durations.

In summary, construction activities would be temporary and would occur mainly in the boundaries of the Bravo site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operation, ambient noise levels would be minimal at the site boundary. Therefore, the physical impacts of construction and operation of the proposed nuclear power plant at the Bravo site would be SMALL.

9.3.3.4.6.2 Demography

The Bravo site is in Henderson County, Texas. The population distribution near the site is low with typical rural characteristics.

As discussed in Subsection 4.4.2, Exelon anticipates employing 6300 construction and 265 operations workers during the peak construction period (Table 3.10-2). Exelon anticipates that approximately 5985 construction and 265 operations workers would relocate to the area. Based on their proximity to the

Bravo site, Exelon estimates that most of construction workers would locate in Henderson and Navarro Counties. About 60% would settle in Henderson County, primarily in Athens and Malakoff, and 40% in Navarro County, primarily in Corsicana. In reality, some workers could locate to one of the other counties within 50 miles of the site.

Based on the 2000 Census, the total population of the two most affected counties is 118,401 people. The 2000 population in the counties was 73,277 in Henderson County and 45,124 in Navarro County (USCB 2000a). In 2000, the population within 50 miles of the site was 603,832 people (76.9 people per square mile), and the population within 20 miles of the site was 68,838 people (54.8 people per square mile). The nearest population center, as defined in 10 CFR 100, is Dallas, Texas (population 5,221,801); northwest of the Bravo site. The distance between the Bravo site and Dallas is about 60 air miles. Based on the sparseness and proximity matrix in NUREG-1437, the Bravo site is in a medium population area.

As discussed in Subsection 4.4.2, approximately 70% of the in-migrating construction workers and 100% of operations workers are likely to bring families. Therefore, of 5985 construction workers, 4190 would bring families into the 50-mile region, for a total of 4455 construction and operations workers bringing families. Assuming an average family household size of 3.25 people, construction would increase the population in the 50-mile region by 16,273 people, which is about 2.7% of the region's population in 2000. As stated previously, it is assumed that approximately 9764 (60%) people would locate to Henderson County and 6509 (40%) people would locate to Navarro County. These numbers constitute 13.3% and 14.4% of the 2000 Census populations of Henderson and Navarro Counties, respectively.

Exelon is adopting the NRC definition of impacts as small if plant-related population growth is less than 5% of the study area's total population and large if plant-related population growth is greater than 20%. Therefore, the potential increases in population during construction of the proposed nuclear power plant at the Bravo site would represent MODERATE impact to the population in Henderson and Navarro Counties and a SMALL impact to the total population elsewhere in the 50-mile region. Mitigation methods would be similar to those described in Subsection 4.4.2.

Exelon assumed the operations workforce would have the same residential distribution as the construction workforce. Exelon estimates that 800 workers (Subsection 3.10.3), would be required for the operation of two nuclear power facilities at the Bravo site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. Employees relocating to the region would most likely choose to live in Henderson or Navarro Counties. However, for the purpose of analysis, Exelon assumed that all 800 employees and their families would come from outside the region. The 800 employees would translate into an additional 2600 people (assuming an average family household size of 3.25 people). Based on the counties' proximity to the site, approximately 1560 (60%) people would locate to Henderson County and 1040 (40%) people would locate to Navarro County. These numbers constitute 2.1% and 2.3% of the 2000 Census populations of Henderson and Navarro Counties, respectively. Overall, the potential increase in population from operation of the proposed nuclear power plant at the Bravo site would represent a SMALL impact to the total population throughout the 50-mile region, and mitigation would not be warranted.

9.3.3.4.6.3 Economy

Based on 2000 census data in the two most affected counties near the Bravo site, there are 51,679 people in the civilian labor force. Of the civilian labor force, 93.0% are employed and 7.0% are unemployed. In 2000, Henderson County had a civilian labor force of 31,643 people and an unemployment rate of 6.5%. Navarro County had a civilian labor force of 20,036 people and an unemployment rate of 7.8% (USCB 2000c).

As described in Subsections 4.4.2.1 and 5.8.2.1, the wages and salaries of the construction and operations workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses, and increased job opportunities for local residents. The economic effect on the 50-mile region would be beneficial. For the purpose of analysis, Exelon conservatively assumes that direct jobs would be filled by an in-migrating workforce, but most indirect jobs would be service-related, not highly specialized, and would be filled by the existing workforce in the 50-mile region. Expenditures made by the direct and indirect workforce would strengthen the regional economy. This would be considered a positive impact.

As discussed in Subsections 9.3.3.4.6.2, Exelon estimates that 5985 construction and 265 operations workers would in-migrate to the region during peak construction of the proposed nuclear power plant at the Bravo site. Assuming a multiplier of 1.68 jobs (direct and indirect) for every construction job and a multiplier of 2.79 for each operations job (BEA 2008c), an influx of 5985 construction and 265 operations workers would create 4561 indirect jobs, permanent or temporary, for a total of 10,811 new jobs in the 50-mile region. The number of new jobs would represent about 20.5% of the employment in Henderson County and 21.6% of the employment in Navarro County.

Exelon is adopting the NRC definition of impacts as small if plant-related employment is less than 5% of the study area's total employment and large if plant-related employment is greater than 10%. Exelon concludes that the impacts of construction on the economy would be beneficial and SMALL everywhere in the region except Henderson and Navarro Counties, where the impacts could be beneficial and large.

As discussed in Subsection 9.3.3.4.6.2, about 800 workers would be required for the operation of two nuclear power facilities at the Bravo site, and Exelon assumes that all the new employees would migrate into the region. Assuming a multiplier of 2.79 jobs (direct and indirect) for every operations job at the new units (BEA 2008c), an influx of 800 workers would create 1429 indirect jobs for a total of about 2229 new jobs in the region. The number of new jobs would represent about 4.2% of the employment in Henderson County and 4.5% of the employment in Navarro County. Because most indirect jobs are service-related and not highly specialized, Exelon assumes that most, if not all, indirect jobs would be filled by the existing labor force in the 50-mile region. Exelon concludes that the impacts of operation of two nuclear power facilities on the economy would be beneficial and SMALL everywhere in the region.

9.3.3.4.6.4 Taxes

Taxes collected as a result of constructing and operating the proposed nuclear power plant at the Bravo site would be of benefit to state and local taxing jurisdictions. In Texas, property tax assessments are made by the county appraisal district, which bases its appraisal on a consideration of cost, income, and market value. This appraisal is used by all taxing jurisdictions in the county, including special districts and independent school districts, which apply their individual millage rates to determine the taxes owed. Based on the analysis in Subsection 4.4.2.2.2, Exelon anticipates that additional property taxes would be paid to Henderson County during the construction period.

In 2006, Henderson County had property tax revenues of $21,986,101 (Combs Jan 2008). Assuming that tax payments to Henderson County for nuclear power facilities at the Bravo site would be similar to those of the VCS site (Section 4.4.2.2.2 and 5.8.2.2.2), the tax payments would represent a large portion of the tax revenue for the county. For the operations period, Exelon estimates its total payment to all taxing entities would be approximately $24 million, annually. Table 5.8.2-12 estimates the county property tax for VCS at approximately $6.9 million. The benefits of taxes are considered small when new tax payments by the nuclear plant constitutes less than 10% of total revenues for local jurisdictions and large when new tax payments represent more than 20% of total revenues. The projected operations-phase taxes for the nuclear power facilities represent more than 30% of current property tax revenues for Matagorda County. Therefore, Exelon concludes that the potential beneficial impacts of taxes collected during construction of the proposed project would be MODERATE to LARGE in Henderson County and small in the remainder of the 50-mile region. The potential beneficial impacts of taxes collected during operations would be LARGE in Henderson County and small in the remainder of the 50-mile region.

The Bravo site is in the Malakoff ISD, which is categorized as a property-wealthy district (see Subsection 2.5.2.3.5). Increased tax revenues would therefore have only a SMALL positive impact to the Malakoff ISD. In-migrating construction and operation workers would result in larger enrollments in the ROI schools, which would not receive direct property tax revenues from the plant. Because the Texas school funding formula is based on weighted average daily attendance, increases in the number of students would lead to increased funding, but would also result in the additional expenses related to a larger student body. Fiscal impacts to the ISD from increased enrollment would be small to moderate, depending on their existing capacity, funding status, and fiscal condition. Subsection 9.3.3.4.6.9 discusses capacity and enrollment issues for the Bravo site ROI in detail.

9.3.3.4.6.5 Transportation

The regional and local road system is shown on Figure 9.3-15. Highway access to the Bravo site is provided by FM 90, a two-lane paved road. The Bravo site is approximately 60 miles southeast of Dallas. Two interstate roadways provide access to the region, Interstate 20 to the north of the site and

Interstate 45 to the south. Just north of the site is State Highway 31, which has an interchange with Interstate 45 at Corsicana. TX 31 is a divided four-lane highway that stretches east-west nearly linking the two interstates. A traveler must go north on U.S. 69 in Tyler for approximately 7 miles to reach an interchange with Interstate 20.

The average annual traffic count south of Malakoff along FM 90 is 3900 vehicles per day (TXDOT 2006). In keeping with the analysis in Subsection 4.4.2.2.4, the maximum number of vehicles on a highway in a single hour is estimated to be 10% of the daily average. Therefore, Exelon estimates the maximum number of cars on FM 90 in a single hour to be 390. The largest impact on traffic would be during the construction period day/back shift change, with up to 6250 vehicles entering or leaving the site. FM 90 has a threshold capacity of 2300 passenger cars per hour.

Transportation impacts are considered to be small when increases in traffic do not result in delays or other operational problems; impacts are moderate when increases in traffic begin to cause delays or other operational problems.

Assuming construction shifts as described in Subsection 4.4.2.2.4, the additional traffic that could be on the road during shift changes could cause potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could bring additional congestion during certain times of the day. Shift changes for the proposed nuclear power plant at the Bravo site could be staggered to mitigate the impact on traffic. Impacts of construction on transportation would be SMALL to MODERATE on the two-lane roads in Henderson County, particularly Highway 31 and FM 90, and some mitigating actions such as those described in Subsection 4.4.2.2.4 would be needed.

With respect to facility operations, the addition of 800 cars (assuming a single occupant per car) to the existing traffic on Highway 31 or FM 90 would not materially congest the roadways. Shift changes for the proposed nuclear power plant at the Bravo site would be staggered resulting in a limited traffic increase that would not cause congestion. Impacts of the operations workforce on transportation would be SMALL and mitigation would not be warranted.

9.3.3.4.6.6 Aesthetics and Recreation

The Bravo site encompasses approximately 5000 acres in the southwestern part of Henderson County. Natural and man-made features that give the landscape its character include topographic features, vegetation, and existing structures. The topography of the region consists of undulating hills with elevations ranging from 256 to 763 feet above MSL (TSHA 2008). The vegetation of the area features mixed hardwoods and a dense undergrowth of shrubs and vines (TSHA 2008). The site was originally used for lignite mining and then later considered for a coal-fired generating facility by Houston Lighting and Power. Most of the site is rural, undeveloped agricultural fields, but there are industrial facilities constructed in the northeastern corner of the property.

The property is on the outskirts of the town of Malakoff. Other nearby residential areas that could be affected by construction are Trinidad, 3 miles to the west, and Star Harbor, 2.5 miles to the north. Cedar Creek Reservoir is a 34,000 acre lake 2.5 miles to the north of the site and is the largest recreational area in the region. Additionally, Creslenn Park, Cain Civic Center Park, and Purtis Creek State Park are located 7 miles southwest, 10.5 miles east in downtown Athens, and 14 miles north, respectively.

The attractiveness of the southern part of the Cedar Creek Reservoir for sport fishing and other recreational uses could be impacted during construction of intake and discharge structures. Other recreational areas would be affected by increased traffic on area roads during peak travel periods, but impacts would be minimal. During the operating period, it is expected that some employees and their families would use the recreational facilities in the region. However, the increase attributable to plant operations would be small compared to overall use of these facilities. Impacts on tourism and recreation are considered small if current facilities are adequate to handle local levels of demand. Therefore, impacts of facility construction and operation on tourism and recreation would be SMALL.

The construction and operation of the proposed nuclear power plant at the Bravo site would have minimal impacts on aesthetic and scenic resources. The upper portions of facility structures would potentially be visible from elevated areas near the site. There would be occasional visible plumes associated with the PSWS and circulating water system cooling towers. The visibility of the plumes would be dependent upon the weather and wind patterns and the location of the viewer in the general topography of the area. Impacts on aesthetic resources are considered to be moderate if there are some complaints about diminution in the enjoyment of the physical environment and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. Construction and operation of an industrial facility on a previously undeveloped site would likely result in some complaints from the affected public regarding diminution in the enjoyment of the physical environment. Therefore, impacts of construction and operation of the proposed nuclear power plant on aesthetics would be MODERATE and could warrant mitigation.

9.3.3.4.6.7 Housing

Impacts on housing from the construction labor force depend on the number of workers already residing in the 50-mile region and the number that would relocate and require housing.

As discussed in Subsection 9.3.3.4.6.2, approximately 5985 construction and 265 operations workers would migrate into to the 50-mile region. Of these, approximately 3750 (60%) would settle in Henderson County and 2500 (40%) would settle in Navarro County.

In 2000, a total of 9089 vacant housing units were available for sale or rent in Henderson and Navarro Counties. Exelon estimates that, in absolute numbers, the available housing would be sufficient to house the workforce. However, there may not be enough housing of the type desired by the movers in each county, especially in Navarro County. The median price of housing in Henderson County in 2000 was $75,300. The median price of housing in Navarro County was $56,700 for the same year (USCB 2000d). If pricing is too high, workers would relocate to other areas in the 50-mile region, have new homes constructed, bring their own housing, or live in hotels and motels. Given this increased demand for housing, prices of existing housing could rise to some degree. Henderson and Navarro Counties (and other counties to a lesser extent) would benefit from increased property values and the addition of new houses to the tax rolls. Increasing the demand for homes could increase rental rates and housing prices. It is unlikely, but possible, that some low-income populations could be priced out of their rental housing due to upward pressure on rents. However, the construction workforce would increase over time. The gradual influx of new residents would give the housing market time to adjust to the additional demands.

In summary, the two counties where most of the construction workforce would seek housing have adequate housing resources for the entire workforce. Impacts on housing are considered to be small when a small and not easily discernable change in housing availability occurs, and impacts are considered to be moderate when there is a discernable but short-lived reduction in the availability of housing units. Exelon concludes that the potential impacts of construction on housing could be MODERATE to LARGE in Henderson and Navarro Counties and would be SMALL in the remainder of the 50-mile region. Mitigation would not be warranted where the impacts are small. Mitigation of the moderate to large impacts would most likely be market-driven but may take some time. Additional mitigation measures similar to those discussed in Subsection 4.4.2 could also be implemented.

Exelon estimates that about 800 workers would be needed for operation of two nuclear power facilities at the Bravo site. For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate to the region. Employees relocating to the region would most likely be scattered throughout the counties in the region, with most choosing to live in Henderson or Navarro counties. If all 800 employees and their families were to come from outside the region, it is likely that adequate housing would be available in the region, especially in the larger metropolitan areas. In the two most affected counties, the average income of the new workforce would be expected to be higher than the median or average income in the county; therefore, the new workforce could exhaust the high-end housing market and some new construction could result.

Exelon concludes that the potential impacts of operations on housing in Henderson and Navarro Counties would be SMALL to MODERATE and SMALL elsewhere in the 50-mile region. Market forces could result in more housing being built in the two-county region, eventually mitigating any housing shortages. Additional mitigation would not be warranted.

9.3.3.4.6.8 Public Services

Public services include water supply and waste water treatment facilities; police, fire and medical facilities; and social services. As discussed in Subsection 9.3.3.4.6.2 construction of the proposed nuclear power plant at the Bravo site would increase the population in the 50-mile region by 16,273 people (2.7% of the population in the region). The new construction employees and their families would increase the total population in Henderson County by 13.3%, and in Navarro County by 14.4%. Operation of the proposed nuclear power plant at the Bravo site would increase the population in the 50-mile region by 2600 people (0.4% of the population in the region). The new operations employees and their families would increase the total population in Henderson County by 2.1% and Navarro County by 2.3%.

New construction or operations employees relocating from outside the region would most likely live in residentially developed areas where adequate water supply and waste treatment facilities already exist. The medical facilities in the two-county area provide medical care to much of the population in the 50-mile region, and the small increases in the regional population would not materially impact the availability of medical services.

The proposed nuclear power plant and the associated population influx would likely economically benefit the disadvantaged population served by the Texas Department of Human Resources. The additional direct jobs would increase indirect jobs that could be filled by currently unemployed workers, thus removing them from social services client lists.

In 2002, Henderson and Navarro Counties' persons per law enforcement officer ratios were 733:1 and 78:1, respectively (USCB Sep 2004). The persons per officer ratio for Texas is 490:1 (USCB Sep 2004). The 2002 persons per firefighter ratios in Henderson and Navarro Counties were 452:1 and 83:1, respectively (USFA Dec 2007). The persons per firefighter ratio for Texas is 342:1 (USFA Dec 2007). Ratios are partly dependent on population density. Fewer public safety officers are necessary for the same population if the population resides in a smaller area. The population increase in the two most affected counties from construction or operations employees relocating from outside the region could result in the need to hire additional emergency personnel. This is most likely to happen in Henderson and Navarro Counties. However, increased tax revenues would be adequate to pay the salaries of any additional emergency personnel hired.

As discussed above, it is not expected that public services would be materially impacted by new construction or operations employees relocating from outside the region. Impacts on public services are considered to be small if there is little or no need for changes in the level of service provided to the community. Therefore, impacts of construction and operation of the proposed nuclear power plant on public services would be SMALL and mitigation would not be warranted.

9.3.3.4.6.9 Education

As discussed in Subsection 9.3.3.4.6.2, Exelon anticipates that most of in-migrating workers in the construction and operation workforces would settle in Henderson and Navarro counties. Therefore, this analysis is restricted to the two counties that would be most affected by the new workforce.

Based on data for the 2004-2005 school year, Henderson County has 33 pre-kindergarten through 12 (PK-12) schools with a total enrollment of 10,602 students and Navarro County has 26 PK-12 schools with a total enrollment of 9650 students (NCES 2007).

As discussed in Subsection 9.3.3.1.6.2, Exelon assumed that 70% of the 5985 in-migrating nuclear plant construction workers were likely to bring families: 4190 would bring families and 1796 would not. However, Exelon assumed that 100% of the overlapping operations workforce (265 people) would bring families. As in Subsection 4.4.2.8, Exelon assumes that the average number of school-aged children per worker who relocated his or her family was 0.8 (BMI Apr 1981). This would increase the school-aged population within 50 miles of the Bravo site by about 3564 students. About 40% would settle in Navarro County and 60% in Henderson County. The student populations in Henderson and Navarro counties would increase by 20.2% and 14.8%, respectively. Small impacts are generally associated with project-related enrollment increases below 4%, and large impacts on local school systems are generally associated with project-related enrollment increases above 8%. Therefore, the projected increase in the student population would constitute a SMALL impact on the education system everywhere in the 50-mile region except Henderson and Navarro Counties where the projected increases in the student populations would constitute LARGE impacts. Mitigation measures similar to those discussed in Subsection 4.4.2 could be implemented if the proposed nuclear power plant were constructed at the Bravo site. The quickest mitigation would be to hire additional teachers and move modular classrooms to existing schools. Increased property tax revenues as a result of the increased population would fund additional teachers and facilities. No additional mitigation would be warranted.

For the purpose of analysis, Exelon conservatively assumes that all the new employees would migrate into the region. If all 800 employees and their families were to come from outside the region, the school-aged population in Henderson and Navarro Counties would increase by about 640 students, or by 3.6% and 2.7%, respectively. These increases in student population are below 4% of the total student populations in these counties, hence project-related enrollment increases would constitute a SMALL impact on the education systems and mitigation would not be warranted.

