CHAPTER 5

Environmental Impacts of Station Operation

The environmental impacts of station operation on the area within and surrounding the EGC ESP Facility are described in the following sections:

- Land Use Impacts (Section 5.1);
- Water-Related Impacts (Section 5.2);
- Cooling System Impacts (Section 5.3);
- Radiological Impacts of Normal Operations (Section 5.4);
- Environmental Impacts of Waste (Section 5.5);
- Transmission System Impacts (Section 5.6);
- Uranium Fuel Cycle Impacts (Section 5.7);
- Socioeconomic Impacts (Section 5.8);
- Decommissioning (Section 5.9); and
- Measures and Controls to Limit Adverse Impacts During Operation (Section 5.10).

For purposes of this ER, the site is defined as the property within the CPS fenceline (see Figure 2.3-1). The vicinity is the area within a 6-mi radius from the centerpoint of the power block footprint. The region of the site is the area between the 6-mi radius and the 50-mi radius from the centerpoint of the power block footprint.

Impacts evaluated in this chapter are those associated with station operation. Impacts due to operation of the EGC ESP Facility include potential impacts from operational staff, traffic from staff commutes and delivery of raw materials, storage of raw materials, waste disposal associated with operation, and water and air emissions from operation of the facility.

Section 3.1 describes the plant layout and configuration for the EGC ESP Facility. As stated in Section 3.1, the specific technology and design for the proposed reactor(s) have not been selected. However, sufficient information is available from the range of possible facilities in order to assess the potential environmental impacts to the station operation. In summary, up to 580 workers will be needed to operate the EGC ESP Facility. The power block structures will be located 700-ft south of the CPS, in an area approximately 800 ft by 1,200 ft. Additional buildings, such as offices, a water intake structure, a security building, and miscellaneous storage buildings will be located outside this area, within the site boundary.

5.1 Land Use Impacts

As described in Section 2.2.1, one hundred percent of land use within the site is identified as industrial. Within the vicinity, 82 percent of the land is identified as agricultural, and less than one percent of the land is identified as industrial. As detailed below, the operation will not have a significant adverse impact on land use in nearby communities.

5.1.1 Site and Vicinity

In general, there will be no zoning or USGS land use classification changes to the site or vicinity as a result of operation. Any physical land use changes to the site and the vicinity will be the result of facility construction and are described in Section 4.1.1. Any additional land use impacts from operation will occur as a result of operation of the heat dissipation system, and could include land use impacts from cooling tower fog or mist. These impacts are expected to be minor and are described in Section 5.1.1.2.

5.1.1.1 Summary of Land Use Impacts

Land use impacts from operation will be similar to the land use impacts from construction, which are described in Section 4.1. Operation impacts will be limited to the site and transmission corridor, and up to approximately 96 ac will be disturbed. Additional sirens are not anticipated, and no undesirable land use impacts are anticipated to affect surrounding communities. Normal recreational practices near the site are not anticipated to change as a result of the operation of the EGC ESP Facility.

Roads and highways in the vicinity will be slightly more traveled compared to existing operations, with up to 580 additional workers required (see SSAR Table 1.4-1). To determine impact of additional workers on traffic, average daily traffic counts were obtained from IDOT’s website for IL Route 54 and 10. Near the EGC ESP Facility, 2,750 and 2,000 cars and trucks travel daily on IL Route 54 and 10, respectively (IDOT, 2003). According to IDOT's Bureau of Design and Environmental Manual, the typical average daily traffic count for a rural 2-lane highway is 5,000 cars and trucks (IDOT, 1999). The EGC ESP Facility would add an additional 300 cars and trucks to each highway. This was estimated assuming that each worker commuted individually, that an extra 20 miscellaneous trips occurred throughout the day, and that the commuters will equally divided between IL Route 54 and 10. Based on the addition of the average daily traffic counts and the expected number of additional trips from facility workers, the additional workers would not put an excessive amount of burden on the roadways near the EGC ESP Facility.

As detailed in Section 4.1.1.3, there are no federal, state, or regional land use plans for the area. However, DeWitt County has published a countywide generalized land use plan, which designates the site for industrial land use. This plan guides future land use throughout the county, and has designated a site for transportation and utility use. Further, the county land use plan targets expansion and spin-off development from the CPS as a way to realize further economic development in DeWitt County (University of Illinois, 1992).

Figure 2.2-1 and Figure 2.2-2 depict the land use within the site and vicinity, and Table 2.2-1 presents the acreage of land within the site and vicinity for each land use category. In addition, the location of roads is shown in Figure 2.1-1, and the location of major bridges in the area is shown in Figure 5.1-1.

5.1.1.2 Heat Dissipation System Impacts to Land Use

A detailed description of the heat dissipation system (or cooling system) is described in Chapter 3. If required due to reactor design, UHS cooling towers, of the mechanical draft type, will be located adjacent to the 800-ft by 1,200-ft power block area on the southeast side, and will encompass 0.5 ac of land. The estimated height of these cooling towers is 60 ft.

NHS cooling towers, either mechanical draft or natural draft hyperbolic types, for the normal (non-safety) plant cooling services will be located approximately 600-ft southeast of the major station structures and will require a siting area of approximately 50 ac. The estimated height of the mechanical draft type cooling towers is 60 ft and the estimated dimensions of the natural draft towers are 550-ft high and 550 ft in diameter.

Potential impacts to land use from cooling towers are primarily related to salt drift from a cooling tower. In addition, the potential for fogging, icing, or drift damage may also result from a cooling tower plume. Both wet and dry mechanical draft cooling technologies are being considered for the EGC ESP Facility. If wet mechanical draft cooling technology is used, there will be a mist plume from the cooling tower. While there is the potential for minor salt drift, fogging, and icing to occur, it is expected to be of such small magnitude that no land use changes will result.

As previously discussed, if wet mechanical draft cooling technology is used, there will be a mist plume from the cooling tower. The salt drift associated with this mist plume is anticipated to be minor in nature, and impacts to resident species are not expected. Quantification of impacts associated with salt drift will be reassessed, as appropriate, once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.

5.1.2 Transmission Corridors and Off-Site Areas

Land use impacts from transmission corridor operations primarily fall into two broad categories: maintenance roads for access to pole structures, and vegetation control in the right-of-way. The transmission corridor for the EGC ESP Facility will, most likely, be within the existing right-of-way. No other off-site areas are proposed in association with the EGC ESP. Therefore, no conflicts are apparent between the project and the objectives of land use plans described in Section 2.2.2. Operation and maintenance of the proposed transmission system will be the responsibility of the owner. It has been assumed that operation and maintenance activities will be conducted in a similar manner to the existing transmission facilities because it is anticipated that the transmission corridor will, most likely, be within the existing right-of-way.

5.1.2.1 Maintenance Roads

A major portion, approximately 88 percent, of the transmission line right-of-way that will most likely serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that existing access to the right-of-way is adequate and no permanent roads will be built on the right-of-way for either construction or maintenance. However, road construction may become necessary if the landowner requires it as a condition of the right-of-way or for access to a switching structure.

A road will be constructed to the following general specifications:

- Aligned to avoid impacts to wetland resource areas;
- Grades will be minimized to eliminate erosion;
- Grading, ditches, cut and fill areas, or other disturbed areas will be re-vegetated to prevent erosion;
- Culverts will be installed where needed to prevent erosion and prevent flooding of the road; and
- The surface of the road will be paved with crushed rock or natural gravelly material to withstand expected loads. Once constructed, these roads will be permitted to "grass-over" for grazing, aesthetics, and minimal maintenance.

5.1.2.2 Vegetation Control

Vegetation control will be performed in accordance with customary practices. With such a high percentage of the transmission right-of-way crossing productive agricultural land, there will be a minimal amount of vegetation control required. Where the transmission line crosses wooded areas, trees with the potential to impact the lines may be removed or pruned during construction. For maintenance purposes those tree species with the potential for resprouting may be controlled with an environmentally acceptable selective basal spray herbicide. It is not customary for trees to be allowed directly under the transmission lines for approximately 50 ft on either side of the centerline. Trees outside of the 50-ft limit may be maintained through periodic trimming in order to keep them out of the danger timber zone, see Figure 5.1-2.

Where the transmission line crosses public roads, a screen of trees may be left to minimize visual impacts from the line. Any new access to the right-of-way, though not anticipated, may be constructed at oblique angles to the road in order to prevent line of sight down the right-of-way, see Figure 5.1-3.

Routine inspections of the right-of-way for vegetation control monitoring will be conducted periodically. It is assumed that inspections will be conducted by aircraft in order to determine the need for roads and minimize associated impacts. Maintenance and repair inspections required by cause, such as storms that may down timber on or near the lines, will be conducted by air, road, or foot, as required by the circumstances. These occurrences are expected to be few, and will have limited impact on the land.

5.1.3 Historic Properties

As described in Section 2.5.3, no historic standing structures have been identified within the EGC ESP Site power block footprint, cooling tower footprint, or in the immediate vicinity of the CPS. Impacts of operation of the EGC ESP Site will be no more than what is described regarding the impact from construction, see Section 4.1.3.

5.2 Water-Related Impacts

This section describes the analysis and assessment of anticipated hydrological alterations on water supply and to water users that may result from the EGC ESP Facility. The topics covered include:

- Hydrologic alterations resulting from station operations and the potential impacts on other surface and groundwater users;
- Adequacy of water sources proposed in order to supply total station water needs;
- Water quality changes and possible effects on water use;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize, or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations that are applicable to water use and water quality.

The evaluation of potential hydrological alterations was conducted relative to how they may impact the water environment and both surface water and groundwater users including domestic, commercial, municipal, agricultural, industrial, mining, recreation, navigation, and hydroelectric power.

5.2.1 Hydrologic Alterations and Plant Water Supply

The evaluation of anticipated hydrologic alterations resulting from the operation of the EGC ESP Facility, and the adequacy of water sources proposed to supply plant water needs included:

- Identification and description of proposed operational activities that could result in hydrologic alterations;
- Identification, description, and analysis of the resulting hydrologic alterations and the effects of these alterations on other water users;
- Analysis of proposed practices to minimize hydrologic alterations that could have adverse impacts;
- Analysis and comparison of plant water needs and the availability of water supplies to meet those needs; and
- Conclusions with respect to the adequacy of water supplies to meet plant water needs.

As discussed in Section 2.3.1, Clinton Lake has a storage capacity of approximately 74,200 ac-ft. The Salt Creek Watershed, upstream of the Clinton Lake Dam, delivers an average of 188,000 ac-ft of water annually to Clinton Lake, or about 2.5 times the total lake volume. According to the CPS USAR, the estimated recirculating water system requirements for the CPS are between 718,000 ac-ft (winter) and 913,000 ac-ft (summer) per year, or about 9.6 and 12.2 times the total lake volume (CPS, 2002).

The CPS draws lake water through the screen house on the northwest side and uses it as recirculating cooling water and plant service water. The bulk of this water is returned to the lake through the discharge flume (Outfall No. 2). Evaporative losses are increased (forced evaporation from the lake surface) due to increased temperature of the return flow discharge to the lake. The CPS discharge is 566,000 gpm (summer) and 445,000 gpm (winter), which represents about 84 percent (summer) and 66 percent (winter) of the permitted discharge rate of 670,000 gpm for Outfall No. 2 (IEPA, 2000). These withdrawal and discharge relationships along with the estimated consumptive use or forced evaporation are identified in Table 5.2-1.

The CPS NPDES permit allows a 90-day average maximum discharge temperature of 99°F and maximum daily allowable temperature not to exceed 110.7°F. The CPS NPDES permit also requires monitoring for flow, temperature, pH, total residual chlorine, and total residual oxidant (IEPA, 2000).

One target established for the EGC ESP Facility is to maintain a discharge rate within the CPS NPDES permit conditions. With 66 percent (winter) to 84 percent (summer) of the permitted discharge flow already used by the CPS, the EGC ESP Facility must maintain lower discharge flows by using a less consumptive cooling process to reduce the volume of water withdrawn and discharged.

The need for the selected cooling method to incorporate some form of low consumption wet/dry cooling will also depend on the water available for use during drought conditions. The following sections describe three cooling options that are generally compatible with any one of the ESP facility options being considered. These cooling options and associated water use (consumptive use) requirements are summarized in Table 5.2-2.

The potential impacts to surface water and groundwater from hydrologic alterations resulting from the operation of the EGC ESP Facility, and the adequacy of water sources proposed to supply plant water needs are discussed in the following sections.

5.2.1.1 Freshwater Streams

5.2.1.1.1 Flow Characteristics

The dam that forms Clinton Lake is operated to provide a minimum downstream release of 5 cfs from Clinton Lake to Salt Creek. This flow rate will not change under the operation of the EGC ESP Facility. The total annual discharge volume to Salt Creek downstream of the dam will be slightly reduced by the value of the consumptive use of the lake water.

The results of the model simulation are presented in Table 5.2-5. The average number of days at low flow for the CPS plant only, is estimated to be 76 days per year. With a new ESP facility and wet/dry cooling, the average number of days at low flow increases by 35 days per year. With a new ESP and wet cooling, the average number of days at low flow increases by 114 days per year. The monthly distribution of days at low flow range from 0 days in April to 27 days in October for wet/dry cooling and 2 days in April to 31 days in October for wet cooling.

5.2.1.1.2 Floods

Flooding conditions downstream of the dam have been significantly reduced as a result of initial dam construction and flow attenuation in the Clinton Lake (see Section 2.3.1.1.3).

Flood conditions will continue to be attenuated and may be further reduced with additional consumptive use of lake water.

5.2.1.1.3 Temperature and Water Quality

Review of temperature data from the Rowell gauging station (12-mi downstream of the dam) indicates no measurable change in temperature from predam to preplant operation to postplant operation. Stream temperatures at Rowell are not influenced by increased temperatures in Clinton Lake. Figure 2.3-11 presents the temperature data at the Rowell gauging station.

As part of the required monitoring for the CPS NPDES permit, the temperature data are collected continuously downstream from the dam during the months of June, July, and August of each year. These data are representative of the lake temperature due to the proximity of the monitoring point to the dam. A summary of the temperature data recorded on the 1st and 15th of each month between 1994 and 2000 is presented in Table 2.3-11. A comparison of stream temperatures immediately downstream of the dam (lake temperatures) and temperatures at the Rowell gauging station for June, July, and August of 1994, 1995, and 1996 are presented in Figures 2.3-20, 2.3-21, and 2.3-22, respectively. The comparison indicates higher temperatures near the dam than at the Rowell gauging station, as would be expected. Average temperatures at the dam were 2°F to 8°F higher than those observed at the Rowell gauging station for the summer periods monitored.

With addition of the new EGC ESP Facility, temperatures are expected to increase by a minimal level described for Clinton Lake in the following section. The minimal change will be further diminished as flow moves downstream from the Clinton Lake Dam. No change is expected at Rowell, as the temperatures at that location are under the stronger influence of natural stream temperature moderating processes.

5.2.1.2 Lakes and Impoundments

5.2.1.2.1 Floods

The operation of the EGC ESP Facility is not expected to have a significant impact on flooding. The EGC ESP Facility will take water in from the lake and discharge a smaller amount of water (intake less consumptive use) back to the lake. This results in no increase in lake levels and potentially lower lake levels during dry conditions based on water use requirements identified in Table 5.2-2.

5.2.1.2.2 Droughts

A drawdown analysis was completed to determine the capacity of the cooling water supply during dry periods. The 50- and 100-yr recurrence interval dry periods with a five-year duration were selected for the evaluation. The normal lake level of 690 ft was used as the initial water surface elevation. The lake volume at normal lake level was assumed to be 72,400 ac-ft. Inflow to the lake (in acre-feet) was computed on a monthly basis by multiplying the rainfall runoff (in feet) by the watershed area (in acres). Water loss from the lake was comprised of downstream discharge; net lake evaporation; forced evaporation due to CPS operations; seepage; and the cooling water consumed by the new facility. Forced evaporation is defined as the additional evaporation produced due to an increase in lake water temperature caused by the discharge of cooling water to the lake under the open-cycle lake cooling process employed by the existing plant.

A minimum lake discharge rate of 5 cfs was maintained at the Clinton Lake Dam when lake levels are at or below the 690-ft spill elevation. For the purpose of drought analysis calculations, the lake elevation was not allowed to exceed 690 ft. The discharge was allowed to exceed 5 cfs if inflows would increase the lake level to a level above the spillway elevation of 690 ft. The minimum allowable water level in the lake was 677 ft, which provides a 2-ft water depth over the submerged dam elevation of the UHS.

The analysis reviewed CPS plant operations and consumptive use for a 100 percent load factor on the uprated 1,138.5-MWe plant. The results of the drawdown analysis, in terms of total water available and water available for new plant withdrawal, are presented in Table 5.2-3. The results indicate the consumptive use limitations for the 50- and 100-yr droughts to maintain the required minimum lake level.

Comparing the water use requirements for the various cooling methods (see Table 5.2-2) with the water availability from the drought analysis (see Table 5.2-3), it is apparent that the maximum wet cooling method water use range exceeds the volume of water available for the 50 and 100-yr droughts. The minimum wet cooling method water use range is compatible with the volume of water available for both the 50 and 100-yr droughts. The maximum wet/dry cooling method water use range is generally compatible with the volume of water available for the 50-yr drought for the full range listed and is compatible with the volume of water available for both the 50 and 100-yr drought for the lower end of the range listed. The minimum wet/dry cooling method water use is compatible with both the 50 and 100-yr droughts. Dry cooling is compatible with both the 50-yr and 100-yr droughts as it is a non-consumptive process. If a cooling method is selected that has a consumption rate that exceeds the available water for drought conditions, it may be necessary for periods of time to reduce or curtail plant operation to protect the minimum lake level and the integrity of the UHS.

5.2.1.2.3 Temperature and Water Quality

The CPS NPDES permit allows a cooling water discharge of 670,000 gpm at a temperature that does not exceed 99°F during 90 days in a fixed calendar year and 110.7°F for any given day. The CPS discharges a summer volume of 566,000 gpm and a winter volume of 445,000 gpm, both at 99°F, leaving considerable discharge capacity (104,000 gpm in summer and 225,000 gpm in winter) under the permit for the CPS. The estimates of discharge requirements for the EGC ESP Facility using the wet and wet/dry cooling tower methods and dry cooling methods are presented in Table 5.2-4. The wet cooling tower method has a maximum water discharge value of 49,000 gpm and normal discharge value of 12,000 gpm.

The wet/dry cooling towers have a reduced discharge flow of up to 70 percent of the wet cooling method or in the range of 14,700 to 3,600 gpm. There is no discharge required from the dry cooling method. The added ESP water discharge values for any of the cooling methods combined with the CPS discharge is well within the available capacity of 670,000 gpm established under the CPS NPDES permit.

If the dry cooling option is selected for the new EGC ESP facility, there would be no change in lake temperature with continued operation of the current CPS along with a new EGC ESP Facility. Lake temperature increases are expected with wet/dry or wet cooling options for the new EGC ESP facility. The increases will result from new consumptive loss of water in the cooling process. A maximum of 16,000 gpm and 31,500 gpm of cooling lake water are expected to be consumed (evaporated) by the wet/dry and dry cooling processes respectively. This water is withdrawn and not returned to the cooling lake. The result is lower average lake levels.

A Period of Record Model was completed to determine the extent of lake level changes. The results are described in Table 5.2-6. Average lake level reductions range from a low of 0.03 ft in March and April to a high of 0.35 ft in October for the wet/dry cooling process and 0.12 ft in April and 1.68 ft in November for wet cooling process. These lower lake levels will result in reduced lake surface area and lake volume. Both factors can contribute to increased lake temperatures. Surface area and volume reductions associated with proposed ESP plant operations with wet/dry and wet cooling are shown on Tables 5.2-7 and 5.2-8.

In 1989, J.E. Edinger Associates Inc., studied lake temperature changes in Clinton Lake with changing lake levels. A three dimensional hydrothermal model of the lake was developed and calibrated with lake temperatures measured during the summer of 1988. The model considered lake surface area and volume as well as many other hydrologic and meteorological conditions to predict temperatures throughout the lake. The calibrated model established excess temperatures for two lake levels, the normal lake level at elevation 690.0 and a low lake level at elevation 686.5. A sensitivity analysis was performed to establish temperature changes that result from small changes in the plant load, the open lake cooling pumping rate, and lake water surface elevations. These sensitivity values are presented in Section 6.0 of the Edinger Report. The current CPS plant load and cooling pumping rate are not expected to change with the new ESP facility. The lake water surface elevation is expected to decrease with the new ESP facility. Temperature changes associated with this decrease can be calculated using the Edinger values established in the sensitivity analysis. Changes in mixing zone temperatures (point of discharge into model Segment 16) associated with changes in lake water surface elevation are presented in Table 5.2-9. The mixing zone is the point of discharge where temperature changes will be the most significant. Average lake temperature increases range from a low of 0.0°F to a high of 0.2°F in October and November for the wet/dry cooling process and 0.0°F in April and May to 0.8°F in November for wet cooling process. Temperature changes at other locations downstream in the cooling loop will be progressively less and approach zero at the plant intake (model Segment 5).

There will be a minor discharge of water from the wet/dry or wet cooling process for tower blowdown. Tower blowdown discharge rates range from 3,600 gpm for wet/dry cooling to 12,000 gpm for the wet cooling. Blowdown water temperatures are variable depending on ambient conditions but will be significantly less than the allowable 99°F permitted limit. Because the blowdown discharge rates are relatively small (1 to 3 percent of existing CPS discharge) and the blowdown water temperatures are low, the lake temperature increases due to boiler blowdown are expected to be negligible.

Review of lake water quality monitoring data between 1987 and 1991 indicates that, with the exception of the temperature and dissolved oxygen, the quality of lake water near the CPS intake structure is similar to water near the discharge flume. A comparison of intake and discharge water quality is presented in Table 2.3-19. The comparison is made by reviewing data recorded at lake monitoring Site 4 (see Figure 2.3-25), near the plant intake and lake monitoring Site 2, near the plant discharge flume. Both sites are representative of the intake and discharge water, but are also influenced by other lake conditions and flow patterns in the vicinity. These locations were used because direct monitoring data of the plant intake and discharge water are not available.

Review of the temperature data indicates that average lake temperatures increase from upstream (19.3° C or 66.7°F) to downstream (24.6° C or 76.3°F) of the CPS. Dissolved oxygen decreased from 9.3 mg/L to 8.1 mg/L, as would be expected with an increase in temperature. There appear to be only slight changes in other constituents presented including turbidity, hardness, TDS, magnesium, chloride, orthophosphate, and sulfate.

Other constituents such as hardness and TDS may increase as a result of evaporation if the wet or wet/dry cooling method is selected. For example, the TDS intake water concentration at Site 4 measured in the range of 275 mg/L. Discharge concentrations of TDS from the EGC ESP Facility (see SSAR Table 1.4-2) are estimated to be 17,000 mg/L. The combined discharge will be in the range of 380 mg/L (based on 3,600 gpm) to 620 mg/L (based on 12,000 gpm) of TDS. The discharge will be diluted by lower dissolved solids in the lake and in the base flows from Salt Creek and North Fork of Salt Creek. Dissolved solids will also be passed downstream through the dam. Over time, a rise in ambient lake dissolved solids concentration is expected to a level of equilibrium higher than the ambient level. Further discussion of dissolved solids concentration is included in Section 5.3.

5.2.1.2.4 Lake Levels

A 24-year Period of Record model was developed to determine any change in lake levels with addition of the ESP facility. The Period of Record model was run for the 24-year period of local hydrologic record from June 1, 1978 to April 31, 2002 for three scenarios; 1) with the current 1138.5 MW CPS plant operating at 100 percent power, 2) with the current CPS and new ESP with wet/dry cooling, and 3) with the current CPS and new ESP with wet cooling. The hydrologic conditions for this period of record reflected monitored average daily values from recording stations near the plant. Plant operating conditions for the three scenarios were imposed over the total 24-year period of record.

Note that there are certain model limitations noted in Section 5.2.1.1.1 that limit the use of the daily values simulated. The comparison of changes over the modeled base case are, however, considered representative of actual conditions.

The results of the model simulation are presented in Table 5.2-6. The average water surface elevation of Clinton Lake with the CPS plant only is estimated to be 690.4 ft. With a new ESP facility and wet/dry cooling, the average annual lake level is reduced by 0.2 to 690.20 ft. With a new ESP and wet cooling, the average lake level is reduced by 0.7 to 689.70 ft. The monthly distribution of reduced lake levels range from 0.0 ft in March, April, May, and June to 0.4 ft in October and November for the wet/dry cooling, and from 0.1 ft in April and May to 1.9 ft in November for wet cooling.

5.2.1.3 Groundwater

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated hydrologic alteration impacts to groundwater from the operation of the EGC ESP Facility.

5.2.2 Water Use Impacts

This section discusses the predicted impacts of station operation on water use, including:

- Hydrologic alterations that could have impacts on water use including water availability;
- Water quality changes that could affect water use;
- Impacts resulting from these alterations and changes;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize, or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations applicable to water use and water quality.

5.2.2.1 Freshwater Streams

5.2.2.1.1 Water Availability

There are no significant water users either upstream or downstream of Clinton Lake that draw water from Salt Creek or the Sangamon River. The 5-cfs minimum discharge from Clinton Lake to Salt Creek will be maintained in accordance with the CPS NPDES permit requirements.

5.2.2.1.2 Water Quality

Clinton Lake is expected to buffer potential water quality impacts to Salt Creek resulting from station operations. Downstream users will not be affected, provided that the operating CPS and the EGC ESP Facility operate within the bounds of the their NPDES permits.

5.2.2.2 Lakes and Impoundments

5.2.2.2.1 Water Availability

Clinton Lake was designed and constructed to accommodate two similar sized power plants. The CPS is the first plant and the only major water user on the lake. Recreation is the secondary use of the lake, which includes camping, boating, and fishing. There are no other significant identified withdrawals of water from Clinton Lake (ISWS, 2002).

The EGC ESP Facility will be designed and operated to be compatible with the operation of the CPS and their respective NPDES permits. Incorporating wet/dry cooling rather than the more consumptive wet cooling process will minimize water consumption. Operation of the dam structure is also an important water management function. The dam outfall structure is operated in a passive manner with gate settings periodically set based on long-term weather conditions. Dam operation practices will be reviewed and revised where appropriate in conjunction with the CPS to maintain minimum flows in Salt Creek downstream of the dam and conserve water in the lake impoundment for power plant operation and recreational purposes.

With these design considerations, there is expected to be a minimal impact on the operation of the CPS. The EGC ESP Facility operation will comply with federal laws related to hydrology and water quality. There are no regional or local regulations applicable to water use (ISWS, 2002).

5.2.2.2.2 Water Quality

The water quality of Clinton Lake is presently classified as an impaired water body by the IEPA (IEPA, 2002). The causes of impaired use include a Confidence Level 3 (high) Excess Algal Growth, and a Confidence Level 2 (moderate) Metals. Review of the impairments and possible causes are discussed in Chapter 2. The power plant operation is not uniquely related to either of the impairments. Algal growth is related to nutrient levels in the water column that originate from the dominant agricultural land use. Metals concentrations in the water column and sediment have a number of sources including natural geologic formations, agricultural practices, and industrial sources. For both impairments, stormwater management and erosion control practices for sediment control are the best control option. Nutrients and metals attach to sediment and are effectively controlled with control of sediment in stormwater. Industrial pollution control practices, strategic materials selection, and corrosion control are also expected to be effective in reducing metals contributions from industrial sources.

Lake water temperatures may be marginally increased (see Section 5.2.1.2.3) due to plant operation. The combined discharge of the two plants will be within with the limits of the NPDES permit for the CPS. There are no expected impacts to the CPS or lake recreational users.

5.2.2.3 Groundwater Use

As discussed above, it is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility, and that groundwater will not be used as a source of water. In addition, based on the proposed design of the plant, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated groundwater use impacts resulting from the operation of the EGC ESP Facility.

5.3 Cooling System Impacts

This section describes the impacts of the cooling system intake and discharge facilities. As described in Section 3.3, either mechanical draft or natural draft hyperbolic type cooling towers will be used for normal non-safety plant cooling and for safety-related cooling. The makeup water for the normal (non-safety) plant operations will be taken up through a new intake structure located approximately 65 feet south of the CPS intake structure on the northern basin of Clinton Lake. The intake will include a screening system similar in function to the CPS intake, but for a significantly smaller flow rate. Makeup water for the safety-related cooling towers will be supplied from the same intake structure, which will draw water from the bottom of the submerged impoundment within Clinton Lake (i.e., the UHS). The cooling tower(s) blowdown will be discharged to the CPS discharge flume that flows to the southern basin of Clinton Lake.

The discussion of the cooling system impacts have been divided into the following sections:

- Intake system;
- Discharge system;
- Heat-discharge system; and
- Impacts to members of the public.

5.3.1 Intake System

This section describes the impacts of the intake system during station operation including the physical impacts caused by the flow field induced by the intake system and the potential impacts on the aquatic ecology.

The descriptions of the new intake system that will draw makeup water from Clinton Lake and the UHS, and convey it to the EGC ESP Facility NHS and the UHS cooling towers are presented in Section 3.4.2. Although the specific design details have not been finalized, it is anticipated that the new intake structure will consist of a shore structure adjacent to the existing intake structure that allows access to impounded water of Clinton Lake down to the bottom of the UHS cooling towers. The location of the intake structure will provide a secure source for makeup water to the UHS in the unlikely event of a failure at the Clinton Lake Dam. Intake water temperatures are expected to be similar to existing seasonal ambient lake temperatures of 40°F to 75°F.

5.3.1.1 Hydrodynamic Descriptions and Physical Impacts

This section describes the intake hydrodynamics and the predicted spatial and temporal alterations in the ambient flow field and physical hydrologic effects (e.g., bottom scouring, induced turbidity, silt buildup) induced by the intake system operation. In addition, design considerations and descriptions of practices or procedures to mitigate or minimize predicted adverse impacts are identified and evaluated.

5.3.1.1.1 Intake-Hydrodynamic Description

The new cooling system intake structure will increase the overall flow and velocity through the eastern end of the submerged UHS. The maximum approach velocity to the new intake structure will be limited to 0.5 fps at a normal lake level of 690 ft (see Section 3.4.2.1). Review of the cross section of the eastern end of the UHS (see Figure 5.3-1) near the CPS intake structure and existing summer intake flow rate indicates that at normal lake level, the average intake velocity is approximately 0.09 fps. The average velocity of combined flows for the CPS and EGC ESP Facility through the eastern end of the submerged UHS is estimated to be 0.10 fps. At the elevation of 675 ft, which is the full elevation of the UHS, the velocities increase from 0.33 fps to 0.35 fps. These minor changes in velocity are not expected to have an adverse impact on soil erosion near the plant intake. Velocities in this range are below the erosion velocity for structures and soils (Knighton, 1998) present at this location (see Table 5.3-1). Design of the intake structure will include features that maintain an even distribution of intake flows. Where necessary, the intake area will be protected to prevent local areas of erosion.

5.3.1.1.2 Physical Impacts of Intakes

The slight increase in velocity across the intake end of the UHS is not expected to cause any change in shoreline erosion, bottom scouring, induced turbidity, or silt buildup. The increased velocity may slightly increase the suspended solids concentration drawn into the cooling system. Such a minimal change will tend to pass through the cooling system without impact.