9.3.3.4.7 **Historic and Cultural Resources**

Exelon conducted historical and archaeological records searches on the National Park Service's NRHP and reviewed information on historic and archaeological sites provided in documents associated with the canceled Malakoff coal-fired unit.

Several archaeological sites were identified at the Bravo site during cultural resources surveys to support the cancelled coal-fired unit. The sites were evaluated for listing in the National Register but none were eligible.

A search of the NRHP identified 34 sites in the three counties surrounding the Bravo site; including 6 sites in Navarro County (24 miles from the site), 26 sites in Anderson County (25 miles from the site), 1 site in Freestone County (40 miles from the site), and 1 site in Henderson County (12 miles from the site) (NPS 2008c). No properties are within 10 miles of the Bravo site (NPS 2008c).

Building the proposed nuclear power plant at the Bravo site would require a formal cultural resources survey to be conducted so that no archaeological or historic resources would be damaged during construction. Mitigative measures would be coordinated with the THC to prevent permanent damage and ensure that any impacts to cultural resources from construction or operation of the proposed nuclear power plant at the Bravo site would be SMALL.

9.3.3.4.8 **Environmental Justice**

Environmental justice refers to a federal policy under which each agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. NRC has a policy on the treatment of environmental justice matters in licensing actions (69 FR 52040) and guidance (U.S. NRC May 2004). Subsection 2.5.4.1 describes the methodology Exelon used to establish locations of minority and low-income populations.

The 2000 Census block groups were used for ascertaining minority and low-income populations in the area. There are 476 block groups within 50 miles of Bravo. The Census Bureau data for Texas characterizes 11.5% of the population as black races, 0.6% as American Indian or Alaskan native, 2.7% as Asian, 0.1% as native Hawaiian or other Pacific Islander, 11.7% as all other races, 2.5% as multracial, 29.0% as an aggregate of minority races, and 32.0% as Hispanic ethnicity. If any block group minority percentage exceeded 50%, then the block group was identified as containing a minority population. If any block group percentage exceeded its corresponding state percentage by more than 20%, then the block group was identified as having minority population. There are 69 block groups with significant black races with 50 miles of the Bravo site, there are 11 block groups with "other" minority populations, 68 block groups with significant aggregate races, and 14 block groups with significant Hispanic populations. The locations of the minority populations within 50 miles of the Bravo site are shown in Figure 9.3-16.

The Census Bureau data characterizes 14% of Texas households as low-income. Based on the "more than 20%" criterion, 25 block groups contain a low-income population. The locations of the low-income populations in the 50-mile radius of the Bravo site are shown in Figure 9.3-17.

Construction activities (noise, fugitive dust, air emissions, traffic) would not impact minority populations because of their distance from the Bravo site. In fact, minority and low-income populations would most likely benefit from construction activities through an increase in construction-related jobs. Operation of the proposed nuclear power plant at the Bravo site is unlikely to have a disproportionate impact on minority or low-income populations.

9.3.4 Summary and Conclusions

The decision to locate the two nuclear power units at the VCS site was based on a comparison of the five candidate sites. The Victoria County site ranked higher than the four alternative sites based on the environmental criteria ratings (health and safety, environmental, and socioeconomic). A comparison of projected construction and operational impacts at the proposed and alternative sites demonstrates that there is no significant difference in environmental impact among the five candidate sites. For these reasons, there is no alternative site that is "environmentally preferable" to the Victoria County site.

Tables 9.3-2 and 9.3-3 compare the environmental impacts of construction and operation of the proposed nuclear power plant at each of the alternative sites with impacts at the VCS site. This site-by-site comparison did not result in identification of a site environmentally preferable to the proposed VCS site. Therefore, no additional analysis is required to determine whether the candidate sites are "obviously superior" to the proposed VCS site.

9.3.5 References

BEA 2008a. U.S. Bureau Economic Analysis, *RIMS II Multipliers for Matagorda, Buckeye sites, TX. Table 1.5*, 2008.

BEA 2008b. U.S. Bureau Economic Analysis, *RIMS II Multipliers for Alpha Site TX Region* 2, 2008.

BEA 2008c. U.S. Bureau Economic Analysis, *RIMS II Multipliers for Bravo Site TX Region 2*, 2008.

BMI Apr 1981. Battelle Memorial Institute, S. Halhotra and D. Manninen, *Migration and Residential Location of Workers at Nuclear Power Plant Construction Sites; Forecasting Methodology (Volume 1) and Profile Analysis of Worker Surveys (Volume 2)*, NUREG/CR-2002, PNL-3757, U.S. NRC Accession Number 8105180373 (Volume 1) U.S. NRC Accession Number 8105180378 (Volume 2), April 1981.

BRA Undated. Brazos River Authority, *Questions and Answers for Proposed Allens Creek Reservoir*, available at http://www.brazos.org/acrFAQs.asp#status, accessed May 28, 2008.

Combs Jan 2008. Texas Comptroller of Public Accounts, S. Combs, *Annual Property Tax Report Tax Year 2006*, January 2008.

ERCOT May 2008. Electric Reliability Council of Texas, *ERCOT Quick Facts*, May 2008.

HL&P 1973. Houston Lighting and Power Company, *Preliminary Safety Analysis Report Allens Creek Nuclear Generating Station Units 1 and 2*, 1973.

LCRA Apr 2007. Lower Colorado River Authority and San Antonio Water System, *Existing Conditions Report Matagorda Bay Health Evaluation*, April 2007.

LCRWPG Jan 2006. Lower Colorado River Water Planning Group, *2006 "Region K" Water Plan for the Lower Colorado River Water Planning Group*, January 2008. Available at http://www.twdb.state.tx.us/rwpg/2006_RWP/RegionK/, accessed July 19, 2008.

NAS 2008. National Audubon Society, *Christmas Bird Count (CBC) Results: Count Data by Count Circle Matagorda County-Mad Island Marsh [TXMM]*, available at http://cbc.audubon.org/cbccurrent/count_table.html, accessed April 23, 2008.

NAS Undated. National Audubon Society, *Christmas Bird Count FAQs*, available at http://www.audubon.org/bird/cbc/FAQ.html, accessed April 23, 2008.

NCES 2007. National Center for Education Statistics, *Common Core of Data Texas Table by County for the 2005-2006 School Year*, available at http://nces.ed.gov/ccd/bat, accessed January 4, 2008.

NPS 2008a. National Park Service, *National Register Information System — Matagorda and Brazoria Counties Texas*, available online at http://www.nr.nps.gov/, accessed on February 15, 2008.

NPS 2008b. National Park Service, *National Register Information System — Austin, Colorado, Fort Bend, Waller, and Wharton Counties Texas*, available online at http://www.nr.nps.gov, accessed on April 8, 2008.

NPS 2008c. National Park Service, *National Register Information System — Navarro, Anderson, Freestone, and Henderson Counties Texas*, available at http://www.nr.nps.gov, accessed April 8, 2008.

RCWPG Jan 2006. Region C Water Planning Group, *2006 Region C Water Plan*, available at http://www.twdb.state.tx.us/rwpg/main-docs/2006RWPindex.asp, accessed July 19, 2008.

RHWPG Jan 2006. Region H Water Planning Group, *2006 Region H Water Plan*, available at http://www.twdb.state.tx.us/rwpg/main-docs/2006RWPindex.asp, accessed July 19, 2008.

STPNOC Sep 2007. South Texas Project Nuclear Operating Company, *Combined Construction and Operating License Application for South Texas Project 3 & 4, South Texas Project Nuclear Operating Company, Wadsworth, TX*, September 2007.

TNC 2008. The Nature Conservancy, *Clive Runnells Family Mad Island Marsh Preserve*, available at http://www.nature.org/wherewework/northamerica/states/texas/preserves/ Art6400.html, accessed February 14, 2008.

TWDB Nov 2006. Texas Water Development Board, *Water for Texas 2007*, November 14, 2006.

TPWD Feb 2007a. Texas Parks and Wildlife Department, *Great Texas Coastal Birding Trails*, February 9, 2007, available at http://www.tpwd.state.tx.us/huntwild/wild/wildlife_trails/ coastal/, accessed May 4, 2008.

TPWD Feb 2007b. Texas Parks and Wildlife Department, *Stephen F. Austin State Park,* February 9, 2007, available at http://www.tpwd.state.tx.us/spdest/findadest/parks/ stephen_f_austin_and_san_felipe/, accessed August 8, 2007.

TPWD Sep 2007. Texas Parks and Wildlife Department, *Gulf Coast*, September 19, 2007, available at http://www.tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/maps/ ?action=getMap&region=4, accessed April 29, 2008.

TWDB 2008. Texas Water Development Board, *Historical Water Use Information*. Available at http://www.twdb.state.tx.us/wushistorical/DesktopDefault.aspx?PageID=1. Accessed July 19, 2008.

TSHA Jan 2008a. Texas State Historical Association, *The Handbook of Texas Online Gulf of Mexico*, January 17, 2008, available at http://www.tshaonline.org/handbook/online/ articles/GG/rrg7.html, accessed February 13, 2008.

TSHA Jan 2008b. Texas State Historical Association, *The Handbook of Texas Online Henderson County*, January 17, 2008, available at http://www.tsha.utexas.edu/handbook/online/articles/ HH/hch13.html, accessed April 29, 2008.

TSTNR 2007. Texas Sea Turtle Nesting Report, *Ongoing News on Sea Turtle Topics for the Texas Gulf Coast*, available at http://texasturtlenest.blogspot.com, accessed February 14, 2008.

TXDOT 2006. Texas Department of Transportation, *Statewide Traffic Count Maps*, available at http://www.dot.state.tx.us/apps/statewide_mapping/StatewidePlanningMap.html, accessed July 17, 2008.

USCB 2000a. U.S. Census Bureau, *DP-1 Profile of General Demographic Characteristics: 2000 for Austin, Brazoria, Fort Bend, Henderson, Matagorda, Navarro, and Waller Counties*, available at http://factfinder.census.gov, accessed April 29, 2008.

USCB 2000b. U.S. Census Bureau, *GCT-PH1 Population, Housing Units, Area, and Density: 2000, for Austin, Brazoria, Fort Bend, Henderson, Matagorda, Navarro, and Waller Counties*, available at http://factfinder.census.gov, accessed April 29, 2008.

USCB 2000c. U.S. Census Bureau, *QT-P24 Employment Status by Sex: 2000, for Austin, Brazoria, Fort Bend, Henderson, Matagorda, Navarro, and Waller Counties*, available at http://factfinder.census.gov, accessed April 29, 2008.

USCB 2000d. U.S. Census Bureau, *QT-H14 Value, Mortgage Status, and Selected Conditions: 2000 , for Austin, Brazoria, Fort Bend, Henderson, Matagorda, Navarro, and Waller Counties*, available at http://factfinder.census.gov, accessed May 27, 2008.

USCB 2000e. U.S. Census Bureau, *DP-3 Profile of Selected Economic Characteristics: 2000 for Texas*, available at http://factfinder.census.gov, accessed June 3, 2008.

USCB Sep 2004. U.S. Census Bureau, *Compendium of Public Employment: 2002, QC02(3)-2, September 2004*, 2002 Census of Governments Volume 3, "Public Employment."

USFA Dec 2007. U.S. Fire Administration, *National Fire Department Census State Download, December 12, 2007*, available at http://www.usfa.dhs.gov/applications/census/states.cfm, accessed February 15, 2008.

USFWS 2007. U.S. Fish and Wildlife Service, Alphabetical Refuge List, available at http://www.fws.gov/refuges/profiles/ByLetter.cfm, accessed April 29, 2008.

USFWS 2008. U.S. Fish and Wildlife Service, *Classification of Wetlands and Deepwater Habitats of the U.S. U.S. DO1*, USFWS. Washington D.C.

USGS Jun 2000. U.S. Geological Survey, *Coastal Prairie, USGS FS-019-00, June 2000*, available at http://www.nwrc.usgs.gov/factshts/019-00.pdf, accessed February 15, 2008.

USNRC Jul 1976. U.S. Nuclear Regulatory Commission, *Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations, Revision 2*, July 1976.

USNRC May 1996. U.S. Nuclear Regulatory Commission, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, May 1996.

USNRC May 2004. U.S. Nuclear Regulatory Commission, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues*, NRR Office Instruction Number LIC-203, Revision 1, May 24, 2004.

Table 9.3-1
Sites Considered by Exelon

Site Name	County
Alpha	Austin
Bravo	Henderson
Victoria County	Victoria
Buckeye	Matagorda
Matagorda County	Matagorda
Powderhorn Ranch	Calhoun
Placedo	Victoria
Franzen	Matagorda
Womack	Victoria
Sam Rayburn Reservoir Area	Nacogdoches
Rusk County	Rusk
Navarro County	Navarro
Occidental-Hardy	Matagorda
Douglas-Runnels	Matagorda
O'Connor Tract	Victoria
Munson	Grayson
Red River	Cooke
Moss Lake	Cooke
McGregor	McLennan
Hughes Farm	Williamson
South Texas Project	Matagorda
Comanche Peak	Somervell

Table 9.3-2 (Sheet 1 of 2)
Characterization of Construction Impacts at the VCS Site and Alternative Sites

Category	Victoria County	Matagorda County	Buckeye	Alpha	Bravo
Land Use Impacts					
The Site and Vicinity	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission rights-of-way	SMALL	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Water Related Impacts					
Water Use	SMALL	SMALL	SMALL	LARGE	MODERATE
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological Impacts					
Terrestrial Ecosystems	MODERATE	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Aquatic Ecosystems	SMALL	SMALL	SMALL	SMALL to LARGE	SMALL
Threatened and Endangered Species	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomic Impacts					
Physical Impacts	SMALL	SMALL	SMALL	SMALL	SMALL
Demography	MODERATE	MODERATE	MODERATE	SMALL	MODERATE
Economy	SMALL to MODERATE (Beneficial)	SMALL (Beneficial)	SMALL (Beneficial)	SMALL to LARGE (Beneficial)	SMALL
Taxes	SMALL to MODERATE (Beneficial)	SMALL (Beneficial)	SMALL (Beneficial)	LARGE (Beneficial)	MODERATE to LARGE (Beneficial)
Transportation	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Aesthetics	SMALL to MODERATE	MODERATE	MODERATE	MODERATE	MODERATE

**Table 9.3-2 (Sheet 2 of 2)
Characterization of Construction Impacts at the VCS Site and Alternative Sites**

Category	Victoria County	Matagorda County	Buckeye	Alpha	Bravo
Recreation	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL
Housing	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE
Public and Social Services	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE
Historic and Cultural Resources	SMALL to LARGE[a]	SMALL	SMALL	SMALL	SMALL
Environmental Justice	None[b]	None[b]	None[b]	None[b]	None[b]

a. Physical impacts to cultural resources would be SMALL. Visual impacts to historical properties could potentially be LARGE.
b. Adverse and disproportionate impacts to minority and low-income populations have not been identified.

Table 9.3-3 (Sheet 1 of 2)
Characterization of Operations Impacts at the Victoria County Site and Alternative Sites

Category	Victoria County	Matagorda County	Buckeye	Alpha	Bravo
Land Use Impacts					
The Site and Vicinity	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission rights-of-way	SMALL	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Water Related Impacts					
Water Use	SMALL	SMALL	SMALL	LARGE	MODERATE to LARGE
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological Impacts					
Terrestrial Ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic Ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL
Threatened and Endangered Species	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomic Impacts					
Physical Impacts	SMALL	SMALL	SMALL	SMALL	SMALL
Demography	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL
Economy	SMALL (Beneficial)	SMALL (Beneficial)	SMALL (Beneficial)	SMALL to MODERATE (Beneficial)	SMALL
Taxes	SMALL to LARGE (Beneficial)	LARGE (Beneficial)	LARGE (Beneficial)	LARGE (Beneficial)	LARGE (Beneficial)
Transportation	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL
Aesthetics	SMALL to MODERATE	MODERATE	MODERATE	MODERATE	MODERATE

Table 9.3-3 (Sheet 2 of 2)
Characterization of Operations Impacts at the Victoria County Site and Alternative Sites

Category	Victoria County	Matagorda County	Buckeye	Alpha	Bravo
Recreation	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL
Socioeconomic Impacts (continued)					
Housing	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Public and Social Services	SMALL	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL
Historic and Cultural Resources	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice	None[a]	None[a]	None[a]	None[a]	None[a]

a. Adverse and disproportionate impacts to minority and low-income populations have not been identified.