5.3.1.1.3 Maintenance of Intake Facilities

The intake piping and screens will require cleaning to keep them free of debris, algae growth and aquatic organisms. The intake screens will be kept clean by mechanical means. The screens will be washed or scraped to remove algae, dead fish, trash, and debris that may have been drawn in. Captured material will be removed and disposed of onshore at an approved landfill site. There will be no direct discharge of these materials except for water to Clinton Lake.

In addition, the piping system will need to be kept clean of aquatic organisms such as algae and shellfish. Standard practices that have been used by the utility industry include scraping, backwash with the heated cooling water and chemical treatment including certain biocides, anti-corrosion, and anti-scaling chemicals. These chemicals will ultimately be discharged to Clinton Lake through the thermal discharge piping, as described in Section 3.6.1. If a chemical addition is required to protect the new cooling system, this same approach may be used in the intake piping. It is anticipated that there will be a minor change in the quality of the water discharged. The selection of chemicals will be done in order to minimize the impacts on water quality. It is assumed that the discharges will be comparable to those associated with the CPS as approved under their NPDES permit.

5.3.1.2 Aquatic Ecosystems

As previously discussed, Clinton Lake was constructed as a source for cooling water for the CPS. Clinton Lake is a significant resource for a variety of recreational activities including fishing, boating, swimming, and wildlife viewing. The water quality of Clinton Lake is presently classified as an impaired water body by the IEPA (CPS, 2001).

5.3.1.2.1 Fish Impingement

The ER for the CPS documented that juvenile centrarchid species (including largemouth bass, bluegill, and crappie) were not anticipated to be subject to high levels of impingement (CPS, 1973 and CPS, 1982). It was noted that any adult fish species that are drawn into the intake screens and structures would already be in a physiologically weakened state, and therefore, would not be able to avoid the intake velocities. Such fish would likely be lost due to other circumstances and would be of limited value to the fishery resource of the lake. The impacts to aquatic organisms were monitored for a 5-yr period following the startup of the CPS. Finfish populations have continued to be monitored in Clinton Lake by the IDNR.

The proposed intake facilities are of a similar nature to the CPS. Therefore, it is projected that the EGC ESP Facility will have similar effects. The total number of fish lost, both juvenile and adult, as a result of operation of the proposed EGC ESP Facility will be insignificant in comparison to the total number of fish that exist in Clinton Lake, as natural residents or through stocking programs.

5.3.2 Discharge System

This section describes the hydrothermal discharge, associated physical impacts to the CPS discharge flume, and the potential impacts to important aquatic populations in the vicinity of the point of discharge to Clinton Lake. The scope of the evaluation includes the analysis of alterations to the receiving body (i.e., the discharge flume and Clinton Lake) resulting from station thermal, physical, and chemical discharges, and potential impacts on the aquatic ecosystems.

The EGC ESP Facility cooling system will discharge cooling tower blowdown to the CPS discharge flume. The layout of the CPS discharge flume and point of connection of the cooling system discharge from the EGC ESP Facility is described in Section 3.4.2.

5.3.2.1 Thermal Description and Physical Impacts

A hydrothermal analysis of the discharge system of the EGC ESP Facility cooling system was conducted to characterize the temporal and spatial temperature distribution in Clinton Lake and potential physical impacts (e.g., increased turbidity, scouring, erosion, sedimentation) resulting from the EGC ESP Facility's thermal discharges. The EGC ESP Facility cooling system will discharge to the CPS discharge flume; therefore, the impacts of the CPS were examined to determine the incremental impact that would be attributable to the EGC ESP Facility. In addition, design considerations and descriptions of practices or procedures to mitigate or minimize predicted adverse impacts have also been identified.

5.3.2.1.1 Discharge Thermal Description

A thermal description of Clinton Lake is presented in Section 2.3. Characteristics of thermal discharges to Clinton Lake and nonradioactive wastes that may be discharged to Clinton Lake via the discharge flume are presented in Section 3.3 and Section 3.6. In general terms, the average discharge temperature is expected to remain below the NPDES permit maximum 90-day average limit of 99°F. The discharge flow rate will increase slightly, but will also fall within the NPDES permit limit of 670,000 gpm. Discharge flow will increase from a summer rate of 566,000 gpm to 615,000 gpm, increasing the total heat discharge to Clinton Lake. Flow and temperature values for existing, future, and permitted discharge are identified in Table 5.3-2.

5.3.2.1.2 Physical and Chemical Impacts of Discharge

The discharge flume is a trapezoidal section with a design water depth of 13 ft, bottom width of 120 ft, and side slopes of 3-ft horizontal to 1-ft vertical. The flume is designed to carry 1,372,077 gpm at a velocity of 1.5 fps. The existing summer discharge is less than half of the design flow capacity of the flume (CPS, 2002). The combined flow of the CPS and EGC ESP Facility system will also be less than half of the capacity of the existing flume. Therefore, the flow and velocity will be within the design capacity of the existing flume. The existing and combined system flow and velocity relationships are presented in Table 5.3-3.

The quality of water discharged will be similar to intake water and reflect changes that result from evaporative losses during the cooling process, addition of suitable chemicals to aid the cooling system such as biocides, dispersants, molluskicides, and scale inhibitors, and other compatible flow streams. These constituents are described in Section 3.6.1. The chemicals will be selected for their effectiveness and to minimize the impacts on water quality. The discharge-monitoring program will be revised, as necessary, to monitor for potential water quality impacts.

Potential chemical impacts of discharge to water quality in Clinton Lake were examined by estimating the concentration of TDS in Clinton Lake under a range of hydrologic conditions (mean runoff and drought conditions) and loading (with and without the addition of the EGC ESP Facility). The peak TDS concentrations were calculated over a 5-yr period for each scenario with an initial condition based on average TDS values observed by Illinois Power Company (CPS, 1992). The impacts to Clinton Lake water quality are conservatively examined by comparing results to IEPA’s general use standard for TDS of 1,000 mg/L (IEPA, 2002). The results of the analysis indicated that additional loading from the EGC ESP Facility would not impact Clinton Lake water quality under the mean runoff or 50-yr drought conditions, but may exceed the general use standard during the 100-yr drought.

The chemicals used will be subject to review and approval for use by the IEPA, and releases will be in compliance with water quality standards and an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.

The proposed changes in the quality, quantity, and velocity of the discharged water are not expected to cause any change to shoreline erosion, bottom scouring, induced turbidity, or silt buildup in the discharge flume or at the point of entrance to Clinton Lake. The increased velocity of the intake and discharge may slightly increase the suspended solids concentration or turbidity of discharge waters to Clinton Lake.

5.3.2.2 Aquatic Ecosystems

Several cooling alternatives are being considered for the operation of the proposed facility. The alternatives will discharge cooling waters in a similar manner to the CPS. As noted above, the discharge water temperature will continue at the NPDES permit level. Flows will increase slightly in the range of 1 to 8 percent. Under the discharge conditions, it is expected that certain fish species would migrate to other portions of Clinton Lake where temperatures are more tolerable. This condition is expected to continue with the addition of the EGC ESP Facility.

As previously mentioned, the average discharge temperature is expected to remain at the current NPDES permit temperature limit (approximately 99°F). In the event of an unexpected shutdown of the discharge system, temperatures would be expected to drop significantly, potentially resulting in adverse impacts to fish populations, consistent with impacts (due to "cold shock") that were observed after a shutdown event that occurred in December 2000. However, design alternatives being considered may lessen the potential for temperatures to drop as significantly, in the event of a shutdown.

5.3.3 Heat-Discharge System

This section describes the impacts of the heat-discharge system during station operation. The evaluation of potential impacts includes consideration of physical and aesthetic impacts attributable to vapor plumes resulting from heat dissipation to the atmosphere and the impacts to terrestrial ecosystem induced by operation of heat dissipation systems, especially cooling towers.

The CPS uses the lake and atmosphere for heat dissipation. There are no cooling towers for mechanical heat dissipation. The plant takes in water from the lake, passes it through a heat exchanger, and discharges the same volume of water at a higher temperature back into the lake. The added heat is dissipated in the discharge channel and Clinton Lake, with an exchange of heat to the atmosphere and (to a much lesser extent) to the ground as the cooling water moves through the discharge channel and Clinton Lake. Of the total volume of cooling water that is discharged from the plant, a portion of the water evaporates to the atmosphere, a portion passes over or through the Clinton Lake Dam to Salt Creek, and the remaining portion is drawn back to the plant intake to go through the heating and cooling cycle again. Discharged and evaporated water is made up from runoff from the upstream watershed.

The average discharge temperature from the CPS is in the range of the maximum 90-day average temperature limit in the NPDES permit of 99°F. The CPS discharge flow rate ranges from 566,000 gpm (summer) to 445,000 gpm (winter). The intake temperature varies seasonally with an average monthly summer temperature that ranges from 72°F (June of 1989) to 84°F (August of 1988). Average monthly temperatures measured near the CPS intake for periods 1987 through 1991 are presented in Table 5.3-4.

The EGC ESP Facility will use cooling towers for plant cooling. The facility will pump cooling water from the cooling tower basins, and after the water passes through the heat exchangers it will be returned to the cooling tower for cooling and discharge to the basin. A portion of the water will be evaporated to the atmosphere in the cooling tower and a portion of the water will be discharged as blowdown to the discharge flume in order to limit the buildup of impurities in the basin water. Water from Clinton Lake will be used for makeup to the cooling tower to replace the evaporation and blowdown losses. Blowdown water will be discharged back into the lake. This water will be combined with the CPS discharge water, and the associated heat load will be dissipated to the atmosphere in the discharge channel and Clinton Lake.

For the EGC ESP Facility, the maximum blowdown discharge temperature is expected to be below the NPDES discharge limit. The actual discharge temperature is expected to be 10°F above the ambient wet bulb temperature. The EGC ESP Facility discharge flow rate is expected to be significantly less than what is being discharged by the CPS. For the cooling processes being considered for the EGC ESP Facility, the normal discharge flow is estimated to be 12,000 gpm, which is about 2 percent of the summer discharge flow rate from the CPS (Table 5.2-4). The incoming cooling water temperature for the EGC ESP Facility is expected to vary seasonally and be similar to the intake temperatures for the CPS.

5.3.3.1 Heat Dissipation to the Atmosphere

The operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere. Depending on the type of cooling system(s) that will be used to dissipate heat from the facility, the rejected heat will be manifested in the form of thermal and/or vapor plumes from one or more locations at the site. For wet cooling processes, resulting water vapor plumes will have the potential to result in a variety of physical or aesthetic impacts. The extent of these impacts will depend primarily on the prevailing meteorological conditions, the type of cooling tower selected (mechanical or natural draft), cooling water quality, and plant load. For dry cooling processes, dry thermal plumes are not normally expected to result in significant environmental or other impacts.

The scope of this evaluation includes a qualitative assessment of potential impacts attributable to wet cooling processes, specifically mechanical and natural draft cooling towers. The ambient impacts that are expected to be of most concern as a result of the use of these wet cooling systems include the following:

- Length and frequency of occurrence of visible plumes;
- Frequency of occurrence and spatial extent of ground level fogging and icing in the immediate vicinity of the cooling towers;
- Solids deposition (i.e., cooling tower drift droplet deposition);
- Cloud formation, cloud shadowing, and additional precipitation attributable to vapor formation downwind of wet cooling towers; and
- Interaction of the vapor plume with existing pollution sources in the area including the potential for wet deposition effects.

Wet cooling systems that utilize mechanical or natural draft cooling towers use evaporative cooling to transfer heat from the process to the atmosphere. Within a wet cooling tower, hot process water is sprayed in at the top of the tower and cooled by evaporation. Large amounts of water can be lost by evaporation. Depending on the meteorological conditions, this evaporated water vapor can produce visible plumes of varying densities and lengths.

Dry cooling systems transfer heat to the atmosphere by pumping hot process water through a large heat exchanger or radiator, over which ambient air is passed to transfer heat from the process water to the air. This is a closed non-contact process, thus, no water is lost to evaporation, and there is no visible plume. The temperature of the ambient air passing through the system is increased during the cooling process, and the warm air rises naturally and dissipates into the local atmosphere, typically with no visible effects. Dry cooling is less efficient than wet cooling; therefore, dry cooling systems tend to be much larger and more costly than wet cooling systems. It is assumed that the dry cooling system would fit within the same footprint as wet cooling system and associated plant facilities.

Hybrid wet/dry cooling systems are a combination of the wet and dry cooling methods. The amount of visible vapor that will result from a wet/dry cooling process will necessarily depend on the proportional mix of wet and dry cooling, as well as the meteorological conditions present at the time of operation.

Table 5.3-5 provides a qualitative assessment of the nature and extent of water vapor plumes that can be expected to occur as a result of the operation of the EGC ESP Facility, depending on the type of cooling system that is ultimately selected for use at the facility.

A quantitative assessment of the potential impact of heat dissipation to the atmosphere requires the use of mathematical and/or empirical models to simulate a cooling tower operation under a variety of meteorological conditions. Models are available that will predict the frequency of occurrence of visible plumes, fogging, icing, and drift droplet deposition as a result of the wet cooling tower operation. The EGC ESP Facility will be located on property that is owned by CPS, and the distances to the CPS property boundaries are relatively large and necessarily restricted from public access. The most significant impacts attributable to the operation of the cooling towers are expected to be limited primarily to on-site locations because of the proximity of the EGC ESP Site to the property boundaries. The nearest public roadway is more than 0.5 mi in any direction. Additionally, there is no agricultural or public land use in the immediate vicinity of the EGC ESP Site; thus, deposition effects are not expected to be a significant concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only install standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, moisture plumes from the cooling towers may be visible from some off-site locations, depending on wind direction and other meteorological parameters.

The impacts attributable to the operation of the EGC ESP heat dissipation system are expected to be primarily aesthetic in nature, namely visible plumes that may be evident from on-site and some off-site locations depending on the time of day, the prevailing meteorological conditions, and the direction/orientation of the observer with regard to the ESP site. These and other impacts such as fogging, icing, and drift droplet deposition are not expected to be of significant concern at off-site locations, nor will they be inconsistent with the current heat dissipation system impacts that are attributable to the existing CPS facility, which is located adjacent to and on the same property as the EGC ESP Site.

5.3.3.2 Terrestrial Ecosystem

Impacts resulting from the proposed heat dissipation system would be consistent, if not less significant, in comparison to the CPS. As noted in the preceding sections, potential impacts to terrestrial and aquatic ecosystems were monitored for a 5-yr period following the startup of the CPS.

5.3.3.2.1 Impacts to Terrestrial Ecosystems

The following sections describe the anticipated impacts to the terrestrial environment and biota of the site and vicinity likely to be affected by operation of the proposed facility. Descriptions of existing terrestrial habitats including important habitats as defined by the USNRC, are presented in Section 2.4.

Impacts to terrestrial ecosystems associated with salt drift will be assessed once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted before or during a later licensing stage.

5.3.3.3 Impacts to Important Terrestrial Species and Habitats

5.3.3.3.1 Important Species

As previously discussed, "important species" are defined, by the USNRC, as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

5.3.3.3.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation of the proposed facility is not anticipated to adversely affect federally-listed threatened or endangered species at the site or within the site vicinity (IDNR, 2002). Federal wildlife agencies including the USFWS and National Marine Fisheries Service will be contacted at a date closer to the station construction in order to confirm the absence of federally-listed threatened and endangered species, since confirmation letters are valid for only one year after issuance.

5.3.3.3.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation of the proposed facility is not anticipated to adversely affect state-listed threatened or endangered species at the site or in the site vicinity. According to data provided by the IDNR, no state-listed threatened or endangered terrestrial wildlife species have been documented within the site or site vicinity (IDNR, 2002). However, as discussed in Section 2.4, based on other sources, several state-listed threatened and endangered birds have been observed in the vicinity of Clinton Lake.

Some mortality of birds is expected that result from collisions with the cooling towers. However, impacts to state-listed threatened and endangered species populations are not anticipated.

State wildlife agencies will be contacted at a date closer to the station construction in order to confirm the absence of state-listed threatened and endangered species, since confirmation letters are valid for only two years after issuance.

5.3.3.3.1.3 Species of Commercial or Recreational Value

Several species of commercial or recreational value were identified in Section 2.4. These species include white-tailed deer, various species of waterfowl, and various species of small mammals.

No direct adverse impacts to species of commercial or recreational value are anticipated as a result of the implementation of the proposed project. It is assumed that any impacts on species of commercial or recreational value, resulting from the EGC ESP Facility would be consistent with or less significant than those impacts associated with the existing facility.

5.3.3.3.2 Important Habitats

According to the USNRC, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

5.3.3.3.2.1 Clinton Lake State Recreation Area

It is not anticipated that the proposed heat dissipation system will have any adverse impacts on the terrestrial environment within the Clinton Lake State Recreation Area. The proposed system will not inhibit access to or use of the terrestrial system surrounding Clinton Lake.

Activities such as hunting, fishing, hiking, and other recreational activities that rely on the terrestrial environments of the Clinton Lake State Recreation Area are not anticipated to be impacted by operation of the proposed facility.

5.3.3.3.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 6 mi from the location of the proposed facility. Due to the location of this area, no direct impacts to this recreation area are anticipated as a result of operation of the proposed facility.

5.3.3.3.2.3 Environmentally Sensitive Areas (Illinois Natural Area Inventory Sites)

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees, under the jurisdiction of the Illinois Nature Preserves Commission. There are two environmentally sensitive areas located within 6 mi of the site. Descriptions of these areas are presented in Section 2.4.

Due to the location of these areas, operation of the proposed facility is not anticipated to adversely affect any environmentally sensitive areas within the site vicinity.

5.3.3.3.2.4 Wetlands and Floodplains

As previously discussed, the location for the proposed facility is at the site of an existing power plant, which is comprised of impervious surfaces, crushed stone, existing structures, and other facilities necessary for the operation and maintenance of the facility, in addition to small amounts of open fields.

As previously discussed, four small (less than 1 ac) wetlands are located within the site boundaries; however, these wetland areas are not anticipated to be adversely impacted as a result of the operation of the proposed cooling system.

Any aquatic vegetation existing prior to the operation of the proposed facility will likely adapt to the new conditions resulting from the additional station.

5.3.3.4 Ultimate Heat Sink

An UHS is required to provide a secure source of cooling water for a safe plant shut down. In the event that the main impounding structure of Clinton Lake is breached, the UHS for the CPS is provided in a submerged impoundment within Clinton Lake. There is a primary impounding structure for the main lake and secondary impounding structure within the main lake that makes up the UHS. This secondary structure extends across the north basin of Clinton Lake or the streambed of the now submerged North Fork of Salt Creek. This secondary structure has an overflow elevation of 675.0 ft, 15-ft below the overflow elevation of the primary structure of 690.0 ft. The volume (see Figure 5.3-2) of the UHS is 1,022 ac-ft, a small portion of the total Clinton Lake volume of 74,200 ac-ft.

The UHS for the CPS was designed to accommodate safe plant shutdown cooling for two 992-MW BWR units. The UHS is designed to provide cooling and to safely bring two units to a cold shutdown, assuming heat loads for loss-of-coolant accident (LOCA) for one unit and a shutdown of the second unit with a loss of off-site power (LOOP) for two 992-MW plants. This UHS requirement is considered the worst case combination for two units. The minimum UHS volume to accommodate these criteria is 849 ac-ft.

The design of existing UHS was examined to evaluate if it can adequately supply emergency shutdown cooling water to both the CPS and the UHS cooling tower makeup water for the EGC ESP Facility. The analysis is based on data available on the existing UHS and previous modeling conducted for Illinois Power Company. The results of the analysis indicated the previous modeling is sufficient to evaluate the adequacy of the UHS as a supply for emergency shutdown cooling water and no additional modeling or associated analysis are necessary.

Based on the information reviewed, the UHS at a current 1,022 ac-ft, has the volumetric and heat load capacity for the 30-day shut down of the CPS and proposed EGC ESP Facility. The actual required UHS capacity for the CPS is 849 ac-ft for LOOP and LOCA failure scenarios. The required capacity for makeup cooling water for the EGC ESP Facility, under LOOP or LOCA failure scenarios, is 87 ac-ft. The worst case volume necessary to accommodate the emergency shutdown requirements of the two stations combined is 936 ac-ft. This leaves about 86 ac-ft of excess storage capacity. With an estimated annual sedimentation rate of 5 ac-ft per year, the UHS will require dredging in approximately 17 yrs. Without addition of the proposed EGC ESP Facility, dredging would be required in 34 yrs.

The volume of the UHS is measured annually to track the progress of sedimentation. These annual measurements will be continued to confirm the available volume of the impoundment.

5.3.4 Impact to Members of the Public

Impacts to members of the public from the cooling system of the proposed EGC ESP Facility might include:

- Thermophilic organisms that could negatively impact human health;
- Thermal and/or vapor plumes; and/or
- Potential for increases in ambient noise levels from the operation of the EGC ESP Facility cooling system and towers.

5.3.4.1 Thermophilic Organisms

Thermophilic organisms are microorganisms that are associated with cooling towers and thermal discharges that have a negative impact on human health. The presence and numbers of these organisms can increase due to elevated temperatures in and around the cooling tower and discharge flume (CPS, 2001). The NPDES permit for the CPS allows a 90-

day average maximum discharge temperature of 99ºF and maximum daily allowable temperature not to exceed 110.7ºF.

Thermophilic organisms may include, but are not limited to, enteric pathogens such as *Salmonella sp., Shigella sp., Pseudomonas aeriginosa,* and *thermophilic fungi.* They also include the bacteria *Legionella sp.* and free-living amoeba of the genera *Naegleria fowleri* and *Acanthomoeba*. Exposure to these microorganisms, or in some cases the endotoxins or exotoxins produced by the organism, may cause illness and death (USNRC, 1999).

Recent IDNR studies on Clinton Lake indicate that these elevated water temperatures may be increasing the risk of the presence of pathogenic amoeba (*Naegleria fowleri*) in the thermal discharge zone and at the beach. Although the IDNR has expressed concern about the presence of *Naegleria fowleri* in Clinton Lake, they also have concluded that the risk to human health is very small and decided to allow swimming and water-skiing in the lake (CPS, 2001). The potential increases in temperature within the mixing zone due to the EGC ESP Facility are discussed in Section 5.2.1.2.3. The increase in the average annual lake temperature within the mixing zone for wet cooling process was estimated to be 0.3 degrees F. This relatively small change in temperature would not increase the risk significantly. Additionally, the EGC ESP Facility thermal discharges will comply with the approved CPS NPDES permit, and therefore, operations will not increase the risk of the presence of *Naegleria fowleri* in Clinton Lake.

5.3.4.2 Cooling Tower Thermal and/or Vapor Plumes

As discussed in Section 5.3.3.1, the operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere. Depending on the type of cooling system(s) used to dissipate this heat, the rejected heat will be manifested in the form of thermal and/or vapor plumes on and around the site.

Quantification of these ambient impacts will necessarily require a more in depth assessment once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.

5.3.4.3 Noise Impacts

There are basically two types of cooling systems that are being considered for use in the EGC ESP Facility and are described below.

- Wet cooling systems utilize mechanical or natural draft cooling towers for evaporative cooling to transfer heat from closed loop process water systems to the atmosphere.
- Hybrid wet/dry cooling systems are a combination of the wet and dry cooling methods.

According to the PPE data gathered, for both the natural draft cooling towers and the mechanical draft cooling towers, the anticipated noise levels from cooling tower operations is anticipated to be 55 dB at 1,000 ft. The Department of Housing and Urban Development uses a day-night average sound level recommended by the USEPA as guidelines or goals for ambient noise levels outdoors in residential areas. Noise levels are deemed acceptable if the day-night average sound level outside in a residential area is less than 65 dB (24 CFR 51). Based on anticipated noise levels being less than USEPA guidelines and Illinois noise requirements, no noise mitigation will be required.

5.4 Radiological Impacts of Normal Operations

The following section identifies and describes the environmental pathways and impacts by which radiation and radiological effluents can be transmitted to the living organisms in and around the EGC ESP Facility. The scope of this section encompasses the pathways by which gaseous and liquid radiological effluents can be transported to and expose individual receptors as well as biota. It also assesses exposure to operations to living organisms in and around the station from increased ambient background radiation levels from plant.

5.4.1 Exposure Pathways

A radiological exposure pathway is the vehicle by which a receptor may become exposed to radiological releases from nuclear facilities. The major pathways of concern are those that could cause the highest calculated radiological dose. These pathways are determined from the type and amount of radioactivity released, the environmental transport mechanism, and how the station environs are used (e.g., residence, gardens). The environmental transport mechanism includes the historical meteorological characteristics of the area that are defined by wind speed and wind direction. This information is used to evaluate how the radionuclides will be distributed within the surrounding area. The most important factor in evaluating the exposure pathway is the use of the environment by the residents in the area around the proposed EGC ESP Facility. Factors such as location of homes in the area, use of cattle for milk, and the growing of gardens for vegetable consumption are considerations when evaluating exposure pathways.

Routine radiological effluent releases from the EGC ESP Facility are a potential source of radiological exposure to man and biota. The potential exposure pathways include aquatic (liquid) and gaseous particulate effluents. The radioactive gaseous effluent exposure pathways include direct radiation, deposition on plants and soil, and inhalation by animals and humans. The radioactive liquid effluent exposure pathways include fish consumption and direct exposure from radionuclides that may be deposited in Clinton Lake. An additional exposure pathway is the direct radiation from the facility equipment and structure during normal operation of the EGC ESP Facility.

The description of the exposure pathways and the calculational methods utilized to estimate doses to the maximally exposed individual and to the population surrounding the EGC ESP Site are based on Regulatory Guides 1.109 and 1.111 (USNRC, 1977 and 1977a). The source terms used in estimating exposure pathway doses are based on the bounding values provided in Chapter 3.

5.4.1.1 Liquid Pathways

Small amounts of liquid radioactive effluents (below regulatory limits) may be mixed with the cooling water and discharged to Clinton Lake. It is expected that the EGC ESP Facility will be operated in a similar fashion to the CPS, which in nine years has not discharged any liquid radiological effluents to the environment. However, since the release of small amounts of radioactive liquid effluents is permitted at the CPS and is expected to be permitted at the EGC ESP Facility as long as releases comply with the requirements specified in 10 CFR 20, the following analyses are provided in order to bound the doses from liquid pathways.

The important exposure pathways include:

- Internal exposure from ingestion of water or contaminated food chain components;
- External exposure from the surface of contaminated water or from shoreline sediment; and
- External exposure from immersion in contaminated water.

Water from Clinton Lake is utilized for potable water at the CPS, and will be used at the EGC ESP Facility, but it will not be utilized in any way for public consumption.

Population dose estimates out past 50 mi will not be calculated based on the conclusions presented in the CPS ER (OLS), Section 5.2.1.2.2, where it is stated that the liquid pathway is not very significant for the 50-mi population dose estimate. There are no municipal or industrial water intakes within 50-mi downstream of the station. Commercial fishing is not allowed on Salt Creek, but is allowed on the Sangamon River. Per the CPS ER (OLS), Section 2.1.3.2.1, Salt Creek joins the Sangamon River 56-mi west of the station. Therefore, the only possible aquatic pathway is due to sport fishing on Clinton Lake and on Salt Creek. However, without detailed dilution and statistics on number of fish caught by sport fishermen, the calculation is not meaningful. In any case, this is not considered to be a significant contribution to the annual population dose within 50 mi, and is therefore, not included in the liquid effluent pathway (CPS, 1982).

The LADTAP II computer program, as described in NUREG/CR-4013, and the liquid pathway parameters presented in Table 5.4-1 and Table 5.4-2 were used to calculate the maximally exposed individual dose from this pathway (USNRC, 1986). This program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1, for radioactivity releases in liquid effluent (USNRC, 1977).

A discussion pertaining to doses calculated for liquid pathways is presented in Section 5.4.2.1.

5.4.1.2 Gaseous Pathways

The methodology contained in the GASPAR II program (described in NUREG/CR-4653) was used to determine the doses for gaseous pathways (USNRC, 1987). This program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1, for radioactivity releases in gaseous effluent. The code calculates the radiation exposure to man from:

- External exposure to airborne radioactivity;
- External exposure to deposited activity on the ground;
- Inhalation of airborne activity; and
- Ingestion of contaminated agricultural products.

Table 5.4-3 and Table 5.4-4 present the gaseous pathway parameters used by the code to calculate doses for both the maximally exposed individual and for the population. A discussion pertaining to doses calculated for this gaseous pathways is presented in Section 5.4.2.2.

5.4.1.3 Direct Radiation from Station Operation

Contained sources of radiation at the EGC ESP Facility will be shielded as was done at the CPS. It is assumed that the direct radiation from any of the EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building.

5.4.2 Radiation Doses to Members of the Public

The following discussion is based on the cumulative impacts from both active CPS and EGC ESP facility operations.

5.4.2.1 Liquid Pathways Doses

Maximum dose rate estimates to man due to liquid effluent releases were determined in the following ways:

- Eating fish or invertebrates caught near the point of discharge;
- Using the shoreline for activities, such as sunbathing or fishing; and
- Swimming and boating on Clinton Lake near the point of discharge.

The estimates for whole-body and critical organ doses from these interactions are presented in Table 5.4-5. These dose rates would only occur under conditions that maximize the resultant dose. It is unlikely that any individual would receive doses of the magnitude calculated.

5.4.2.2 Gaseous Pathways Doses

Dose rate estimates were calculated for hypothetical individuals of various ages exposed to gaseous radioactive effluents through the following pathways:

- Direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground;
- Inhalation of gases and particulates;
- Ingestion of milk contaminated through the grass-cow-milk pathway; and
- Ingestion of foods contaminated by gases and particulates.

Table 5.4-6 provides the estimated whole-body and critical organ doses for the identified gaseous effluent pathways.

5.4.3 Impacts to Members of the Public

5.4.3.1 Impacts from Liquid Pathways

The maximally exposed individual dose calculated was compared to 10 CFR 50, Appendix I criteria and is presented in Table 5.4-7. The maximally exposed individual dose calculated was also compared to 40 CFR 190 criteria and is presented in Table 5.4-8.

5.4.3.2 Impacts from Gaseous Pathways

The following section provides a comparison between the calculated maximally exposed individual dose and 10 CFR 50, Appendix I criteria (see Table 5.4-9). In addition, the maximally exposed individual dose calculated was also compared to 40 CFR 190 criteria (see Table 5.4-10).

The population dose due to gaseous effluents to individuals living within a 50-mi radius of the EGC ESP Facility was also calculated. For these doses, the population data were projected to the year 2010. The population dose for the various pathways (immersion, inhalation, ingestion, and ground deposition) is provided in Table 5.4-11.

5.4.3.3 Direct Radiation Doses from the EGC ESP Facility

It is assumed that the direct radiation from any of the EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building provided in the CPS ER (see Table 5.2-10). The data are reproduced in Table 5.4-12.

Population doses resulting from natural background radiation to individuals living within a 50-mi radius of the EGC ESP Facility is presented in Table 5.4-13 for comparison.

5.4.4 Impacts to Biota Other than Members of the Public

Radiation exposure pathways to biota other than man or members of the public are examined to determine if the pathways could result in doses to biota greater than those predicted for man. This assessment uses surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used since important attributes are well defined and are accepted as a method for judging doses to biota.

Important biota considered are state-or federally-listed species that are endangered, threatened, commercial, recreationally valuable, or important to the local ecosystem. Table 5.4-14 identifies important biota from Section 2.4 and the assigned surrogates in this assessment. Surrogate biota used includes algae (also taken as aquatic plants), invertebrates (taken as fresh water mollusks and crayfish), fish, muskrat, raccoon, duck, and heron.