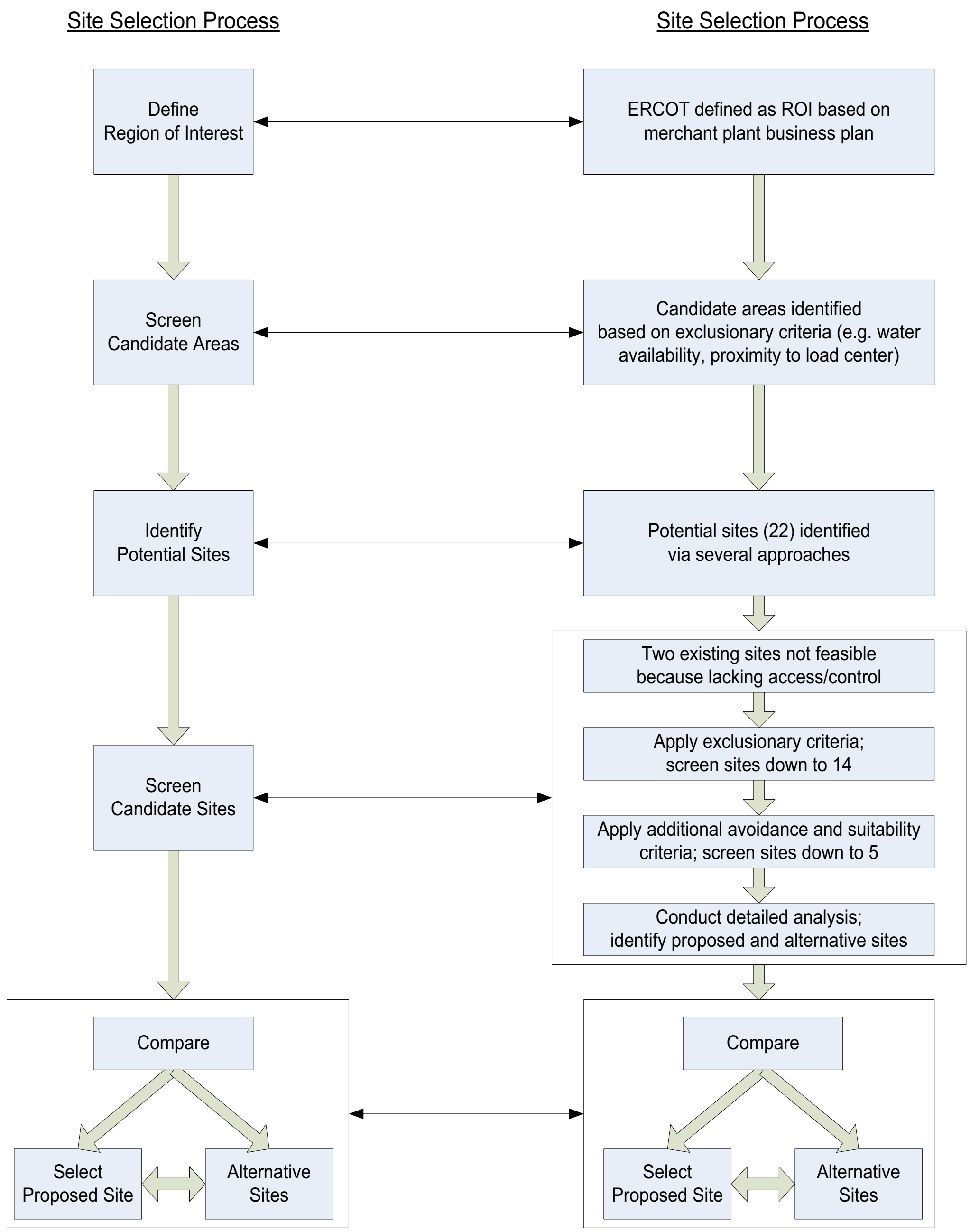

Figure 9.3-1 Comparison of Exelon Site Selection Process with NUREG-1555 Process

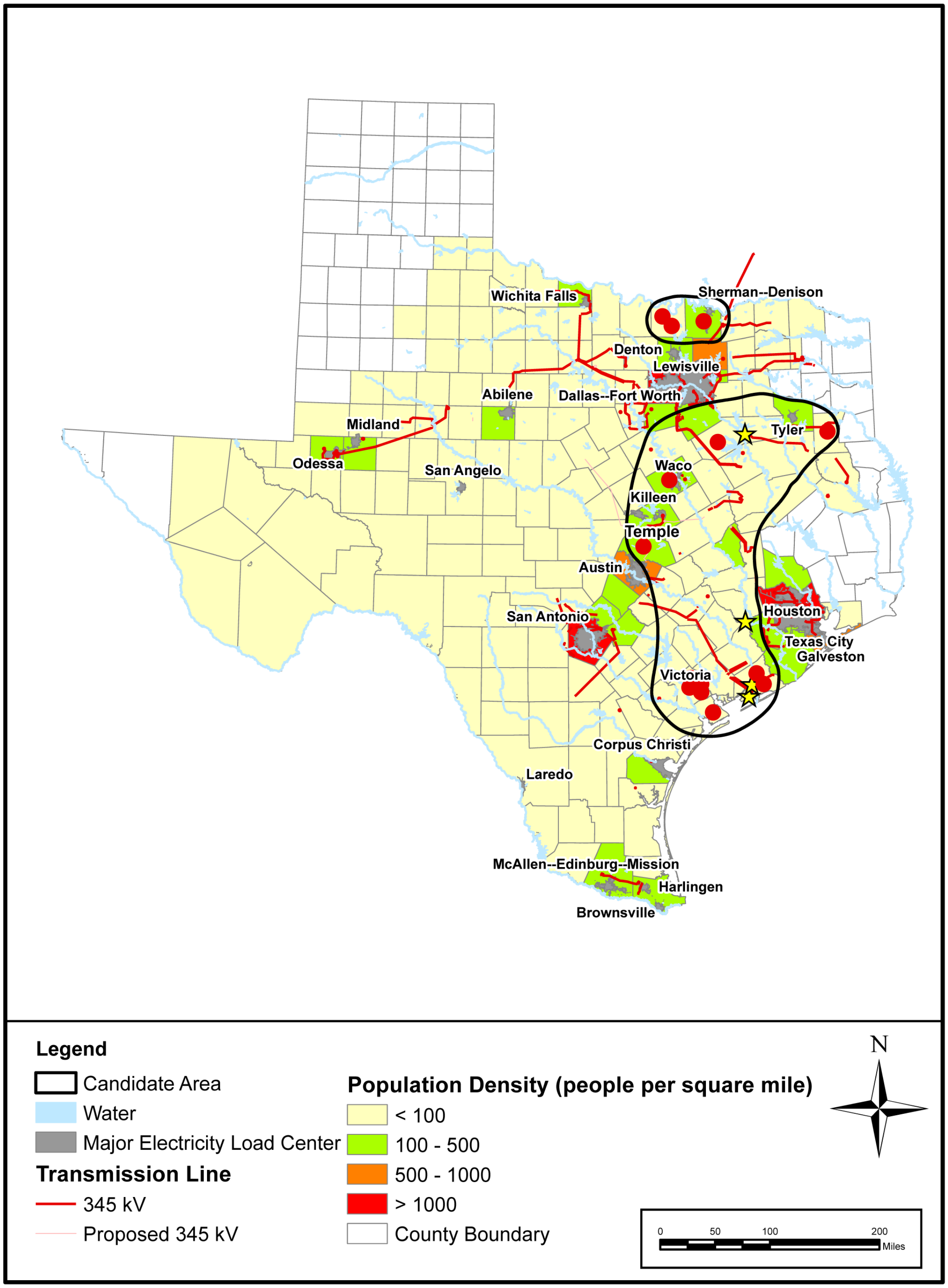

Figure 9.3-2 Composite Map of Major Load Centers, Transmission Infrastructure, Major Water Bodies, and Population Densities in the ERCOT Region

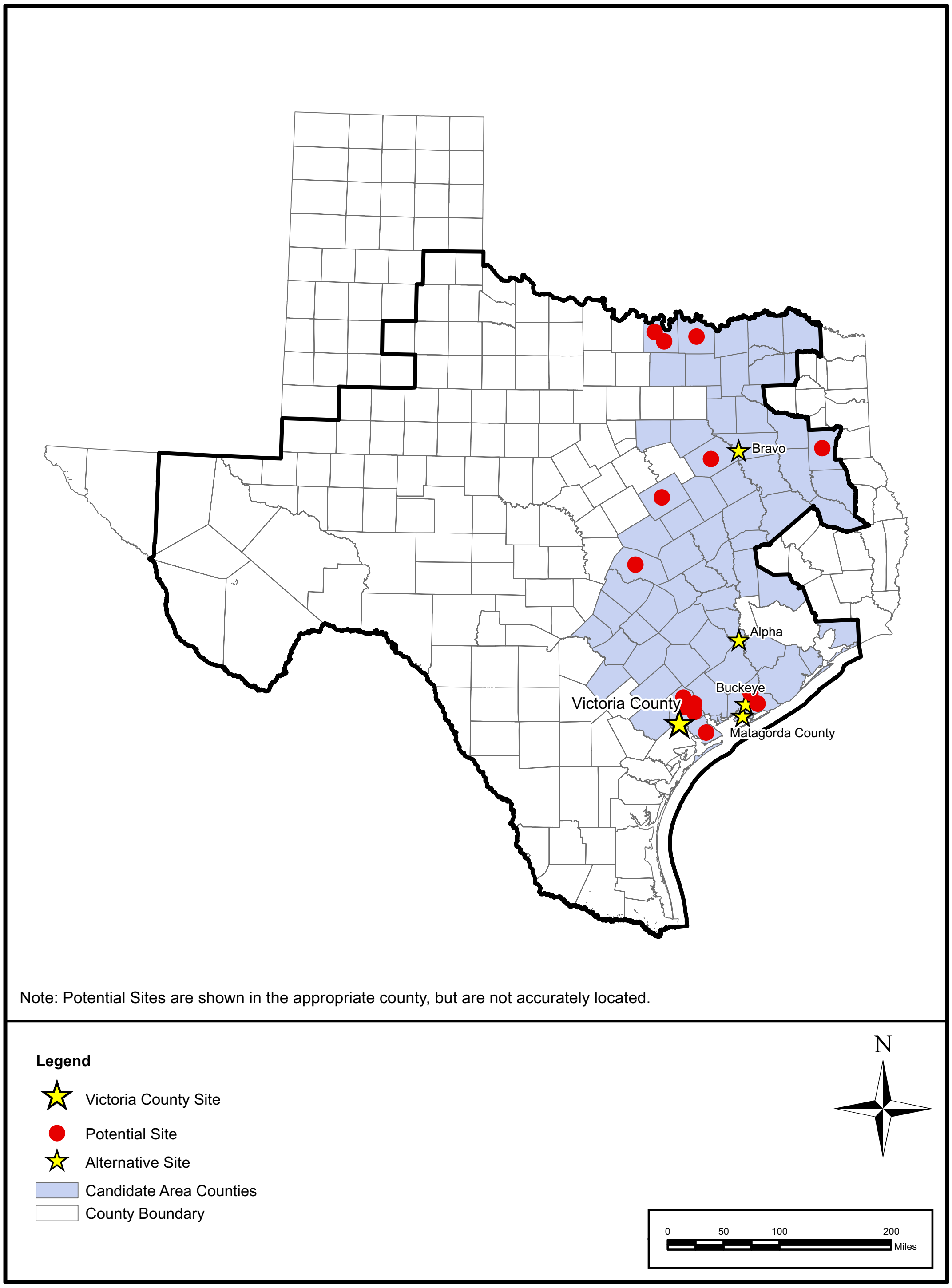

Figure 9.3-3 Candidate Areas and Potential Sites

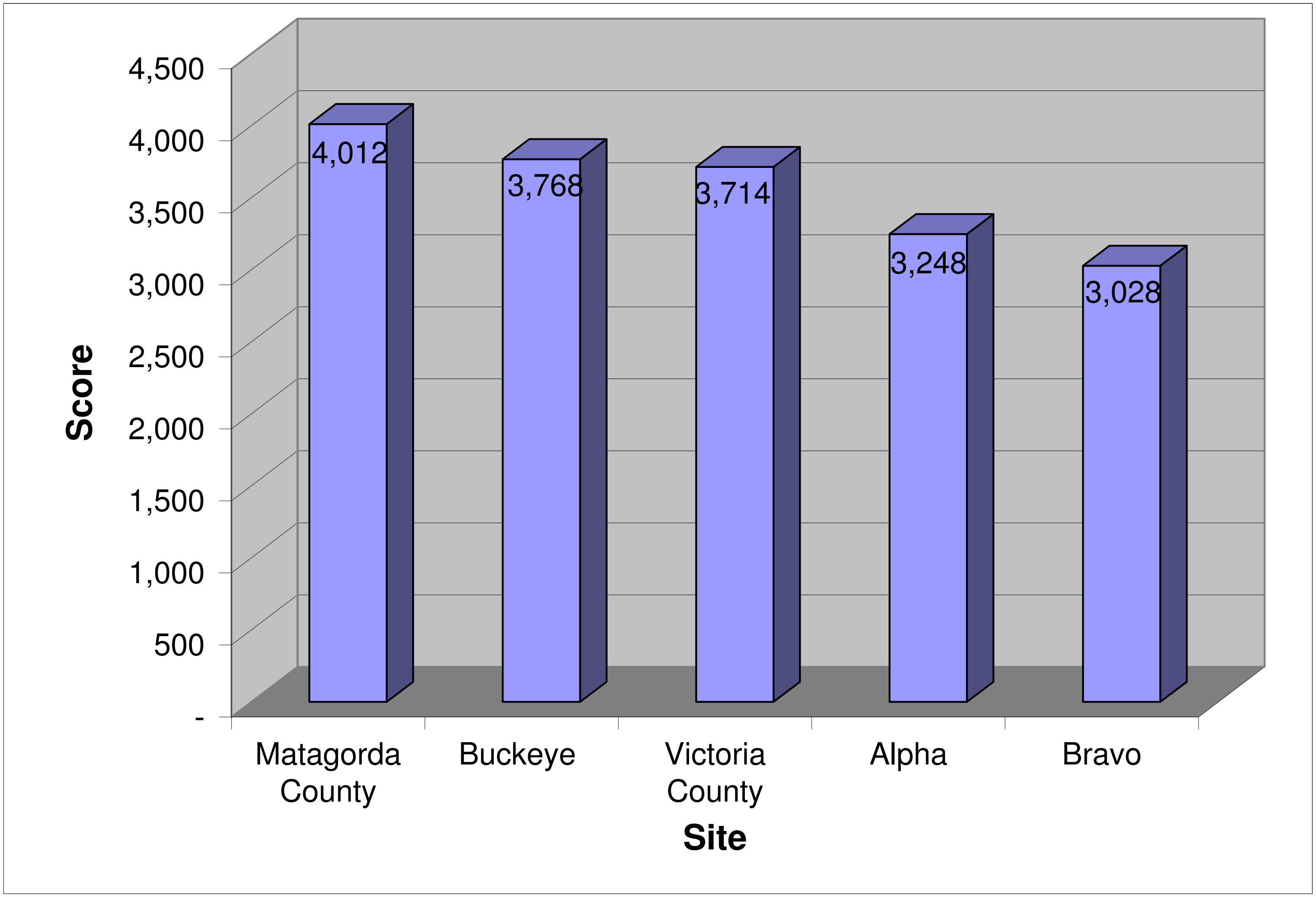

Figure 9.3-4 Initial Site Selection Scores

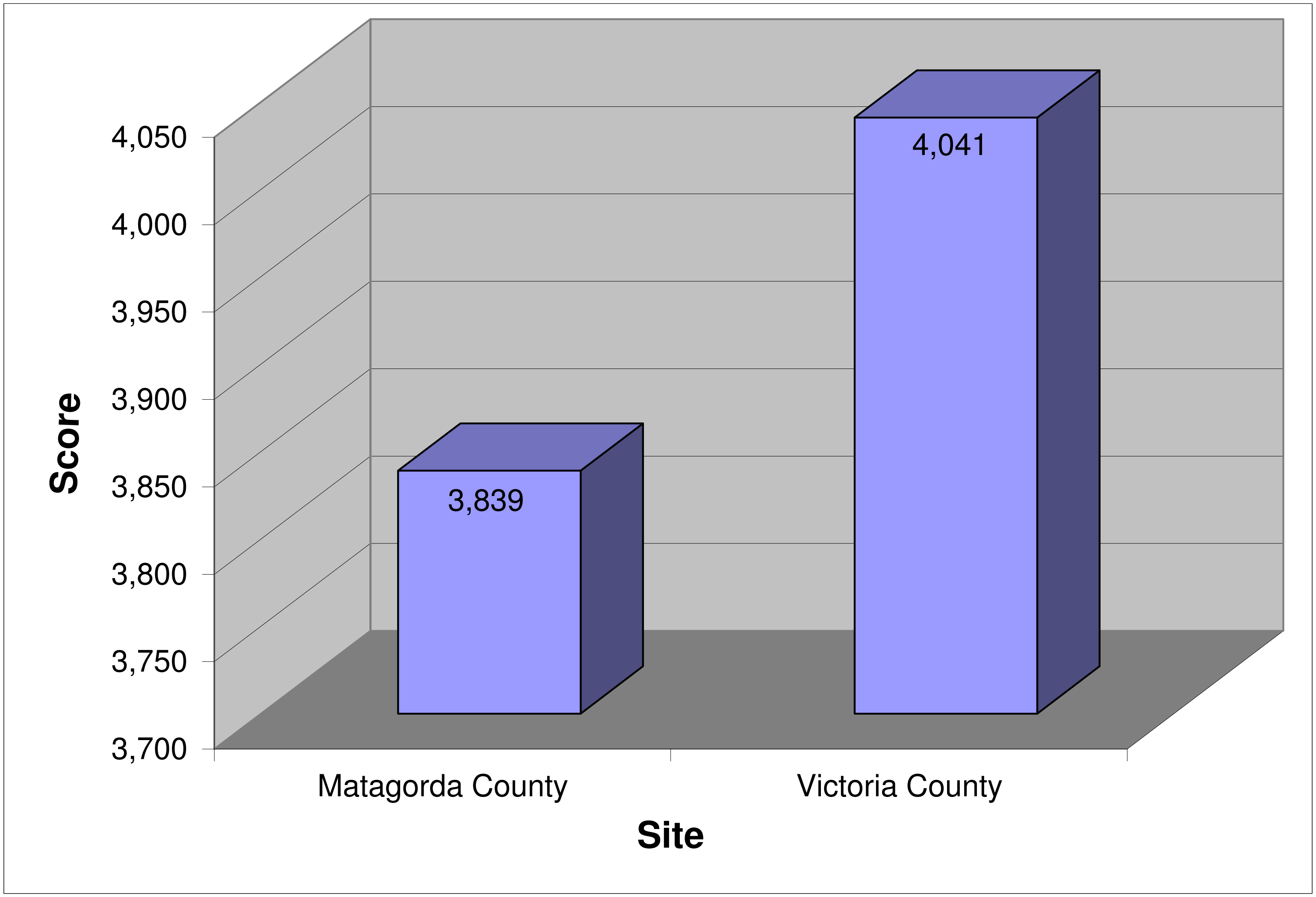

Figure 9.3-5 Updated Site Selection Scores

Figure 9.3-6 Matagorda County Site

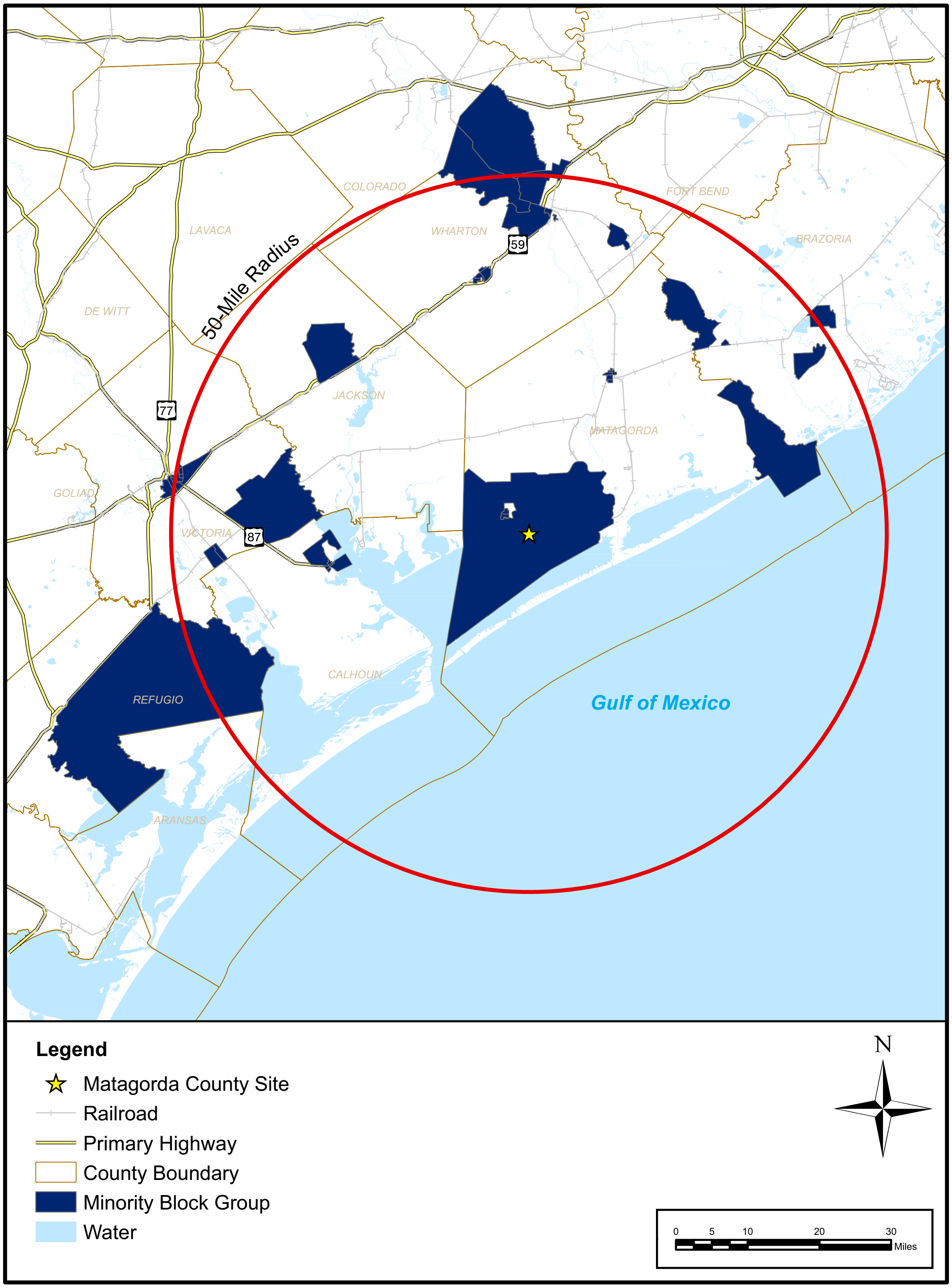

Figure 9.3-7 Minority Population Block Groups within 50 Miles of the Matagorda County Site