This assessment uses dose pathway models adopted from Regulatory Guide 1.109 (USNRC, 1977). Pathways included are:

- Ingestion of aquatic foods including fish, invertebrates, and aquatic plants;
- Ingestion of water;
- External exposure water immersion or surface effect;
- External exposure to shoreline residence;
- Inhalation of airborne nuclides;
- External exposure to immersion in gaseous effluent plumes; and
- Surface exposure from deposition of iodine and particulates from gaseous effluents.

Internal exposures to biota from the accumulation of radionuclides from aquatic food pathways are determined using element-dependent bioaccumulation factors. The terrestrial doses are calculated as total body doses resulting from the consumption of aquatic plants, fish, and invertebrates. The terrestrial doses are the result of the amount of food ingested, and the previous uptake of radioisotopes by the "living" food organism. The total body doses are calculated using the bioaccumulation factors corresponding to the "living" food organisms and dose conversion factors for adult man modified for terrestrial animal body mass and size. The use of the adult factors is conservative since the full 50-yr dose commitment predicted by the adult ingestion factors would not be received by biota due to their shorter life spans. These models show that the largest contributions to biota doses are from liquid effluents via the food pathway.

5.4.4.1 Liquid Effluents

The concentrations of radioactive effluents in Clinton Lake are estimated using a partially mixed impoundment model (USNRC, 1977b). The impoundment (Clinton Lake) receives plant effluents and allows additional time for radiological decay before release of effluents to the receiving water body. Dilution of the impoundment occurs due to flow from Salt Creek. Mixing occurs due to drawing water from the impoundment for discharge of the plant's liquid effluents. The model used for estimating nuclide concentrations is similar to that used in the analysis for doses to man described in Section 5.4.2. Table 5.4-1 summarizes parameters used in the calculation of nuclide concentrations in the lake.

The calculation of biota doses in nontidal rivers and near lakeshore environments was performed using LADTAP II (USNRC, 1986). Doses to biota are estimated at Clinton Lake (within the impoundment), and no credit is taken for dilution or transit time from the outflow. Downstream of the Clinton Lake Dam, additional credit for dilution and radio decay occur, resulting in lower nuclide concentrations and doses to biota. This assessment, however, is made for the higher doses occurring in or near Clinton Lake.

Food consumption, body mass, and effective body radii used in the dose calculations are shown in Table 5.4-15. Residence times for the surrogate species are shown in Table 5.4-16 (USNRC, 1986). Table 5.4-17 summarizes parameters used in the pathways dose models. Surrogate biota doses from liquid effluents are shown in Table 5.4-18.

5.4.4.2 Gaseous Effluents

Doses from gaseous effluents also contribute to terrestrial total body doses. External doses occur due to immersion in a plume of noble gases and deposition of radionuclides on the ground. The inhalation of radionuclides followed by the subsequent transfer from the lung to the rest of the body also contributes to total body doses. Inhaled noble gases are poorly absorbed into the blood and do not contribute significantly to the total body dose. The noble gases do contribute to a lung organ dose, but do not make a contribution via this path to the total body dose.

Immersion and ground deposition doses are largely independent of organism size and the doses for the maximally exposed individual, described in Section 5.4.2, can be applied. The external ground doses, described in Section 5.4.2, and calculated by GASPAR II are increased to account for the closer proximity to ground of terrestrials (USNRC, 1987). This approach is similar to the adjustments made for biota exposures to shoreline sediment performed in LADTAP II. Doses from gaseous effluents to terrestrials are also adjusted for site residency times and are based on Table 5.4-16. The inhalation pathway doses for biota are the internal total body doses calculated by GASPAR II for man, as described in Section 5.4.2. The total body inhalation dose (rather than organ specific doses) is used since the biota doses are assessed on a total body basis. Table 5.4-17 summarizes some of the parameters used in the gaseous effluent dose models.

5.4.4.3 Biota Doses

The following discussion is based on the cumulative impacts from both active CPS and EGC ESP facility operations. Doses to biota from liquid and gaseous effluents are shown in Table 5.4-18. Table 5.4-19 shows those doses meeting the whole body dose equivalent criterion in 40 CFR 190. Dose criteria are applicable to man and are considered conservative when applied to biota. The criteria in 40 CFR 190 for thyroid and next highest organ doses are not used in this analysis since doses are based on total body doses. The total body dose is taken as the sum of the internal and external dose. In man, the internal dose from individual organs is weighted by factors less than unity to arrive at the whole body dose equivalent. Thus, a unity factor is assumed for the entire internal dose. Table 5.4-19 shows that annual doses to five of the seven surrogates can meet the requirements of 40 CFR 190.

Use of exposure guidelines, such as 40 CFR 190, which apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. The International Council on Radiation Protection states that "...if man is adequately protected then other living things are also likely to be sufficiently protected," and uses human protection to infer environmental protection from the effects of ionizing radiation (ICRP, 1977 and ICRP, 1991). This assumption is appropriate in cases where humans and other biota inhabit the same environment and have common routes of exposure. It is less appropriate in cases where human access is restricted or pathways exist that are much more important for biota than for humans. Conversely, it is also known that biota with the same environment and exposure pathways as man can experience higher doses without adverse effects.

Species in most ecosystems experience dramatically higher mortality rates from natural causes than man. From an ecological viewpoint, population stability is considered more important to the survival of the species than the survival of individual organisms. Thus, higher dose limits could be permitted. In addition, no biota have been discovered that show significant changes in morbidity or mortality to radiation exposures predicted for nuclear power plants.

An international consensus has been developing with respect to permissible dose exposures to biota. The International Atomic Energy Agency (IAEA) evaluated available evidence (ORNL, 1995) including the *Recommendations of the International Commission on Radiological Protection* (ICRP, 1977). The IAEA found that appreciable effects in aquatic populations would not be expected at doses lower than 1 unit of absorbed dose (100 ergs/gm) per day (rad/day) and that limiting the dose to the maximally exposed individual organisms to less than 1 rad/day would provide adequate protection of the population. The IAEA also concluded that chronic dose rates of 0.1 rad/day or less do not appear to cause observable changes in terrestrial animal populations. The assumed lower threshold occurs for terrestrials rather than for aquatic animals primarily because some species of mammals and reptiles are considered more radiosensitive than aquatic organisms. The permissible dose rates are considered screening levels and higher species-specific dose rates could be acceptable with additional study or data.

The calculated total body doses for biota are compared in Table 5.4-20 to the dose criteria evaluated in the *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards* (ORNL, 1995). The biota doses meet the dose guidelines by a large margin. In these cases, the annual dose to biota is much less than the daily allowable doses to aquatic and terrestrial organisms.

5.4.5 Occupational Radiation Exposures

This section provides a discussion of the anticipated occupational radiation exposure to EGC ESP Facility operating personnel. Estimates of these radiation doses are intended to provide a quantitative basis for the regulatory assessment of the potential risks and health impact to operating personnel.

Similar to current plant designs, occupational exposure from the operation of advanced reactor designs will continue to result from exposure to direct radiation from contained sources of radioactivity and from the small amounts of airborne sources typically resulting from equipment leakages. Past experience demonstrates that, for commercial nuclear power reactors, the dose to operating personnel from airborne activity is not a significant contributor to the total occupational dose. This experience is expected to continue to apply to the EGC ESP Facility.

As indicated in NUREG-1437 (USNRC, 1996), for the purpose of assessing radiological impacts to workers, the Commission has concluded that impacts are of small significance if doses and releases do not exceed permissible levels in the Commission's regulations. The standards for acceptable dose limits are given in 10 CFR Part 20. For any reactor concept selected for deployment at the ESP site, the radiation exposures to operating personnel will be maintained within the limits of 10 CFR 20 and will also satisfy the as low as reasonably achievable (ALARA) guidance contained in Standard Review Plan Chapter 12.1 (USNRC, 1996a) and Regulatory Guide 8.8 (USNRC, 1978a).

Administrative programs and procedures governing Radiation Protection and Health Physics in conjunction with the radiation protection design features of the EGC ESP Facility will be developed with the intent to maintain occupational radiation exposures ALARA. The advanced light water reactor designs being considered have or will incorporate radiation protection features that go beyond the designs provided for plants currently in operation. In addition, gas-cooled reactor design basis source terms and expected operating characteristics exhibit lower radiation levels during normal operation and for abnormal operating occurrences. Consequently, for environmental impact assessment purposes, it is reasonable to expect and conclude that the annual operator exposures for the EGC ESP Facility will be bounded by the operating experience exhibited by existing operating light water reactors (LWR).

The average annual collective occupational dose information for LWR plants operating in the United States between 1973 and 2002 is given in Table 5.4-21, based on data provided in NUREG-0713 (USNRC, 2003). The more recent dose data presented in this report are based on 35 operating BWRs and 69 PWRs. The data show that, historically (since 1974), the average collective dose and average number of workers per BWR type plant have been higher than those for PWRs and that the values for both parameters, in general, continued to rise until 1983. Thereafter (data through 2002), the average collective dose per LWR dropped by 84 percent. The overall decreasing trend in average reactor collective doses since 1983 is indicative of successful implementation of ALARA dose reduction measures at commercial power reactor facilities.

The variation in annual collective dose at operating reactors results from a number of factors such as the amount of required maintenance, the amount of reactor operations and required in-plant surveillances. These factors have varied in the past, but are expected to improve with the advance designs concepts under consideration for the EGC ESP Facility.

The 3-year average collective dose per reactor is one of the metrics that the NRC uses in the Reactor Oversight Program to evaluate the effectiveness of a licensee's ALARA program. Tables 5.4-22 and 5.4-23 show the BWR and PWR commercial reactor sites in operation for at least 3 years as of December 31, 2002 and detail the occupational exposure statistics. As shown in Table 5.4-22, the BWR average annual collective total effective dose equivalent (TEDE) per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 162 person-rem, 0.19 rem, and 0.20 person-rem per MW-yr, respectively. Similarly, as presented in Table 5.4-23, the PWR average annual collective TEDE per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 91 person-rem, 0.15 rem, and 0.11 person-rem per MW-yr, respectively.

Using this metric and the distribution of occupational exposures, a conservative estimate for the EGC ESP Facility is expected to be less than the recent BWR average collective TEDE dose per reactor of 162 person-rem, but could average during any particular 3 year averaging period as much as 2 to 3 times this value over the life of the facility. The average annual dose of about 0.2 rem per nuclear plant worker at operating BWRs and PWRs is well within the limits of 10 CFR 20. These exposures are considered to be of small significance and pose a risk that is comparable to the risks associated with other industrial occupations.

5.5 Environmental Impacts of Waste

Presented in the following sections is a generic discussion regarding the environmental impacts of waste, nonradioactive and mixed waste (a matrix of low-level radioactive and hazardous waste), as they pertain to the EGC ESP Facility operation. Regulations for generating, management, handling, storage, treatment, protection requirements and disposal of these types of waste are contained in 10 CFR series managed by the USNRC and the 40 CFR series managed by the USEPA.

5.5.1 Nonradioactive Waste-System Impacts

This section describes the nonradioactive waste management systems and associated impacts from the generation of nonradioactive and non-hazardous solid, liquid, and gaseous waste from EGC ESP Facility operations. A more detailed description of these nonradioactive waste management and effluent systems is provided in Chapter 3.

5.5.1.1 Nonradioactive Solid Waste

Solid nonradioactive and non-hazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, paper, etc., and will be collected from several on-site locations and deposited in dumpsters located throughout the site. Segregation and recycling of waste will be practiced to the greatest extent practical. The material will either be disposed of on site or the Applicant will contract with an outside vendor who will perform weekly collections and disposal at area landfills. If collected and disposed of off site, it is not expected that the amount of solid waste generated will significantly contribute to the total amount of household waste disposed of weekly by area residents.

5.5.1.2 Nonradioactive Liquid Effluents

Nonradioactive liquid wastes from the site may include, but are not limited to, boiler blowdown (continual or periodic purging of impurities from auxiliary boilers), water treatment wastes, floor and equipment drains, sanitary sewer systems, and stormwater runoff.

5.5.1.2.1 Liquid Effluents Containing Biocides or Chemicals

The chemical waste effluents may consist of the nonradioactive wastes produced from the regeneration of demineralizers and blowdown; waste discharges from reverse osmosis units and filter backwash water; and wastes from laboratory and sampling processes. Drains from radioactive sources or potentially radioactive sources will not be connected to the chemical waste drain system. Chemical waste discharges will be collected in a tank for sampling and pH adjustment before being discharged as neutralized wastes to Clinton Lake. The chemical wastes will be routed to the discharge flume of the CPS, which flows to Clinton Lake.

Based on the evaluation of PPE bounding data (see SSAR Tables 1.4-1 and 1.4-2), a generic list of principal chemical, biocide, and pollutant sources that may be used or produced during the operation of the EGC ESP Facility may include, but are not limited to, the following:

- Sodium hydroxide and sulfuric acid, which are used to regenerate resins (depending on plant design);
- Phosphate in cleaning solutions;
- Biocides used for condenser defouling;
- Boiler blowdown chemicals;
- Oil and grease from plant floor drains;
- Chloride;
- Sulphates;
- Copper;
- Iron; and
- Zinc.

The estimated concentration of impurities in the blowdown water is presented in Chapter 3. The total amount of anticipated discharges from the chemical waste and demineralizer treatment system to Clinton Lake is also presented in Chapter 3.

Other small volumes of wastewater, which may be released from other station sources, are described in the SSAR for the EGC ESP Facility. These will be discharged from sources such as the service water and auxiliary cooling systems, water treatment, laboratory and sampling wastes, floor drains, and stormwater runoff. These waste streams will be discharged as separate point sources or will be combined with the cooling water discharges.

It is expected that chemical treatment of the safety-related cooling water system with biocides, dispersants, molluskicides, and scale inhibitors will be required on a periodic basis. The chemicals used will be subject to review and approval for use by the IEPA, and releases will comply with an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA. These limits will be protective of the water quality of Clinton Lake.

5.5.1.2.2 Sanitary System Effluents

Sanitary system wastes that are anticipated to be discharged to Clinton Lake during actual station operations include discharges from the potable and sanitary water treatment system. It is anticipated that the sanitary system effluents will receive tertiary treatment consisting of presettling, filtration, and chlorination prior to release to the environment via the circulating water discharge flume. The normal and maximum amount of sanitary discharges to Clinton Lake based on PPE data for the composite reactor (see SSAR Table 1.4-1) is presented in Chapter 3. These discharges will comply with the approved NPDES permit for the EGC ESP Facility.

5.5.1.2.3 Other Effluents

Other small volumes of wastewater will be discharged from additional sources, such as the service water and auxiliary cooling systems, water treatment, laboratory and sampling wastes, floor drains, and stormwater runoff. Some of these waste streams will be discharged as separate point sources or will be combined with the cooling water and discharged to Clinton Lake. The normal and maximum amount of miscellaneous discharges to Clinton Lake based on PPE data (see SSAR Table 1.4-1) is presented in Chapter 3.

Facility stormwater drainage control systems will be presented at the COL phase to the appropriate permitting agency.

A Storm Water Pollution Prevention Plan (SWPPP) will be written, if deemed appropriate, that will meet the requirements of a permit for stormwater discharges from the EGC ESP Facility. The plan will include aspects of stormwater pollution prevention common to areas of the EGC ESP Facility that have a potential to discharge stormwater to waters of the U.S. The aspects common to activities will include site description and assessment, erosion and sediment control, stormwater management, identification and control of potential sources of pollution, implementation, maintenance, inspection, and stabilization.

Stormwater discharges are a significant source of pollutants and a major cause of water use impairment in receiving streams. Stormwater runoff becomes polluted as it flows over surfaces picking up soil particles and other pollutants. The USEPA's goal of stormwater management is to improve water quality by reducing pollutants in stormwater discharges.

A SWPPP primary purpose is to prevent discharges from facilities that cause, or have reasonable potential to cause or contribute to, violations of water quality standards. The USEPA determined the best approach to stormwater management for facilities is through self-designed stormwater pollution prevention plans based on the use of control measures. There are three types of control measures: those that prevent erosion, those that trap pollutants before they can be discharged, and those that prevent contact between pollutants and stormwater runoff. The plans are designed to prevent or minimize the pollution of stormwater before it has a chance to affect receiving streams. Erosion and sedimentation controls for preconstruction and construction activities are discussed in Section 4.6.

5.5.1.2.4 Mitigation

The nonradioactive liquid wastes will be checked for proper pH and the presence of radiological and hazardous constituents, discharged as a separate point source or combined with plant circulating water prior to discharge to Clinton Lake. These discharges comply with the approved NPDES permit for the EGC ESP Facility issued by the IEPA.

5.5.1.3 Gaseous Effluents

Bounding estimates for gas releases are provided in Chapter 3.

Air emissions will be in compliance with the limits that will be established and imposed by state and local regulations. These limits will be protective of the air quality in and around the EGC ESP Facility.

5.5.2 Mixed Waste Impacts

In regulatory parlance, the term "mixed waste" refers specifically to waste that is regulated as both radioactive and hazardous waste. Mixed wastes are dually regulated for their radioactive materials and hazardous waste constituents. The radioactive materials are regulated by the USNRC or an Agreement State (states that have entered into an Agreement with the USNRC to regulate facilities, other than Federal facilities and nuclear power plants) under the AEA; and the hazardous wastes are regulated by the USEPA or an Authorized State (a state authorized by the USEPA to regulate those portions of the Federal act) under the Resource Conservation and Recovery Act (RCRA).

Most low-level mixed wastes consist of low-level radioactive wastes combined with hazardous materials in the same matrix. It exists throughout the commercial, industrial, and government sectors. Mixed waste falls into two basic waste forms, liquids and solids.

The hazardous component of mixed waste presents the major regulatory treatment challenge in meeting the USEPA regulations for land disposal. The radioactive component of mixed waste, while posing a challenge from a health, safety, and environmental protection standpoint, is usually not the controlling factor for treatment.

These tend to be difficult waste streams to manage and facilities with the proper technology and permits are not ubiquitous; thus, the technology required to process the waste is the most influential factor in deciding where the waste will be sent for treatment, storage, and disposal. Transportation costs are a minimal factor when selecting treatment options.

As a general practice, EGC ESP Facility personnel will strive not to generate mixed waste at the EGC ESP Facility. It is expected that with the implementation of proper chemical handling techniques, prejob planning, and compliance with an approved facility waste minimization plan, only small quantities of mixed waste will be generated. It is almost impossible to project the types and quantities of mixed waste that may be generated without knowing specific design details about the plant. However, if mixed waste is generated, the volume may be reduced or eliminated by one or more of the following basic types of treatment prior to disposal: decay, stabilization, neutralization, filtration, and chemical or thermal destruction by an off-site vendor. If required, programs will be implemented and mixed waste storage facilities constructed to store mixed waste for decay or for storage prior to shipment to an approved off-site treatment or disposal area. It is not the Applicant's intention to dispose of mixed waste on site.

There will be no environmental impacts from storage or shipment activities if both activities are performed in compliance with approved facility procedures, storage requirements, and regulatory requirements. In the event of a spill, emergency procedures will be implemented to limit any on-site impacts. Emergency response personnel will be properly trained and will be routinely provided with a facility inventory, which will include types, volumes, locations, hazards, control measures, and precautionary measures to be taken in the event of a spill.

If generated on site, mixed waste will be assessed based on the following regulatory guidance. Mixed waste (low level radioactive and hazardous waste) is waste that satisfies the definition of low level radioactive waste in the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA) and contains hazardous waste that either: 1) is listed as a hazardous waste in 40 CFR 261(d); or 2) causes the waste to exhibit any of the hazardous waste characteristics identified in 40 CFR 261(c). Persons who generate, treat, store, or dispose of mixed wastes are subject to the requirements of the AEA, as amended, the Solid Waste Disposal Act (SWDA) as amended by the RCRA, and the Hazardous and

Solid Waste Amendments of 1984 (HSWA). The federal agencies responsible for ensuring compliance with the implementing regulations of these two statutes are the USNRC and the IEPA. In October of 1992, Congress enacted the Federal Facilities Compliance Act (FFCA), which, among other things, added a definition of mixed waste to RCRA. Mixed waste is defined in the FFCA as "waste that contains both hazardous waste and source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954."

Since there is presently no information available regarding the generation of mixed waste during operations of the proposed composite reactor, information was obtained from a preliminary survey performed for the USNRC. It identified two potential types of generated mixed low-level waste (LLW) at reactor facilities:

- LLW containing organic liquids, such as scintillation liquids and vials; organic lab liquids; sludges; and cleaning, degreasing, and miscellaneous solvents.
- LLW containing heavy metals, such as discarded lead shielding, discarded lined containers, and lead oxide dross containing uranium oxide; light-water reactor (LWR) process wastes containing chromate and LWR decontamination resins containing chromium; and mercury amalgam in trash.

Mixed waste is sometimes generated during routine maintenance activities, refueling outages, health physics activities, and radiochemical laboratory activities. The vast majority of mixed waste that is stored at nuclear power plants is chlorinated fluorocarbons (CFCs) and waste oil. Other sources may include liquid scintillation fluids, and other types of organic materials including lead, chromium, and aqueous corrosives (USNRC, 1999).

Mixed waste is commonly stored on site due to the lack of treatment and disposal sites. For this reason, impacts resulting from the chemical hazards and occupational exposures to radiological material may be somewhat higher than would otherwise be expected. In addition, occupational chemical and radiological exposures may occur during the testing of mixed wastes in order to determine if the constituents are chemically hazardous.

The EGC ESP Facility personnel will place primary importance on source reduction efforts to prevent pollution, and eliminate or reduce the generation of mixed waste. Potential pollutants and wastes that cannot be eliminated or minimized will be evaluated for recycling. Treatment to reduce the quantity, toxicity, or mobility of the mixed waste before storage or disposal will be considered only when prevention or recycling is not possible or practical. Environmentally safe disposal will be the last option (USNRC, 1999).

A Pollution Prevention and Waste Minimization Program (PPWMP) will be developed, if deemed appropriate, and implemented before initial reactor operations. Elements of a successful program are described in the following sections.

5.5.2.1 Pollution Prevention and Waste Minimization Program

5.5.2.1.1 Inventory Management

Inventory management or control techniques will be used to reduce the possibility of generating mixed waste resulting from excess or out-of-date chemicals and hazardous substances. Where necessary, techniques will be implemented to reduce inventory size of hazardous chemicals, size of containers, and amount of chemicals, while increasing inventory turnover.

A chemical management system, if required, will be established, prior to initial operation, and acquisition of new chemical supplies will be documented in a controlled process that addresses, as appropriate, the following:

- Need for the chemical;
- Availability of non-hazardous or less hazardous substitutes or alternatives; and
- Amount of chemical required and the on-site inventory of the chemical.

Excess chemicals will be managed in accordance with the station's chemical management procedures. Excess chemicals that are deemed usable will be handled through an excess chemical program. Material control operations will be revised or expanded to reduce raw material and finished product loss, waste material, and damage during handling, production, and storage. The inventory management procedures will be periodically assessed and updated, as appropriate, using criteria that include the following considerations:

- If existing inventory management techniques are in accordance with existing pollution prevention and waste minimization guidelines, and regulatory guidelines;
- How existing inventory management procedures can be applied more effectively;
- Whether new techniques will be added to or substituted for current procedures;
- If the review and evaluation approval procedures for the purchase of materials will be revised;
- If additional employee training in the principles of inventory management is needed;
- How specifications for the review and revision of procurement limit the purchase of environmentally sound products; and
- How to increase the purchase of recycled products.

5.5.2.1.2 Maintenance Program

Equipment maintenance programs will be periodically reviewed to determine whether improvements in corrective and preventive maintenance can reduce equipment failures that generate mixed waste. The methods for maintenance cost tracking and preventive maintenance scheduling and monitoring will be examined. Maintenance procedures will be reviewed in order to determine which are contributing to the production of waste in the form of process materials, scrap, and cleanup residue. In addition, the need for revising operational procedures, modifying equipment, and source segregation and recovery will be determined.

5.5.2.1.3 Recycling and Reuse

Recycling of the waste types will be considered. Opportunities for reclamation and reuse of waste materials will be explored whenever feasible. Decontamination of tools, equipment, and materials for reuse or recycle will be used whenever possible to minimize the amount of waste for disposal. Impediments to recycling, whether regulatory or procedural, will be challenged to enable generators to recycle whenever possible.

5.5.2.1.4 Segregation

When radiological or hazardous waste is generated, proper handling, containerization, and separation techniques will be employed, as applicable. This will be done to minimize cross contamination resulting in the generation of unnecessary mixed waste.

5.5.2.1.5 Decay-In-Storage of Mixed Waste

Some portion of the generated mixed waste will, most probably, contain radionuclides with relatively short half-lives. The USNRC generally allows facilities to store waste containing radionuclides with half-lives of less than 65 days until 10 half-lives have elapsed and the radiation emitted from the unshielded surface of the waste, as measured with an appropriate survey instrument, is indistinguishable from background levels. The waste can then be disposed of as a nonradioactive waste. Radioactive waste can also be stored for decay under certain circumstances in accordance with 10 CFR 20. For mixed waste, storage for decay is particularly advantageous, since the waste can be managed solely as a hazardous waste after the radionuclides decay to background levels. Thus, the management and regulation of these mixed wastes are greatly simplified by the availability of storage for decay.

5.5.2.1.6 Work Planning

Prejob planning will be completed to determine what materials and equipment are needed to perform the anticipated work. One objective of this planning is to prevent pollution and minimize the amount of mixed waste that may be generated and to use only what is absolutely necessary to accomplish the work. Planning will also be completed to prevent mixing of materials or waste types.

5.5.2.1.7 Pollution Prevention Tracking Systems

A tracking system will be developed, if required, to identify waste generation data and PPWMP opportunities. This will provide essential feedback to successfully guide future efforts. The data collected by the system will be used for internal reporting. The tracking system will provide feedback on the progress of the PPWMP including the results of the implementation of pollution prevention technologies. In addition, it will facilitate reporting pollution prevention data and accomplishments to the USNRC and IEPA.

The system will track waste from point of generation to point of final disposition (cradle to grave). The system will also permit the tracking of hazardous substances from the point of site entry to the final disposition in order to comply with environmental regulations and reporting requirements. The system will collect data on input material, material usage, type of waste, volume, hazardous constituents, generating system, generation date, waste management costs, and other relevant information.

5.5.2.1.8 Implement Pollution Prevention and Waste Minimization Awareness Programs

A successful PPWMP requires employee commitment. By educating employees in the principles and benefits of a PPWMP, solutions to current and potential environmental management problems can be found. The broad objective of the PPWMP is to educate employees in the environmental aspects of activities occurring at the EGC ESP Facility, in their community, and in their homes. A PPWMP will be developed and implemented, as required, that incorporates the following:

- A waste minimization plan that will be routinely reviewed, revised, and implemented during the phases of the EGC ESP Facility construction and operation;
- Educate employees of general environmental activities and hazards at the EGC ESP Facility and pollution prevention program and waste minimization requirements, goals, and accomplishments;
- Inform employees of specific environmental issues;
- Train employees on their responsibilities in pollution prevention and waste minimization;
- Recognize employees for efforts to improve environmental conditions through pollution prevention and waste minimization; and
- Encourage employees to participate in pollution prevention and waste minimization.

5.5.2.1.9 Implement Environmentally Sound Pollution Prevention Procurement Practices

The EGC ESP Facility will implement procurement practices that comply with regulatory guidance, and other requirements for the purchase of products with recovered materials. This includes the elimination of the purchase of ozone depleting substances and the minimization of the purchase of hazardous substances.

5.5.2.1.10 Assure Consistent Policies, Orders, and Procedures

Policies and procedures will be developed, as applicable, to reflect a focus on integrating PPWMP objectives into EGC ESP Facility activities. The Environmental, Health, and Safety departments will review new procedures for EGC ESP Facility activities. The procedures will determine whether the elimination or revision of procedures can contribute to the reduction of waste (hazardous, radiological, or mixed). This will include incorporating PPWMP into the appropriate on-site work procedures. Changes to procurement procedures to require affirmative procurement of IEPA-designated recycled products, and reduction of procurement of ozone-depleting substances will also be completed.

5.5.2.2 Mixed Waste Impacts

5.5.2.2.1 Chemical Hazards Impacts

Generation and storage of mixed waste on site has the potential to expose workers to hazards associated with the chemical component of the mixed waste matrix from leaks and spills. Mixed waste can, and usually does, exhibit one of the following hazardous characteristics: ignitability, corrosivity, reactivity, or toxicity, as well as exhibiting the characteristics of a radiological hazard (i.e., contamination and radiation). Even though personnel may be properly trained, handling and storage accidents do occur where acids are stored with bases and may become reactive during a spill. Thus, it potentially exposes workers and emergency response personnel during subsequent cleanup efforts both from the standpoint of the chemical hazard, but also based on the radiological hazards that may be present. Another example might include the improper storage of oxidizers (nitric acid, nitrates, peroxides, chlorates) and organics with inorganic reducing agents (metals).

The EGC ESP Facility Environmental Health and Safety management will implement and enforce the following guides if it is necessary to store mixed wastes on site:

- Use the area only for storage of mixed waste and not for storing unrelated materials or equipment, or for other functions;
- Follow proper storage protocols for different kinds of mixed waste;
- Label the containers properly and in accordance with regulatory requirements;
- Follow the container label requirements;
- Post applicable material safety data sheets, emergency spill response procedures, and have a spill kit in the area;
- Install fire detection and suppression equipment (if required), alternate water supply, telephone, and alarm at the area;
- Make an emergency shower/eyewash station immediately available, where it is tested weekly and functioning;
- Fence and lock the gate to the accumulation area or long-term storage area when authorized personnel are not present;
- Post "MIXED HAZARDOUS WASTE AREA" and "DANGER—UNAUTHORIZED PERSONNEL—KEEP OUT" signs at the entrance;
- Provide secondary containment for liquid mixed hazardous waste;
- Conduct weekly inspections; and
- Post "NO SMOKING OR OPEN FLAME" signs.

The EGC ESP Facility management will also develop and implement contingency plans, emergency preparedness, and prevention procedures that will be utilized in the event of a mixed waste spill. The EGC ESP Facility personnel who are designated to handle mixed waste or whose job function it is to provide emergency response to mixed waste spills will receive appropriate training in order to perform their work properly and safely.

If mixed waste is generated and shipped for treatment and disposal rather than stored, EGC ESP Facility management will identify potential disposal facilities considering the following selection criteria:

- The desired method of treatment or disposal (e.g., incineration vs. land disposal);

- The disposal facility's permit (e.g., can they accept polychlorinated biphenyls (PCBs), hazardous waste, or radioactive waste);
- The disposal facility's turnaround time on approvals;
- The form of waste, (e.g., is it soil, debris, semi-solid, or liquid);
- The mass or volume of waste; and
- The cost of transportation and disposal.

The EGC ESP Facility management will also identify one disposal facility as the primary facility, and a second facility will be identified as an alternate in the event that laboratory testing or other observations prove the waste to be different than initially determined.

5.5.2.2.2 Radiological Hazards Impacts

If mixed waste is generated, it must either be stored on site or shipped off site for treatment and subsequent disposal. Off-site shipment, treatment, and disposal will depend on the toxicity levels and radiological characteristics of the mixed waste. Personnel performing packaging and shipping operations have the potential to be exposed to increased ambient radiation levels from the containers and may exceed their yearly ALARA goals. If stored at the facility, the USEPA mandates that waste storage containers must be inspected on a weekly basis, and certain aboveground portions of waste storage tanks must be inspected on a daily basis. The purpose of these inspections is to detect leakage from, or deterioration of, containers (40 CFR 264). The USNRC recommends that waste in storage be inspected on at least a quarterly basis (10 CFR 20). The methods used for these inspections may include direct visual monitoring or the use of remote monitoring devices for detecting leakage or deterioration. The remote methods would reduce exposures due to direct visual inspections. Additionally, measures will be provided to promptly locate and segregate or remediate leaking containers.

5.6 Transmission Systems Impacts

This section describes the potential impacts on terrestrial and aquatic ecosystems induced by the operation and maintenance of transmission systems including operation and maintenance of applicable rights-of-way. The impacts described in this section were developed by the applicant. However, operation of transmission lines and corridors necessary to connect a new plant to the grid will generally be the responsibility of the transmission system operator, and the applicant assumes that the transmission system operator will perform new impact studies under FERC regulations.

Proposed transmission systems will be sited within existing Illinois Power Company rights-of-way to the greatest extent possible. The proposed transmission line enhancements will require dual transmission lines and encompass an area approximately 250 ft in width (see Section 3.7).

Transmission systems are typically maintained using a combination of mechanical trimming and mowing and selective use of herbicides. Trees and shrubs that obstruct access along the transmission line right-of-way or pose a safety concern to the lines and pole structures will be removed. The right-of-way will periodically be maintained to control vegetative growth using mechanical mowing (e.g., brush hogs) and selective use of herbicides to control noxious species such as vines that climb poles. It has been assumed that the transmission line will be operated and maintained in accordance with existing approved Illinois Power Company plans and procedures.

5.6.1 Terrestrial Ecosystems

This section describes the potential impacts to terrestrial ecosystems as a result of operation and maintenance of transmission system corridors required to support the EGC ESP Facility. The proposed transmission corridor (see Figure 2.2-4) will be sited within an existing utility corridor to the greatest extent possible.

Land uses traversed by the proposed transmission corridor are predominantly agricultural. Operation and maintenance activities in agricultural areas are typically minimal as the vegetative growth is under control.

Periodic maintenance of the proposed transmission rights-of-way will result in the cutting of any trees, shrubs, or other vegetation observed. Rights-of-way will be maintained in accordance with the transmission corridor owner or operators plans and procedures.

Towers required for the transmission system may eliminate a small amount of productive agricultural lands, but the overall amount of land used will be insignificant in comparison to the total amount of agricultural lands along the proposed transmission corridor.

5.6.1.1 Important Species

According to the USNRC, "important species" are defined as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

5.6.1.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation and maintenance of the proposed transmission systems are not anticipated to impact federally-listed threatened or endangered species (IDNR, 2002).

The USFWS will be contacted in order to discuss any federally-listed (or proposed for listing) threatened or endangered terrestrial species within the proposed transmission system corridor.

5.6.1.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation of the EGC ESP Facility is not anticipated to impact state-listed threatened or endangered species (IDNR, 2002). Transmission towers and lines will be located in the vicinity of existing towers and lines; therefore, mortality to any state-listed species of concern (including a variety of birds species discussed in Section 2.4) is not anticipated to increase significantly over current levels.

5.6.1.1.3 Species of Commercial or Recreational Value

As previously mentioned, “important species” include those terrestrial species that present value in a commercial or recreational manner. Species that are commercially or recreationally valuable that can be found within the site vicinity include white-tailed deer, several species of waterfowl, and a variety of small mammals commonly hunted along the proposed transmission system corridor. Detailed descriptions of these species can be found in Section 2.4.1.

It is anticipated that construction of the proposed transmission system may temporarily displace certain recreationally valuable species including deer, small mammals, game birds, and waterfowl. However, operation and maintenance activities are not anticipated to have adverse effects on species of commercial or recreational value.

5.6.1.2 Important Habitats

According to the USNRC, “important habitats” include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

5.6.1.2.1 Clinton Lake State Recreation Area

The proposed transmission system corridor will be sited within an existing utility corridor to the greatest extent possible. Periodic maintenance of the right-of-way will be required; however, no adverse impacts to the Clinton Lake State Recreation Area are anticipated as a result of the operation and maintenance of the proposed transmission systems.

5.6.1.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 5.5 mi from the location of the EGC ESP Facility. The proposed transmission system corridor is not located within the Weldon Springs State Recreation Area, and therefore, will have no direct impacts to the area.

5.6.1.2.3 Environmentally Sensitive Areas

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees under the jurisdiction of the Illinois Nature Preserves Commission.

The proposed transmission systems will be located within existing utility rights-of-way to the greatest extent possible. Towers required to support the proposed transmission system would be sited in upland areas to the greatest extent possible. Appropriate best management practices will be utilized so that adverse impacts to any environmentally sensitive areas potentially occurring along the proposed corridor are avoided during periodic maintenance activities.

5.6.1.2.4 Other Important Habitats

As previously mentioned, the proposed transmission system will be located within existing utility rights-of-way to the greatest extent possible. Appropriate best management practices will be utilized so that adverse impacts to any important habitats potentially occurring along the proposed corridor are avoided during periodic maintenance activities.

5.6.1.2.5 Wetlands and Floodplains

The proposed transmission system corridor has been located within existing utility rights-of-way to the greatest extent possible. Towers required to support the proposed transmission system will be sited within upland areas within the existing utility corridor. There will be no net loss of wetland or floodplain resources resulting from operation or maintenance of the proposed transmission system corridor.

5.6.1.3 Maintenance

Required maintenance activities will be consistent with maintenance practices being utilized for the existing utility corridor. It is anticipated that there will be no adverse effects to terrestrial ecosystems resulting from maintenance activities including applicable roadway maintenance and required periodic mechanical clearing.

5.6.1.4 Indirect Impacts

The proposed transmission system will be located within an active transmission right-of-way. Therefore, it is assumed that any projected indirect impacts associated with such issues as EMF and bird strikes along transmission lines will be minimal. Approximately 88 percent of the right-of-way is active agricultural land, and it is assumed that any residential development will occur outside of the utility corridor (see Section 3.7). Active agricultural lands typically have low quality habitat for bird nesting and roosting. Given the length of time the existing transmission towers and lines have been in the area, it is presumed that bird strike potential will not significantly increase.

5.6.2 Aquatic Ecosystems

This section describes the impacts to aquatic ecosystems as a result of operation and maintenance of transmission system corridor required to support the EGC ESP Facility.

The proposed transmission corridor (see Figure 2.2-4) has been sited along an existing utility corridor.

Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor to the greatest extent possible. An effort will be made to avoid adverse impacts to watercourses, wetlands, and floodplains.

Appropriate construction procedures and best management practices will be used to minimize disturbances to existing wetlands, floodplains, and other aquatic ecosystems located within or along the existing corridor, during operation and maintenance activities. In marsh and emergent growth, wetlands vegetation maintenance is typically not required. In shrub and forested wetland areas, mowing and trimming is periodically required to keep growth outside of the line areas and away from poles. Periodic maintenance will be performed in accordance with the transmission corridor owner or operators plans and procedures.

5.6.2.1 Important Species

According to the USNRC, “important species” are defined as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

5.6.2.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation and maintenance of the proposed transmission system is not anticipated to impact federally-listed threatened or endangered species (IDNR, 2002). The USFWS will be contacted in order to confirm the absence of any federally-listed (or proposed for listing) threatened or endangered fish or other aquatic species. In addition, the National Marine Fisheries Service will be contacted in order to confirm the presence or absence of any federally-listed (or proposed for listing) threatened or endangered species under their jurisdiction.

5.6.2.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation and maintenance of the EGC ESP Facility is not anticipated to impact state-listed threatened or endangered aquatic species (IDNR, 2002). Appropriate state wildlife agencies will be contacted to confirm the absence of state-listed threatened or endangered species along the proposed transmission system corridor.

5.6.2.1.3 Species of Commercial or Recreational Value

As previously mentioned, “important species” include those aquatic species that present value in a commercial or recreational manner. Species that are commercially or recreationally valuable that can be found within the vicinity include channel catfish, striped bass, largemouth bass, and walleye. Detailed descriptions of these species can be found in Section 2.4.2.

No direct impacts to watercourses, including Clinton Lake and other streams and tributaries along the proposed transmission system corridor, are anticipated as a result of operation and maintenance. Therefore, impacts to commercially or recreationally valuable aquatic species are not anticipated as a result of the operation and maintenance of the proposed transmission system corridor.

5.6.2.2 Important Habitats

According to the USNRC, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

5.6.2.2.1 Clinton Lake State Recreation Area

The proposed transmission system corridor has been sited within an existing utility corridor to the greatest extent possible. No adverse impacts to the Clinton Lake State Recreation Area are anticipated as a result of the operation and maintenance of the proposed transmission systems.

5.6.2.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 5.5 mi from the site. The proposed transmission system corridor is not located within the Weldon Springs State Recreation Area, and therefore, will have no direct impacts to the area.

5.6.2.2.3 Environmentally Sensitive Areas

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees under the jurisdiction of the Illinois Nature Preserves Commission.

The proposed transmission system will be located within the existing utility rights-of-way to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized so that adverse impacts to any environmentally sensitive areas along the proposed corridor are avoided.

5.6.2.2.4 Other Important Habitats

As previously mentioned, the proposed transmission system will be located within existing utility rights-of-way to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized so that adverse impacts to any important habitats along the proposed corridor are avoided.

5.6.2.2.5 Wetlands and Floodplains

The proposed transmission system corridor has been located within upland habitats and within the existing utility rights-of-way to the greatest extent possible. Towers required to support the proposed transmission system will be sited within upland areas and within the existing utility corridor. Adverse impacts to wetland and floodplain resources along the existing right-of-way will be avoided to the greatest extent possible. There will be no net loss of wetland or floodplain resources resulting from operation or maintenance of the proposed transmission system corridor.

5.6.2.3 Maintenance

Required maintenance activities will be consistent with maintenance practices being utilized for the existing utility corridor. It is anticipated that there will be no adverse effects on aquatic ecosystems resulting from maintenance activities including applicable roadway maintenance and required periodic mechanical clearing. Periodic maintenance activities will be performed in accordance with the transmission corridor owner or operators plans and procedures.

5.6.3 Impacts to Members of the Public

5.6.3.1 Design Parameters

It is assumed that only two 345-kV transmission lines will need to be constructed. The first will span 15 mi from the plant to the Brokaw substation, located to the north. The second line will span 9 mi from the plant to Oreana substation, located to the south. The transmission lines will be constructed on existing rights-of-way; thus, there will be minimal disruption of land. Wood pole H-Frames, which are an Illinois Power Company standard, will be approximately 80-ft to 100-ft high and be spaced approximately 600-ft to 700-ft apart.

5.6.3.2 Maintenance Practices

A major portion, approximately 88 percent, of the transmission line right-of-way proposed to serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that existing access to the right-of-way is adequate, and that no permanent roads will be built on the right-of-way for either construction or maintenance. If access roads need to be constructed, these roads will be permitted to "grass-over" for grazing, aesthetics, and minimal maintenance.

Where the transmission lines cross public roads, a screen of trees will be left to minimize visual impacts from the lines. Any new access to the right-of-way, though not anticipated, will be constructed at oblique angles to the road to prevent line of sight down the right-of-way, see Figure 5.1-3.

5.6.3.3 Electric Field Gradient

Although there are no standards to limit EMF levels in Illinois, EMF reduction measures will be incorporated into the design of the transmission lines and facility. Since there are no local criteria, the NESC guideline of a 5 milliamperes (mA) maximum EMF will be maintained.

5.6.3.4 Communication System Reception

Audible noise or RI and TVI can occur from corona, from electrical sparking and arcing between two pieces of loosely fitting hardware, or from burrs or edges on hardware. Design practices for the proposed transmission lines include use of EHV conductors, corona resistant line hardware, and grading rings at insulators. The effect of corona on radio and television is dependent on the radio/television signal strength, distance from the transmission line, and the transmission line noise level.

In a 1972 field study, in support of the CPS ER, RI and TVI were measured at existing 345-kV lines with similar construction to those proposed in this report. This study found that little or no interference would be experienced in radio receivers located outside the typical 132-ft right-of-way, providing that the strength of the signal from the radio stations exceeded 500 micro volts per meter, a value that is accepted by the Federal Communications Commission as the minimum for providing good reception. No electrical interference was experienced in a portable television receiver having a standard rod antenna when operating near lines of similar construction to those proposed in this report.

5.6.3.5 Grounding Procedures

Ground faults will be installed to limit induced currents from the EMF given off by the lines. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under normal atmospheric conditions. With these construction operational measures taken into consideration, no impacts to members of the public are expected.

5.6.3.6 Noise Levels

During the construction of the H-Frame structures, there will only be slight noise impacts, if any, to members of the public.

When an electric transmission line is energized, an electric field is created in the air surrounding the conductors. If this field is sufficiently intense, it may cause the breakdown of the air in the immediate vicinity of the conductor (corona); corona can result in RI and TVI. This noise occurs at discrete points and can be minimized with good design and maintenance practices. Design practices for the proposed transmission lines will include use of EHV conductors, corona resistant line hardware, and grading rings at insulators.

Audible noise levels are usually very low and not heard, except possibly directly below the line on a quiet day. In a 1972 field study, in support of the CPS ER, RI and TVI were measured at existing 345-kV lines with similar construction to those proposed in this report. This study found that no audible noise caused by the 345-kV power lines near Baldwin Station could be measured above prevailing ambient background noise level.

5.7 Uranium Fuel Cycle Impacts

This section addresses the uranium fuel cycle environmental impacts and is divided into two main subsections. The first subsection addresses the light-water-cooled reactor (LWR) designs presently being considered. The second subsection addresses the gas-cooled reactor designs also being considered. This split addresses the regulatory distinction made in 10 CFR 51.51 for LWRs. In addition, the source for the information discussed in this section is from the Idaho National Engineering and Environmental Laboratory, Engineering Design File # 3747, Early Site Permit Environmental Report Sections and Supporting Documentation, May 14, 2003, Revision 0.

5.7.1 Light-Water-Cooled Reactors

10 CFR 51.51(a) states that "Every environmental report prepared for the construction permit stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, *Table of Uranium Fuel Cycle Environmental Data*, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level waste and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power plant. Table S-3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility."

Table S-3 of 10 CFR 51.51 is reproduced in its entirety herein as Table 5.7-3. Specific categories of natural-resource use included in the table relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high- and low-level wastes, and radiation doses from transportation and occupational exposures. The contributions in the table for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle); that is, the cycle that results in the greater impact is used.

Descriptions of the environmental impact assessment of the uranium fuel cycle as related to the operation of LWRs are well documented by the USNRC. The environmental impact of a LWR on the U.S. population from radioactive gaseous and liquid releases (including radon and technetium) due to the uranium fuel cycle is small when compared with the impact of natural background radiation. In addition, the nonradiological impacts of the uranium fuel cycle are acceptable (10 CFR 51).

The LWR technologies being considered in this analysis are identified in Section 1.1.3 of this Environmental Report and in SSAR Section 1.3. These LWR designs include the ABWR (Advanced Boiling Water Reactor), the ESBWR (Economic Simplified Boiling Water Reactor), the AP1000 (Advanced Passive PWR), the IRIS (International Reactor Innovative and Secure), and the ACR-700 (Advanced light-water-cooled version of the CANDU Reactor). The standard configuration for each of these reactor technologies is as follows. The ABWR is a single unit, 4,300 MWt, nominal 1,500 MWe boiling water reactor. The ESBWR is a single unit, 4,000 MWt, nominal 1,390 MWe boiling water reactor. The AP1000 is a single unit, 3,400 MWt, nominal 1,117-1,150 MWe pressurized water reactor. The IRIS is a three module pressurized water reactor configuration for a total of 3,000 MWt and nominal 1,005 Mwe, and the ACR-700 is a twin unit, 3,964 MWt, nominal 1,462 MWe, light-water-cooled CANDU reactor. (Note that for this analysis, the ABWR is conservatively presumed to be the uprated design while other evaluations within this ESP application are based on the certified design configuration.)

These reactor technologies are all light-water-cooled nuclear power reactors with uranium dioxide fuel and therefore Table S-3 of paragraph (b) of 10 CFR 51.51 provides the environmental effects from the uranium fuel cycle for these reactor technologies.

5.7.2 Gas-Cooled Reactors

5.7.2.1 Introduction and Background

This section provides an assessment of the environmental impacts of the fuel cycle, as related to the operation of the gas-cooled reactor technologies, based on a comparison of the key parameters that were used to generate the impacts listed in 10 CFR 51.51 Table S-3 (and repeated in Table 5.7-3). The key parameters are energy usage, material involved, number of shipments, etc. associated with the major fuel cycle activities. These activities are mining and milling, uranium hexafluoride conversion, enrichment, fuel fabrication, and radioactive waste disposal. This analysis assumes that, for the gas-cooled reactor fuel cycle, if less energy is needed, if fewer shipments are required, and if less material is involved, then the overall environmental impacts are less than or equal to the impacts identified as acceptable for the LWR fuel cycle.

There are two gas-cooled reactor technologies being considered at this time (also see Section 1.1.3 of this Environmental Report and SSAR Section 1.3). The GT-MHR is a four module, 2,400 MWt, nominal 1,140 MWe reactor that operates at a unit capacity of 88 percent. The PBMR is an eight module, 3,200 MWt, nominal 1,320 MWe reactor operating at a 95 percent unit capacity.

A key reference for this analysis is NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants,* May 1996, which provides a detailed review of the impacts to the environment from the LWR nuclear fuel cycle. The document also looks at the sensitivity of the changes to the nuclear fuel cycle on the impacts to the environment. As these changes are much more representative of the current and future situation than what was considered in the WASH-1248 *Environmental Survey of the Uranium Fuel Cycle* report (the basis for Table S-3), the conclusions of NUREG-1437 will be used in the following discussion.

Table 5.7-1 describes the major features of the reference LWR fuel cycle that were used to develop Table S-3 and compares these same features with the gas-cooled reactor technologies being considered. This comparison demonstrates that the previously accepted environmental impacts identified in Table S-3 are comparable to the impacts for these gas-cooled technologies. The premise being that if the values of the major contributors to the health and environmental impacts that were used for the reference LWR fuel cycle are greater than those comparable values for the gas-cooled reactor technologies, then the published, previously accepted impacts for LWRs would also be greater than the impacts from the new reactor technologies. It is important to point out that even though we are looking at the contributors individually, it is the overall impact that is of concern. As such, there can be increases in individual contributors, yet the total impacts can still be bounded, if offset by decreases in other contributors.

The information to conduct the comparison was taken from 10 CFR 51.51 Table S-3 "Uranium Fuel Cycle Environmental Data," WASH-1248 *Environmental Survey of the Uranium Fuel Cycle*, and Supplement 1 to WASH-1248 (also known as NUREG-0116) *Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle*. The "reference LWR" refers to the model 1,000 MWe light-water-cooled nuclear reactor used as a basis for studying annual fuel related requirements as described in WASH-1248. For the gas-cooled reactor technologies, information was gathered from the reactor vendors, United States Enrichment Corporation (USEC) and ConverDyn.

5.7.2.2 Analytic Approach

The major activities of the reference LWR fuel cycle that were considered in the WASH-1248 report were uranium mining, uranium milling, uranium hexafluoride production, uranium enrichment, fuel fabrication, irradiated fuel reprocessing, radioactive waste management which includes decontamination and decommissioning, and transportation. Three comments pertinent to this analysis are: 1) the WASH-1248 report and this evaluation only address the uranium fuel cycle (other fuel cycles such as thorium and plutonium are not part of this effort), 2) irradiated fuel reprocessing is not being considered by any of the new reactor technologies and is not included in this analysis, and 3) the transportation impacts are addressed based on the following premise - if the quantity of material required by the new gas-cooled reactor technologies at each major step of the fuel cycle is less than the reference plant, then the transportation impacts are also less.

The main features of the major activities of the reference LWR fuel cycle that were identified as being the primary contributors to the health and environmental impacts are as follows. For the mining operation, annual ore supply is the major determinant of environmental and health impacts. Less ore will necessitate less energy, fewer emissions, less water usage, and less land disturbed. Secondarily, the mining technique can play a significant role in any impacts. Open pit mining has by far the most environment impact, followed by underground mining, with *in situ* leaching being the most environmentally benign. Recent practice has been primarily *in situ* leaching (USNRC, 1996).

For the milling operation, annual yellowcake (U_3O_8) production is the metric of interest. If a plant requires less U_3O_8 than the reference plant, then there will be less energy needed, fewer emissions, and less water usage. This is especially true if *in situ* leaching was used to obtain the ore, because the major milling steps of crushing and grinding are not required.

For the uranium conversion process, annual uranium hexafluoride (UF_6) production is the primary determinant of environmental impacts. If the new technology requires less UF_6 than the reference plant, then there will be less energy required, fewer emissions and less water used. As with the mining step, the conversion process (wet versus dry) is also a consideration. However, NUREG-1437 states that in either case "the environmental releases are so small that changing from 100 percent use of one process to 100 percent of the other would make no significant difference in the totals given in Tables S-3 or S-4."

For the enrichment operation, there are two quantities of interest. The first quantity is the separative work units (SWU) needed to enrich the fuel, and the second quantity is the amount of enriched UF_6. The SWU is a measure of energy required to enrich the fuel. More SWUs would by itself indicate not only more energy required but also more emissions associated with the production of the energy needed and with that more water usage. However, this assumes the same technology is used to achieve the enrichment. As discussed in NUREG-1437, the centrifuge process uses 90 percent less energy than the gaseous diffusion process. Since the major environmental impacts for the entire fuel cycle are from the emissions from the fossil fueled plants needed to supply the energy demands of the gaseous diffusion plant, this reduction in energy requirements results in a fuel cycle with much less environmental impact. With regard to the amount of enriched UF_6 produced, the major effect would be the number of shipments. More UF_6 would necessitate more shipments, while less UF_6 would require fewer shipments. Slight increases or decreases would probably result in the same number of shipments.

For the fuel fabrication process, the quantity of UO_2 produced is the value of interest. This is equivalent to the annual fuel loading in MTU, which will also be evaluated. Here again, the production of more UO_2 would require more energy, greater emissions, and increased water usage. New reactor technologies with an annual fuel loading less than the reference LWR plant would have less environmental impact, requiring less energy, fewer emissions and less water usage.

The last activity to be addressed is radioactive waste management. There are two aspects of radioactive waste that are considered as part of Table S-3: operations and reactor decontamination and decommissioning (D&D). For these activities, curies (Ci) of low-level waste (LLW) from annual operations and Ci of LLW from reactor D&D are the measures to consider. Curies by themselves are not a direct indicator of the potential environmental impacts. The radionuclide, its half-life and type of emission, and its physical and chemical form are the main contributors to risk. While we recognize this distinction, for this bounding analysis we will use curies as was done in the WASH-1248. More curies generally indicate the potential for greater impacts, while fewer curies indicate lesser impacts.

This comparison between the reference LWR and the gas-cooled reactor technologies begins with the annual fuel loading in MTU for each of the gas-cooled reactor technologies. Using annual fuel loading as the starting point, the analysis will proceed in the reverse direction for the fuel cycle until the mining has been addressed, then the radioactive waste will be addressed. Before beginning this comparison, it is important to recognize that the gas-cooled reactor technologies being considered are a different size, have a different electrical rating and have a different capacity factor from the reference LWR. The reference LWR is a 1,000 MWe plant with a capacity factor of 80 percent. In order to make a proper comparison, we need to evaluate the activities based on the same criterion. For this analysis, electrical generation is the metric of choice. The electrical generation is the metric that establishes whether the new reactor technologies, for the same electrical output, have a greater or lesser impact on human health and environment. Based on this, the reactor technologies have been normalized to 800 MWe using plant specific electrical ratings and capacity factors.

5.7.2.3 Analysis and Discussion

5.7.2.3.1 Fuel Fabrication/Operations

The reference LWR required 35 MTU of new fuel on an annual basis. This is equivalent to 40 MT of enriched UO_2, the annual output needed from the fuel fabrication plant. In comparison, the normalized annual fuel needs for the new gas-cooled reactor technologies ranged from 4.3 MTU to 5.3 MTU, approximately 88 percent to 85 percent lower than the reference plant. Similarly, the annual output needed from the fuel fabrication plant range from a low of 4.89 MT of UO_2 to 6.0 MT of UO_2, again approximately 88 percent to 85 percent lower than the reference plant. The specific breakdowns are shown on Table 5.7-1.

One important distinction is that the fuel form for the gas-cooled reactors is also different. For the GT-MHR, the fuel is a two-phase mixture of enriched UO_2 and UC_2, usually referred to as UCO. For the PBMR, the fuel kernel is UO_2. Both fuels are then TRISO coated. For the GT-MHR these TRISO fuel particles are blended and bonded together with a carbonaceous binder. These fuel compacts are then stacked within a graphite block. For the PMBR, the fuel unit is a 6-cm diameter graphite sphere containing approximately 15,000 fuel particles. As a result, the gas-cooled reactors require a different fuel fabrication process and a different type of fuel fabrication facility. Ideally, to verify that the environmental impacts of this change in the fabrication process are bounded by the reference LWR fuel fabrication process, a comparison of the land use, energy demand, effluents, etc., would be in order. However, because there are no planned or currently operating gas-cooled reactor fuel fabrication plants in the United States, a direct comparison cannot be made at this time. Therefore, we have provided information on the reference fuel fabrication plant along with conceptual design information for a TRISO fabrication plant that was planned for the New Production Reactor and conceptual design information received from one of the gas-cooled reactor vendors.

From WASH-1248, the reference LWR fuel fabrication plant produced fuel for 26 plants (~910 MTU), was located on a site of about 100 acres, required 5.2 million gallons of water per annual fuel requirement of 35 MTU, and required 1,700 MW-hours of electricity per 35 MTU. The WASH-1248 report also states that nearly all of the airborne chemical effluents resulted from the combustion of fossil fuels to produce electricity to operate the fabrication plant. These numbers represented a very small portion of the overall fuel cycle. For example, the electrical usage represented less than 0.5 percent of that needed for the enrichment process, and the water use was less than 2 percent of the overall fuel cycle.

The fuel fabrication facility for the New Production Reactor was for a modular high temperature gas reactor (MHTGR) design and was sized for just one plant. The dimensions for the fuel fabrication building were 230 ft x 150 ft. The annual production was about 2 MTU. The plant required 960 kW of electrical power and 45 liters per minute of water. Effluents consisted of 60 m^3/yr of miscellaneous non-combustible solids and filters; 50 m^3/yr of combustible solids; 50 m^3/yr of process off-gas and HVAC filters; 2.0 m^3/yr of tools and failed equipment; and process off-gases of 900,000 m^3/yr. The process off-gases consisted of 74 percent N_2, 12 percent O_2, 7.2 percent Ar, 6.4 percent CO_2, 0.2 percent CO, and 0.02 percent CH_3CCl_3. The activity associated with this off-gas was 0.01 pCi alpha/m^3, and 0.01 pCi beta/m^3.

The information gathered from one of the current reactor vendors was for a plant producing 6.3 MTU, about 19 percent more than the annual reload of 5.31 MTU for its reactor. Again this plant was sized for just one reactor. This plant would require 10 MW of electrical power with an annual electrical usage of 35,000 MW-hr. The gaseous emissions consist of 80 MT of nitrogen, 52 MT of argon, 22.4 MT of CO, 22 MT of hydrogen and 3.7 MT of CO_2. The solid waste totals about 84 m^3 of LLW, 3 m^3 of intermediate level waste, and the remainder sanitary/industrial wastes. The liquid processing system would generate an additional 3.8 m^3 of LLW, would discharge about 3,700 m^3 of low activity aqueous effluent, and would discharge about 45,000 m^3 of industrial cooling water.

Because of the differences in scale and the state of design of the LWR and gas-cooled reactor facilities, it is not possible or appropriate to make a direct comparison of the impacts. Further, there are economies of scale and design improvements that will naturally occur for a plant comparable in size to the reference plant. Regardless, the projected impacts of a TRISO fuel plant based on the two conceptual designs are not inconsistent with the reference plant and would be operated within existing air, water, and solid waste regulations. Further, like the impacts associated with the sintered UO_2 pellet plant, the impacts from a TRISO fuel plant would still be a minor contributor to the overall fuel cycle impacts. By characterizing the impacts as "not inconsistent," we mean that while certain parameters such as electrical usage for fuel fabrication might be higher for the gas-cooled plants on an annual fuel loading basis, the environmental impacts from the TRISO plants as conceptualized would still be bounded by the overall LWR fuel cycle impacts.

5.7.2.3.2 Uranium Enrichment

In order to produce the 40 MT of enriched UO_2 for the reference LWR, the enrichment plant needed to produce 52 MT of UF_6, which required 127 MT of SWU (USNRC, 1976). The normalized enriched UF_6 needs for the new gas-cooled reactor technologies ranged from 6.38 MT of UF_6 to 7.9 MT of UF_6, approximately 88 percent to 85 percent lower. To produce these quantities of UF_6 requires (due to the higher enrichment requirements) from 124 MT of SWU to 163 MT of SWU, slightly lower to 28 percent higher. The enrichment SWU calculation for the new reactor technologies was performed using the USEC SWU calculator and assumes a 0.30 percent tails assay, the same value as for the NUREG-0116 reference plant. Using this calculator for the reference LWR plant yielded 126 MT of SWU versus the NUREG value of 127. This is very close indicating that this latest version of the USEC SWU calculator is appropriate for use in this computation. Table 5.7-2 gives the details of the computations.

The 28 percent increase in the MTU of SWU would by itself indicate greater environmental impacts. However, a close look at the original WASH-1248 analysis shows that the environmental impacts are almost totally from the electrical generation needed for the gaseous diffusion process. These impacts result from the emissions from the electrical generation that is assumed to be from coal plants and from the associated water to cool the plants. Today, and in the future, the enrichment process is and will be different. A significant fraction of the enrichment services to US utilities today is provided from European facilities using centrifuge technology rather than the fifty-year-old gaseous diffusion technology. For the future, two private companies, United States Enrichment Corporation and Louisiana Energy Services, are currently (2003) planning to develop centrifuge technology in the US. In fact, USNRC has just recently accepted United States

Enrichment Corporation's centrifuge license application for technical review. Centrifuge technology requires less than 10 percent of the energy needed for the gaseous diffusion process and as such the environmental impacts associated with the electrical generation will be correspondingly less. This tremendous reduction in energy and the associated environmental impacts more than offsets a 28 percent increase in SWU. Only a portion of the SWU would have to be expended via centrifuge technology to obtain an impact equivalent to that for the reference LWR using only the gaseous diffusion process.

5.7.2.3.3 Uranium Hexafluoride Production

In order to provide the feed needed for the reference LWR to the enrichment plant, the uranium hexafluoride plant needed to produce 360 MT of UF_6. The normalized feed needed for the new gas-cooled reactor technologies, the output from the uranium hexafluoride plant, ranged from 241 to 303 MT of UF_6, well below the reference plant. The feed calculations were performed using the USEC SWU calculator. Using this calculator for the reference LWR yielded 353 MT of UF_6 versus the NUREG value of 360. Again this value is very close (less than 2 percent) to the published value (USNRC, 1976).