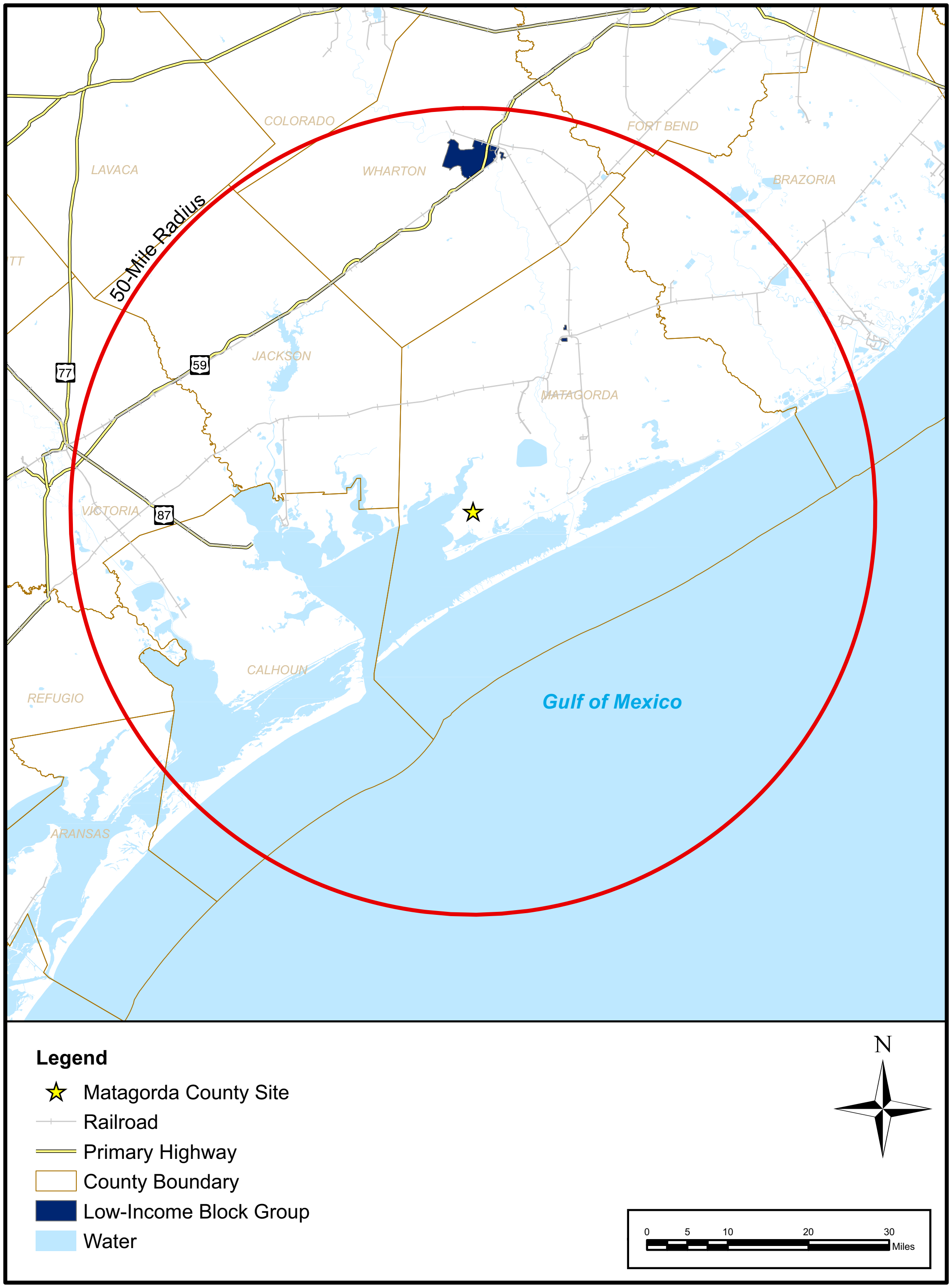

Figure 9.3-8 Low-Income Household Block Groups within 50 Miles of the Matagorda County Site

Figure 9.3-9 Buckeye Site

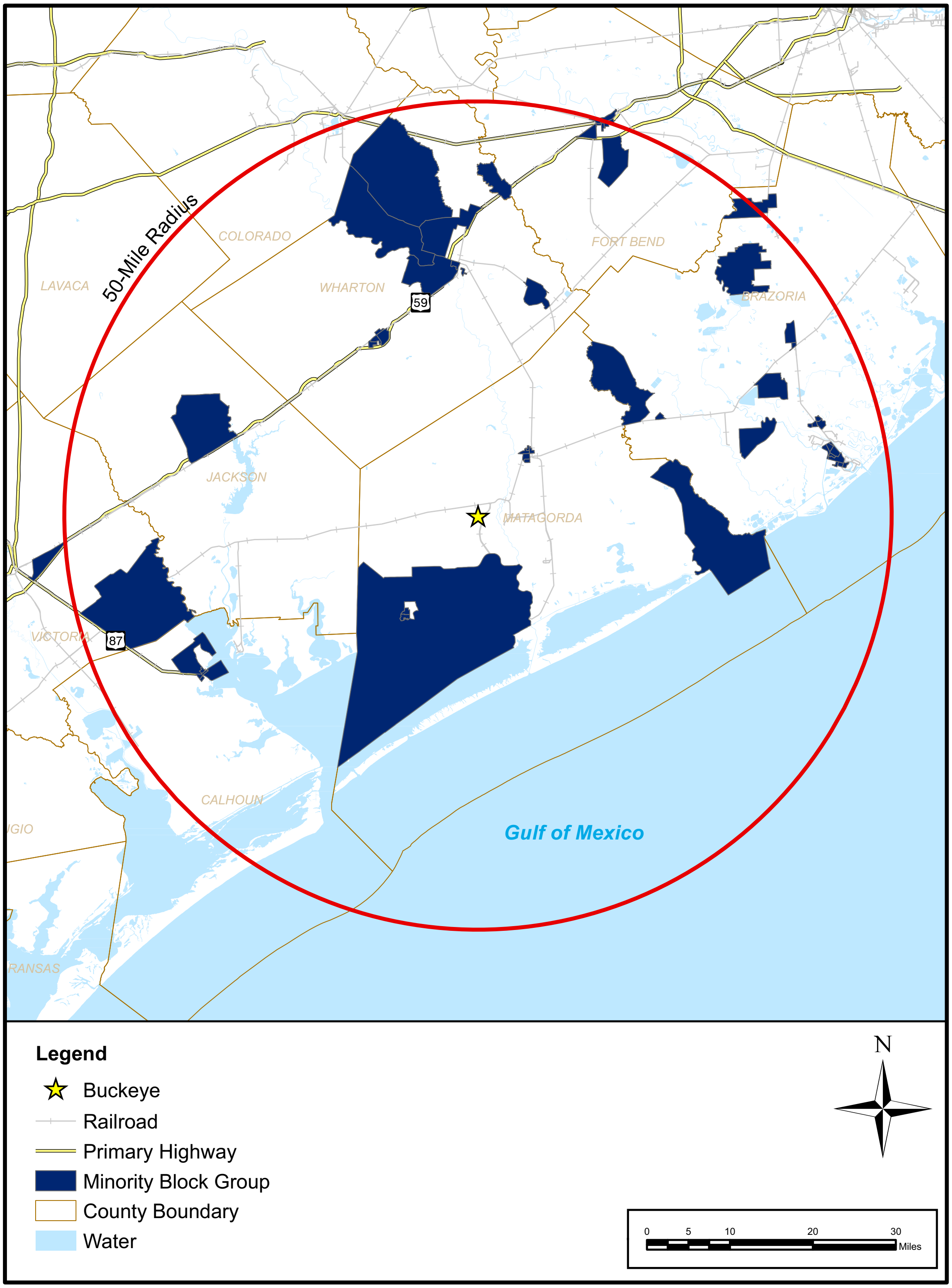

Figure 9.3-10 Minority Block Groups within 50 Miles of the Buckeye Site

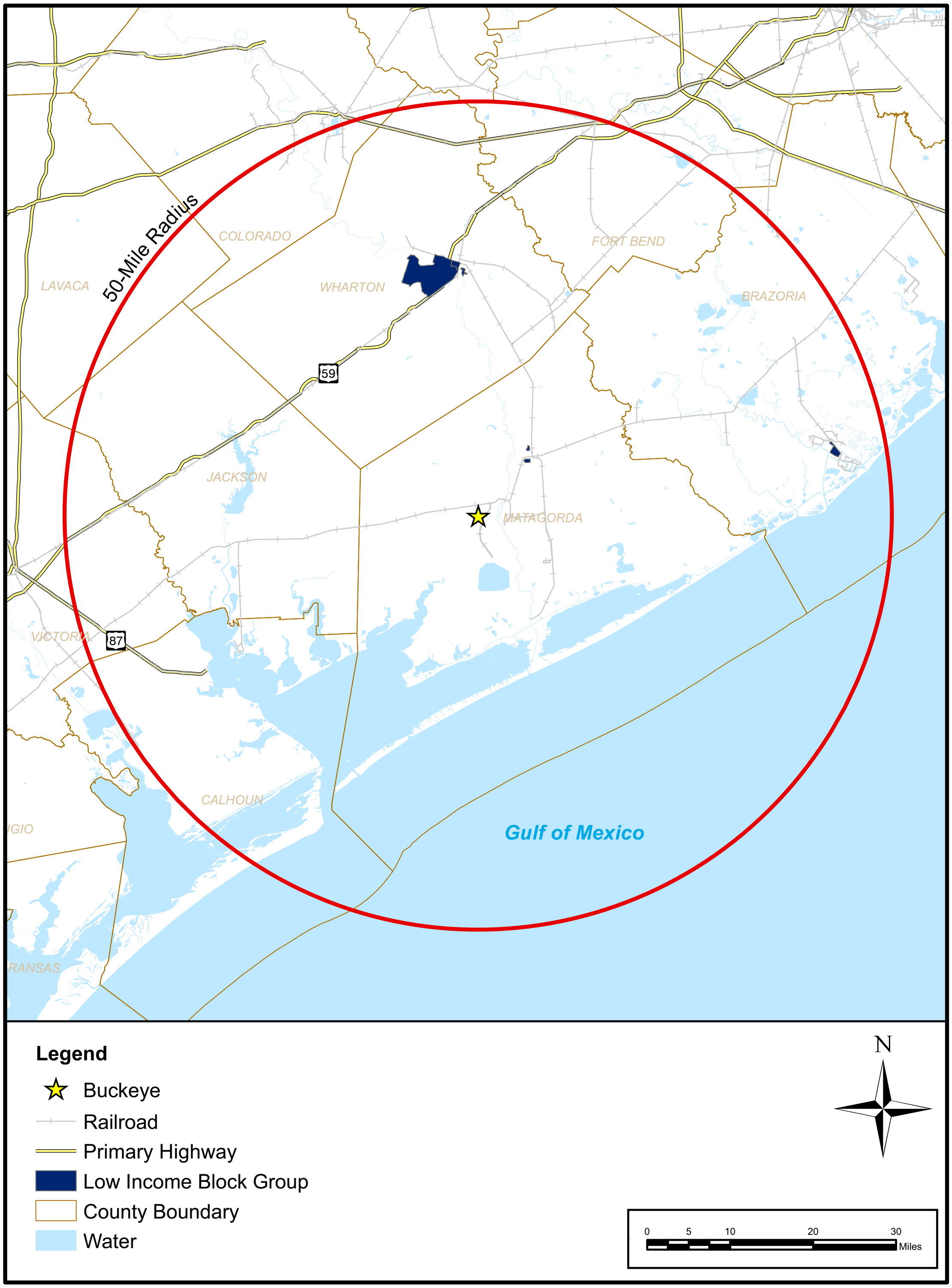

Figure 9.3-11 Low-Income Household Block Groups within 50 Miles of the Buckeye Site