5.7.2.3.4 Uranium Milling

To produce the 360 MT of UF_6 for the reference LWR, 293 MT of yellowcake (U_3O_8) from the mill was required (USNRC, 1976). The normalized new gas-cooled reactor technologies needs ranged from 193 MT of U_3O_8 to 243 U_3O_8, well below the reference plant. These yellowcake numbers were generated using the relationship 2.61285 lbs of U_3O_8 to 1 kg of UF_6. This conversion factor was obtained from ConverDyn.

5.7.2.3.5 Uranium Mining

The raw ore needed to produce the 293 MT of yellowcake (U_3O_8) for the reference LWR was 272,000 MT. Now assuming a 0.1 percent ore body and a 90 percent recovery efficiency, the normalized new gas-cooled reactor technologies ore requirements ranged from 215,000 to 270,000 MT of ore, both below the reference plant. Of note, the NUREG table value of 272,000 should be about 325,600 using the same assumptions. It is not clear why this number is different, but in any case, the gas-cooled reactor technologies are below the published reference plant value (USNRC, 1976).

Uranium mining completes the front end of the fuel cycle. However, there are two areas on the down stream cycle to be considered. These are the LLW generated by operations and the LLW generated as part of the D&D process. As mentioned earlier, spent fuel reprocessing is not germane to this analysis, and therefore, not discussed.

5.7.2.3.6 Solid Low-Level Radioactive Waste – Operations

For the reference LWR, 10 CFR 51.51, Table S-3, Table of Uranium Fuel Cycle Environmental Data, states that there are 9,100 Ci of LLW generated annually from operations. The range of activity of LLW generated annually projected by the new gas-cooled reactor technologies is 65.4 Ci to 1,100 Ci, far below the reference LLW. This decrease would also suggest many fewer shipments to the disposal facility and less worker exposure.

5.7.2.3.7 Solid Low-Level Radioactive Waste – Decontamination and Decommissioning

10 CFR 51.51, Table S-3, states 1,500 Ci per Reactor Reference Year (RRY) "comes from reactor decontamination and decommissioning – buried at land burial facilities." Based on this small quantity and the modifying phrase "buried at land burial facilities" it is clear that

only waste suitable for shallow land burial was being considered as a basis for the Table S-3 line item. At this time, only general conclusions can be drawn to indicate these gas-cooled reactor technologies would generate less D&D LLW than the reference plant. The new plants will operate much cleaner than the reference LWR as evidenced by the annual generation of much less LLW. Improvements in fuel integrity and differences in fuel form as well as the use of the chemically and radiologically inert helium as the coolant are responsible for this reduction and also should contribute to both a lower level and less overall contamination to be managed during the D&D process. The plants higher thermal efficiency and higher fuel burnup would produce less heavy metal radioactive waste. Lastly, the plants are typically more compact than the reference LWR contributing to less D&D waste. For these reasons it is expected that the D&D LLW generation from the gas-cooled reactor designs would be comparable or less than that associated with the reference LWR.

The key areas of impact from D&D LLW for the gas-cooled reactor are expected to be identical to those of the reference LWR, namely, transportation and land use supporting waste disposal. As discussed in WASH-1248, the largest portion of D&D LLW transportation and land use is associated with the mining, milling, and enrichment steps. Relative contributions of D&D are quite small. WASH-1248 also points out that other areas of impact are dominated by the these “front-end” phases of the nuclear fuel cycle, e.g., land use and power consumption to support enrichment, related water usage, and power plant emissions.

As noted above, the D&D LLW impacts related to the gas-cooled reactor designs are expected to be comparable or less than that of the reference LLW.

5.7.2.4 Summary and Conclusion

To recap, there are only two instances where any part of the uranium fuel cycle is/might be exceeded by the new gas-cooled reactor technologies. These fuel cycle steps are enrichment, with a 28 percent increase, and possibly D&D. As discussed above, the enrichment requirement for SWU, while slightly larger, can be conducted, in full or in part, in a much more environmentally benign manner, centrifuge versus gaseous diffusion, from current overseas sources or expected new domestic facilities. The net effect will be that the environmental and health impacts will be not more than those identified in Table S-3. The second area, D&D, is a minor contributor to the overall fuel cycle impacts. While definitive D&D LLW information was not readily available for the gas-cooled reactor technologies, for the numerous reasons set forth above, the impacts are expected to be comparable or less than the reference LLW. However, while not expected, even an increase in the D&D LLW impacts would be more than offset by the significant decreases in the impacts due to reduction in fuel needs and changes in the enrichment process and mining technique.

In conclusion, this detailed comparison of the underpinnings of Table S-3 show qualitatively that the existing WASH-1248 environmental and health effects are conservative and appropriate for use by these new gas-cooled reactor technologies. Collectively, improvements in both methods and technology have resulted in a fuel cycle with lower environmental impact.

5.7.3 Methodology Assessment

As indicated in Section 1.1.3, the selection of a reactor design to be used for the EGC ESP Facility is still under consideration. Selection of a reactor to be used at the EGC ESP Site may not be limited to those considered above. However, the methodology utilized above is appropriate to evaluate the final selected reactor. Further, should the selected design be shown to be bounded by the above evaluation, then the selected design would be considered to be within the acceptable fuel cycle environmental impacts considered for this ESP.

5.8 Socioeconomic Impacts

Within the site, there is no permanent population that would be impacted from station operation (U.S. Census Bureau, 2001). As detailed below, socioeconomic impacts to the vicinity and the region are anticipated to be minor.

The operation workforce will consist of up to 580 people (see SSAR Table 1.4-1). It is expected that while some of the workforce will relocate from other areas, a significant amount of the workforce will already be located within the region. The proposed site is proximate to three significant population and employment centers (Bloomington-Normal, Champaign-Urbana, and Decatur) and within two additional employment centers (Springfield and Peoria). The population of the region is approximately 1.2 million, and it is typical in this part of Illinois for workers to commute up to 50 mi one-way to work. Additionally, a significant number of employees at the CPS already lived within the region before operation began; these employees have not moved to the vicinity but have remained in their community. A similar experience is anticipated for the EGC ESP Facility.

5.8.1 Physical Impacts of Station Operation

The physical impacts are defined as noise, air, and aesthetic disturbances. Physical impacts will be controlled as specified by applicable regulations and will not significantly impact the site, vicinity, or region.

5.8.1.1 Site and Vicinity

Within the vicinity, the population is approximately 2,343 people. The two largest cities within the vicinity include DeWitt, with a population of 188, and Weldon, with a population of 440 (U.S. Census Bureau, 2001). These two cities are small rural communities that include small businesses, houses, and farm buildings. These communities will not experience any physical impact from station operation. No impacts to structures, including residences on the site or vicinity, are anticipated. No significant impacts to hospitals or other institutional facilities are anticipated; this is described in more detail in Section 5.8.2.

Roads within the vicinity are described in Section 2.2. The roads and highways within the immediate vicinity of the site will experience an increase in use, especially at the beginning and the end of the workday. However, the road network has sufficient capacity to accommodate a substantial increase in volume, as detailed in Section 5.1.1.1. Thus, no significant congestion problems are expected from station operation.

Clinton Lake State Recreation Area and Weldon Springs State Recreation Area are the only major recreational facilities within the vicinity. As described above, it is not anticipated that a significant number of workers will move to the region to work at the EGC ESP Facility; therefore, these facilities would not experience any abnormal influx in use due to station operation.

Outside of the 6-mi radius of the vicinity of the site, there will be no physical (noise, air, and aesthetic disturbances) impacts from station operation.

5.8.1.2 Noise

Turbines, generators, pumps, transformers, and switchyard equipment are noise producers. Noise levels will be controlled in accordance with the following regulations:

- OSHA noise exposure limit to workers, and workers' annoyance determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910);
- Federal (40 CFR 204) noise pollution control regulations; and
- State or local (35 IAC Subtitle H) noise pollution control regulations.

Equipment that exceeds the noise abatement criteria will use noise control devices. Equipment manufacturers will be required to guarantee that specifications on allowable octave bands will be met. Most equipment will be located inside structures; therefore, building walls will reduce outside noise levels as much as 15 dB. Further, reduction will be achieved as the noise travels to the property line (CPS, 1982). The heat dissipation system is anticipated to have a noise level of up to 55 dB at a distance of 1,000 ft from the system (see SSAR Table 1.4-1). This level is below the typical outside noise criterion, 65 dB, for residential areas (24 CFR 51).

There are few rural families close to the site that may be affected by an increase in traffic noise generated by station employees, delivery trucks, and off-site shipments (CPS, 1982). It is anticipated that most vehicle trips will occur during normal weekday business hours. Additional traffic from the operation workforce, to and from the site, will increase the level of vehicular noise for those residents living along routes that access the EGC ESP Facility. However, the low volume highway, even with the added traffic, is expected to be below the noise criteria for residential areas.

Noise impacts are anticipated to be minor for several reasons: noise levels from operation are not expected to exceed 60 dB, 1,000 ft from the system; traffic noise will be limited to normal weekday business hours; and noise control devices will be used when necessary. The nearby Clinton Lake State Recreation Area will not be impacted by noise, since recreational facilities are well beyond 1,000 ft from the facility. The nearest campground is approximately 1 mi from the EGC ESP Facility.

5.8.1.3 Air

The annual average exposure at the site boundary from gaseous sources will not exceed applicable regulations during normal operation. Additionally, it is anticipated that air emission levels at the site boundary will be insignificant, as defined by USEPA. Depending on the reactor technology selected, air pollution control devices may be needed and will be used to meet applicable regulations. Additional air emissions from the increased vehicular traffic from the new operation workforce will have a negligible effect on the area. This is because central Illinois is considered by USEPA to be either an attainment or unclassifiable area for criteria pollutants (CO, PM_{10}, NO_X, TSP, SO_2, and ozone) (40 CFR 81.314). This indicates good overall air quality in the region.

5.8.1.4 Aesthetic Disturbances

The closest residence is approximately 0.73 mi to the southwest of the site (IDNR, 1998 and 1999), and the closest town is DeWitt, which is approximately 3 mi to the east (U.S. Census

Bureau, 2002). Many recreational users of the Clinton Lake State Recreation Area will be able to view the operation areas.

The CPS has a power block structure that is approximately 200-ft tall. The EGC ESP Site will have a power block structure that could be up to 234-ft tall. The heat dissipation system could have a height of up to 550 ft (see SSAR Table 1.4-1). An off-gas structure may be required; however, the height of this structure is unknown. The off-gas structure will likely be the same height as the power block structure and shorter than the height of the heat dissipation system. The CPS Site already exhibits an industrial environment; therefore, the EGC ESP Site will not substantially alter an already visually disturbed site. Any visual impacts from the visible plumes from the EGC ESP Facility will be similar to those associated with the CPS. There is a potential that an additional visible plume will result from the heat dissipation system.

The viewshed of the EGC ESP Facility is limited to only a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS (with the exception of the new plume from the heat dissipation system), the EGC ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake. Therefore, no mitigation will be provided.

5.8.2 Social and Economic Impacts of Station Operation

Social and economic impacts include impacts to the economy, tax and social structure, housing, educational, recreation, public services and facilities, transportation facilities, distinctive communities, and agriculture.

5.8.2.1 Economic Characteristics

Section 2.5.2.1 describes the regional employment by industry (see Table 2.5-8), the construction labor force within the region (see Table 2.5-8), the total regional labor force (see Table 2.5-8), and the regional unemployment levels and future economic outlook (see Table 2.5-10).

The operation workforce will consist of up to 580 people (see SSAR Table 1.4-1). Operation workforce salaries will have a multiplier effect, where money is spent and re-spent within the region. Local businesses in and around Clinton may see an increase in business, especially in the retail and services sector during normal business hours. The additional employment, although not expected to be significant, may help to sustain existing businesses throughout the region, as well as provide opportunities for some new businesses. The effect of the EGC ESP Site may slightly improve the unemployment levels in the area, which in 2000 were at about 5 percent (see Table 2.5-10). In addition, the increase in tax revenue (described in Section 5.8.2.2) and the slight increase in workforce may provide opportunities for further development in the area.

Finally, the EGC ESP Facility will provide a new source of reliable electricity for the region, which may result in the siting of new industries into the region or expansion of existing industries.

5.8.2.2 Tax Impacts

The taxing districts, as listed in Section 2.5.2.2, will benefit from the EGC ESP Facility. Any property taxes paid in connection with the EGC ESP Facility are expected to be a benefit to the local community. Other potential tax impacts will include an increase in state income tax revenue generated from the additional operation jobs and indirect salaries created by operation.

5.8.2.3 Social Structure

The social structure for the region is described in Section 2.5.2.3. No impacts from operation to the social structure of the region are anticipated. The operation workforce will largely be from the region (see Section 5.8) and is expected to commute to the site from the major metropolitan areas (Bloomington-Normal, Champaign-Urbana, Decatur, and Springfield) within the region. Therefore, the social structure and patterns observed in the surrounding communities will not experience the effects of a rapid population increase. It is expected that the social structure will remain unchanged during operation.

5.8.2.4 Housing Information

Within the 20-county region surrounding the site, the population in the year 2000 was nearly 1.2 million, with most people concentrated in the metropolitan areas of Bloomington-Normal, Champaign-Urbana, Decatur, Lincoln, Morton, Peoria-Pekin, Pontiac, Rantoul, Springfield, and Taylorville (U.S. Census Bureau, 2001).

It is estimated that most of the operation workers will commute to the site rather than move their families to the immediate area of Clinton. A very small number of the operation workers from both within and beyond the 50-mi radius may choose to move to the Clinton area with their families. The 2000 Census indicated that there were 74 vacant, year round housing units within the vicinity and over 19,000 vacant, year round housing units within the region (U.S. Census Bureau, 2001). Based on the housing available and the commuting expected, no housing shortages are anticipated as a result of operation.

The abundance of existing housing within the surrounding area will mitigate against effects on rents or prices produced by the operation.

5.8.2.5 Educational System

Since the majority of the operation workers will be from the region (see Section 5.8) where their educational requirements are already being met, the surrounding school systems will not likely experience any major influx of students because of the operation of the EGC ESP Facility. A survey of class size of schools in the region was performed, and 67 percent of schools have class size at or below the national average. This indicates there is sufficient capacity for a small increase in population.

5.8.2.6 Recreation

Recreational facilities within the region are described in Section 2.5.2.6. The operation worker population will predominately reside at their existing residences (see Section 5.8). Therefore, it is not anticipated that there will be any unusual peaks at recreational facilities within the region.

5.8.2.7 Public Services and Facilities

In general, public facilities are not anticipated to be overcrowded because most of the operation workforce is not expected to move to the area (see Section 5.8). The EGC ESP Site is in a rural area; therefore, community services are not expected to be directly affected. Also, since private security guards will be used, dependence on local police forces will not be required. Public facilities will be able to absorb the minor increase in load due to the small influx of people expected. In the vicinity of the site, residences have private septic systems and obtain water through individual wells or individual city water well systems. The EGC ESP Site will use their own on-site water and septic facilities. A survey was conducted to assess availability of water supply and wastewater facilities in the region. This assessment indicated that the facilities have excess capacity to accommodate a potential increase in population in the region.

5.8.2.8 Transportation Facilities

The roads and highways within the vicinity of the site will experience an increase in use of approximately 580 additional vehicle trips during the peak hours of the workday. However, these roads and highways are 2-lane rural routes that are not heavily traveled and can withstand the increase in vehicular traffic (see Section 5.1.1.1). It is expected that the operation workforce will live in dispersed areas nearly uniform in all directions from the site, and will travel relatively uniformly in all directions. Thus, no significant congestion problems are expected due to the operation.

5.8.2.9 Distinctive Communities

As stated in Section 2.5.2.3, the population in the region is fairly homogeneous, largely white, and not dominated by a particular ethnic group. The only special groups within the region are two Amish communities located around the towns of Arthur and Arcola, which are 37-mi and 44-mi southeast of the site, respectively. These two areas are far enough away from the site that they will not be impacted by station operations.

5.8.2.10 Agriculture

As stated in Section 2.2, no land is designated as agricultural land within the site. However, 82 percent is designated as agricultural land within the vicinity, and 93 percent is designated as agricultural land within the region. Since the land impacted by station operations will be limited to the site and transmission corridor, only minor impacts to agriculture is anticipated at some locations of the transmission towers, and therefore, no mitigation will be provided.

5.8.3 Environmental Justice

This section describes the potential for disproportionate impacts to low-income and minority populations that could result due to the operation of the EGC ESP Facility. The environmental justice assessment includes a technical analysis in order to determine the potential effects of the operation on low-income and minority populations. A disproportionate impact to these populations exists when they endure more than their "fair share" of industrial facilities.

Compared to the general population, it was determined that there would be no disproportionate impact to low-income populations (in accordance with Health and Human Services Poverty Guidelines (Federal Register, 2000)) or minority populations within the region due to the operation of the EGC ESP Facility.

The detailed analysis of the region shows no disproportionate impact to minority populations. Within the vicinity of the site, the total population was 2,343 and the minority population was only 85, or 3.6 percent, in the year 2000. Within the region, the total population was 762,022 and the minority population was 100,331, or 13 percent, in the year 2000. The minority population in DeWitt County is approximately 3 percent. In the State of Illinois, the minority population is 39 percent, while the national average is 37 percent. The vicinity, region, and county, in which the site is located, have minority populations that are below the state and national average. Therefore, it can be concluded that minority populations will not be disproportionately impacted by any adverse impacts from the operation of the EGC ESP Facility. Figure 4.4-1 shows the location of minority populations and the total population within each census block. This figure, as well as Figure 2.1-3, shows that the closest minority population is proximate to the site (approximately 0.6 mi). Further investigation shows that this is a Native American person that lives directly southwest of the site. Since this person is the only resident within the census block, the percent minority is 100 percent for this block (U.S. Census Bureau, 2001and 2002a). While the site may have a disproportionate impact on minorities in one census block, it in fact involved only one person, therefore, no mitigation is required.

The detailed analysis of the region shows no disproportionate impact to low-income populations. Within the vicinity, 8 percent of the population had a 1999 income below the poverty level. Within the region, 10 percent of the population had a 1999 income below the poverty level. In DeWitt County, 8 percent of the population is considered low-income. The average low-income population in Illinois is 10.8 percent, and the national average is 11.3 percent (U.S. Census Bureau, 2001a). The vicinity, region, and county, in which the site is located, have low-income populations that are below the state and national average. Therefore, it can be concluded that low-income populations will not be disproportionately impacted by operation of the EGC ESP Facility. Figure 4.4-2 shows the location of low income populations within each census block (U.S. Census Bureau, 2002b).

An assessment of environmental justice also includes considerations of other factors, such as environmental health effects of air and noise pollution on low-income and minority populations. Noise and air pollution will be controlled by following any federal, state, and local regulation. In summary, no disproportionately high or adverse impacts on minority and low-income populations would result from operation.

5.9 Decommissioning

This section reviews the environmental impacts of decommissioning the EGC ESP Facility. This ER supports an ESP; therefore, USNRC regulations do not require the applicant to inform the USNRC of its plans for decommissioning the facility. Consequently, no definite plan for the decommissioning of the plant has been developed (USNRC, 1999). Additionally, no financial assurances for decommissioning are required at the ESP stage. The general environmental impacts are summarized in this section, since the decommissioning plans and reports (and consequently detailed analyses of alternatives) are not prepared until cessation of operations.

The USNRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license (10 CFR 50). Decommissioning must occur because regulations do not permit an operating license holder to abandon a facility after ending operations.

Although this section does not evaluate the impacts of decommissioning on the proposed site, studies of social and environmental effects of decommissioning other nuclear generating facilities have not identified any significant impacts beyond those considered in the USNRC's Generic Environmental Impact Statement (GEIS) on decommissioning (USNRC, 2002). According to the USNRC, decommissioning of a nuclear power plant has certain environmental consequences. The impacts on the proposed site will be discussed in detail at the COL stage. Generally, expected impacts may include minor radiological impacts to the public, but are expected to remain ALARA. Experience at decommissioned power plants has shown that the occupational exposures during the decommissioning period are comparable to those associated with refueling and routine maintenance of the plant when it is operational (USNRC, 1996 and 2002). Socioeconomic impacts of decommissioning would result from the demands on, and contributions to, the community by the workers employed to decommission a power plant. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant construction or operation because the level of activity and the releases to the environment are expected to be smaller during decommissioning than during construction and operation (USNRC, 2002).

The applicant does not anticipate developing decommissioning plans until termination of operations. As decommissioning plans are developed, efforts will be made to minimize or mitigate any adverse impacts from decommissioning. Additionally, large portions of the site may be available for redevelopment under various regulatory schemes (USNRC, 2002).

5.10 Measures and Controls to Limit Adverse Impacts During Operation

5.10.1 Regulatory Criteria

In accordance with NUREG-1555, *Environmental Standard Review Plan*, potential adverse environmental impacts due to active EGC ESP Facility operations are identified and addressed in this section as well as the specific measures and controls to limit those impacts (USNRC, 1999). Some of the measures and controls to limit the impacts from active EGC ESP Facility operations are discussed in other sections of this chapter.

5.10.2 Adverse Environmental Impacts

The following presents a list of the identified potential adverse environmental impacts that may be encountered during operational activities:

- Noise;
- Dust/Air Pollutants;
- Erosion and Sedimentation Controls;
- Effluents and Wastes;
- Traffic Control;
- Land Use Impacts;
- Water-related Impacts;
- Water Use Impacts;
- Cooling System Impacts;
- Radiological Impacts from Normal Operations;
- Environmental Impacts of Waste;
- Transmission System Impacts;
- Uranium Fuel Cycle Impacts;
- Socioeconomic Impacts; and
- Decommissioning Impacts.

5.10.3 Measures and Controls to Limit Adverse Impacts

The identified impacts will be discussed in the following section as well as the measures and controls that will be implemented to limit these impacts from active EGC ESP Facility operations, if applicable.

5.10.3.1 Noise

During operational activities, ambient noise levels on and off site will increase. Cooling towers, turbines, generators, pumps, transformers, switchyard equipment, and heavy equipment are noise producers. Noise levels will be controlled by an engineering design using the following criteria:

- OSHA noise exposure limit to workers and workers' annoyance determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910);
- Federal noise pollution control regulations (24 CFR 51); and
- State or local noise pollution control regulations, as applicable (35 IAC 1987).

The many pieces of large industrial equipment needed for EGC ESP Facility operations (freight trucks, forklifts, construction equipment, locomotives, etc.) will be the source of noise pollution. Standard noise devices on trucks and other equipment are expected to be sufficient to keep off-site noise levels well-below acceptable levels. In addition, activities requiring the use of heavy equipment will be limited on weekends.

Hearing protection programs for station workers will comply with the requirements specified in 29 CFR 1910.95. This requires that a Hearing Conservation Program be developed to control and protect on-site workers from excessive noise levels. As stipulated in 29 CFR 1910, a Hearing Conservation Program will include the following:

- Provide hearing protection (earplugs or muffs) at no cost to employees;
- Conduct noise monitoring at the work location where employees are exposed to excessive noise;
- Provide annual audiometric exams for noise-exposed employees;
- Notify exposed employees of noise monitoring and audiometric exam results;
- Keep records of noise monitoring and audiometric exams results; and
- Provide training on use/maintenance and limitations of hearing protection.

Procedures and a Hearing Conservation Program will be developed for any employees exposed to excessive noise, which is defined as an 8-hr exposure of 85 dB or more.

5.10.3.2 Dust/Air Pollutants

Dust and engine exhausts represent air pollution potentials, which can be controlled, as appropriate. Good drainage and dry-weather wetting or the paving of the most traveled roads and parking lots will reduce dust generated by vehicular traffic. Bare areas will be seeded, if possible, to provide a ground cover where necessary. Care will be taken to control smoke or other undesirable emissions. Applicable air pollution control regulations will be adhered to as they relate to the operation of fuel-burning equipment. Permits and operating certificates will be secured where required. Fuel-burning equipment will be maintained in good mechanical order to reduce excessive emissions.

5.10.3.3 Erosion and Sedimentation Controls

If the areas around the EGC ESP Facility are not properly graded and seeded, erosion will lead to the runoff of large amounts of sediments to nearby residential areas or surface waters.

The following goals and criteria will be applied, as applicable:

- Erosion and sedimentation controls will be implemented in order to retain sediment on site to the greatest extent practicable.
- In accordance with the manufacturer's specifications and good engineering practices, control measures will be selected, installed, and maintained. If periodic inspections or other information indicate that a particular erosion control measure is ineffective, the control measure will be modified or replaced as necessary.
- If possible and if required, off-site accumulations of sediment will be removed in the event that sediment escapes the construction site in order to minimize the off-site impacts.
- Sediment from sediment traps or sedimentation ponds will be routinely removed when design capacity, as a general rule, has been reduced by approximately 50 percent. This will limit the potential for trap or pond failure.
- Housekeeping practices will be implemented that prevent litter, debris, and chemicals exposed to stormwater from becoming a pollutant source for stormwater discharges.
- Erosion and sediment runoff will be controlled through the use of structural and/or stabilization practices. Structural control practices may include the use of straw bales, silt fences, earth dikes, drainage swales, sediment traps, and sediment basins. Sediment traps and basins will be designed to accommodate the large potential load from the deep excavation dewatering operations. Stabilization practices may include temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation.

Several different structural controls may be used to control the quality of the stormwater running off the site. Table 5.10-1 lists the controls that may be instituted during EGC ESP Facility operations. Based on site conditions, the final location of these controls will be determined just prior to the commencement of operation.

5.10.3.4 Effluents and Wastes

Contained in the following sections is a list of possible pollutant sources that may occur during EGC ESP Facility operations, and specific measures to control discharges of those pollutant sources on and off site.

5.10.3.4.1 Vehicle Fueling

The fueling stations, as appropriate, will have secondary containment structures installed around the fuel tanks with a leak detection system to alert personnel in the event a tank leaks fuel to the secondary containment. For specifics, see Section 5.10.3.5.6.

5.10.3.4.2 Vehicle Maintenance

Regular vehicle maintenance will be performed in an area designated for that purpose. Any spills will be cleaned up promptly. Precautions will be taken to prevent the release of pollutants to the environment from vehicle maintenance. Precautions will include the use of drip pans, mats, and other similar methods. No vehicle washwater will be allowed to run off the EGC ESP Site or enter local, state, or federal waters.

5.10.3.4.3 Excavated Areas and Stockpile Management

To prevent the mobilization of contaminants in stormwater runoff from entering and/or leaving excavated areas, the following controls on erosion and sedimentation controls will be implemented, as applicable and as found appropriate to control the material.

- Stockpiles of excavated soils will be placed on plastic sheeting near the excavation areas.
- Stockpiles will be provided with liner, cover, and perimeter berm to prevent rupture and release or infiltration of liquids.
- Polyethylene sheeting will be used for liners and covers.
- A perimeter berm, typically hay bales placed beneath the liner, will be constructed to allow for collection of any free liquids draining from the stockpile.
- Accumulated free liquids will be pumped or otherwise removed to a sanctioned area or container.
- Covers and perimeter berms will be secured in place when not in use and at the end of the workday, or as necessary to prevent wind dispersion or runoff from major precipitation events.

5.10.3.4.4 Material Handling

The following material handling and housekeeping practices described below will be implemented during EGC ESP Facility operations, as applicable and as found appropriate.

- Auxiliary fuel tanks will have secondary containment. The area will be kept free of trash and spilled fuel.
- Garbage receptacles will be equipped with covers. This includes such receptacles that contain materials that may be carried by the wind or contain water-soluble materials, (e.g., paint).
- Empty storage containers including drums and bags will be stored inside a designated storage building or area.
- Containers will be kept closed except as necessary to add or remove material.
- Containers will be stored in such a manner to prevent corrosion that could result from contact between the container and ground surface, and in a release of material.
- The containers will be appropriately labeled to show the name, type of substance, health hazards, and other appropriate information, if applicable.
- MSDSs for chemical substances used or stored on site will be available for review and use.

5.10.3.5 Traffic Control

The roads and highways within the immediate vicinity of the site will experience an increase in use, especially at the beginning and end of the workday. However, the immediate area surrounding the site is now rural, and the nearby roads and highways are not heavily traveled. It is expected that EGC ESP Facility personnel will be living in areas dispersed nearly uniformly in all directions from the site, and will travel relatively uniformly in all directions. Thus, no significant congestion problems are expected due to EGC ESP Facility operations.

Traffic and traffic control impacts may include, but are not limited to:

- Working adjacent to or in active roadways (day/night);
- Traffic control zones;
- Traffic control device installation;
- Flagging, if applicable;
- Inspection and maintenance of traffic control devices;
- Equipment; and
- General roadway traffic control zone safety.

Some local, state, and Department of Transportation (DOT) plans may have requirements that are more stringent. However, the local, state, and federal requirements regarding traffic control on and off site from active facility operations will be adhered to.

5.10.3.6 Land Use Impacts

Section 5.1 presents a discussion of the land use impacts incurred from siting a reactor at the EGC ESP Site.

Presented in the following sections are selected excerpts from Section 5.1 and associated conclusions.

5.10.3.6.1 Site and Vicinity

Operation will be limited to the operation of facility structures and transmission corridors. In addition, up to approximately 96 ac will be disturbed at the EGC ESP Site. No undesirable land use impacts are anticipated to affect surrounding communities. Normal recreational practices near the site are not anticipated to change as a result of the operation of the EGC ESP Facility. Roads and highways in the vicinity of the site will be less traveled compared to during construction.

As detailed in Section 4.1.1.3, there are no federal, state, or regional land use plans for the area. However, DeWitt County has published a countywide generalized land use plan, which designates the site for industrial land use. This plan guides future land use throughout the county and has designated the site for transportation and utility use. Further, the county land use plan targets expansion and spin-off development from the existing power plant as ways to realize further economic development in DeWitt County.

5.10.3.6.2 Heat Dissipation System Impacts to Land Use

Potential impacts to land use from cooling towers would primarily be related to drift from a cooling tower plume. In addition, the potential for fogging, icing, or drift damage may also result from a cooling tower plume. Both wet and dry mechanical draft cooling are being considered for the EGC ESP Facility. If dry mechanical draft cooling technology is used, there will be no cooling tower plume. Thus, there will be no impact to land use from the plume. If wet mechanical draft cooling technology is used, there will be a mist plume from the cooling tower. While there is the potential for minor drift, fogging, and icing to occur, it is expected to be of such small magnitude that no land use changes will result.

5.10.3.6.3 Transmission Corridor Impacts and Impacts to Off-Site Areas

Land use impacts from transmission corridor operations primarily fall into two broad categories including maintenance roads for access to pole structures and vegetation control in the right-of-way. The transmission corridor for the EGC ESP Facility will be within the existing right-of-way. No other off-site areas are proposed in association with the EGC ESP Facility. Therefore, no conflicts are apparent between the project and the objectives of land use plans described in Section 2.2.2. Operation and maintenance of the proposed transmission system will be the responsibility of the RTO. It has been assumed that operation and maintenance activities will be conducted in a similar manner to the existing transmission facilities.

5.10.3.6.4 Historic Properties

No historic standing structures have been identified within the EGC ESP Site power block footprint or in the immediate vicinity of the CPS Facility. Impacts of the operation of the EGC ESP Site will be no more than what is described regarding the impact from construction.