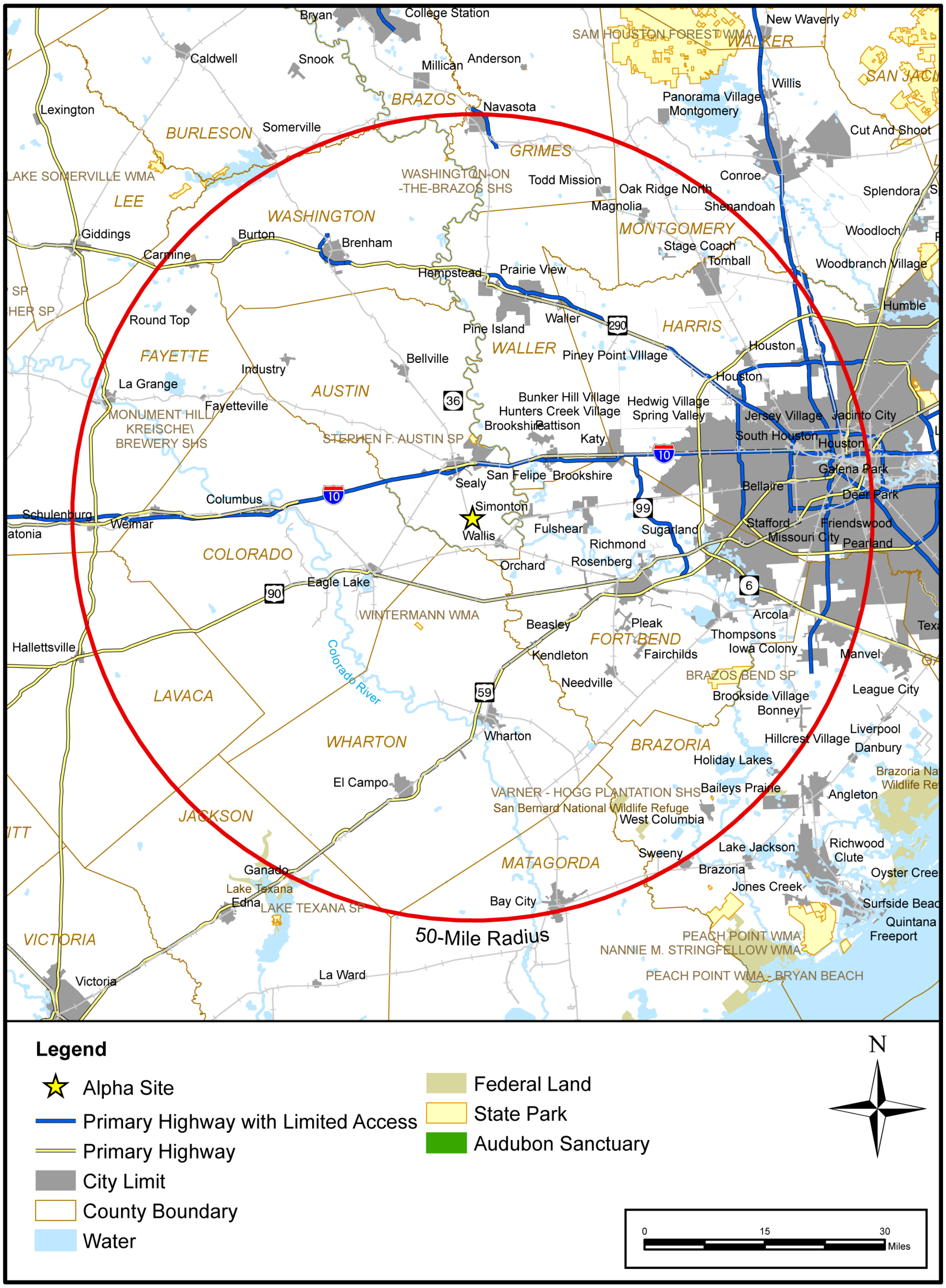

Figure 9.3-12 Alpha Site

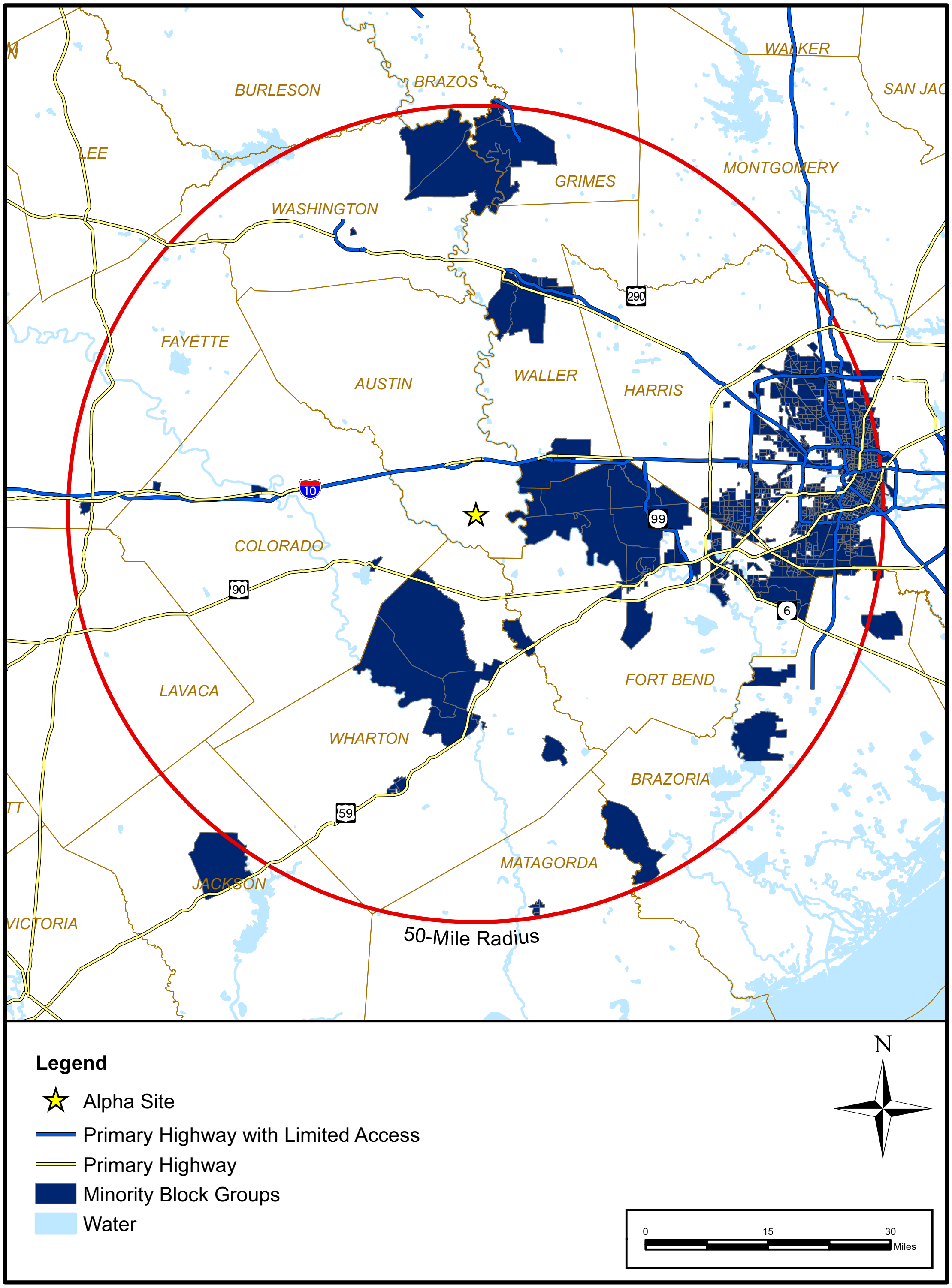

Figure 9.3-13 Minority Block Groups within 50 Miles of the Alpha Site

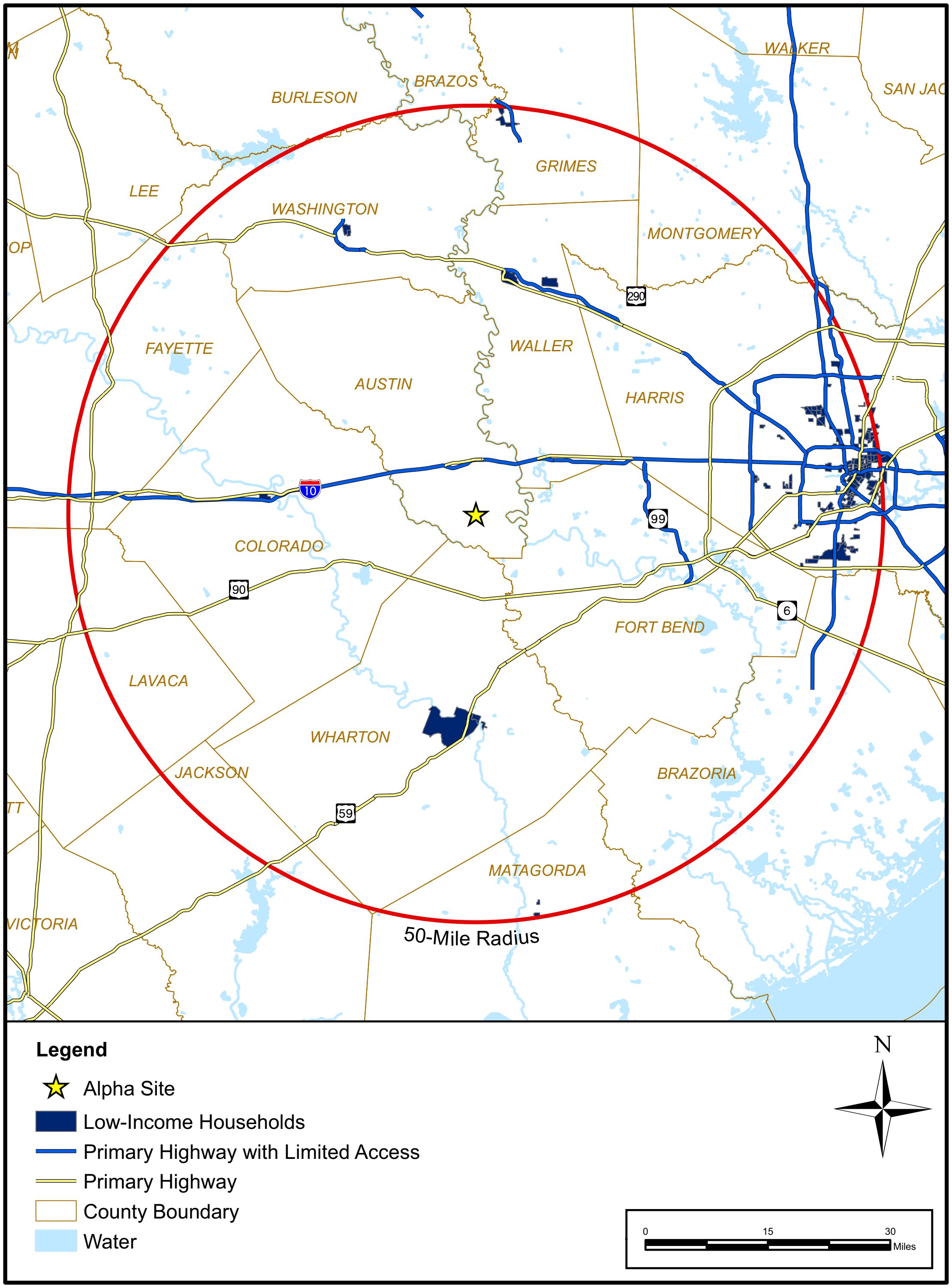

Figure 9.3-14 Low-Income Household Block Groups within 50 Miles of the Alpha Site

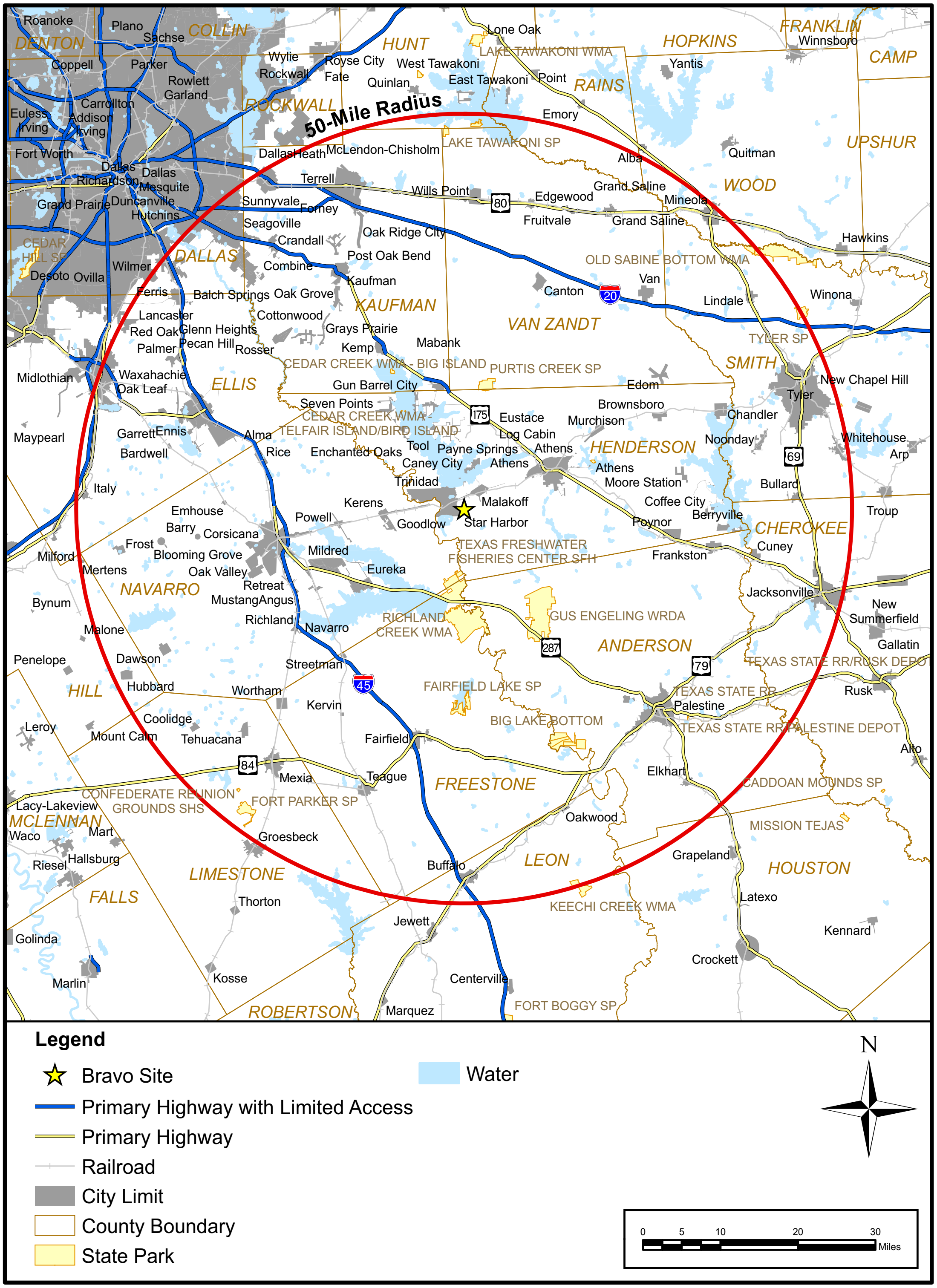

Figure 9.3-15 Bravo Site

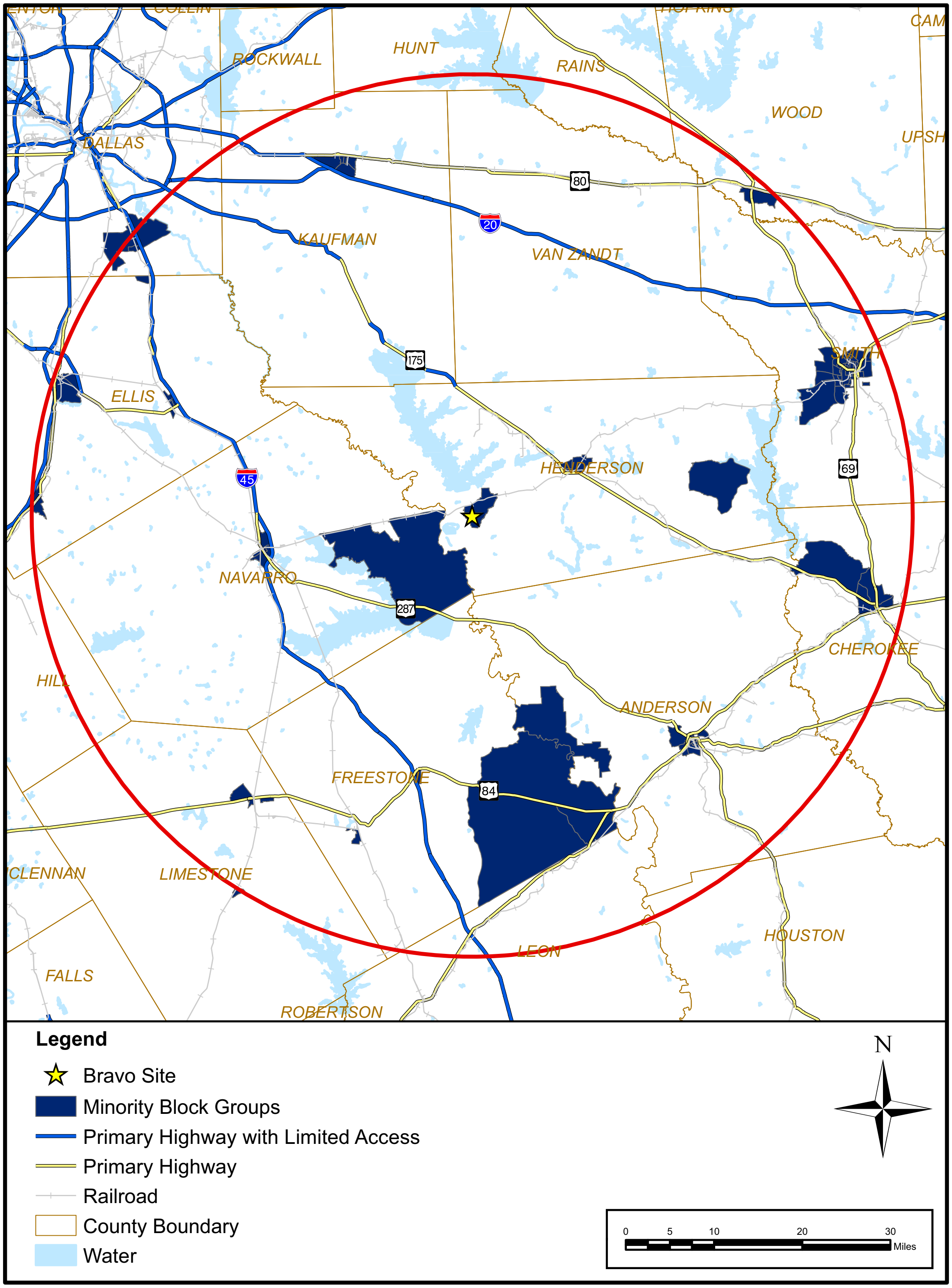

Figure 9.3-16 Minority Block Groups within 50 Miles of the Bravo Site

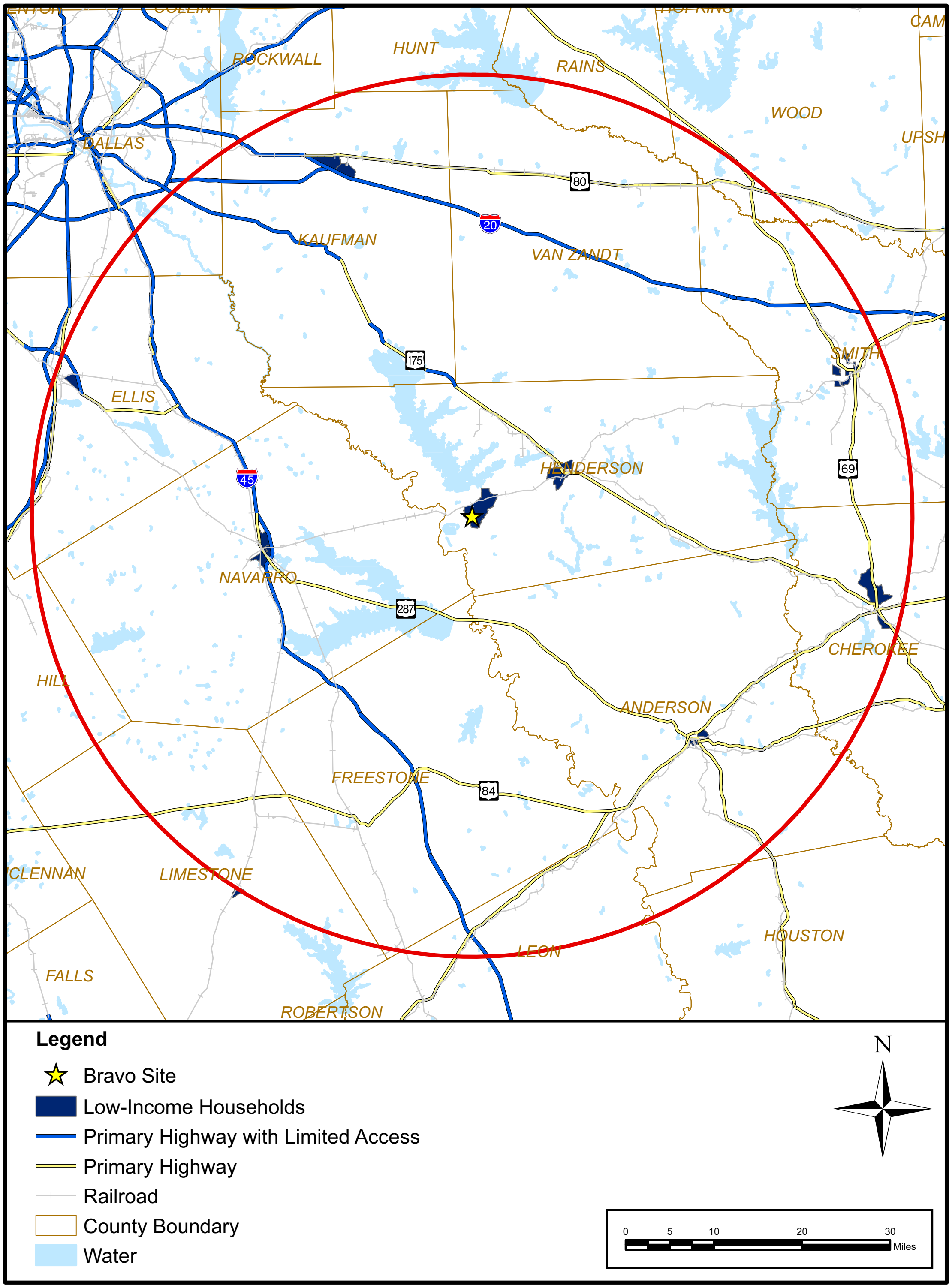

Figure 9.3-17 Low-Income Household Block Groups within 50 Miles of the Bravo Site

9.4 Alternative Plant and Transmission Systems

This section discusses alternative systems for the proposed VCS Units 1 and 2. Subsection 9.4.1 evaluates alternative heat dissipation systems, Subsection 9.4.2 evaluates alternative circulating water systems, and Subsection 9.4.3 evaluates alternative transmission systems.

9.4.1 Heat Dissipation Systems

9.4.1.1 Screening of Alternative Heat Dissipation Systems

This subsection discusses alternatives to the proposed heat dissipation system (described in Section 3.4) based on the guidance provided in NUREG-1555. Alternatives considered are those generally included in the broad categories of "once through" and "closed cycle" systems. The closed cycle category includes the following types of heat dissipation systems:

- Cooling ponds
- Spray ponds
- Dry cooling towers
- Mechanical draft wet cooling towers
- Natural draft wet cooling towers
- Wet-dry cooling towers

An initial environmental screening of the alternative designs was done to eliminate those systems that are obviously unsuitable for use at the VCS site.

Cooling ponds (base case) — The proposed design will include an approximately 4900-acre cooling basin (pond), using makeup water withdrawn from the Guadalupe-Blanco River Authority (GBRA) canal system, as discussed in Sections 3.3, 3.4, and 5.3. An alternative would consist of cooling basins of varying sizes (areal extent and depth). The proposed design was optimized based on the seepage and evaporation rates, which vary with the size of the impoundment, and constraints on the rate of makeup water supply.

Once-through cooling — The water requirements for a once-through cooling system would be approximately 1.1 million gpm (2450 cfs) for each ESBWR unit. The total water requirement would be 2.2 million gpm (4910 cfs). This withdrawal rate is approximately 47 times the average makeup water withdrawal rate of 104 cfs for the proposed cooling basin. Nearly all of the water would eventually be returned; however, the source water body would need to have sufficient stream flow or volume to meet the intake water demand of the once-through system. As discussed in Subsection 2.3.1, the historical 7-day low flow for the Guadalupe River downstream of the confluence with the San Antonio River is estimated at 46.3 cfs, and the 10-year, 7-day low flow is 221.6 cfs. The 10-year annual mean flow is estimated at 4341 cfs, or 569 cfs less than the projected demand for a once-through cooling system. The accessible surface water supplies would not be adequate to support once-through cooling for VCS Units 1 and 2. It is unlikely that Exelon could obtain authorization for a diversion of this size from any water bodies in the VCS region. In addition, once-through cooling would pose risks of thermal effects and damage to aquatic organisms due to changes in water quality, impingement, and entrainment. EPA regulations (40 CFR Part 125) governing cooling water intake structures under Section 316(b) of the Clean Water Act (CWA) pose stringent requirements for steam electric generating plants to use once-through cooling systems. For these reasons, once-through cooling was eliminated from further consideration.

Spray ponds — This alternative is similar to cooling ponds, as it involves the creation of new surface water bodies. Assuming sufficient heat dissipation could be achieved with a spray pond size of approximately 1 acre per 15 MWe, VCS Units 1 and 2 would require approximately 213 acres of spray pond. Spray modules promote evaporative cooling in the pond, which reduces the land requirement relative to cooling ponds. However, this advantage is offset by higher operating and maintenance costs for the spray modules. A water storage reservoir would be required to manage the availability of makeup water from the Guadalupe River. This storage reservoir would be smaller in size than the proposed cooling basin but the impacts from the combination of the spray pond, storage reservoir, and makeup water delivery system would not be appreciably different from those for the proposed system. This alternative has higher initial and operating costs and would not reduce the environmental impacts relative to the proposed cooling basin system. For these reasons, it was eliminated from further consideration.