5.10.3.7 Water-Related Impacts

Section 5.2 describes the analysis and assessment of anticipated hydrological alterations on water supply and to water users that may result from the EGC ESP Facility. The topics covered include:

- Hydrologic alterations resulting from station operations and the potential impacts on other surface and groundwater users;
- Adequacy of water sources proposed in order to supply total station water needs;
- Water quality changes and possible effects on water use;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize, or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations that are applicable to water use and water quality.

The evaluation of potential hydrological alterations was conducted relative to how they may impact the water environment and both surface water and groundwater users including domestic, commercial, municipal, agricultural, industrial, mining, recreation, navigation, and hydroelectric power.

The CPS NPDES permit allows a 90-day average maximum discharge temperature of 99°F and a maximum daily allowable temperature not to exceed 110.7°F. The CPS NPDES permit also requires monitoring for flow, temperature, pH, total residual chlorine, and total residual oxidant (IEPA, 2000).

One target established for the EGC ESP Facility is to maintain a discharge rate within the CPS NPDES permit conditions. With 66 percent (winter) to 84 percent (summer) of the permitted discharge flow already used by the CPS, the EGC ESP Facility must maintain lower discharge flows by using a less consumptive cooling process to reduce the volume of water withdrawn and discharged.

The need for the selected cooling method to incorporate some form of low consumption wet/dry cooling will also depend on the water available for use during drought conditions.

5.10.3.7.1 Fresh Water Streams

5.10.3.7.1.1 Flow Characteristics

The dam that forms Clinton Lake is operated to provide a minimum downstream release of 5 cfs from Clinton Lake to Salt Creek. This flow rate will not change under the operation of the EGC ESP Facility. The total annual discharge volume to Salt Creek downstream of the dam will be slightly reduced by the value of the consumptive use of the lake water.

5.10.3.7.1.2 Floods

Flooding conditions downstream of the dam have been significantly reduced as a result of initial dam construction and flow attenuation in the Clinton Lake (see Section 2.3.1.1.3). Flood conditions will continue to be attenuated and may be further reduced with additional consumptive use of lake water.

5.10.3.7.1.3 Temperature Variations

With addition of the new EGC ESP Facility, temperatures are expected to increase by a minimal level described for Clinton Lake in the following section. The minimal change will be further diminished as flow moves downstream from the Clinton Lake Dam. No change is expected at Rowell, as the temperatures at that location are under the stronger influence of natural stream temperature moderating processes.

5.10.3.7.2 Lakes and Impoundments

5.10.3.7.2.1 Floods

The operation of the EGC ESP Facility is not expected to have a significant impact on flooding. The EGC ESP Facility will obtain cooling water from the lake and discharge a smaller amount of water (intake less consumptive use) back to the lake. This results in no increase in lake levels and potentially lower lake levels during dry conditions based on the increased consumptive use identified.

5.10.3.7.2.2 Droughts

A drawdown analysis was completed to determine the capacity of the cooling water supply during dry periods. The 50- and 100-yr recurrence interval dry periods with a 5-yr duration were selected for the evaluation. Comparing the water use requirements for the various cooling methods (see Table 5.2-2) with the water availability from the drought analysis (see Table 5.2-3), it is apparent that several of the cooling methods analyzed have a consumption rate that exceeds the available water for severe drought conditions. If one of these cooling methods is selected then it may be necessary for periods of time to reduce or curtail plant operation in order to protect the minimum lake level and the integrity of the UHS during severe drought conditions.

5.10.3.7.2.3 Temperature and Water Quality

Lake temperatures are expected to increase slightly with operation of the EGC ESP Facility. The temperature increase is expected to be proportional to the increase in flow and temperature that was observed for the CPS Facility. Both plant discharge temperatures are expected to be within the CPS NPDES permit limit of 99°F. The impact of any increase in temperature is expected to be most significant during the summer months where the difference between the intake water temperature and the wet bulb temperature are the smallest and when recirculating volumes are high.

Similar minimal impacts on dissolved oxygen are expected. Other conservative constituents, such as hardness and total dissolved solids, may increase as a result of evaporation if the wet or wet/dry cooling method is selected. The discharge will be diluted by lower dissolved solids in the lake and in the base flows from Salt Creek and North Fork of Salt Creek. Dissolved solids will also be passed downstream through the dam. Over time, a rise in ambient lake dissolved solids concentration is expected to a level of equilibrium higher than the current ambient level. Further discussion of dissolved solids concentration is included in Section 5.3.

5.10.3.7.3 Groundwater Use

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated hydrologic alteration impacts to groundwater from the operation of the EGC ESP Facility.

5.10.3.8 Water Use Impacts

Section 5.2.2 discusses the predicted impacts of station operation on water use including:

- Hydrologic alterations that could have impacts on water use including water availability;
- Water quality changes that could affect water use;
- Impacts resulting from these alterations and changes;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations applicable to water use and water quality.

Presented in the following sections are the conclusions drawn from Section 5.2.2.

5.10.3.8.1 Fresh Water Streams

5.10.3.8.1.1 Water Availability

There are no major water users either upstream or downstream of Clinton Lake that draw water from Salt Creek or the Sangamon River. The 5-cfs minimum discharge from Clinton Lake to Salt Creek will be maintained in accordance with the CPS NPDES requirements.

5.10.3.8.1.2 Water Quality

Clinton Lake is expected to buffer potential water quality impacts to Salt Creek resulting from EGC ESP Facility operations. Downstream users will not be affected because the operating CPS and the EGC ESP Facility are expected to operate in compliance with their NPDES permits.

5.10.3.8.2 Lakes and Impoundments

5.10.3.8.2.1 Water Availability

Clinton Lake was designed and constructed to accommodate two similar sized power plants. The CPS is the first plant and the only major water user on the lake. Recreation is the secondary use of the lake, and includes camping, boating, and fishing. There are no other major identified withdrawals of water from Clinton Lake.

The EGC ESP Facility will be designed and operated to be compatible with the operation of the CPS and its NPDES permit. Incorporating wet/dry cooling rather than the more consumptive wet cooling process will minimize water consumption. Operation of the dam structure is also an important water management function. The dam outfall structure is operated in a passive manner with gate settings periodically set based on long-term weather conditions. Dam operation practices will be reviewed and revised in conjunction with the CPS, as appropriate. This will provide for maintenance of minimum flows in Salt Creek downstream of the dam and conservation of water in the lake impoundment for power plant operation and recreational purposes.

With these design considerations, there is expected to be a minimal impact on the operation of the CPS. The EGC ESP Facility operation will comply with federal laws related to hydrology and water quality.

5.10.3.8.2.2 Water Quality

The water quality of Clinton Lake is classified as an impaired water body by the IEPA. The causes of impairment include excess algal growth and metals. The power plant operation is not uniquely related to either of the impairments. Algal growth is related to nutrient levels in the water column that originate from the dominant agricultural land use in the vicinity. Metals concentrations in the water column and sediment have a number of sources including natural geologic formations, agricultural practices, and industrial sources. For both impairments, stormwater management and erosion control practices for sediment control are the best control option. Nutrients and metals attach to sediment and are effectively controlled with control of sediment in stormwater. Industrial pollution control practices, strategic materials selection, and corrosion control are also expected to be effective in reducing metals contributions from industrial sources.

5.10.3.8.3 Groundwater

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility, and groundwater will not be used as a source of water. In addition, based on the proposed design of the plant, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated groundwater use impacts resulting from the operation of the EGC ESP Facility.

5.10.3.9 Cooling System Impacts

Section 5.3 describes the impacts of the cooling system intake, discharge facilities, and the proposed measures and controls used to limit those impacts.

It is assumed that either mechanical draft or natural draft hyperbolic type cooling towers will be used for normal non-safety plant cooling, and mechanical draft type cooling towers will be used for safety-related cooling. The makeup water for the normal (non-safety) plant operations will be obtained through a new intake structure located approximately 65 feet south of the CPS intake structure on the North Fork basin of Clinton Lake. The intake will include a screening system similar in function to the CPS intake, but for a significantly smaller flow rate. Makeup water for the safety-related cooling towers will be supplied from the same intake structure, which will draw water from the bottom of the submerged impoundment within Clinton Lake (i.e., the UHS). The cooling tower(s) blowdown will be discharged to the CPS discharge flume that flows to the Salt Creek basin of Clinton Lake.

The discussion of the cooling system impacts have been divided into the following sections:

- Intake System;
- Discharge System;
- Heat-Discharge System; and
- Impacts to Members of the Public.

The conclusions drawn from these impacts are presented in the following sections.

5.10.3.9.1 Intake System

Although the specific design details have not been finalized, it is anticipated that the new intake structure will consist of a shore structure adjacent to the existing intake structure that allows access to the impounded water of Clinton Lake, down to the bottom of the UHS. The location of the intake structure will provide a secure source for makeup water to the UHS in the unlikely event of the failure of the Clinton Lake Dam.

5.10.3.9.1.1 Physical Impacts from Intake System

The slight increase in velocity across the intake end of the UHS is not expected to cause any change in the shoreline erosion, bottom scouring, induced turbidity, or silt buildup. The increased velocity may slightly increase the suspended solids concentration drawn into the cooling system. Suspended solids will tend to pass through the cooling system without impact.

5.10.3.9.1.2 Impacts on Aquatic Ecosystems from Intake System

The proposed intake facilities are of a similar nature to the CPS. The total number of fish lost, both juvenile and adult, as a result of operation of the proposed EGC ESP Facility, will be insignificant in comparison to the total number of fish that exist in Clinton Lake, as natural residents or through stocking programs.

5.10.3.9.2 Discharge System

The EGC ESP Facility cooling system will discharge to the CPS discharge flume. The layout of the CPS discharge flume and point of connection of the cooling system discharge from the EGC ESP Facility will be discussed at the COL phase when plant design information is available.

5.10.3.9.2.1 Thermal Impacts from Discharge

A thermal description of Clinton Lake is presented in Section 2.3. In general terms, the combined average discharge temperature from both the EGC Facility and the CPS is expected to be below the CPS NPDES permit maximum 90-day average limit of 99°F. The combined discharge flow rate will increase slightly, but will also fall within the CPS NPDES permit limit of 670,000 gpm. The combined discharge flow will increase from the CPS summer rate of 566,000 gpm to 615,000 gpm, increasing the total heat-discharge to Clinton Lake.

5.10.3.9.2.2 Chemical and Physical Impacts from Discharge

The EGC ESP cooling system may include certain chemicals to limit biological growth, deicing compounds, and anti-scaling materials that will ultimately be discharged to Clinton Lake. The chemical will be selected for their effectiveness and ability to minimize the impacts on water quality. The discharge-monitoring program will be revised, as necessary, to monitor for potential water quality impacts.

The chemicals used will be subject to review and approval for use by the IEPA and releases will be in compliance with water quality standards and an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.

The proposed changes in the quality, quantity, and velocity of the discharged water are not expected to cause any change to shoreline erosion, bottom scouring, induced turbidity, or silt buildup in the discharge flume or at the point of entrance to Clinton Lake. The increased velocity of the intake and discharge may slightly increase the suspended solids concentration or turbidity of discharge waters to Clinton Lake. Observations will be made at the point of discharge to identify any impediment to the existing flow or cause any local erosion or scour of the existing flume.

5.10.3.9.2.3 Impacts to Aquatic Ecosystems from Discharge

Several cooling alternatives are being considered for the operation of the proposed facility. The alternatives will discharge cooling waters in a similar manner to the CPS flume. The discharge water temperature will continue at the NPDES permit level. Flows will increase slightly in the range of 1 to 8 percent. Under the discharge conditions, it is expected that certain fish species would migrate to other portions of Clinton Lake where temperatures are more tolerable. This condition is expected to continue with addition of the EGC ESP Facility.

5.10.3.9.3 Heat-Discharge System

The EGC ESP Facility will depend less on Clinton Lake for heat dissipation because the facility will use a mechanical cooling system of wet cooling or wet/dry cooling for the bulk of the plant cooling. The facility will pump cooling water from the cooling tower basins. After the water passes through the heat exchangers, it will be returned to the cooling tower for cooling and discharge to the basin. A portion of the water will be evaporated in the cooling tower process, and a portion of the water will be discharged as blowdown to the discharge flume to limit the concentration of impurities in the basin water. The lake water will be used for make-up to the cooling tower in order to replace the evaporation and blowdown losses. The blowdown water will be discharged at an elevated temperature back into the lake. This water will be combined with the CPS discharge water, and the associated heat load will be dissipated through the lake cooling loop.

5.10.3.9.3.1 Heat Dissipation to the Atmosphere

The operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere in the immediate vicinity of the site. Depending on the type of cooling system(s) used to dissipate this heat, the rejected heat will be manifested in the form of thermal and/or vapor plumes from one or more locations at the site. The presence of water vapor plumes, associated with wet cooling processes, have the potential to result in a variety of physical or aesthetic impacts. The extent of impacts will depend on the increased moisture content of the air and the prevailing meteorological conditions. The presence of thermal plumes in the atmosphere, associated with dry cooling options, are not expected to have significant environmental or other impacts because the EGC ESP Facility will be located on property that is owned by the CPS. The CPS property boundaries are restricted from public access; any significant impacts attributable to the operation of the cooling towers for plant heat dissipation are expected to be limited to on-site locations. The nearest public roadway is more than 0.5 mi in any direction, and no significant impacts attributable to cooling tower operation are anticipated at or beyond these distances. Additionally, there is no agricultural or public land use in the immediate vicinity of the cooling towers, so salt deposition effects are not expected to be a concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only be installing standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, used only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, vapor/moisture plumes from the towers may be visible from some off-site locations depending on wind direction and other meteorological parameters.

5.10.3.9.3.2 Impacts to Terrestrial Ecosystems

Impacts resulting from the proposed heat dissipation system would be consistent, if not less significant, in comparison to the CPS. As noted in the preceding sections, potential impacts to terrestrial and aquatic ecosystems were monitored for a 5-yr period following the startup of the CPS.

5.10.3.9.3.3 Important Species

Operation of the proposed facility is not anticipated to adversely affect federally-listed, state-listed, threatened or endangered species at the site or within the site vicinity.

Several species of commercial or recreational value in the vicinity of the site include white-tailed deer, various species of waterfowl, and various species of small mammals. It is not anticipated that operation of the proposed facility will have significant adverse impacts to terrestrial species of commercial or recreational value.

5.10.3.9.3.4 Important Habitats

It is not anticipated that the proposed heat dissipation system will have any adverse impacts on the terrestrial environment within the Clinton Lake State Recreation Area. The proposed system will not inhibit access to or use of the terrestrial system surrounding Clinton Lake. Activities such as hunting, fishing, hiking, and other recreational activities that rely on the terrestrial environments of the Clinton Lake State Recreation Area are not anticipated to be impacted by operation of the EGC ESP Facility.

Weldon Springs State Recreation Area is located approximately 6 mi from the location of the proposed facility. Due to the location of this area, no direct impacts to this park are anticipated as a result of operation of the EGC ESP Facility.

Operation of the proposed facility is not anticipated to adversely affect any environmentally sensitive areas within the site vicinity and is not anticipated to have significant adverse effects on wetlands and floodplains. Any aquatic vegetation existing prior to the operation of the EGC ESP Facility will likely adapt to the new conditions.

5.10.3.9.4 Impacts to Members of the Public

Impacts to members of the public from the cooling system of the proposed EGC ESP Facility might include:

- Thermophilic organisms that could negatively impact human health;
- Thermal and/or vapor plumes; and/or
- Potential for increases in ambient noise levels from the operation of the EGC ESP Facility cooling system and towers.

5.10.3.9.4.1 Impacts from Thermophilic Organisms

Thermophilic organisms are microorganisms that are associated with cooling towers, and thermal discharges that may have a negative impact on human health. The presence and numbers of these organisms can be increased due to elevated temperatures in and around the cooling tower and discharge flume.

To reiterate the conclusions from Section 5.3.4, recent IDNR studies on Clinton Lake indicate that elevated water temperatures may be increasing the risk of the presence of pathogenic amoeba (*Naegleria fowleri*) in the thermal discharge zone and at the beach. Although the IDNR has expressed concern about the presence of *Naegleria fowleri* in Clinton Lake, they also have concluded that the risk to human health is very small and decided to allow swimming and water-skiing in the lake. In addition, the USNRC decided to approve the CPS uprate. The increase in heat which was proposed to be rejected to the lake due to the uprate is greater than the increase due to the EGC ESP Facility. Therefore, the EGC ESP Facility would not pose a significant increase of risk. Additionally, the EGC ESP Facility thermal discharges will be within the approved CPS NPDES permit, the limits on which are intended to minimize risks to human health.

Monitoring will be performed, as appropriate and if required, for the presence of thermophilic organisms, and the potential health risk will be evaluated during preapplication monitoring. If the health risk is judged to be significant, the EGC ESP Facility may choose to use an alternate cooling process that will add no heat to the lake, and therefore, not change the existing degree of risk.

If wet cooling is selected, the cooling tower water will be treated with biocides to prevent the growth of dangerous organisms. Monitoring programs will be established to test for the presence of thermophilic microorganisms once the EGC ESP Facility is operational, both to protect on-site workers and the public.

5.10.3.9.4.2 Cooling Tower(s) Thermal and/or Vapor Plumes

The EGC ESP Facility will be located on property that is owned by the CPS. The distances to the CPS property boundaries are large and necessarily restricted from public access; therefore, any significant impacts attributable to the operation of the cooling towers for plant heat dissipation are expected to be limited to on-site locations. The nearest public roadway is more than 0.5 mi in any direction, and no significant impacts attributable to cooling tower operation are anticipated at or beyond these distances. Additionally, there is no agricultural or public land use in the immediate vicinity of the cooling towers, so salt deposition effects are not expected to be a concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only install standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, used only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, vapor/moisture plumes from the towers may be visible from some off-site locations depending on wind direction and other meteorological parameters.

5.10.3.9.4.3 Noise Impacts

The PPE data presented in Table 1.4-1 of the SSAR provides information on the amount of noise generated during operations if cooling towers are chosen as the preferred cooling method. For both the natural draft cooling towers and the mechanical draft cooling towers, the anticipated noise levels from cooling tower operations is anticipated to be 55 dB at 1,000 ft. The Department of Housing and Urban Development uses a day-night average sound level recommended by the USEPA as guidelines or goals for ambient noise levels outdoors in residential areas. Noise levels are deemed acceptable if the day-night average sound level outside in a residential area is less than 65 dB (24 CFR 51). Therefore, no additional noise monitoring is anticipated to be required.

5.10.3.10 Radiological Impacts from Normal Operation

Section 5.4 presents the radiological impacts from normal operations. Specifically addressed are the following topics:

- Exposure pathways;
- Radiation doses to members of the public and measures and controls to limit those impacts;
- Impacts to members of the public and measures and controls to limit those impacts; and
- Impacts to biota other than members of the public, and measures and controls to limit those impacts.

Conclusions drawn from Section 5.4 are presented in the sections that follow.

5.10.3.10.1 Doses and Impacts to Members of the Public

5.10.3.10.1.1 Impacts from the Liquid and Gaseous Pathways

Calculated doses to members of the public from active plant operations were compared to 10 CFR 50, Appendix I and 40 CFR 190 criteria. In all cases, calculated doses were well within the established criteria.

5.10.3.10.1.2 Direct Radiation

It is assumed that the direct radiation from any of the proposed EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building.

5.10.3.10.2 Impacts to Biota

Radiation exposure pathways to biota other than man or members of the public were examined to determine if the pathways could result in doses to biota greater than those predicted for man.

Calculated doses to biota from liquid and gaseous effluents were compared to the doses provided in 40 CFR 190 and are considered conservative when applied to biota. In all cases, calculated doses were well within the established criteria.

5.10.3.10.3 Radiological Environmental Monitoring Program

To establish confidence and credibility that any radiological environmental monitoring data collected and reported are accurate and precise, monitoring activities will be incorporated into the construction phase quality assurance program established pursuant to 10 CFR 50, Appendix B, in concurrence with COL activities.

The EMP will utilize 10 CFR 50, Appendix B, compliant quality programs and processes to:

Provide that personnel are trained and qualified to perform radiological monitoring;

Create and approve procedures for sample collection, packaging, shipment, and receipt of samples for analysis, and prepare and analyze samples at the lab;

Document lab processes such as maintenance, storage, and use of radioactivity reference standards, and document the calibration and checks of radiation, radioactivity measurement systems, and sample tracking and control;

Document the processes and procedures of the monitoring program;

Conduct periodic audits of analysis laboratory functions and their facilities;

Maintain records of sample collection, shipment, and receipt. Lab activity records will also be maintained including sample description, receipt, lab identification, coding, sample preparation and radiochemical processing, data reduction, and verification.

In addition, the following activities will be performed:

- Perform duplicate analysis of the samples (excluding TLDs) to check laboratory precision;
- Routinely count quality indicator and control samples; and
- Participation in inter-comparison programs, such as the Environmental Resource Associates (ERA) cross-check program.

The analytical results provided by the laboratory will be reviewed monthly to validate that the required minimum sensitivities have been achieved and the correct analyses have been performed.

5.10.3.11 Environmental Impacts of Waste

Section 5.5 presents the environmental impacts of waste and measures and controls to limit those impacts. Specifically addressed are the following topics:

- Nonradioactive waste system impacts and measures and controls to limit those impacts; and
- Mixed waste impacts and measures and controls to limit those impacts

5.10.3.11.1 Nonradioactive Waste Systems

5.10.3.11.1.1 Solid Waste

Solid nonradioactive and non-hazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, paper, etc., and will be collected from several on-site locations and deposited in dumpsters located throughout the site. Segregation and recycling of waste will be practiced to the greatest extent practical. An outside vendor will perform weekly collections and disposal.

5.10.3.11.1.2 Liquid Waste

The nonradioactive liquid wastes will be combined with plant circulating water and checked for proper pH and the presence of radiological and hazardous constituents prior to discharge to Clinton Lake. These discharges will comply with an approved NPDES permit for the EGC ESP Facility issued by the IEPA.

5.10.3.11.1.3 Gaseous Waste

The nonradioactive air emissions will be in compliance with the limits that will be established and imposed by the IEPA. These limits will be protective of the air quality in and around the EGC ESP Facility.

5.10.3.11.2 Mixed Waste

As a general practice, mixed waste will not be generated at the EGC ESP Facility, if at all possible.

The EGC ESP Facility personnel will place primary importance on source reduction efforts to prevent pollution and eliminate or reduce the generation of mixed waste. Potential pollutants and wastes that cannot be eliminated or minimized will be evaluated for recycling. Treatment to reduce the quantity, toxicity, or mobility of the mixed waste before storage or disposal will be considered only when prevention or recycling is not possible or practical. Environmentally safe disposal is the last option.

A PPWMP will be developed and implemented before initial reactor operations.

5.10.3.12 Transmission System Impacts

Section 5.6 describes the potential impacts on terrestrial and aquatic ecosystems induced by the operation and maintenance of transmission systems including operation and maintenance of rights-of-way. Operation of transmission lines and corridors necessary to connect a new plant to the grid will generally be the responsibility of the regional transmission system operator, and EGC assumes that the transmission system operator will perform new impact studies.

5.10.3.12.1 Impacts to Terrestrial Ecosystems

There will be no construction of new right-of-way or access roadways required for the proposed transmission system. Land uses traversed by the proposed transmission corridor are predominantly agricultural. There may be temporary disturbances to agricultural activities during construction of the proposed transmission system, but following construction, the disturbed areas will be restored to preconstruction activities. Operation and maintenance activities in agricultural areas are typically minimal as the vegetative growth is under control.

Towers required for the transmission system may eliminate a small amount of productive agricultural lands, but the overall amount of land used will be insignificant in comparison to the total amount of agricultural lands along the proposed transmission corridor.

5.10.3.12.1.1 Important Species

Operation and maintenance of the proposed transmission system is not anticipated to impact federally-listed, state-listed, threatened or endangered species, or species of commercial or recreational value.

It is anticipated that construction of the proposed transmission system may temporarily displace certain recreationally valuable species including deer, small mammals, game-birds, and waterfowl. However, operation and maintenance activities are not anticipated to have adverse effects on species of commercial or recreational value.

5.10.3.12.1.2 Important Habitats

No adverse impacts to the Clinton Lake State Recreation Area are anticipated as a result of the operation and maintenance of the proposed transmission system.

Weldon Springs State Recreation Area is located approximately 6 mi from the location of the EGC ESP Facility. The proposed transmission system corridor is not located within the Weldon Springs State Recreation Area, and therefore, will have no direct impacts to the area.

Towers required to support the proposed transmission system will be sited in upland areas to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized to make certain that the adverse impacts to any environmentally sensitive areas or important habitats potentially occurring along the proposed corridor are avoided.

5.10.3.12.2 Impacts to Aquatic Ecosystems

Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor. Adverse impacts to watercourses, wetlands, and floodplains within the existing right-of-way will be avoided to the greatest extent possible.

Appropriate construction procedures and best management practices will be used to make certain that minimal disturbances occur to existing wetlands, floodplains, and other aquatic ecosystems located within or along the existing corridor. In marsh and emergent growth wetlands, vegetation maintenance is typically not required. In shrub and forested wetland areas, mowing and trimming is periodically required to keep growth outside of the line areas and away from poles.

5.10.3.12.2.1 Important Species

Operation and maintenance of the proposed transmission system is not anticipated to impact federally-listed, state-listed, threatened or endangered aquatic species, or aquatic species of commercial or recreational value.

Appropriate federal and state wildlife agencies will be contacted to confirm the absence of federally-listed, state-listed, and threatened or endangered aquatic species along the proposed transmission system corridor.

No direct impacts to watercourses including Clinton Lake and other streams and tributaries along the proposed transmission system corridor are anticipated as a result of operation and maintenance. Therefore, impacts to commercially or recreationally valuable aquatic species are not anticipated as a result of the operation and maintenance of the proposed transmission system corridor.

5.10.3.12.3 Impacts to Members of the Public

5.10.3.12.3.1 Maintenance Practices

A major portion, approximately 88 percent, of the transmission line right-of-way proposed to serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that existing access to the right-of-way is adequate, and that no permanent roads will be built on the right-of-way for either construction or maintenance. If access roads need to be constructed, these roads will be permitted to “grass-over” for grazing, aesthetics, and minimal maintenance.

Where the transmission lines cross public roads, a screen of trees will be left to minimize visual impacts from the lines. Any new access to the right-of-way, though not anticipated, will be constructed at oblique angles to the road in order to prevent line of sight down the right-of-way.

5.10.3.12.3.2 Electric Field Gradient

Although there are no standards to limit EMF levels in Illinois, EMF reduction measures will be incorporated into the design of the transmission lines and facility. Since there are no local criteria, a guideline of 5 mA maximum EMF will be maintained.

5.10.3.12.3.3 Communication System Reception

Audible noise or RI and TVI can occur from corona, from electrical sparking and arcing between two pieces of loosely fitting hardware, or from burrs or edges on hardware. Design practices for the proposed transmission lines include use of EHV conductors, corona resistant line hardware, and grading rings at insulators. The effect of corona on radio and television is dependent on the radio/television signal strength, distance from the transmission line, and the transmission line noise level.

5.10.3.12.3.4 Grounding Procedures

Ground faults will be installed to limit induced currents from the EMF given off by the lines. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under normal atmospheric conditions. With these construction operational measures taken into consideration, no impacts to members of the public are expected.

5.10.3.12.3.5 Noise Levels

During the construction of the H-Frame structures, there will only be slight noise impacts, if any, to members of the public.

When an electric transmission line is energized, an electric field is created in the air surrounding the conductors. If this field is sufficiently intense, it may cause the breakdown of the air in the immediate vicinity of the conductor (corona); corona can result in RI and TVI. This noise occurs at discrete points and can be minimized with good design and maintenance practices. Design practices for the proposed transmission lines will include use of EHV conductors, corona resistant line hardware, and grading rings at insulators.

Audible noise levels are usually very low and not heard, except possibly directly below the line on a quiet day.

5.10.3.13 Uranium Fuel Cycle Impacts

Section 5.7 addresses the uranium fuel cycle impacts associated with operations. As required by 10 CFR 51.51, every ER prepared for an LWR, and submitted on or after September 4, 1979, will take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor.

Table S-3 was originally promulgated in the early 1970s to generically address the environmental impacts of the uranium fuel cycle for LWRs that were to be considered in environmental analyses for construction permits. The LWR technologies being considered are all light-water-cooled nuclear power reactors with uranium dioxide fuel and therefore Table S-3 of paragraph (b) of 10 CFR 51.51 provides the environmental effects from the uranium fuel cycle for these reactor technologies. The detailed comparison in Section 5.7, of the underpinnings of Table S-3 shows qualitatively that the existing WASH-1248 environmental and health effects are conservative and appropriate for use by the new gas-cooled reactor technologies included in this ER.

5.10.3.14 Socioeconomic Impacts

Section 5.8 presents the impacts, and measures and controls to limit the socioeconomic impacts. The following topics discussed include:

- Physical impacts from EGC ESP Facility operations, and measures and controls to limit those impacts; and
- Social and economic impacts from EGC ESP Facility operations, and measures and controls to limit those impacts.

Conclusions drawn from Section 5.8 are presented in the sections that follow.

5.10.3.14.1 Physical Impacts from EGC ESP Facility Operation
Physical impacts are defined as noise, air, and aesthetic disturbances. Physical impacts will be controlled as specified by applicable regulations and will not significantly impact the site, vicinity, or region. As summarized in Section 5.8, local communities will not experience any physical impact from station operation. The road network has sufficient capacity to accommodate a substantial increase in volume. Thus, no significant congestion problems are expected from station operation.

Clinton Lake State Recreation Area and Weldon Springs State Recreation Area are the only major recreational facilities within the site vicinity. Since it is not anticipated that a significant number of workers will move to the region to work at the station, these facilities would not experience any abnormal influx in use due to station operation. Outside of the 6-mi radius of the site vicinity, there will be no physical (noise, air, and aesthetic disturbances) impacts from station operation.

5.10.3.14.1.1 Noise
Any equipment that exceeds the noise abatement criteria will use noise control devices. Equipment manufacturers will be required to guarantee that specifications on allowable octave bands will be met. Most equipment will be located inside structures; therefore, building walls will reduce outside noise levels. Further, reduction will be achieved as the noise travels to the property line. The heat dissipation system is anticipated to have a noise level of up to 55 dB and at a distance of 1,000 ft from the system. This level is below the typical outside noise criterion, 65 dB, for residential areas.

There are few rural families close to the site that may be affected by an increase in traffic noise generated by station employees, delivery trucks, and off-site shipments. It is anticipated that most vehicle trips will occur during normal weekday business hours. Additional traffic from the operation workforce, to and from the site, will increase the level of vehicular noise for those residents living along routes that access the EGC ESP Facility. However, the low volume highway, even with the added traffic, is expected to be below the noise criteria for residential areas.

Noise impacts from operation are anticipated to be minor for several reasons: noise levels are not expected to exceed 55 dB, 1,000 ft from the system; traffic noise will be limited to normal weekday business hours; and noise control devices will be used when necessary. The nearby Clinton Lake State Recreation Area will not be impacted by noise, since recreational facilities are well beyond 1,000 ft from the facility. The nearest campground is approximately 1 mi from the EGC ESP Facility.

5.10.3.14.1.2 Air Emissions
The annual average exposure at the site boundary from gaseous sources will not exceed applicable regulations during normal operation. Additional air emissions from the increased vehicular traffic from the new operation workforce will have a negligible effect on the area.