Dry cooling towers — Dry cooling carries high capital and operating and maintenance costs that are sufficient to pose a barrier to entry to the marketplace for some facilities. In addition, dry cooling has a detrimental effect on electricity production by reducing the efficiency of steam turbines. Dry cooling tower performance is dependent on the ambient dry bulb temperature. Thermal performance limitations under high ambient air temperature conditions would result in a large dry tower array and/or the plant efficiency would be significantly reduced due to high condenser water temperature and the increase in steam turbine backpressure. Dry cooling requires the facility to use more energy than would be required with wet cooling towers to produce the same amount of electricity. This energy penalty is most significant in the warmer southern regions during summer months, when the demand for electricity is at its peak. The energy penalty would result in an increase in environmental impacts as replacement generating capacity would be needed to offset the loss in efficiency from dry cooling. The EPA concluded in the preamble to its final rule addressing intake structures for new facilities (66 FR 6526; December 18, 2001) that dry cooling is appropriate in areas with limited water available for cooling or where the source of cooling water is associated with extremely sensitive biological resources (e.g., endangered species, specially protected areas). There is adequate water supply available from the Guadalupe River to meet the demand of the proposed cooling basin system (Section 5.2). As discussed in Subsection 2.4.2, no state or federal listed threatened or endangered species were observed in Exelon's aquatic resource surveys of the Guadalupe River or the GBRA’s canal system. Therefore, the conditions at the VCS site do not warrant further consideration of dry cooling.

Wet and wet-dry cooling towers — Wet and wet-dry hybrid cooling towers are potential alternate heat dissipation systems for VCS. A detailed evaluation of potential alternative cooling tower designs was performed to identify the most viable option for the VCS site. The following potential alternatives were considered:

Rectilinear induced draft cooling tower — This is often the "default" cooling tower design for power applications and its relatively low profile makes it a good choice when aesthetics are a major concern. This type of tower is in widespread use in industry, and many cooling tower vendors would be able to supply a rectilinear tower. If necessary, this type of tower could be designed to be plume abated. Plume abatement should be considered when towers are located such that the plume would visually disturb surrounding communities or if the plume can settle on roadways, causing dangerous fogging and icing conditions. There is enough available area at the VCS site to sufficiently mitigate these issues, and thus plume abatement was not considered for this type of cooling tower. It would take several rectilinear towers to handle the required duty and flow, and adequate spacing would be necessary to minimize interference between the towers.

Natural draft cooling tower — This design is the most commonly used cooling tower for nuclear power plants in the United States. Favorable features include the absence of fans, which provides for very low operating cost, low auxiliary power requirements, and minimal noise impact. Natural draft towers are relatively tall and may have negative public perception because the towers and plume are visible from a great distance. However, the height can be favorable in terms of environmental impact, because the drift is dispersed at such a great height that the concentration that accumulates around the tower is lower than other tower designs.

Round forced draft hybrid tower — This design uses dedicated dry section fans, which can result in decreased water usage versus other designs. However, the extra section of fans results in a high auxiliary power load and makes this design taller than a rectilinear tower. The round design minimizes required spacing between the towers.

Hybrid system consisting of dry cooling tower and round forced draft hybrid cooling tower — In this design, the circulating water flows in series, first through a dry tower and then through a round forced draft cooling tower. This system provides the important benefit of water savings because when the dry tower is used, the duty on the round tower is lowered, decreasing evaporation. However, the dry tower component is large, requiring additional fans and resulting in higher overall power consumption. This design has the highest capital costs. The EPA's *Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities* (U.S. EPA 2001) notes that the common hybrid systems do not dramatically reduce water use as compared to wet cooling towers. The water usage of a hybrid system is generally one-third to one-half of that for wet cooling towers. The comparative cost increases of the hybrid systems to the wet cooling systems do not outweigh water use savings of approximately one-half to two-thirds (U.S. EPA 2001).

Because each cooling tower type has its own pros and cons, a matrix type selection process was used to identify the most favorable candidate. Based on the size and thermal output of the two ESBWR units, as well as the geographic characteristics of the VCS site, the following criteria were developed and applied in selecting the most viable alternative. These criteria (weighted as numbered in order of importance, with 7 being the most important consideration) include:

7 Water usage

6 Tower height

5 Drift deposition concentration

4 Noise impact

3 Auxiliary power consumption with maximum output

2 Number of towers required per unit

1 History of nuclear application

Detailed descriptions of the weighting factors are provided in Table 9.4-1. Using the above weighting factors, the four potential tower types were ranked from 1-4, with 4 being the most favorable design. Scores were assigned based on a combination of engineering expertise and preliminary design information obtained from the cooling tower vendor. The results of this evaluation of the alternative cooling tower designs are summarized in Table 9.4-2. The natural draft tower yielded the highest total weighted score. This design represents the most favorable alternative to the cooling basin for the VCS site and is evaluated in detail in Subsection 9.4.1.2. In accordance with NUREG-1555, the feasible heat dissipation alternatives (the proposed cooling basin and the recommended cooling tower alternative) were evaluated for land use, water use, and other environmental requirements (Table 9.4-3).

9.4.1.2 **Analysis of Recommended Cooling Tower Alternative**

Exelon modeled the impacts from natural draft cooling towers using the Seasonal/Annual Cooling Tower Impact (SACTI) code described in Subsection 5.3.3.1. Engineering data for the ESBWR was used to develop input to the SACTI model. Four identical cooling towers (two ESBWR units with two cooling towers per unit) were modeled, each with a heat rejection rate of 1448 MW and circulating water flows of 335,500 gpm per tower. The tower height was set at 550 feet. The meteorological data was from the National Weather Service meteorological station located at the Victoria Regional Airport for the years 2003 to 2007, purchased from the National Climatic Data Center (NCDC 2008). The five most recent years of meteorological data available was input into the SACTI code.

Additional physical and performance characteristics of the natural draft cooling towers would be as follows:

Parameter	Value
Base diameter of cooling tower	369 feet
Maximum drift rate (percentage of circulating water flow rate)	0.001%
Cooling range	29.8°F
Approach	8.4°F
Dry bulb temperature	86.5°F
Wet bulb temperature	78.7°F
Cycles of concentration	1.5
Salt (NaCl) concentration	220 mg/L

The value for the salt concentration is derived from the GBRA main canal water quality data (see Subsection 2.3.3) assuming 1.5 cycles of concentration for the natural draft cooling towers.

Length and Frequency of Elevated Plumes — The SACTI code calculated the expected plume lengths by season and direction for the combined effect of the four natural draft cooling towers. The longest average plume lengths would occur in the spring months while the shortest would be in the winter and fall. The plumes would occur in all compass directions. No impacts other than aesthetic would result from the plumes. Although visible from offsite, the plumes resemble clouds and would not disrupt the aesthetic view.

Projected plume lengths, directions, and frequencies are provided in the table below.

Ground-Level Fogging and Icing — Fogging from the natural draft cooling towers is not expected due to their height. Therefore, icing would also not occur from these towers.

Salt Deposition — Water droplets drifting from the cooling towers would have the same concentration of dissolved salts as the water in the cooling tower basin. The water in the cooling tower basin is assumed to have salt concentrations 1.5 times that of the Guadalupe River, the source of cooling water makeup. As these droplets evaporate, either in the air or on the vegetation or equipment, they would deposit these salts.

The maximum predicted salt deposition rate from the combination of the four towers would be as follows:

The maximum predicted salt deposition is 0.00045 pounds per acre per month. This is much less than the NUREG-1555 significance level for possible visible effects to vegetation of 8.9 pounds per acre per month.

The electrical switchyard for VCS would be located approximately 3000 feet to the west of the centerpoint of where the cooling towers would be located. Salt deposition was not predicted to occur at the electrical switchyard.

The predicted salt deposition from the operation of the cooling towers would be less than the NUREG-1555 significance level where visible effects to vegetation may be observed. Salt deposition in other potentially sensitive areas, including the VCS switchyard, are not expected to impact these facilities. The impact from salt deposition from the cooling towers would be small and would not require mitigation.

Cloud Shadowing and Additional Precipitation — The SACTI code predicted that cloud shadowing would occur for a maximum of 312 hours at agricultural areas in the vicinity of the site during the spring season and a total of 982 hours annually. This compares to a total of 1220 hours of daylight during the spring season and 4440 hours of daylight annually at the VCS site.

The SACTI code predicted that precipitation would be expected from the natural draft cooling towers. The maximum precipitation would occur in the spring, with a seasonal total of less than an inch of precipitation at 3600 feet north-northwest of the towers. This value is small compared to the average annual rainfall for Victoria County of 40 inches during the 1970–2000 period (NWS Apr 2008).

Other Impacts — The potential for increases in absolute and relative humidity exist where there are visible plumes.

9.4.1.3 **Summary**

Table 9.4-3 contains a summary comparison of the relative environmental impacts and regulatory restrictions for the base case and the alternative heat dissipation systems for VCS Units 1 and 2. This table identifies the cooling basin as the preferred cooling system option because of its advantages from a water usage perspective. The potential for fogging and salt deposition would not be significantly greater for the natural draft towers than for the cooling basin. Natural draft towers would pose somewhat greater aesthetic impact due to their height (550 feet) versus the height of the other proposed VCS structures (approximately 166 feet above grade) and the cooling basin. The natural draft cooling towers would consume more water relative to the cooling basin, as shown in Table 9.4-3. Given the significance of water availability relative to these other considerations for the VCS site, the natural draft cooling towers would not be environmentally preferable to the proposed cooling basin.

9.4.2 **Circulating Water Systems**

In accordance with NUREG-1555, this section considers alternatives to the following components of the plant circulating water system:

- Intake systems
- Discharge systems
- Water supply
- Water treatment

NUREG-1555 indicates that the applicant should consider only those alternatives that are applicable at the proposed site and are compatible with the proposed heat dissipation system. As discussed in Subsection 9.4.1, only the proposed cooling basin and wet cooling towers are considered viable and feasible heat dissipation systems for the VCS site.

The proposed heat dissipation system relies on evaporation and thermal radiation from the cooling basin for heat transfer. The water lost to the atmosphere through evaporation or as seepage from the basin must be replaced. In addition, this evaporation would result in an increase in the concentration of solids in the circulating water. To control solids, a portion of the recirculated water must be removed, or blown down, and replaced with fresh water. Water obtained from the Guadalupe River via the GBRA canal system (Subsection 9.4.2.1) would be used to replace water lost by evaporation, seepage, and blowdown from the cooling basin. Blowdown water would be returned to the Guadalupe River via a submerged multi-port diffuser.

9.4.2.1 **Intake Systems**

The raw water makeup (RWMU) system would consist of the pumphouse located on the GBRA main canal and a buried pipeline that follows an approximately 19.5-mile route leading to the cooling basin at the VCS site. The location of the raw water intake from the GBRA main canal is shown in Figure 2.3.1-12. Details of the proposed RWMU system are shown in Figures 3.4-3 and 3.4-4.

As described in Subsection 3.4.2.1, the proposed RWMU system pumphouse would be a reinforced concrete structure with four pump bays. The intake face would be parallel to the canal and occupy approximately 140 feet of shoreline. The pumphouse would extend approximately 110 feet inland. It would have four pump bays with a continuous line of trash racks at the intake, a pair of traveling water screens for each bay, provisions for stop logs or gates, and spray wash pumps for the traveling water screens. Each pump bay would be equipped with a 33% capacity pump. Normal operations would require use of two 33% capacity pumps. Three 33% capacity pumps would be needed to recover the cooling basin level following an extended dry period. A 15% capacity pump would be installed in one of the four bays so that water can be pumped from the GBRA main canal when less than 49 cfs is available. The proposed RWMU system pumphouse would comply with the technology requirements of Section 316(b) of the CWA by virtue of a design intake velocity that is less than or equal to 0.5 fps and the fact that no threatened or endangered species have been identified as living or breeding in the canal. Reducing design intake velocity to less than or equal to 0.5 fps is one of the technology-based performance requirements for minimizing adverse impacts of cooling water intake structures at facilities having a design intake flow of 10 million gpd or greater (40 CFR 125.84(b)(2)).

The most important elements of the intake system are its location and configuration. The following factors were considered in siting the intake system:

- Water availability
- Water quality
- Intake hydraulics
- Constructability and cost
- Maintenance and dredging
- Operation and maintenance

Water availability and water quality considerations are addressed in Subsection 9.4.2.3. The proposed location for the RWMU system pumphouse was selected to place the VCS intake at a location downstream of more senior users under the combined GBRA/Union Carbide Corporation water rights (Subsection 2.3.2). The intake is at a location that can be protected from seasonal flooding and saltwater intrusion more readily than the bayous that form part of the GBRA's Calhoun Canal system. The main canal is an engineered system in which the flow and water level can be adjusted to meet the operational constraints of the pumphouse. Infrastructure to support pumphouse operations is available at this location due to the existing Relift #1 pump station, and the land is currently owned by the GBRA.

The alternative intake systems considered for raw water makeup to VCS are the following:

- Shoreline pump intake using active screening (base case)
- Onshore pumphouse with offshore intake using submerged passive screens such as wedge wire screens
- Offshore intake with velocity cap in conjunction with onshore pump intake and active screening

The following is a general description of potential intake system alternatives that can be considered at the canal withdrawal location.

Shoreline pump intake

Exelon proposed a shoreline pump intake. As the name implies, the intake would be located at and parallel to the shoreline of the main canal. Trash racks would be provided to filter out debris. After passing through the trash racks, intake water would pass through traveling screens of a modified Ristroph design with a maximum face velocity of 0.42 feet per second. Each traveling screen would be a continuous linkage of framed baskets approximately 14 feet wide and smooth woven mesh basket screening wire with 3/8-inch openings. Each basket would have a trough (fish bucket) on the lower lip designed to prevent re-impingement of fish and provide the mechanism to return fish to the main canal downstream of the intake structure. The fish buckets would allow organisms to remain in the water while being lifted to the fish return trough. As the traveling screen panel traveled over the head sprocket of the traveling screen, low pressure sprays [10 pounds per square inch (psi) nominal] would wash the organisms into the fish return trough. As the traveling screen panel traversed further, high pressure sprays (90 psi nominal) would wash the remaining debris into the debris trough. The fish and debris troughs would be combined and returned to the canal at a sufficient distance from the intake to minimize the likelihood of re-impingement on the traveling screens. An intake velocity of less than or equal to 0.5 fps would comply with CWA Section 316(b) Track 1 technology requirements for aquatic habitat protection. A detailed description of the proposed intake system is provided in Subsection 3.4.2.1 and the potential impacts of operating the proposed system are discussed in Subsection 5.3.1.

Offshore passive wedge wire screens

This option would combine the use of an onshore pump structure of the vertical wet pit design and passive fine screens offshore. The passive intake screen system eliminates the need for trash racks, associated raking mechanism, traveling water screens, screen wash pumps, debris collection/return trough, and a fish return system.

For a design flow of 267 cfs, the intake system would consist of 12 wedge wire tee-screens. Each tee-screen would be 4 feet in diameter with a slot width of 2 mm. The through slot velocity would be lower than 0.5 fps. The screens would be installed in a unidirectional configuration to align with the predominant flow direction in the canal. A cone-shape deflector would be installed at the upstream end of each screen to facilitate the sweeping action of the current to carry debris away from the screens. The wedge wire screens would be equipped with an air backwash clearing system that is designed to dislodge and scour debris from the face of the screens. The air vessel and compressor would be located near the pump structure with an air line extending to the offshore screens. A chlorination line to the screens would be installed if necessary for biofouling control.

Each tee-screen would be installed with a clearance of about 2.5 feet from the invert of the canal. Water depth required for the operation of the wedge wire screens would be about 9 feet during the design low water level at the canal intake location. The design low canal level is elevation 24 feet. The canal invert is currently at an elevation of about 20 feet and the bottom width is about 35 feet near the Relift #1 pump station. The water depth in the canal in its current condition is too shallow for the installation of this alternative intake system. To make use of the passive wedge wire screen system, approximately 350 feet of the canal in front of the pump structure would have to be dredged to a bottom elevation of 15 feet or lower. The screens would be placed at a clear distance of at least 4 feet away from the toe or bulkhead of the bank of the canal. Wooden piles, or similar, would be installed to protect the submerged screens from damage by small water vessels or large debris.

For a passive wedge wire screen system to perform as intended, a current velocity of approximately 1 fps in the ambient source water is generally accepted as sufficient to carry debris downstream of the screens, although this system has been used in slower moving ambient flows. Given the debris loading in the main canal is usually lighter than a typical river environment, the minimum required flow velocity could be as low as 0.5 fps.

Assuming the canal can be modified to allow the successful operation of the passive screen system, canal water entering the wedge wire screens would be diverted to the pump structure via three buried intake pipes, each of 48-inch diameter, to the pump structure. Three intake pipes are preferred over one combined intake pipe of 78-inch diameter because of the relatively short distances of the screens from the pump structure. One of the feasible screen arrangements is to group the 12 screens into three sets, each with four screens connected to a common header. Each common header would be flow connected to one of the three 48-inch intake pipes going to the pump structure. Due to the air backwash action, the bank and bottom of the canal would need to be reinforced to prevent erosion.

Wedge wire screen is passive without the capability for debris cleaning. Its use relies upon the flow velocity or current speed to sweep the debris off the screen face. It is most applicable for river intakes. During low flows in the main canal, debris would potentially pile up against the screens causing reduced or disrupted flow toward screens. While wedge wire screens may offer added protection to aquatic life, the proposed shoreline intake design with active screening offers adequate protection of aquatic ecosystems. Both designs include features to minimize impingement mortality and entrainment, such as maintaining a design intake velocity of less than 0.5 fps. Based on the above, the level of impacts would be similar and this option would not be environmentally preferable to the proposed intake system.

Offshore submerged velocity caps

This option would combine an offshore intake with velocity cap with an onshore pump structure equipped with active screening. For the same design flow rate of 267 cfs, the velocity cap concept would require eight velocity caps, each 7.5 feet in diameter with a 3-foot vertical opening, to achieve an inlet velocity of 0.5 fps or less. The minimum water depth would be about 9 feet, as with the wedge wire screen system. Approximately 300 feet of the canal would have to be dredged to elevation 15 feet to accommodate the velocity caps. Canal water would enter each cap laterally through the vertical opening to the intake pipes that lead to the onshore pump structure. The pump structure would be similar, except near the entrance, to the proposed system. Since there would be no screen installed at the offshore velocity caps, debris screening would be provided by trash racks and traveling screens installed at the pump structure before the pump bays. One possible arrangement would be to group the caps into two sets of three caps and one set of two caps. Each set of velocity caps would be connected to a common header that is tied to a dedicated intake pipe that goes to the pumphouse.

The velocity cap concept is not expected to be acceptable based on the potential ecological impacts and CWA Section 316(b) considerations. Although the inlet velocity would be less than 0.5 fps, there would be no mechanism for fish to escape once they enter the velocity cap. In contrast, the proposed system would include traveling screens to return impinged fish to the canal downstream of the intake structure in addition to having a maximum through-screen velocity of 0.42 fps. Accordingly, the velocity cap option would not be environmentally preferable to the proposed intake system.

9.4.2.2 Discharge Systems

As noted above, the circulating water system for VCS Units 1 and 2 would be a closed loop system using a cooling basin for heat dissipation. The final plant discharge, including the treated liquid radiological waste effluent, would be discharged to the Guadalupe River. The discharge flow would originate from the cooling basin, which collects site nonradioactive wastewaters and plant service water system cooling tower blowdown for both units. Cooling basin blowdown would be pumped from the "cold side" of the cooling basin, where the circulating water and blowdown pumps would be located, to the Guadalupe River via a 48-inch diameter discharge line. The blowdown line would terminate in a submerged multi-port diffuser designed to promote mixing with the receiving water.