5.10.3.14.1.3 Aesthetics
The viewshed of the station is limited to only a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS Facility (with the exception of the new plume from the heat dissipation system), the EGC

ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake.

5.10.3.14.2 Social and Economic Impacts from EGC ESP Facility Operations

Social and economic impacts include impacts to the economy, tax and social structure, housing, education, recreation, public services and facilities, transportation facilities, distinctive communities, and agriculture.

The operation workforce will consist of up to 580 people. Operation workforce salaries will have a multiplier effect, where money is spent and respent within the region. Local businesses in and around the City of Clinton may see an increase in business, especially in the retail and services sector during normal business hours. Though not expected to be significant, the additional employment may help to sustain existing businesses throughout the region, as well as provide opportunities for some new businesses. The effect of the EGC ESP Site may slightly improve the unemployment levels in the area.

In addition, the taxing districts will benefit from the EGC ESP Facility. The assessed value of the EGC ESP Facility will be substantial; therefore, the taxes paid to local jurisdictions will be sizeable. Other potential tax impacts will include an increase in state income tax revenue generated from the additional operation jobs and indirect salaries created by operation.

The abundance of existing housing within the surrounding area will mitigate against effects on rents or prices produced by the operation. Additionally, the majority of the operation workers will be from the region, where their educational requirements are already being met. The surrounding school systems will not experience any major influx of students because of the operation of the EGC ESP Facility.

The operation worker population will predominately reside within the region, and will commute to the facility. Therefore, it is not anticipated that there will be any additional peaks at recreational facilities within the region.

In general, no overcrowding of public facilities is anticipated because most of the operation workforce is not expected to move to the area. The EGC ESP Site is in a rural area; therefore, community services are not expected to be directly affected. Also, since private security guards will be used at the site, dependence on local police forces will not be required. Public facilities will be capable of absorbing the minor increase in load due to the small influx of people expected. The population in the region is fairly homogeneous, largely white, and not dominated by a particular ethnic group. The only special group within the region are two Amish communities located around the towns of Arthur and Arcola, which are 37-mi and 44-mi southeast of the site, respectively. These two areas are far enough away from the site that they will not be impacted by station operations.

No land is designated as agricultural land within the site. However, 82 percent is designated as agricultural land within the vicinity, and 93 percent is designated as agricultural land within the region. Since the land impacted by station operations will be limited to the site, no impact to agriculture is anticipated.

5.10.3.15 Decommissioning

Section 5.9 provides a brief discussion about decommissioning plans and impacts. The following information is provided for the reviewer and more detailed information is presented in Section 5.9.

This section reviews the environmental impacts of decommissioning the EGC ESP Facility. This ER supports an ESP; therefore, USNRC regulations do not require the applicant to inform the USNRC of its plans for decommissioning the facility. Consequently, no definite plan for the decommissioning of the plant has been developed (USNRC, 1999). Additionally, no financial assurances for decommissioning are required at the ESP stage. The general environmental impacts are summarized in Section 5.9, since the decommissioning plans and reports (and consequently detailed analyses of alternatives) are not prepared until cessation of operations.

CHAPTER 5

References

Chapter Introduction

None

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CHAPTER 5

Tables

TABLE 5.2-1
Clinton Power Station Discharge Permit and Plant Cooling Flows

	Intake (gpm)	Discharge (gpm)	Consumptive Use (gpm)
NPDES Permit [a]	-- [d]	670,000	-- [d]
Clinton Power Station (Lake Cooling Loop)	566,000 (summer) 445,000 (winter) [b]	566,000 (summer) 445,000 (winter) [b]	8,292 [b, c]
Capacity Remaining (under current NPDES permit)	-- [d]	104,000 (summer) 225,000 (winter)	-- [d]

[a] IEPA, 2000
[b] CPS, 2002
[c] Evaporative loss in lake cooling loop
[d] Not applicable

TABLE 5.2-2
Water Use Requirements (Consumptive Use) for Plant Options and Cooling Methods

Bounding Plant Requirement	Wet Cooling Tower	Wet/Dry Cooling Tower[a]	Dry Cooling
Maximum	31,500 gpm	16,000 to 9,450 gpm	0 gpm
Minimum	8,000 gpm	8,000 to 2,400 gpm	0 gpm

Source: SSAR Table 1.4-1
[a] Assumes up to 70 percent of cooling is accomplished in the dry cooling process
Note: Additional forced evaporation due to these cooling methods is insignificant

TABLE 5.2-3
Lake Water Available for Use During Drought Events

Water Use	50-yr Drought	100-yr Drought
Total Water Available For Withdrawal	23,400 gpm	17,800 gpm
Water Consumed By Existing Uprated Plant	8,300 gpm	8,300 gpm
Water Available For ESP Use	15,100 gpm	9,500 gpm

TABLE 5.2-4
Water Discharge Requirements for Plant Options and Cooling Methods

Bounding Plant Requirement	Wet Cooling Tower	Wet/Dry Cooling Tower[a]	Dry Cooling
Maximum	49,000 gpm	14,700 gpm	0 gpm
Normal	12,000 gpm	3,600 gpm	0 gpm

Source: SSAR Table 1.4-1
[a] Assumes up to 70 percent of cooling is accomplished in the dry cooling process

TABLE 5.2-5
Average Number of Days at Low Flow Discharge (5 cfs) from Clinton Lake During 24-year Period of Record

Month	CPS Plant	CPS with ESP and Wet/Dry Cooling	CPS with ESP and Wet Cooling
January	2	6	21
February	2	4	12
March	0	1	3
April	0	1	2
May	1	2	5
June	3	4	9
July	7	10	15
August	8	11	18
September	18	22	27
October	23	27	31
November	9	17	27
December	2	6	19
Annual Average	76	111	190

Note: Values are established based on a 24-year period of local hydrologic record from June of 1978 to April of 2002. The Period of Record model does not simulate actual operating conditions but rather continuous operation of the designated plants over the total period of record. This allows determination of relative differences or expected change in the duration of low flow discharge.

TABLE 5.2-6
Average Water Surface Elevation of Clinton Lake During 24-year Period of Record

Month	CPS Plant (Elev. in feet)	CPS with ESP and Wet/Dry Cooling (Elev. in feet)	CPS with ESP and Wet/Dry Cooling (Change in Elev. in feet)	CPS with ESP and Wet Cooling (Elev. in feet)	CPS with ESP and Wet Cooling (Change in Elev. in feet)
January	690.3	690.2	-0.1	689.4	-0.9
February	690.5	690.5	-0.1	690.0	-0.5
March	690.9	690.8	0.0	690.7	-0.2
April	690.8	690.7	0.0	690.7	-0.1
May	690.7	690.7	0.0	690.6	-0.1
June	690.5	690.5	0.0	690.3	-0.2
July	690.3	690.2	-0.1	690.0	-0.3
August	690.2	690.1	-0.1	689.8	-0.5
September	689.9	689.7	-0.2	689.1	-0.8
October	689.8	689.4	-0.4	688.2	-1.6
November	690.1	689.8	-0.4	688.3	-1.9
December	690.4	690.3	-0.2	689.1	-1.3
Annual Average	690.4	690.2	-0.1	689.7	-0.7

Note: Values are established based on a 24-year period of local hydrologic record from June of 1978 to April of 2002. The Period of Record model does not simulate actual operating conditions but rather continuous operation of the designated plants over the total period of record. This allows determination of relative differences or expected change.

TABLE 5.2-7
Water Elevation - Surface Area Relationship for Clinton Lake

Water Surface Elevation	Surface Area (Acres)
670	1,600
672	1,900
674	2,100
676	2,400
678	2,700
680	3,100
682	3,550
684	3,930
686	4,250
688	4,520
690 (Normal Pool Elevation)	4,895

Source: Illinois Power. Clinton Power Station Updated Safety Analysis Report. Revision 10. 2002

TABLE 5.2-8
Water Elevation - Volume Relationship for Clinton Lake

Water Surface Elevation	Volume (Acre-feet)
670	10,500
672	14,500
674	18,000
676	23,000
678	28,000
680	33,900
682	40,600
684	48,000
686	56,000
688	64,800
690 (Normal Pool Elevation)	74,200

Source: Illinois Power. Clinton Power Station Updated Safety Analysis Report. Revision 10. 2002

TABLE 5.2-9
Projected Temperature Changes Due to the Proposed ESP

			Edinger Temp Change per Foot of Lake Level			
			0.24	Deg C/ft	0.43	Deg F/ft
Month	Lake Level Change (ft)		Temperature Change (Deg C)		Temperature Change (Deg F)	
	Wet/dry	Wet	Wet/dry	Wet	Wet/dry	Wet
January	-0.1	-0.9	0.0	-0.2	0.0	-0.4
February	-0.1	-0.5	0.0	-0.1	0.0	-0.2
March	0.0	-0.2	0.0	0.0	0.0	-0.1
April	0.0	-0.1	0.0	0.0	0.0	0.0
May	0.0	-0.1	0.0	0.0	0.0	0.0
June	0.0	-0.2	0.0	0.0	0.0	-0.1
July	-0.1	-0.3	0.0	-0.1	0.0	-0.1
August	-0.1	-0.5	0.0	-0.1	0.0	-0.2
September	-0.2	-0.8	0.0	-0.2	-0.1	-0.3
October	-0.4	-1.6	-0.1	-0.4	-0.2	-0.7
November	-0.4	-1.9	-0.1	-0.5	-0.2	-0.8
December	-0.2	-1.3	0.0	-0.3	-0.1	-0.6
Annual Average	-0.1	-0.7	0.0	-0.2	-0.1	-0.3

Source: J. E. Edinger Associates Inc. Probabilistic Hydrothermal Modeling Study of Clinton Lake, February 1989, Document No 89-15-R

TABLE 5.3-1
Flow and Velocity through a Cross-Section of the Ultimate Heat Sink

	Flow (summer)	Section Area (Elevation 690 ft)	Velocity (Elevation 690 ft)	Section Area (Elevation 675 ft)	Velocity (Elevation 675 ft)
Existing CPS System	566,000 gpm	13,580 ft^2	0.09 ft/sec	3,868 ft^2	0.33 ft/sec
Combined CPS and EGC ESP Facility Systems	615,000[a] gpm	13,580 ft^2	0.10 ft/sec	3,868 ft^2	0.35 ft/sec

[a] Includes the CPS summer flow (566,000 gpm) plus the ESP maximum discharge requirement using a wet cooling tower (49,000 gpm.)

TABLE 5.3-2
Average and Maximum Plant Discharge Values

	Flow (summer)	**Temperature (Maximum 90-Day Average)**	**Temperature (Maximum Daily)**
Existing CPS System	566,000 gpm	99°F	110.7°F
Combined CPS and EGC ESP Facility Systems	615,000[a] gpm	99°F	110.7°F
NPDES Permit	670,000 gpm	99°F	110.7°F

Source: IEPA, 2000
[a] Includes the CPS summer flow plus the ESP maximum water use requirement using a wet cooling tower.

TABLE 5.3-3
Velocity in the Discharge Flume

	Flow Depth	Cross Sectional Area	Flow	Velocity
Design Capacity	13 ft	2,038 ft^2	1,372,077 gpm	1.5 ft/sec
Existing CPS System	-- [a]	-- [a]	566,000 gpm	1.5 ft/sec
Combined CPS and EGC ESP Facility Systems	-- [a]	-- [a]	615,000 gpm	1.5 ft/sec

Source: CPS, 2002

[a] Data on the depth of the flow in the discharge flume and the corresponding cross sectional area are not available.

TABLE 5.3-4
Average Monthly Temperatures at Monitoring Point 4 (Near Plant Intake) from 1987 to 1991

Month	1987 (°F)	1988 (°F)	1989 (°F)	1990 (°F)	1991 (°F)
April	50.0	55.4	46.4	59.0	57.2
May	55.4	57.2	57.2	64.4	75.2
June	80.6	75.2	71.6	78.8	78.8
July	77.0	80.6	80.6	78.8	80.6
August	80.6	84.2	80.6	82.4	78.8
September	71.6	73.4	73.4	73.4	-- [a]

Source: CPS, 1992

[a] Data not available

TABLE 5.3-5
Qualitative Assessment of the Magnitude and Extent of Visible Vapor Plumes

Review Element	Wet Cooling	Dry Cooling	Wet/Dry Cooling
Visible Plumes	Visible plumes of significant length can be observed during cold, moist conditions. During moderate to high wind conditions, vapor plumes can result in a "fumigation" of the area in the immediate vicinity of the cooling towers.	No visible plume	Similar to the wet cooling option; however, the extent of visible plumes will be directly proportional to the ratio of wet/dry cooling.
Ground level fogging and icing	Fogging can occur during cool/cold weather, high humidity, and light or windy conditions. Icing can occur during sub-freezing conditions, or during high winds when drift droplet deposition can accumulate and freeze at ground level or on nearby structures. Most significant impacts will be in the immediate vicinity of cooling towers.	No fogging or icing impacts	Similar to the wet cooling option; however, the extent of fogging and icing impacts will be directly proportional to the ratio of wet/dry cooling.
Solids deposition	Solids deposition results from the entrainment of suspended solids in the circulated cooling water. The extent will depend on the number of cycles of cooling water concentration prior to blowdown. The majority of deposition typically occurs in the immediate vicinity of the tower(s), but can also occur, to a limited extent, farther downwind.	No solids deposition	Similar to the wet cooling option; however, the extent of solids deposition impacts will be directly proportional to the ratio of wet/dry cooling.
Cloud formation, shadowing and precipitation	Cloud formation and precipitation is a very rare occurrence and only occurs for large cooling towers and during very cool/cold temperatures and high humidity conditions.	No cloud formation	Similar to the wet cooling option; however, the extent of cloud formation potential will be directly proportional to the ratio of wet/dry cooling.
Interaction with existing pollution sources	No significant pollution sources are known to exist in the immediate vicinity of the EGC ESP Site. Very low potential for plume interaction is anticipated.	None	Similar to the wet cooling option; however, the extent of interaction potential will be directly proportional to the ratio of wet/dry cooling.
Humidity Increase	An increase in humidity levels would only be expected in the immediate vicinity of the towers.	No increase in humidity	Limited local increase in humidity downwind.

TABLE 5.4-1
Liquid Pathways Parameters

Description	Parameter
Effluent Discharge [a]	2,400 gpm
Source Term [b]	Isotope Maximum Composite Releases
Lake Volume [c]	74,200 ac-ft

[a] SSAR Table 1.4-1
[b] See Table 3.5-1
[c] CPS, 2002

TABLE 5.4-2
Liquid Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Children	Infant
Fish consumption	21 kg/yr	16 kg/yr	6.9 kg/yr	NA
Shoreline usage	12 hr/yr	67 hr/yr	14 hr/yr	NA
Swimming exposure (assumed same as shoreline)	12 hr/yr	67 hr/yr	14 hr/yr	NA
Boating (assumed)	100 hr/yr	67 hr/yr	14 hr/yr	NA

Source: USNRC, 1977
Note: Consumption factors from Regulatory Guide 1.109 Table E-5 in lieu of site specific values.

TABLE 5.4-3
Gaseous Pathways Parameters

Description	Value
Population Data	Tables presented in Chapter 2 of this report
Milk Production	Tables contained in Chapter 2 of this report
Vegetable Production	Tables contained in Chapter 2 of this report
Meat Production	Tables contained in Chapter 2 of this report
Source Term	Tables contained in Chapter 3 of this report
Meteorological Data	Tables contained in Chapter 2 of this report
Annual Average χ/Q	Tables contained in Chapter 2 of this report
Annual Average D/Q	Tables contained in Chapter 2 of this report
Annual Average Decayed χ/Q	Tables contained in Chapter 2 of this report
Annual Average Decayed D/Q	Tables contained in Chapter 2 of this report

TABLE 5.4-4
Gaseous Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Children	Infant
Leafy Vegetables	64 kg/yr	42kg/yr	26 kg/yr	NA
Meat	110 kg/yr	65 kg/yr	41 kg/yr	NA
Milk	310 L/yr	400 L/yr	330 L/yr	330 L/yr
Vegetable	520 kg/yr	630 kg/yr	520 kg/yr	NA

Source: USNRC, 1977
Note: Consumption factors from Regulatory Guide 1.109 Table E-5 in lieu of site specific values.

TABLE 5.4-5
Liquid Pathways – Maximum Exposed Individual Dose Summary

Case	Location	Organ Receiving Maximum Dose	Dose (mrem/yr)	Total Body Dose (mrem/yr)
Maximum Composite	Clinton Lake	Liver	1.33 (Teen)	0.95 (Adult)

TABLE 5.4-6
Gaseous Pathways - Maximum Exposed Individual Dose Summary

		Dose Rate (mrem/year)		
Location [b]	**Pathway**	**Total Body**	**Skin**	**Thyroid**[a]
Nearest Residence (0.73 mi SW)	**Plume**	3.9E-01	1.4E-0	NA
	Inhalation			
	Adult	1.2E-01	NA	4.8E-01
	Teen	1.2E-01	NA	6.0E-01
	Child	1.1E-01	NA	7.0E-01
	Infant	6.3E-02	NA	6.0E-01
Nearest Garden (0.93 mi N)	**Vegetables**			
	Adult	2.7E-01	NA	2.6E+0
	Teen	3.6E-01	NA	3.6E+0
	Child	6.8E-01	NA	7.0E+0
Nearest Meat Animal (0.93 mi N)	**Meat**			
	Adult	6.1E-02	NA	NA
	Teen	4.5E-02	NA	NA
	Child	7.3E-02	NA	NA
Nearest Milk Cow [c] (5.0 mi N)	**Cow Milk**			
	Adult	9.7E-03	NA	1.5E-01
	Teen	1.4E-02	NA	2.4E-01
	Child	2.7E-02	NA	4.7E-01
	Infant	5.0E-02	NA	1.1E+0
Nearest Milk Goat (4.4 mi SE)	**Goat Milk**			
	Adult	1.5E-02	NA	1.7E-01
	Teen	2.0E-02	NA	2.7E-01
	Child	3.4E-02	NA	5.4E-01
	Infant	5.9E-02	NA	1.3E+0

[a] Thyroid is the maximum organ for maximum exposed individual dose due to pathway and location shown.

[b] Locations are based on Tables 2.7-53 to 2.7-56.

[c] The nearest milking cow for human consumption is located beyond 5 miles.

TABLE 5.4-7
Liquid Pathways – Comparison of Maximum Individual Dose Compared to 10 CFR 50, Appendix I Criteria

Type of Dose	Appendix I Criteria Dose Objective	Point of Dose Evaluation [a]	Calculated Doses (mrem/yr)
Liquid Effluents			
Dose to total body from all pathways	3 mrem/yr each unit	Clinton Lake	0.95 Adult
Dose to any organ from all pathways	10 mrem/yr each unit	Clinton Lake	1.33 Teen Liver

Source: 10 CFR 50
[a] Location of the highest dose off site.

TABLE 5.4-8
Liquid Pathways Comparison of Maximum Individual Dose Compared to 40 CFR 190 Criteria

Type of Dose (Annual)	Design Objective	Calculated Dose
Whole body dose equivalent	25 mrem	0.95 mrem
Dose to thyroid	75 mrem	0.03 mrem
Dose to another organ	25 mrem	1.33 mrem (Liver)

Source: 40 CFR 190

TABLE 5.4-9
Gaseous Pathways – Comparison of Maximum Individual Dose Compared to 10 CFR 50, Appendix I Criteria

Type of Dose	Design Objective	Point of Evaluation	Calculated Dose
Gaseous Effluents (Noble Gases Only)			
Gamma Air Dose	10 mrad	Exclusion area boundary	1.35 mrad
Beta Air Dose	20 mrad	Exclusion area boundary	2.89 mrad
Total Body Dose	5 mrem	Exclusion area boundary	0.875 mrem
Skin Dose	15 mrem	Exclusion area boundary	2.94 mrem
Radioiodines and Particulates			
Dose to any organ from all pathways	15 mrem	Varies [a]	9.44 mrem (thyroid)

Source: 10 CFR 50
[a] Locations of highest pathway doses offsite.
Note: mrad = millirad

TABLE 5.4-10
Gaseous Pathways Comparison of Maximum Individual Dose Compared to 40 CFR 190 Criteria

Type of Dose (Annual)	Design Objective	Calculated Dose
Whole Body Dose Equivalent	25 mrem	2.26 mrem
Dose To Thyroid	75 mrem	9.44 mrem
Dose To Another Organ	25 mrem	3.71 mrem (bone)

Source: 40 CFR 190

TABLE 5.4-11
Gaseous Pathways – Annual Population Dose Results

	Calculated Doses (Person rem)	
Pathway	Total Body	Thyroid (worst case organ)
Plume	0.403	0.403
Ground	0.145	0.145
Inhalation	0.480	1.530
Vegetable Ingestion	0.108	0.109
Cow Milk Ingestion	0.392	3.350
Meat Ingestion	0.298	0.420
Total	1.830	5.950

TABLE 5.4-12
Direct Radiation – Estimated Annual Population Dose

Location	Estimated Dose (mrem)	Estimated Population Dose (person rem)
Nearest residence	0.9	2.7E-03
Recreation site	7.2E-02	4.8E-02
Nearest site boundary	0.8	NA

Source: CPS, 1982

TABLE 5.4-13
Natural Background – Estimated Whole Body Dose to the Population within 50 mi of the EGC ESP Facility

Source	Annual Individual Dose (mrem/yr)	Annual Population Dose [a] (person-rem/yr)
Terrestrial dose	140	3.6E+04
Man-made source dose	100	8.0E+04
Total background radiation dose	285	2.3E+05

Source: CPS, 1982
[a] Annual population dose based on projected residential population in year 2010 from Tables 2.5-2 and 2.5-4.

TABLE 5.4-14
Identified Important Species and Analytical Surrogates

Basis	Identified Species	Remarks	Surrogate Species
Aquatic Ecology			
Federally threatened	None identified		
State threatened	Spike (freshwater mussel)	Located 10 mi from EGC ESP Site, or about 4 mi from site vicinity	Freshwater invertebrae
Commercial or recreation	Channel catfish Hybrid striped bass Largemouth bass Walleye	Sport fishing. Hybrid striped bass and walleye are restocked in Clinton Lake	Freshwater fish; comparable size
Terrestrial Ecology			
Federally threatened	None identified		
State threatened	None identified	None within site or site vicinity	
Commercial or recreation	Whitetail deer and small game incl. turkey, rabbit, squirrel, raccoon	Hunted near EGC ESP Site	Raccoon, muskrat
	Waterfowl incl. ducks (various species), teal, coot, Canada goose, etc.	Hunted near EGC ESP Site	Duck
	Migratory shorebirds incl. sandpipers and heron	Not hunted	Heron

Note: See Section 2.4, Ecology

TABLE 5.4-15
Terrestrial Biota Parameters

Terrestrial Biota	Food Intake (g/d)	Body Mass (g)	Effective Body Radius (cm)	Food Organism
Muskrat	100	1,000	6	Aquatic Plants
Raccoon	200	12,000	14	Invertebrates
Heron	600	4,600	11	Fish
Duck	100	1,000	5	Aquatic Plants

Source: USNRC, 1986

TABLE 5.4-16
Shoreline (Sediment) and Swimming Exposures

Biota	Shoreline Exposure (hr/yr)	Swimming Exposure (hr/yr)
Fish	4,380	8,760
Invertebrates	8,760	8,760
Algae	NA	8,760
Muskrat	2,922	2,922
Raccoon	2,191	NA
Heron	2,922	2,920
Duck	4,383	4,383

Source: USNRC, 1986

TABLE 5.4-17
Parameters Used in Biota Dose Assessments

Parameter	Source or Bases
Freshwater aquatic plant elemental bioaccumulation factors	NUREG/CR-4013, Table 3.1.
Freshwater fish and invertebrate bioaccumulation factors	Regulatory Guide 1.109, Table A-1
Committed total body dose factors from ingestion of biota	Regulatory Guide 1.109, Table E-11
Tritium dose factor	NUREG/CR-4013, Table 3.8
Effective absorbed energies for internal doses.	NUREG/CR-4013, Appendix B
Total body water immersion dose factors	NUREG/CR-4013, Appendix B
Shoreline and sediment external dose factors	Regulatory Guide 1.109, Table E-6
Increase factor (2) factor for ground exposure	NUREG/CR-4013, Section 3.2.5
Noble gas total body immersion dose factors	Regulatory Guide 1.109, Table B-1
Total body inhalation dose factors	Regulatory Guide 1.109, Table E-7

TABLE 5.4-18
Total Body Dose to Biota from Liquid and Gaseous Effluents

	Liquid Effluents		Gaseous Effluents	
Biota	Internal Dose (mrem/yr)	External Dose (mrem/yr)	Internal Dose (mrem/yr)	External Dose (mrem/yr)
Fish	2.43E+00	3.82E+00	NA	NA
Invertebrate	6.11E+00	7.63E+00	NA	NA
Algae	2.78E+01	7.18E-03	NA	NA
Muskrat	1.34E+01	2.55E+00	1.66E-01	1.06E+00
Raccoon	4.57E+00	1.91E+00	1.66E-01	1.44E+00
Heron	6.63E+01	2.55E+00	8.30E-02	6.27E-01
Duck	1.20E+01	3.82E+00	1.66E-01	1.16E+00

TABLE 5.4-19
Comparison of Biota Doses to 40 CFR 190 Whole Body Dose Equivalent of 25 mrem/yr

Biota Meeting 40 CFR 190	Biota Exceeding 40 CFR 190
Fish	Algae
Invertebrate	Heron
Muskrat	
Raccoon	
Duck	

Source: 40 CFR 190

TABLE 5.4-20
Comparison of Biota Doses to ORNL 1995 Evaluated Daily Limits

Aquatic Biota 1,000 mrad/day [a]	Terrestrial Biota 100 mrad/day
Fish – 6.3 mrem/yr	Muskrat – 17 mrem/yr
Invertebrate – 14 mrem/yr	Raccoon – 8.1 mrem/yr
Algae – 28 mrem/yr	Heron – 70 mrem/yr
	Duck – 17 mrem/yr

[a] A dose equivalent of 1 mrem is approximately the same as 1 mrad of absorbed dose in tissue (man).

TABLE 5.4-21
Summary of Information Reported by Commercial Light Water Reactors (1973 – 2002)

Year	Number of Reactors Included*	Annual Collective Dose (person-rem)	No. of Workers With Measurable Dose**	Electricity Generated (MW-yrs)	Average Measurable Dose Per Worker (rem)	Average Collective Dose Per Reactor (person – rem)	Average No. Personnel With Measurable Doses Per Reactor***
1973	24	13,962	14,780	7,164.1	0.95	582	616
1974	33	13,650	18,139	10,590.9	0.75	414	550
1975	44	20,901	28,234	17,768.9	0.74	475	642
1976	52	26,105	34,515	21,462.9	0.76	502	664
1977	57	32,521	42,393	26,448.3	0.77	571	744
1978	64	31,785	46,081	31,696.5	0.69	497	720
1979	67	39,908	64,253	29,926.0	0.62	596	959
1980	68	53,739	80,457	29,157.5	0.67	790	1,183
1981	70	54,163	82,224	31,452.9	0.66	774	1,175
1982	74	52,201	84,467	32,755.2	0.62	705	1,141
1983	75	56,484	85,751	32,925.6	0.66	753	1,143
1984	78	55,251	98,309	36,497.6	0.56	708	1,260
1985	82	43,048	92,968	41,754.7	0.46	525	1,134
1986	90	42,386	100,997	45,695.1	0.42	471	1,122
1987	96	40,406	104,403	52,116.3	0.39	421	1,088
1988	102	40,772	103,294	59,595.1	0.40	400	1,013
1989	107	35,931	108,278	62,223.0	0.33	336	1,012
1990	110	36,602	108,667	68,291.7	0.34	333	988
1991	111	28,519	98,782	73,448.4	0.29	257	890
1992	110	29,297	103,155	74,012.0	0.28	266	938
1993	106	25,597	93,749	70,704.9	0.27	241	884
1994	107	21,672	83,454	74,536.6	0.26	203	780
1995	107	21,233	85,671	78,875.2	0.25	198	801
1996	109	18,883	84,644	79,660.0	0.22	173	777
1997	109	17,149	84,711	71,851.4	0.20	157	777
1998	105	13,187	71,485	77,069.9	0.18	126	681
1999	104	13,666	75,420	83,197.6	0.18	131	725
2000	104	12,652	74,108	86,006.8	0.17	122	713
2001	104	11,109	67,570	87,552.8	0.16	107	650

TABLE 5.4-21
Summary of Information Reported by Commercial Light Water Reactors (1973 – 2002)

Year	Number of Reactors Included*	Annual Collective Dose (person-rem)	No. of Workers With Measurable Dose**	Electricity Generated (MW-yrs)	Average Measurable Dose Per Worker (rem)	Average Collective Dose Per Reactor (person – rem)	Average No. Personnel With Measurable Doses Per Reactor***
2002	104	12,126	73,242	88,829.7	0.17	117	704

* Includes only those reactors that had been in commercial operation for at least one full year as of December 31 of each of the indicated years.

** Figures are not adjusted for the multiple reporting of transient individuals.

*** Electricity Generated reflects the gross electricity generated for the years 1973 – 1996. Beginning in 1997, it reflects the net.

Source: NUREG-0713, Vol. 24

TABLE 5.4-22
Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per BWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year
Duane Arnold	3	72	217	1,534	0.14	1,468.3	0.15
Pilgrim	3	90	269	1,998	0.13	1,869.9	0.14
Limerick 1, 2	6	105	631	3,654	0.17	6,557.6	0.10
Columbia Generating	3	109	326	2,868	0.11	2,941.4	0.11
Browns Ferry 1, 2, 3*	9	109	985	5,159	0.19	6,286.5	0.16
Vermont Yankee	3	110	331	2,007	0.17	1,443.8	0.23
Fermi	3	118	353	2,931	0.12	2,973.7	0.12
Hope Creek 1	3	123	370	2,988	0.12	2,752.7	0.13
Perry	3	128	384	2,329	0.17	3,169.7	0.12
Lasalle 1, 2	6	132	793	4,378	0.18	6,402.8	0.12
Grand Gulf	3	132	396	2,458	0.16	3,492.5	0.11
Cooper Station	3	136	407	2,634	0.15	1,851.2	0.22
Hatch 1, 2	6	141	847	4,619	0.18	4,717.5	0.18
Susquehanna 1, 2	6	147	880	5,509	0.16	5,995.4	0.15
Brunswick 1, 2	6	150	900	5,014	0.18	4,715.5	0.19
River Bend 1	3	153	459	2,726	0.17	2,690.9	0.17
Monticello	3	159	477	2,025	0.24	1,495.5	0.32
Clinton	3	165	495	2,995	0.17	2,552.8	0.19
Peach Bottom 2, 3	6	168	1,008	5,089	0.20	6,199.9	0.16
Dresden 2, 3	6	170	1,017	7,929	0.13	4,480.7	0.23
Nine Mile Point 1, 2	6	190	1,143	5,603	0.20	4,467.4	0.26
Fitzpatrick	3	198	595	3,166	0.19	2,243.9	0.27
Oyster Creek	3	309	926	3,954	0.23	1,612.7	0.57
Quad Cities 1, 2	6	471	2,824	7,394	0.38	4,285.0	0.66
Totals and Averages	105		17,033	90,961	0.19	86,667.3	0.20
Averages per Reactor-Yr		162		866		825.4	

TABLE 5.4-22
Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per BWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year

Sites where not all reactors had completed 3 full years of commercial operation as of 12/31/02 are not included.

* Browns Ferry 1 remains in the count of operating reactors, but was placed on Administrative Hold in June of 1985.

Source: NUREG-0713, Vol. 24

TABLE 5.4-23
Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year
Indian Point 3	3	45	134	1,313	0.10	2,823.9	0.05
Seabrook	3	48	145	2,676	0.05	2,949.4	0.05
Palo Verde 1, 2, 3	9	53	480	3,983	0.12	10,252.2	0.05
Ginna	3	56	167	1,104	0.15	1,359.7	0.12
Crystal River 3	3	56	168	1,287	0.13	2,392.1	0.07
Prairie Island 1, 2	6	60	359	2,292	0.16	2,879.9	0.12
San Onofre 2, 3	6	64	383	3,513	0.11	5,850.3	0.07
Catawba 1, 2	6	64	384	3,029	0.13	6,387.7	0.06
Braidwood 1, 2	6	64	385	3,418	0.11	6,613.1	0.06
Turkey Point 3, 4	6	66	395	2,912	0.14	3,981.8	0.10
Comanche Peak 1, 2	6	70	418	2,719	0.15	6,078.0	0.07
Three Mile Island 1	3	71	212	1,551	0.14	2,262.7	0.09
Callaway 1	3	73	218	2,100	0.10	3,046.8	0.07
Watts Bar 1	3	74	222	2,159	0.10	3,162.8	0.07
Diablo Canyon 1, 2	6	75	447	3,147	0.14	5,867.3	0.08
Byron 1, 2	6	75	448	2,965	0.15	6,703.0	0.07
Mcguire 1, 2	6	75	450	3,070	0.15	6,264.2	0.07
Point Beach 1, 2	6	75	451	2,450	0.18	2,696.4	0.17
St. Lucie 1, 2	6	80	483	3,357	0.14	4,790.5	0.10
Robinson 2	3	81	244	1,795	0.14	1,976.1	0.12
Waterford 3	3	82	246	1,727	0.14	3,058.4	0.08
Vogtle 1, 2	6	82	495	2,921	0.17	6,397.3	0.08
Wolf Creek 1	3	83	249	1,782	0.14	3,239.9	0.08
North Anna 1, 2	6	86	518	2,875	0.18	4,781.8	0.11
Calvert Cliffs 1, 2	6	91	547	3,389	0.16	4,510.8	0.12
Summer 1	3	99	296	2,104	0.14	2,333.3	0.13
Millstone 2, 3	6	102	609	4,260	0.14	5,327.7	0.11

TABLE 5.4-23
Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year
Kewaunee	3	102	305	1,606	0.19	1,335.4	0.23
Surry 1, 2	6	102	610	3,239	0.19	4,488.1	0.14
Sequoyah 1, 2	6	102	611	4,588	0.13	6,173.9	0.10
Beaver Valley 1, 2	6	102	613	3,980	0.15	4,427.1	0.14
Arkansas 1, 2	6	102	614	4,640	0.13	4,672.0	0.13
Cook 1, 2	6	107	643	4,553	0.14	4,110.8	0.16
Salem 1, 2	6	107	644	4,925	0.13	5,868.6	0.11
Oconee 1, 2, 3	9	120	1,077	5,411	0.20	6,843.3	0.16
Harris	3	120	360	2,619	0.14	2,286.2	0.16
Farley 1, 2	6	129	777	4,265	0.18	4,372.4	0.18
South Texas 1, 2	6	133	798	4,207	0.19	6,615.7	0.12
Palisades	3	138	413	1,511	0.27	1,647.7	0.25
Fort Calhoun	3	142	425	1,761	0.24	1,278.6	0.33
Davis-Besse	3	192	576	3,211	0.18	1,752.2	0.33
Indian Point 2	3	279	838	3,758	0.22	1,862.9	0.45
Totals and Averages	207		18,854	124,172	0.15	175,722.0	0.11
Averages per Reactor-Yr		91		600		848.9	

Sites where not all reactors had completed 3 full years of commercial operation as of 12/31/02 are not included.

TABLE 5.7-1
Gas-Cooled Fuel Cycle Impact Evaluation

Reactor Technology Facility/Activity	Reference LWR (Single unit) (~1,000 MWe) 80% Capacity	GT-MHR (4 Modules) (2,400 MWt total) (~1,140 MWe total) 88% Capacity	PBMR (8 Modules) (3,200 MWt total) (~1,320 MWe total) 95% Capacity
Mining Operations			
Annual ore supply MT	272,000	337,140	337,140
Normalized annual ore supply MT	272,000	269,712	214,739
Fraction of reference LWR	1	0.99	0.79
Calculated number	314,011	269,712	214,739
Milling Operations			
Annual yellowcake MT	293	303	303
Normalized annual yellowcake MT	293	243	193
Fraction of reference LWR	1	0.83	0.66
Calculated number	283	243	193
UF_6 Production			
Annual UF_6 MT	360	379	379
Normalized annual UF_6 MT	360	303	241
Fraction of reference LWR	1	0.84	0.67
Calculated number	353	303	241
Enrichment Operations			
Enriched UF_6 MT	52	8.0	12.3
Normalized enriched UF_6 MT	52	6.38	7.9
Fraction of reference LWR	1	0.12	0.15
Calculated number	52	6.38	7.9
Annual SWU MT	127	204	194
Normalized annual SWU MT	127	163[a]	124
Fraction of reference LWR	1	1.29[a]	0.97
Calculated number	126	163	124
Fuel Fabrication Plant Operations			
Enriched UO_2 MT	40	6.11	9.5
Normalized enriched UO_2 MT	40	4.89	6.0
Fraction of reference LWR	1	0.12	0.15
Calculated number	40	4.89	6.0
Annual Fuel Loading MTU	35	5.39	8.34

TABLE 5.7-1
Gas-Cooled Fuel Cycle Impact Evaluation

Reactor Technology Facility/Activity	Reference LWR (Single unit) (~1,000 MWe) 80% Capacity	GT-MHR (4 Modules) (2,400 MWt total) (~1,140 MWe total) 88% Capacity	PBMR (8 Modules) (3,200 MWt total) (~1,320 MWe total) 95% Capacity
Normalized annual fuel loading MTU	35	4.3	5.31
Fraction of reference LWR	1	0.12	0.15
Reprocessing Plant Operations			
Annual spent fuel reprocessing MTU	35	0	0
Solid Radioactive Waste			
Annual LLW from reactor operations Ci	9,100	1,100 Ci; 98 m^3	65.4 Ci; 800 drums
Fraction of reference LWR	1	0.12	0.01
LLW from Reactor Decontamination & Decommissioning Ci per RRY	1,500	--[b]	2.2E+04 (5.30E+05 Ci after 24 years operation and 2 years decay)[a]
TRU and HLW Ci	1.1E+07	NA [c]	NA [c]

Source: 10 CFR 51.51, Table S-3 Table of Uranium Fuel Cycle Environmental Data

[a] Value larger than Table S-3.

[b] Data not available.

[c] Reprocessing is not considered in this evaluation.

Notes: The enrichment SWU calculation was performed using the USEC SWU calculator and assumes a 0.30% tails assay. The information on the reference reactor (mining, milling, UF_6, enrichment, fuel fabrication values) taken from NUREG-0116, Table 3.2, no recycling. The information on the reference reactor (solid radioactive waste) taken from 10 CFR 51.51, Table S-3. The calculated information on the reference reactor uses the same methodology as for the reactor technologies. The normalized information is based on 1,000 MWe and the reactor vendor supplied unit capacity factor. For the new reactor technologies, the annual fuel loading was provided by the reactor vendor. The USEC SWU calculator also calculated the kgs of Uranium feed. This number was multiplied by 1.48 to obtain the necessary amount of UF_6. The annual yellowcake number was generated using the relationship 2.61285 lbs of U_3O_8 to 1 kg U of UF_6; 1.185 kgs of U_3O_8 to 1.48 kg of UF6. The annual ore supply was generated assuming a 0.1 percent ore body and a 90 percent recovery efficiency. Co-60 with a 5.26 year half-life and Fe-55 with a 2.73 year half-life are the main nuclides listed for the PBMR D&D waste.

TABLE 5.7-2
Gas-Cooled Reactor SWU and Feed Calculation Results

Reactor Technology	Kgs Uranium Product	Weight Percent U235	SWU Quantity (MTU)	Kgs of U Feed Required	Tails Assay
GT-MHR	5,394	19.80%	204.373	255,918	0.30%
PBMR	8,340	12.90%	194.414	255,679	0.30%
NUREG-0116	35,000	3.10%	126.175	238,455	0.30%
WASH-1248	35,000	3.20%	147.280	223,965	0.25%

Notes: The reactor vendors supplied the “Kgs uranium product” and “weight percent U235.” The tails assay was assumed to be 0.3 percent to match NUREG-0116 with the exception of WASH-1248, which used a tail assay of 0.25 percent. The “SWU Quantity” and “Kgs of U Feed Required” were calculated using the USEC SWU Calculator. The results have not been normalized to equivalent electrical generation.

TABLE 5.7-3
10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
Natural Resource Use		
Land (acres)		
Temporarily committed [b]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons)		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once through cooling.
Fossil Fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe output
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
Effluents-Chemical (MT)		
Gases (including entrainment) [c]		
SO_x	4,400	
NO_x [d]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases		
F	0.67	Principally from UF_6, production, enrichment, and reprocessing. Concentration within range of state standards- below level that has effects on human health.
HCl	0.014	
Liquids:		
$SO\text{-}_4$	9.9	From enrichment, fuel fabrication, and reprocessing steps.

TABLE 5.7-3
10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
NO_3^-	25.8	Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3-600cfs., NO_3-20cfs., Fluoride-70cfs.
Fluoride	12.9	
CA^{++}	5.4	
$C1^-$	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	0.4	
Tailings Solutions (thousands of MT)	240	From mills only-- no significant effluents to environment.
Solids	91,000	Principally from mills-- no significant effluents to environment.
Effluents-- Radiological (curies)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85(thousands)	400	
Ru-106	0.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99		Presently under consideration by the Commission
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling-- included tailings liquor and returned to ground -- no effluents; therefore, no effect on the environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	

TABLE 5.7-3
10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
Th-234	0.01	From fuel fabrication plants-- concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9E-06	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 15,000 Ci comes from reactor decontamination and decommissioning -- buried at land burial facilities. 600 Ci comes from mills -- included in tailing returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1E+07	Buried at Federal Repository
Effluents-- thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure	22.6	From reprocessing and waste management.

[a] In some cases where no entry appears, it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However; there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. Radiological impacts of these two radionuclides are addressed in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, May 1996" and it was concluded that the health effects from these two radionuclides pose a small significance.
Data supporting this table are given in the Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp.2 to WASH-1248): and in the record of final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and fuel recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of §51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[b] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

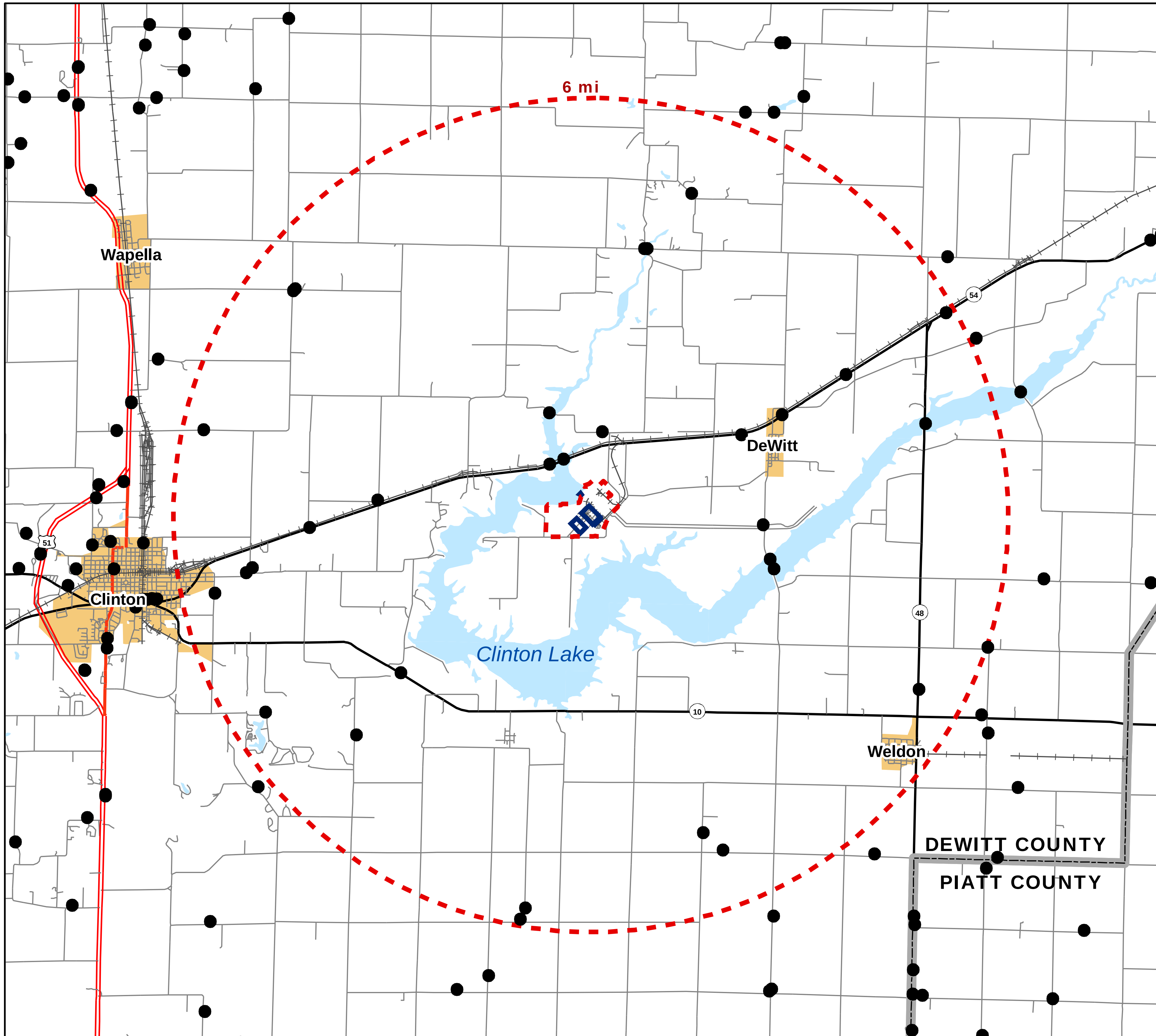
[c] Estimated effluents based upon combustion of equivalent coal for power generation.

[d] 1.2 percent from natural gas use and process.

TABLE 5.10-1
Structural Control Measures

Control Measure	Location	Description of Control Measure
Silt Fencing	Along the perimeter of the site. Drainage areas should be less than 0.25 ac per 100 ft of fence length.	To protect streams or wetland areas, to prevent erosion, and to keep sediment on site. Silt fencing consists of posts with filter fabric stretched across the posts. The lower end of the fence is vertically trenched and covered with backfill. This prevents water from passing by the fence without being filtered. The fabric allows for the water to pass off site while retaining the sediment on site.
Check Dams	If applicable where the grade change is more than 2 percent or where practical.	A check dam is a small dam constructed across a drainage ditch or channel. Its purpose is to slow down the speed of the concentrated flows. The reduced runoff speed will result in less erosion and gulling in the channel and allow the sediment to settle out. The check dams can be built with materials such as straw bales, rock, timber, or other materials that will retain water.
Limit Entrance/Exit	Designated paved site entrances/exits.	The purpose is to reduce tracking of soil off the site.
Inlet Protection	Located around inlet areas to the storm sewer system.	Filtering material placed around an inlet to a receiving stream to trap sediment. It can be composed of gravel, stone with a wire mesh filter, block and gravel, or straw bales.
Sediment Basins	Sediment basins are required for drainage locations that serve 10 or more disturbed acres at one time. For drainage locations serving less than 10 ac, smaller sediment basins or sediment traps should be used.	Sediment basins are either temporary or permanent settling ponds with a controlled stormwater release structure. Their function is to collect and store sediment-laden stormwater from construction activities long enough to allow the sediment to settle. At a minimum, silt fences, vegetative buffer strips, or equivalent sediment controls are required.

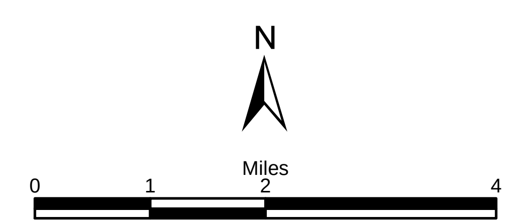
Figure 5.1-1
Location of Major Bridges in the Vicinity



Legend

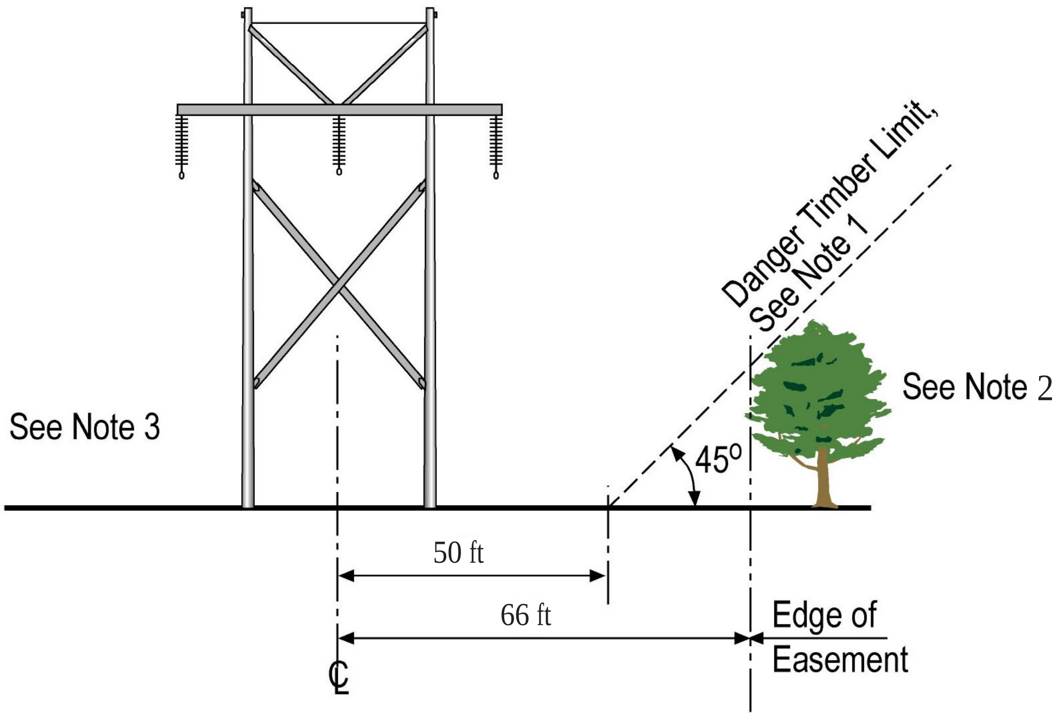
- Highway Bridges
- Proposed Areas for EGC ESP Facility Structures
- Site Boundary: Fenceline
- Vicinity: 6-mi radius around site
- U.S. Highway, Multilane divided
- U.S. Highway
- State Route
- County or other minor road
- Railroads
- Water: Lakes and Rivers
- Incorporated/Designated Places
- County Boundary

Data Sources:
IDOT, 2000
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002
U.S. Census Bureau, 2002a



Environmental Report for the EGC Early Site Permit

Figure 5.1-2
345-kV H-Frame Structure



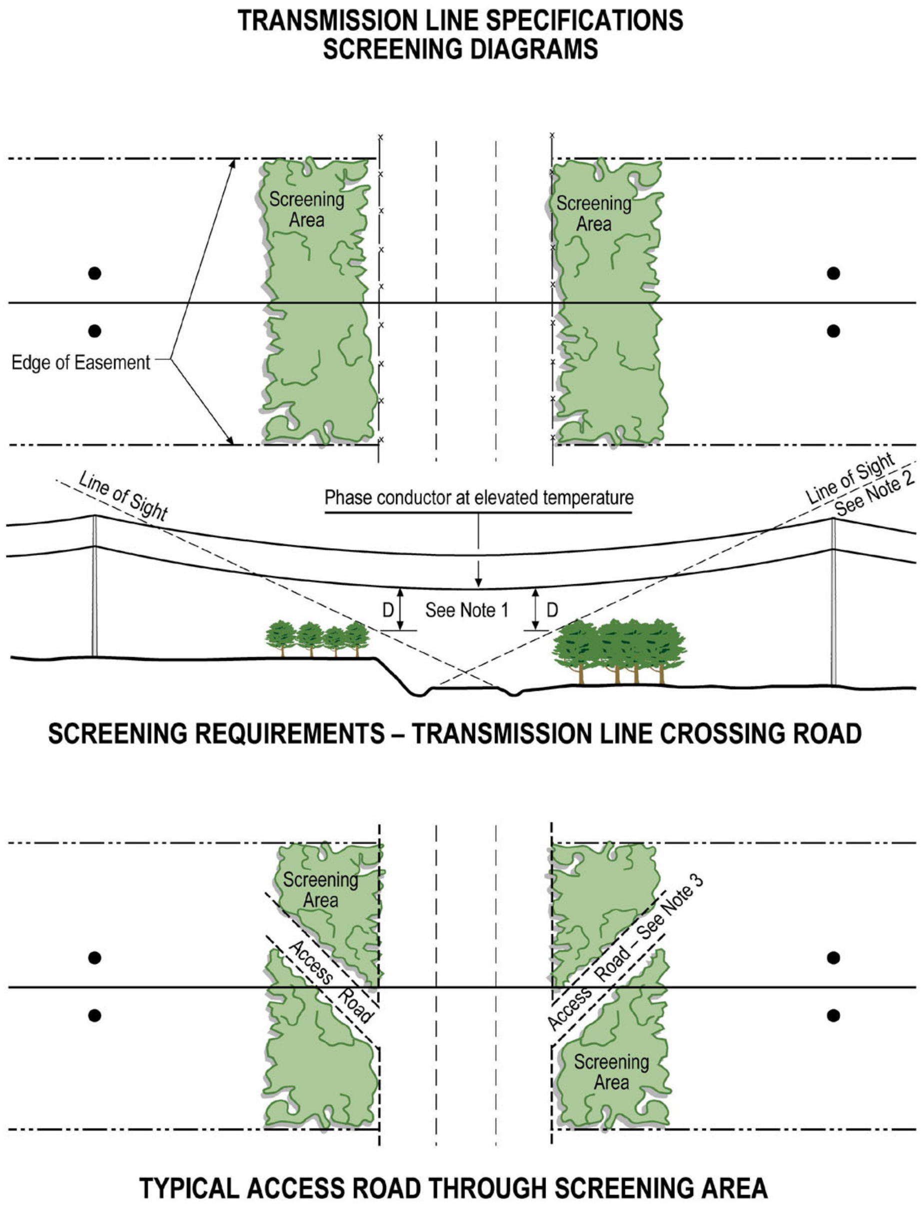
Notes:

1. Danger timber includes all timber extending above the danger timber limit.
2. If only the limbs of a tree extend into the easement strip, and it is not danger timber, do not cut.
3. Both sides of the clearing diagram are identical. On sloping ground, horizontal measurements must be used.

Not to Scale

Environmental Report for the EGC Early Site Permit

Figure 5.1-3
Screening Requirements

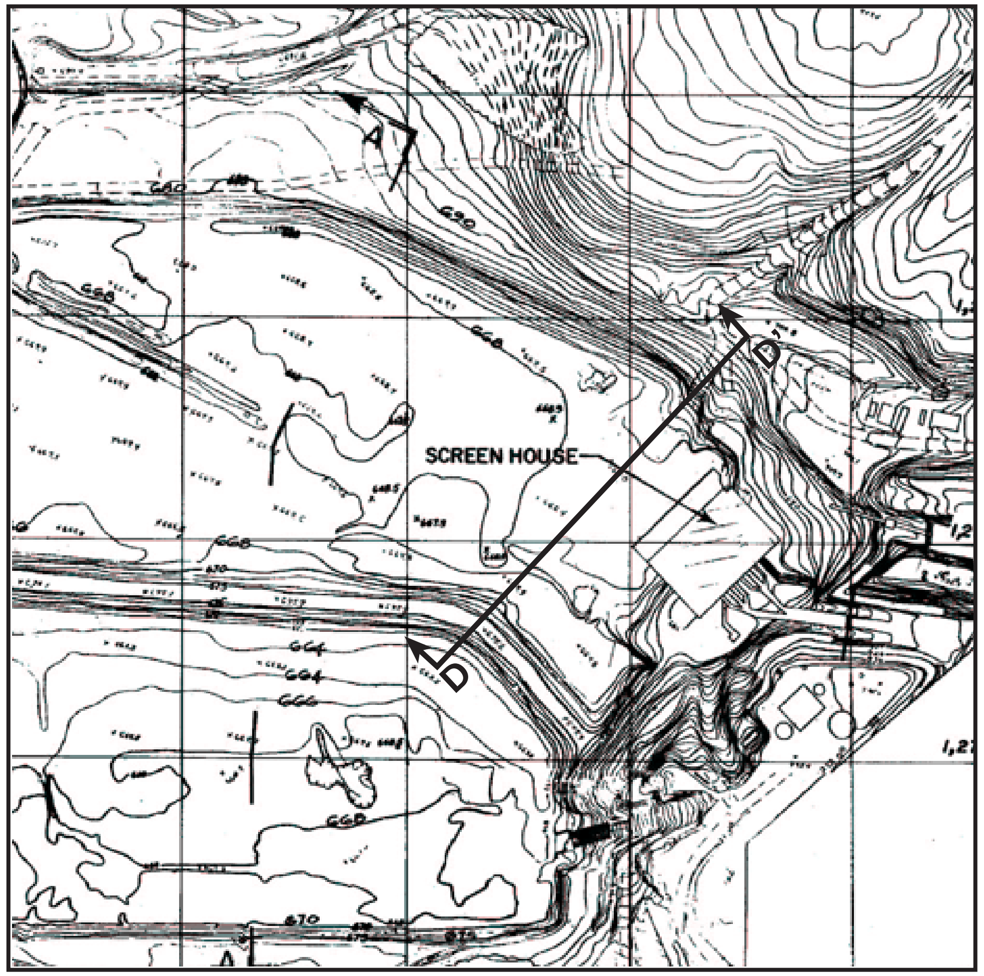


Notes:

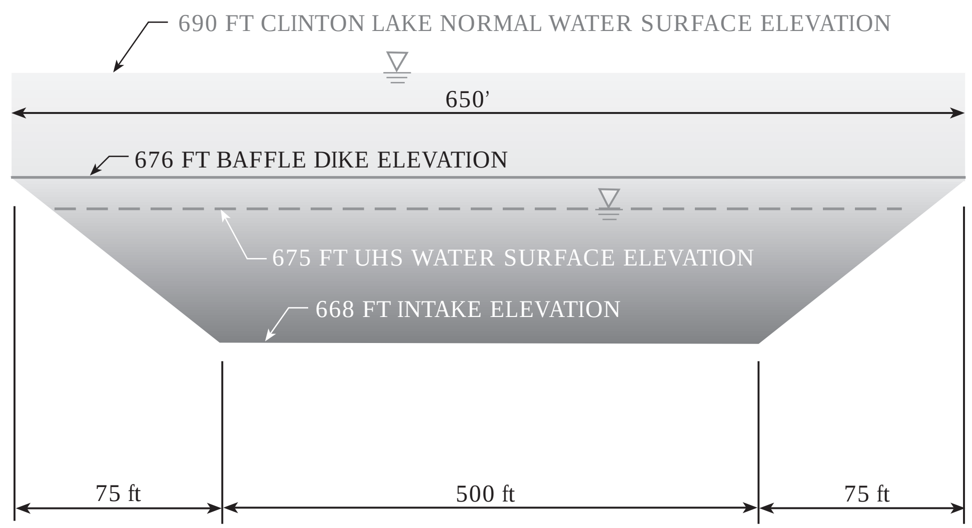
1. Dimension D shall be at least 19 ft for 345-kV lines.
2. Structures may extend above the line of sight, if the line of sight slopes upward at an angle of 15° or more.
3. The access road shall be located so that it does not expose the first structure or the cleared easement strip to view from the public road.

Not to Scale

Figure 5.3-1
Ultimate Heat Sink Plan and Section



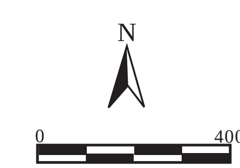
PLAN



INTAKE SECTION D-D'

(DIMENSIONS ARE APPROXIMATE)

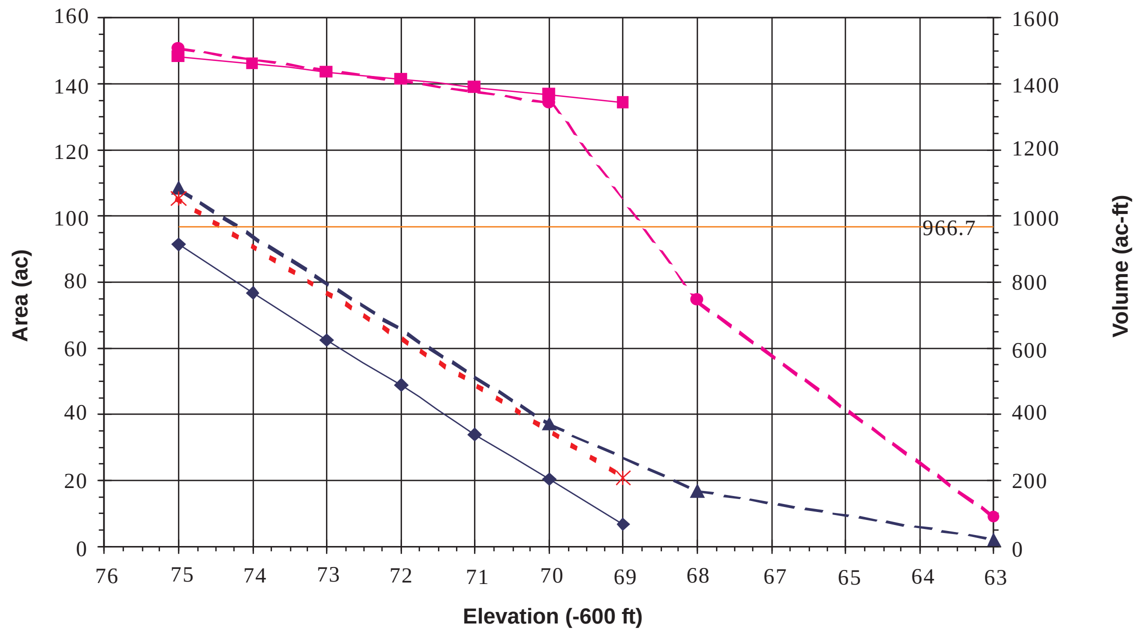
Data Source:
CPS, 2002



Scale in feet
Contour interval 2 feet

Environmental Report for the EGC Early Site Permit

Figure 5.3-2
Design and As-Built UHS Volumes and Areas



Legend

- Design Volume (September 1975)
- As-Built Volume (April 1985)
- Existing Volume (estimate)
- Volume Remaining after CT make-up
- Design Area (September 1975)
- As-Built Area (April 1985)

Not to Scale

REV1