Extreme low flow rates in the Guadalupe River (lowest stream flow for seven consecutive days, expected to occur once in 10 years, also referred to as 7Q10) are of the same order of magnitude as the proposed blowdown flow rate. Therefore, for the purpose of calculating impacts, minimum river flows were assumed below which blowdown would not be discharged. The flow specification was based on the dilution required to comply with state surface water quality standards. As discussed in Subsection 5.3.2, the reach of the river into which the blowdown would flow, designated Stream Segment 1803 by the Texas Commission on Environmental Quality (TCEQ), has been assigned a site-specific, absolute maximum temperature criterion, 93°F, but the general criterion for temperature rise over ambient (ΔT) in freshwater streams, 5°F, applies to this segment of the Guadalupe River (Title 30, Texas Administrative Code, Section 307.4, *General Criteria*). No TPDES permit has yet been obtained for VCS, but Exelon assumes that these criteria would be included in the permit, and so designed the discharge system to comply with them. The DuPont-INVISTA manufacturing plant is located across the river and has a surface discharge outfall approximately 500 feet upstream of the proposed blowdown discharge location. The DuPont-INVISTA discharge mixing zone is 100 feet upstream and 300 feet downstream from the point of discharge. The flow specification sought to determine at what flow the maximum discharge ΔT would be reduced to 2.5°F (one-half the allowable amount under the assumed permit guidelines). Addition of a safety factor to accommodate thermal discharges from the DuPont-INVISTA plant upstream resulted in a multiplier of nine, meaning that, for this analysis blowdown would only be discharged to the river when the natural flow of the river was at least nine times the discharge flow.

A multi-port submerged diffuser (as opposed to a single port diffuser or surface discharge) was taken as the generic discharge design that could result in a reasonable mixing zone size. The CORMIX code's applicability to a multi-port submerged diffuser is predicated on certain parameter ranges.

- The diameter of the discharge ports and the height of those ports above the river bottom must be less than 1/3 of the discharge depth. The Guadalupe River depth corresponding to the minimum river flow during which blowdown would be discharged is approximately 10 feet. Based on that river depth, discharge diameters up to 3 feet (raised up to 3 feet off of the river bottom) would be adequate.
- The smaller the port size, the larger the discharge velocity (for a like number of ports), resulting in greater mixing but more scour (because of the greater discharge velocity) of the river bottom. The proposed discharge port diameter of 1.75 feet was chosen as a compromise between initial mixing and limiting bottom scour.
- The diffuser length (length between the two ports on either end of the line) must be at least as great as the river depth. A longer diffuser line would result in greater near-field (i.e., near to the discharge port where discharge jet mixing dominates ambient effects) mixing. A diffuser length of 20 feet, with five 1.75-foot diameter ports, was proposed. This configuration was found to result in acceptable near field mixing, while also resulting in a good match between near-field dilution of the diffuser line as a whole and each of the individual 1.75-foot diameter ports. The latter match gives greater confidence to the accuracy of the CORMIX results.

The mixing zone size, shape, and orientation were insensitive to the choice of vertical orientation of the port (i.e., angle in the vertical plane from horizontal) and height of the discharge above the river bottom. This was a result of the discharge plume quickly becoming fully mixed vertically in the water column.

Changes in the horizontal port orientation (i.e., angle in the horizontal plane from downstream) were found to change the orientation of the mixing zone, but only small changes were seen in the discharge dilution as a function of distance from the discharge port. A cross-stream angular discharge component (i.e., pointing away from the shore rather than downstream) would result in a greater mixing extent across the stream, making it more difficult to achieve a maximum river width impact consistent with industry best practice. For that reason, the discharge ports would be oriented downstream (diffuser line perpendicular to river flow).

Figure 2.3.1-7 shows the location of the proposed VCS discharge structure. The location of the discharge outfall would be such that it has sufficient water depth for thermal mixing/dilution. The VCS outfall location must be sufficiently downriver of the existing DuPont-INVISTA discharge to produce a mixing zone that would be compliant with the standards of the Texas Administrative Code, Title 30, §307.8(b), i.e., mixing zones will not overlap unless it can be demonstrated that no applicable standards will be violated in the area of overlap and existing and designated uses will not be impaired by the combined impact of a series of contiguous mixing zones. The release of the VCS effluent through the proposed blowdown discharge line was determined to have minimal impact to aquatic biota in the river (Subsection 5.3.2.2). If the mixing zone resulting from the proposed diffuser design described above had been inconsistent with the assumed permit guidelines or industry best practice, additional alternatives would have been considered.

9.4.2.3 Water Supply

As discussed above, there would be a need for makeup water to the VCS closed loop circulating water system. The maximum makeup water flow to the proposed cooling basin is estimated at 217 cfs (97,433 gpm).

There are two potential sources of makeup water supply for VCS. The proposed system would use fresh water obtained from the Guadalupe River. Salt water may be obtained from the Gulf of Mexico, either from one of the bays or from the Victoria Barge Canal. Groundwater wells (Subsection 2.3.1 and Section 3.3) would not provide sufficient fresh water volume to support the makeup requirements of the circulating water system (normal use of 75,000 acre-ft per year or roughly 46,500 gpm) in addition to other operational demands.

9.4.2.3.1 Alternate Fresh Water Supply

Exelon evaluated an alternate freshwater intake location on the Guadalupe River, upstream of the salt water barrier near the existing diversion to the GBRA Calhoun Canal. The intake would be a shoreline structure similar to the proposed RWMU system pumphouse and include features to reduce impingement mortality.

After passing through the trash racks, intake water would flow through vertical traveling screens of a modified Ristroph design with a maximum face velocity of 0.42 fps. Each traveling screen would be a continuous linkage of framed baskets approximately 14 feet wide and smooth woven mesh basket screening wire with 3/8-inch openings. Each basket would have a trough (fish bucket) on the lower lip designed to prevent re-impingement of fish and provide the mechanism to return fish to the Guadalupe River downstream of the intake structure. The fish buckets would allow organisms to remain in the water while being lifted to the fish return trough. As the traveling screen panel traveled over the head sprocket of the traveling screen, low pressure sprays would wash the organisms into the fish return trough. As the traveling screen panel traversed further, high pressure sprays would wash the remaining debris into the debris trough. The fish and debris troughs would be combined and returned to the Guadalupe River at a sufficient distance from the intake to minimize the likelihood of re-impingement on the traveling screens.

Freshwater would be pumped from the river via a buried pipeline to the VCS cooling basin and GBRA storage water reservoir (GSWR) to replace water lost to evaporation and seepage. The pipeline would cross the San Antonio River and potentially one or more creeks. As for the proposed intake location and water supply pipeline, construction techniques such as directional drilling would be used to pass underneath those waterways, if required, to reduce the effects on ecological resources.

The intake would provide approximately 267 cfs to meet the design basis peak makeup flow rate, with a maximum 217 cfs supplied to the VCS cooling basin and a maximum 50 cfs supplied to the GSWR. The average pumping rate would be approximately 125 cfs, with 103.5 cfs supplied to the cooling basin and 22 cfs supplied to the GSWR.

The intake structure would be constructed of reinforced concrete. Its layout would include a four-bay pumphouse with through-flow traveling water screens in each bay, provisions for stop logs or stop gates, spray wash pumps for the traveling water screens, makeup water pumps, and all necessary support facilities for operation of the intake structure. The intake face would be parallel to, and flush with, the west bank of the Guadalupe River and would occupy approximately 140 feet of shoreline. The intake structure would be equipped with steel trash racks (grates) with 1.0-inch openings to prevent heavy debris from entering the intake and damaging the traveling screens. The maximum flow (velocity) through the trash racks would be 0.44 fps. After passing through the trash racks, intake water would flow through vertical traveling screens of a modified Ristroph design. Maximum through-screen velocity would be 0.42 fps.

Limiting the withdrawal of water from the Guadalupe River to no more than 5% of its mean annual flow and limiting through-screen velocities to 0.5 fps or less at the intake structure trash racks and traveling screens are "technology-based performance standards" established in the EPA's Phase I rule addressing cooling water intake structures (CWIS) for new facilities (66 FR 65256). Ristroph-style traveling screens and fish handling (return) systems are listed in the Phase I rule as potentially effective design and construction technologies available for installation at CWIS for minimizing adverse impacts.

Impingement

Impingement and impingement mortality associated with the intake structure would be similar to that described for the RWMU system pumphouse in Subsection 5.3.1.2.1. Under the design-basis peak makeup flow rate of 267 cfs, the approach velocity would be less than 0.5 fps at the trash racks, intake apertures, and traveling screens. The maximum velocity through the bar grill would be 0.44 fps. The maximum through-screen velocity would be 0.42 fps. Intake velocities of this magnitude are rarely a threat to healthy adult and juvenile fishes, but do have the potential to impinge younger, smaller individuals and unhealthy individuals. The Ristroph traveling screens and associated fish return system would further reduce impingement mortality, as any fish impinged would be gently washed from the traveling screens and sluiced back into the Guadalupe River at a point far enough removed from the intake to prevent re-impingement. Impacts from impingement would be small as they were for the proposed intake structure at the main GBRA canal.

Entrainment

Exelon surveyed fish, including ichthyoplankton (eggs and larvae), in the Guadalupe River, Goff Bayou, and the GBRA main canal in 2008. In the Guadalupe River, ichthyoplankton were sampled over the February–June 2008 period at a station designated GR-05 (the point at which water is diverted from the Guadalupe River into the GBRA Calhoun Canal system), the approximate location of the alternate intake structure. Sampling methods and data treatment are summarized in Subsection 5.3.1.2.2.

Only three fish species were collected at the Guadalupe River sampling station: common carp (*Cyprinus carpio*), inland silverside (*Menidia beryllina*), and shad (*Dorosoma* species; it is difficult to distinguish between *Dorosoma cepedianum* and *Dorosoma petenense* larvae). Most larvae collected (78%) were common carp, a nonnative nuisance species. Carp were only collected in one month, March 2008, but spawning almost certainly continued, at a lower intensity, into early summer. Based on densities of larvae in the water column and design pumping rates, an estimated 627,386 carp larvae would have been entrained in March 2008 under the maximum pumping scenario (Table 9.4-4). A single large female carp can produce several million eggs per season, but the more typical range is 100,000 to 500,000 eggs. These eggs would develop into 10,000–50,000 larvae, according to the species- and age-specific mortality table in the case study analysis for the Phase II Cooling Water Intake Structures [Section 316(b)] rule (U.S. EPA Dec 2006a). Thus, the number of larvae that would have been entrained over the February-June 2008 spawning period represents the production of approximately 13–63 female carp. Losing the production of 13–63 fish would have a small impact on carp in the immediate vicinity of the intake, but would have negligible impact on the Guadalupe River carp population. Proportionately fewer larvae would be entrained under the average pumping scenario (Table 9.4-5), making the impact even smaller.

This evaluation assumes that carp have some intrinsic value, and their losses would adversely affect the fish community of the Guadalupe River. Many fisheries managers regard the common carp, a nonnative species introduced to the United States in the middle of the 19th century, as a nuisance. The common carp is considered a pest in the Gulf states and much of the United States because it roots along the bottom searching for food and stirs up bottom sediments. These suspended sediments increase turbidity, reduce photosynthetic growth in submerged vascular plants, and may settle out in the spawning beds of more valuable fish species, smothering their eggs. Carp also eat the eggs and larvae of other fishes including those of native fish and more highly-esteemed sport fishes.

Small numbers of inland silverside larvae were collected at the Guadalupe River sampling station. The calculated density of inland silverside larvae in the river translated into a loss of 58,756 larvae in April 2008 and 80,953 larvae in May 2008 under the maximum withdrawal case and 27,508 larvae in April 2008 and 37,899 larvae in May 2008 under the average withdrawal case. The total number of larvae lost under the maximum withdrawal case, 139,709, would develop into 18,022 reproducing adults, according to the mortality table in the U.S. EPA (Dec 2006a) case study. A single school of inland silversides may contain tens of thousands of fish. These projected losses would be insignificant for the inland silverside, a species with a very high reproductive potential.

A prototypical "r-selected" species, the inland silverside matures early (generally as a 1-year-old), spawns over an extended period, and produces many young. Inland silversides in Texas and Florida spawn over the February–August period, with activity peaking in spring and late summer. Inland silversides spawned in February or March are capable of spawning as 5-month-old fish in July and August. Fish species like the inland silverside, with virtually unlimited reproductive potential, are genetically programmed to produce large numbers of young when conditions are favorable to compensate for high mortality rates when conditions are bad. Populations can sustain catastrophic losses as a result of droughts and floods and rebound in a matter of months when auspicious conditions lead to a successful spawning season and higher-than-normal survival of eggs and larvae.

Small numbers of *Dorosoma* (shad) larvae were also collected over the February–June 2008 period. Because adult gizzard shad were three times as abundant as adult threadfin shad (see Subsection 2.4.2), the analysis that follows assumes that these larvae were predominantly gizzard shad. Gizzard shad make use of a range of spawning habitats, including large rivers, backwaters of rivers, ponds, lakes, and reservoirs. Females broadcast eggs near the surface; eggs sink to the bottom or adhere to vegetation. Based on the densities of shad at Station GR-05, an estimated 40,477 larvae would have been entrained in March 2008 at the alternate intake under the maximum pumping case. A single female may produce from 22,000 to 540,000 eggs per spawning season, depending on its age and size. Given that approximately 10% of gizzard shad eggs survive and hatch into larvae (U.S. EPA Dec 2006a), the maximum estimated entrainment in March 2008 at the alternate river intake represents the spawn of one or two large female shad.

In summary, small numbers of fish larvae were collected by biologists from sampling station GR-05 over the February–June 2008 spawning period. Densities of larvae in the river were used to estimate the total number of larvae that would have been entrained over the same period if Guadalupe River water were being withdrawn and pumped to the VCS cooling basin/GSWR at a rate of 125 cubic feet per second (average rate) or 267 cubic feet per second (design-basis maximum rate). Only three species of ichthyoplankton were collected, and the bulk of these specimens were common carp, a nonnative nuisance species. An estimated 627,706 carp larvae would have been entrained, an ecologically insignificant number. Smaller and ecologically insignificant numbers of inland silverside and shad larvae were also collected. This data suggests that densities of larval fish in this reach of the Guadalupe River are very low, and entrainment losses would be correspondingly small. Entrainment losses of this magnitude would have no detectable impact on fish populations; therefore, impacts would be small. The species most likely to be affected are common to ubiquitous in the river, are of no value as food or sport fish, and have unusually high reproductive potential, and thus can easily replace any losses. The low densities of ichthyoplankton in the river appear to stem from the fact that most river species spawn in sheltered areas (e.g., sloughs, backwaters, and oxbow lakes) or tributary streams outside of the main river channel where spawning fish and young can avoid strong currents and predators. As a consequence, few larvae are found in the main channel of the river, where they would be vulnerable to entrainment.

For the reasons described above, impacts from entrainment at the alternate Guadalupe River intake structure would be somewhat smaller than those estimated for the proposed intake location on the GBRA main canal. However, this does not take into account the commercial, recreational, and ecological value of the respective fisheries. An intake on the Guadalupe River has the potential for affecting fish populations that are important to recreational and commercial fishermen (see Subsection 2.4.2.2) and provide a source of food for a variety of birds and mammals (e.g., wading birds, anhingas, kingfishers, ospreys, minks, river otters). The GBRA main canal, on the other hand, is closed to the public, unavailable to recreational and commercial fishermen, and is mostly devoid of the sort of streamside cover and trees that would encourage its use by fish-eating birds and mammals. The Guadalupe River fishery is characterized by greater diversity (species richness), greater productivity, and the presence of more native, big-river fishes (e.g., gars and Ictalurid catfishes) than the GBRA main canal. Therefore, an alternate intake location on the lower Guadalupe River would not be environmentally preferable to the proposed raw water makeup pumphouse on the GBRA main canal.

9.4.2.3.2 **Salt Water Supply**

Exelon evaluated two options for a salt water cooling system for VCS. Both systems would use salt water as makeup to mechanical draft wet cooling towers, which are preferable over natural draft cooling towers for salt water operation. The towers would be located in the area to the north of the power block and switchyard. The towers would be constructed of materials resistant to salt water corrosion and be designed to reduce drift rates. There would be three towers per unit, with a makeup water demand of 116,000 gpm (258 cfs). The total blowdown discharge rate would be approximately 77,000 gpm (172 cfs). The pumphouse would be a shoreline concrete structure approximately 97 feet wide, with three 31-foot wide pump bays, each with a 50% capacity pump. Each pump bay would be equipped with two traveling screens. The offshore intake pipeline would be equipped with a velocity cap. The options involve different intake and discharge locations as described below.

Option 1 — This option would obtain makeup water from the Victoria Barge Canal using an intake pumphouse located on the Lott Mott Branch of the canal. The makeup water would be transported 22 miles via a 96-inch pipeline to the cooling tower basins at VCS. The discharge would be directed to a location in San Antonio Bay south of Seadrift, Texas. The 102-inch discharge pipeline would be 30 miles long and would be routed parallel to the makeup pipeline. It would continue south, along Highway 185, past the intake pumphouse and past the town of Seadrift, to a submerged discharge structure located in San Antonio Bay, approximately 2 miles offshore. For approximately 1 mile along each of their routes, the makeup and discharge pipelines would be installed by directional boring under the Guadalupe River and the Victoria Barge Canal.

The Victoria Barge Canal supports barge traffic between the Gulf Intercoastal Waterway and the Port of Victoria. The salt water intake would be located approximately 5.75 miles from San Antonio Bay. The induced flow velocity in the canal from a makeup water flow rate of 258 cfs would be approximately 0.1 foot per second, producing a frictional gradient of approximately 1 foot per 20 miles of canal. A northbound current of 0.1 foot per second and a frictional gradient of less than 0.3 feet over the 5.75 miles of canal are not expected to be a problem for navigation.

Option 2 — This option would obtain makeup water from the Gulf of Mexico using an intake pumphouse located on the mainland near the Espiritu Santo Bay shoreline. The discharge would also be directed to the Gulf of Mexico. For this option, 11 miles of 144-inch intake piping would extend from the intake pumphouse, across the bay, under the barrier island, and out to the intake velocity cap in the Gulf of Mexico (4 miles under salt marshes, 2 miles under Espiritu Santo Bay, 1.5 miles under the beach on the barrier island, and 3.5 miles under the sands of the Gulf of Mexico). The makeup line would be 32 miles of 96-inch pipe and the discharge line would be 41 miles of 108-inch pipe (including 9 miles that would extend from the shoreline of Espiritu Santo Bay to the submerged discharge structure, 1.5 miles into the Gulf of Mexico). For approximately 1 mile along each of their routes, the makeup and discharge pipelines would be installed by directional boring under the Guadalupe River and the Victoria Barge Canal.

The electricity consumption associated with pumping the water to the VCS site would be approximately 52,000 MW-hr per year for Option 1 and 67,000 MW-hr per year for Option 2. For comparison, the estimated electricity use for a freshwater supply system is 21,000 MW-hr per year. Both salt water supply systems would require more than twice the electricity to operate than that of a freshwater supply.

Both saltwater intake options pose greater potential ecological concerns than the proposed freshwater intake at the GBRA main canal. As discussed in Subsection 2.4.2.1.3, the Victoria Barge Canal provides habitat for commercially and recreationally important fishes, including redfish. In contrast, the GBRA main canal is off-limits to the public and offers no commercial or recreational fishing opportunities.

In addition to providing foraging and rearing habitat, deep channels adjacent to shallow estuarine waters are known to be used as thermal refuges for estuarine fishes during winter. For example, the movement of redfish into lower reaches of rivers during fall and winter has been attributed to their seeking warmer freshwater sources (Shipp 1986, page 137). It is possible that the Victoria Barge Canal serves this purpose during cold weather along the Texas coast.

The Gulf intake option could pose potential problems for recreational and commercial fisheries and, thus, be viewed as undesirable by the agencies charged with protecting estuarine nursery grounds (U.S. EPA Dec 2006b, Gulf of Mexico Fisheries Management Council 1998). In addition, there would be concerns with threatened or endangered sea turtles, which are known to travel these waters. The barrier islands serve as nesting grounds for sea turtles (TSTNR 2007) and critical habitat for wintering piping plovers (66 FR 36038). Concern over this critical habitat could require that the pipeline to the Gulf be established under the barrier islands by horizontal direction drilling.

Pipeline Construction Impacts in Estuary/Bay:

The intake and discharge pipelines could cross areas that provide habitat for submerged aquatic vegetation, oysters, commercially important shrimp species, and several finfish species that are recreationally or commercially important. Rooted aquatic plants and sessile organisms are the focus of the assessment of construction impacts as their growth, reproduction, and even survival can be jeopardized by turbidity and silt/sediment associated with construction. Most finfish simply leave the area when confronted with construction noise and construction-generated silt and, therefore, are not likely to be harmed by noise or sediment as adults. The impact of pipeline construction on spawning and nursery areas is of potentially greater significance.

Even when control techniques are employed, dredging typically can cause an increase in suspended sediment in the immediate area, and may result in a plume of suspended sediment some distance from the site. In a study of the effects of hopper dredging in the Chesapeake Bay, near-field concentrations of suspended sediment, <980 feet from the dredge, reached 840 to 7200 mg per liter or 50 to 400 times the normal background level. Far-field concentrations (>980 feet) were enriched 5 to 8 times background concentrations and persisted 34 to 50% of the time during a dredging cycle (1.5 to 2.0 hours) (Nichols 1990).

The ecological effect of the suspended sediment depends on a variety of factors, including the type of dredge used, the timing and duration of the dredging, the particle size of the suspended sediment, the presence of toxins in the sediment, the success of environmental controls to contain suspended sediment, and the life stage of the species present. Both short term direct behavioral effects (such as entrainment, turbidity, fish injury, and noise) and long term cumulative effects (such as contaminant release and habitat alteration) on marine organisms can result from dredging (Nightingale and Simenstad 2001).

As discussed in Subsection 2.4.1.5, Aransas National Wildlife Refuge is listed as critical wintering habitat for the endangered whooping crane. Construction of the pipeline and operation of the intake and/or discharge in the shallows of San Antonio Bay could be viewed as detrimental to the cranes' foraging habitat. The use of saltwater in lieu of the proposed Guadalupe River water would result in greater freshwater inflows to San Antonio Bay.

While the salt water intake options have the potential to conserve freshwater resources, they present greater impacts related to the increased distances the makeup water supply and blowdown discharges must travel. Those distances result in substantially greater material and operating costs and increased land disturbance related impacts. The salt water intake and discharge locations also present somewhat greater ecological concerns. The salt water supply options would not be environmentally preferable to the proposed makeup water supply from the Guadalupe River.

9.4.2.4 **Water Treatment**

As described in Subsection 3.3.2, groundwater and surface water used at VCS would be treated based on qualities of groundwater and surface water available for VCS.

As described in Subsection 3.3.1.1, groundwater would be supplied from wells installed in the Evangeline aquifer. Sodium hypochlorite would be injected downstream of the well pumps for disinfection. The treated groundwater would be placed in the potable water storage tank to supply VCS potable water demands. Groundwater would also be filtered and placed in the station water storage tank to supply the fire water and demineralized water treatment systems. Station water feeding the demineralization system would be treated for pH control, scale control, and dechlorination.

Evaporation of water from the cooling basin is expected to lead to an increase in concentration of dissolved impurities in the circulating water, which in turn can increase the scaling tendencies of the water. The circulating water would be treated for biofouling and scale control using chemicals such as sodium hypochlorite and scale inhibitor. These chemicals would be injected either continuously or in batches into the cooling basin near the suction of the circulating water pumps.

The cooling basin would be operated so that the concentration of dissolved impurities in the cooling basin would be at acceptable levels. The concentration ratio (cycle of concentration) would be sustained through blowdown of the circulating water from the cooling basin to the Guadalupe River and the addition of makeup water from the Guadalupe River.

Evaporation of water from the plant service water system cooling towers is expected to lead to an increase in concentration of dissolved impurities in the cooling tower basins. The water in the plant service water system would be treated for pH control, biofouling, scale control, and dechlorination using chemicals such as sulfuric acid, sodium hypochlorite, nonoxidizing based biocide, scale inhibitor, sodium bisulfite, and dispersant. These chemicals would be injected into the basins of the cooling towers either continuously or in batches.

The plant service water system cooling towers would be operated so that the concentration of dissolved impurities in the basin would be at acceptable levels. The concentration ratio (cycle of concentration) would be sustained through blowdown of the plant service water from the cooling towers to the cooling basin and makeup from the cooling basin to the cooling towers.

During the periods when the RWMU system pumps are transferring water to the cooling basin from the Guadalupe River, sodium hypochlorite, as a biocide, would be added either continuously or in batches to shock the pump bay near the suction of the makeup pumps to prevent fouling in the makeup water supply pipeline.

The final choice of water treatment chemicals or combination of chemicals is dictated by groundwater and surface water conditions, technical feasibility, economics, and discharge permit requirements. If alternative treatment chemicals are to be used to improve the conditions of the groundwater and surface water, they would be chosen from those approved by the EPA or the state of Texas, and the volume and concentration of each chemical constituent discharged to the environment would meet the requirements established in the applicable permits. The anticipated aquatic impacts of alternative chemical use would be environmentally equivalent to those resulting from the use of the proposed chemicals described in Subsection 3.3.2.

9.4.3 **Transmission Systems**

Planning, siting, and constructing transmission lines is a multi-year process that has already begun but would not be completed until after Exelon decides to construct VCS. Therefore, at the COL application stage, information on the proposed transmission system is, necessarily, limited and is even more limited on alternatives to that system. Subsection 2.2.2 provides as much information as is available on the corridors for the proposed transmission system and describes the transmission line siting process. Section 3.7 discusses the electrical and structural design characteristics of the proposed transmission lines. This section provides the information available on alternatives to transmission system design.

9.4.3.1 **Alternative Corridor Routes**

American Electric Power (AEP), the transmission service provider, would design, construct, own, and operate any new transmission lines. In its application to the Public Utility Commission of Texas (PUCT) for a Certificate of Convenience and Necessity, AEP would present its corridor routing analysis, which would contain a preferred route as well as multiple alternative routes for approval. While that process is years away from completion, Exelon has performed its own routing study described in Subsection 2.2.2 of this ER using the Electric Power Research Institute (EPRI) Transmission Siting process. Because the EPRI process is similar to the PUCT Certificate of Convenience and Necessity (CCN) process, Exelon considers that the CCN results would not be significantly different from Exelon's. As described in Subsection 2.2.2, a large study area was selected to contain the proposed transmission lines, and then macrocorridors were selected that minimize impacts to land use, cultural resources, ecological resources, and other considerations. The EPRI process defined a 3-mile wide macrocorridor that has a 95% probability of covering the preferred and alternate corridors. Although there are no definite alternate corridor routes that can be presented in this subsection, the EPRI process assures that all possible routes employ environmental values as a major selection criterion.

9.4.3.2 Alternatives to the Proposed Transmission System Design

AEP has performed an interconnection study that examined multiple alternatives to the transmission system design for each of two voltages: the predominant 345 kilovolt (kV) system in the region and 765 kilovolts, which is being considered for use within the Electric Reliability Council of Texas service area.

For the 345-kV system, AEP examined eight transmission interconnection options. Each of the eight options proved to be viable, although all resulted in thermal overloads that required upgrades in the existing transmission system. Option 345D was selected for analysis in this ER, based on several factors:

- Option factored into the impact of South Texas Project (STP) 3 & 4 on grid (conservative)
- Option maximized use of existing 345-kV lines and substations
- Least cost

This option is further discussed in Subsection 2.2.2 and Section 3.7. The study assumed the existence of 3633 MW of planned generation currently under study and scheduled for service before 2010. Seven of the options involved eight new transmission lines with variations in the termination points and one involved nine new lines. The alternative analyses were performed with and without STP 3 & 4.

AEP examined 10 options that contained a combination of 345-kV and 765-kV lines. Nine of the options required two 765-kV lines and four 345-kV lines. One required five 345-kV lines in addition to the two 765-kV lines. Currently there are no 765-kV lines in Texas. However, Electric Transmission Texas, LLC (a proposed joint venture of AEP and MidAmerican Energy Holdings) is proposing a 765-kV "backbone" through Texas designed to connect renewable energy sources in west Texas with load centers in the south, central, and north-central parts of the state. Given the lack of current 765-kV infrastructure in Texas, there would be significant costs associated with these options. New long transmission lines would be required to create the 765-kV interconnections. These issues were the main factors in determining all 10 options to be nonviable.

NUREG-1555 requires evaluation of tower options for the new transmission lines. As stated in Section 3.7, the new lines would be either lattice steel structures or tubular designs. Both options have advantages based on terrain and installation requirements. AEP has not specified which design they would pursue at this point. Underground installation as part of the routing is not viable due to the voltage levels.

The environmental impacts of the proposed transmission system are presented in Sections 4.1, 4.3, and 5.6. No analysis of environmental impacts was performed for the alternatives identified in this section because Exelon considers the impacts to the proposed system (to the extent that it can be specified) to be representative of the viable options. During the siting and design process for the proposed new transmission lines it is expected that AEP would examine not only routing alternatives but alternatives in tower designs.

9.4.4 References

Gulf of Mexico Fisheries Management Council 1998. *Generic Amendment for Addressing Habitat Requirements in the following Fishery Management Plans of the Gulf of Mexico: Shrimp Fishery of the Gulf of Mexico, United States Waters, Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic, Stone Crab Fishery of the Gulf of Mexico, Spiny Lobster in the Gulf of Mexico and South Atlantic, Coral and Coral Reefs of the Gulf of Mexico*, October. 26, 1998., available at http://www.gsmfc.org/pubs/Habitat/efh.pdf.

NCDC 2008. National Climatic Data Center, *Hourly Surface Meteorological Observation from the Victoria Regional Airport*, available at http://www.ncdc.noaa.gov/oa/ncdc.html, accessed January 16, 2008.

Nichols 1990. Effects of hopper dredging and sediment dispersion, *Chesapeake Bay*, Environmental Geology 15(1) M. Nichols, R.J. Diaz, and L.C. Schaffner, 1990. Abstract available at http://www.springerlink.com/content/l4365616t1203716/

Nightingale and Simenstad 2001, *Executive Summary: Dredging Activities: Marine Issues*, B. Nightingale and C. Simenstad, 2001 Available at http://wdfw.wa.gov/hab/ahg/execdrg.pdf

Shipp, R. L. 1986. *Dr. Bob Shipp's Guide to the Fishes of the Gulf of Mexico*. KME Seabooks, Mobile, Alabama (5th printing, 1999, with corrections).

NWS Apr 2008. National Weather Service, Normals, *Victoria County*, April 3, 2008.

TSTNR 2007. Texas Sea Turtle Nesting Report, *2007 Nest Count*, available at http://texasturtlenest.blogspot.com/2007/07/late-newsflash-juvenile-release.html, accessed September 14, 2007.

U.S. EPA Dec 2006a. U.S. Environmental Protection Agency, *Phase II — Large Existing Electric Generating Plants: Case Study Analysis*, December 1, 2006, available at http://www.epa.gov/waterscience/316b/phase2/casestudy/, accessed May 30, 2008.

U.S. EPA Dec 2006b. U.S. Environmental Protection Agency, *Proposed regulations for cooling water intake structures at phase III facilities*. http://www.epa.gov/waterscience/316b/phase3/ph3-proposed-fs.htm. Last updated December 1, 2006.

U.S. EPA Nov 2001. U.S. Environmental Protection Agency, *Technical Development Document for the Final Regulations Addressing Cooling Water Intake Structures for New Facilities*, EPA-821-R-01-036, November 2001.

Table 9.4-1
Weight Factors Used in Evaluating Potential Cooling Tower Alternatives

Weight Factor	Definition
7	Water usage — Each of the two potential sources for makeup water presents difficult design considerations. One potential makeup source is the Guadalupe River, which has a supply limitation of 46,500 gpm (in accordance with a water reservation agreement with the GBRA). The second potential source is the Gulf of Mexico, which is approximately 36 miles from the site and thus would require large quantities of piping to bring the water to the site. The intake structure in the Gulf would require careful design to minimize environmental impact. The Gulf of Mexico water source would also result in more expensive material selections due to the water quality. Water usage must be limited to ensure that the water limitations for the Guadalupe River are not exceeded, and to minimize the piping costs if makeup is routed from the Gulf of Mexico.
6	Tower height — Due to the site's proximity to U.S. Route 77 and the city of Victoria, the height should be minimized to limit the aesthetic impact the towers would have in the area.
5	Drift deposition concentration — Drift is circulating water lost from the tower as liquid droplets entrained in the exhaust air stream and would have the same water chemistry as the circulating water. These droplets would deposit salts (depending on the water quality) in the vicinity of the towers, which can impact vegetation and soil and leave unfavorable salty residue on surrounding cars and buildings. For a given water quality, the concentration of solids deposited is a function of different tower design characteristics, and the tower should be chosen that minimizes drift concentration.
4	Noise impact — Noise from a cooling tower is generated by falling water, fans, and motors. Noise levels should be minimized to avoid negatively impacting surrounding wildlife and communities.
3	Auxiliary power consumption with maximum output — It is desirable for a tower to be able to achieve the lowest possible cold water temperature while requiring the least auxiliary power for fans and pumps. This helps to maximize plant output.
2	Number of towers required per unit — Not a high priority because the site area is large, but as the number of towers increases, the potential for wider-spread environmental impacts also increases. Pumping and piping costs may also increase with the number of towers.
1	History of nuclear application — Some of the tower types have been used widely at power plants worldwide, while some have never been constructed and are conceptual ideas only.

Table 9.4-2
Screening Summary of Potential Cooling Tower Systems

	Minimum Water Usage	Minimum Tower Height	Minimum Drift Deposition Concentration	Minimum Noise Impact	Minimum Auxiliary Power Consumption/ Maximum Output	Minimum Number of Towers per Unit	History of Nuclear Application	Total Weighted Score
Weighting Factor	7	6	5	4	3	2	1	
Rectilinear Tower	2	4	2	2	3	3	3	74
Natural Draft Cooling Tower	2	2	4	4	4	4	4	86
Round Forced Draft Hybrid Tower	3	3	3	3	2	4	2	82
Dry + Wet Hybrid Cooling Tower	4	3	3	1	1	4	1	77

Table 9.4-3 (Sheet 1 of 2)
Screening of Alternative Heat Dissipation Systems

Factors Affecting System Selection	Cooling Basin (Base Case)	Natural Draft Wet Cooling Tower (NDCT)
Land Use		
Onsite land requirements	A cooling basin would require more land (4940 acres for both units). A cooling basin could be placed within the confines of the VCS site.	NDCT system would require less land per reactor unit. An NDCT system could be placed within the confines of the VCS site.
Terrain considerations	Terrain features of the VCS site are suitable for the cooling basin.	Terrain features of the VCS site are suitable for an NDCT system.
Water Use	Consumptive water use of 21,600 gpm per reactor unit.[a]	Raw water consumption of 28,900 gpm per reactor unit.
Atmospheric Effects	The cooling basin presents limited potential for fogging and salt deposition (Subsection 5.3.3).	Fogging from NDCT is not expected due to their height. NDCT present limited potential for salt deposition (Subsection 9.4.1.2).
Thermal, Chemical, and Physical Effects	Discharges associated with the cooling basin would meet water quality standards. The plume would be diluted rapidly and concentrations in the water would return to ambient levels almost immediately downstream of the discharge pipe. Because of the relatively low discharge velocities and placement of the discharge ports approximately 3 feet off the river bottom, the discharge velocity would be quickly attenuated by the slower moving river, and minimal scouring of the river bottom would be expected (Subsection 5.3.3).	Discharges associated with NDCT would meet water quality standards. Because of the relatively low discharge velocities and placement of the discharge ports approximately 3 feet off the river bottom, the discharge velocity would be quickly attenuated by the slower moving river and minimal scouring of the river bottom would be expected.
Noise Levels	Pumps associated with the proposed cooling basin system would emit broadband noise that is consistent with existing background noise levels at the VCS site and is unobtrusive at the nearest residence (Subsection 5.3.4.2).	NDCT would emit broadband noise that is consistent with existing background noise levels at the VCS site and is unobtrusive at the nearest residence.

Table 9.4-3 (Sheet 2 of 2)
Screening of Alternative Heat Dissipation Systems

Factors Affecting System Selection	Cooling Basin (Base Case)	Natural Draft Wet Cooling Tower (NDCT)
Aesthetic and Recreational Benefits	Consumptive water use for the cooling basin would be consistent with minimum flow requirements for the Guadalupe River and environmental maintenance, fish and wildlife water demand, and recreation. Fogging associated with the cooling basin is not expected to disrupt the viewscape.	Consumptive water use for an NDCT system would be consistent with minimum flow requirements for the Guadalupe River and environmental maintenance, fish and wildlife water demand, and recreation. NDCT plumes resemble clouds and would not disrupt the viewscape; however, the towers themselves would be visible for many miles.
Legislative Restrictions	The makeup water intake structure for the proposed cooling basin would meet Section 316(b) of the CWA and the implementing regulations, as applicable. Thermal discharge would be consistent with TCEQ temperature standard and mixing zone regulations. The regulatory restrictions would not negatively impact application of this heat dissipation system.	A makeup intake structure for an NDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. Thermal discharge would be consistent with TCEQ temperature standard and mixing zone regulations. The regulatory restrictions would not negatively impact application of this heat dissipation system.
Is this a suitable alternative for the VCS site?	Yes	Yes

a. Water consumption estimate is based on normal evaporation, drift, and seepage rates from Table 3.3-2. Cooling basin water consumption would be further reduced by approximately 4965 gpm per reactor unit by the average precipitation collected in the cooling basin.

Table 9.4-4
Estimated Number of Larvae Entrained Per Month (2008), Maximum (267 cfs) Withdrawal Case

Species	February		March		April		May		June		Total
Common carp	Day	0	Day	141,668	Day	0	Day	0	Day	0	
	Night	0	Night	485,718	Night	0	Night	0	Night	0	
	Total	0	Total	627,386	Total	0	Total	0	Total	0	627,386
Inland silverside	Day	0	Day	0	Day	0	Day	80,953	Day	0	
	Night	0	Night	0	Night	58,756	Night	0	Night	0	
	Total	0	Total	0	Total	58,756	Total	80,953	Total	0	139,709
Shad spp.	Day	0	Day	40,477	Day	0	Day	0	Day	0	
	Night	0	Night	0	Night	0	Night	0	Night	0	
	Total	0	Total	40,477	Total	0	Total	0	Total	0	40,477

Table 9.4-5
Estimated Number of Larvae Entrained Per Month (2008), Average (125 cfs) Withdrawal Case

Species	February		March		April		May		June		Total
Common carp	Day	0	Day	66,234	Day	0	Day	0	Day	0	
	Night	0	Night	227,396	Night	0	Night	0	Night	0	
	Total	0	Total	293,720	Total	0	Total	0	Total	0	293,720
Inland silverside	Day	0	Day		Day	0	Day	37,899	Day	0	
	Night	0	Night	0	Night	27,508	Night	0	Night	0	
	Total	0	Total	0	Total	27,508	Total	37,899	Total	0	65,407
Shad spp.	Day	0	Day	18,950	Day	0	Day	0	Day	0	
	Night	0	Night	0	Night	0	Night	0	Night	0	
	Total	0	Total	18,950	Total	0	Total	0	Total	0	18,950