CHAPTER 2

Site Characteristics

This chapter provides information on the EGC ESP Site location, on-site activities and controls, present and projected population distribution, meteorological, hydrological, geological, and seismological characteristics. The purpose of presenting this information is to provide the bases for demonstrating the adequacy of the site characteristics from a site safety viewpoint and to provide input to support environmental characterization. The influence of the EGC ESP site characteristics on the design and operation of a possible future nuclear power facility will be assessed at the construction and operating license (COL) stage pursuant to 10 CFR 52 Subpart C.

2.1 Geography and Demography

2.1.1 Site Location and Description

2.1.1.1 Specification of Location

The EGC ESP Facility will be co-located on the property of the existing CPS Facility and its associated 4,895 ac man-made cooling reservoir (Clinton Lake) (CPS, 2002). The EGC ESP Facility will be located approximately 700 ft south of the existing CPS Facility. The CPS Facility lies within Zone 16 of the Universal Transverse Mercator (UTM) coordinates. The exact UTM coordinates for the EGC ESP Facility will depend upon the specific reactor technology selected for deployment and will be finalized at COL.

As shown on Figures 1.2-1 and 2.1-1 there is a complex transportation system surrounding the EGC ESP Site. The nearest major highways are Illinois State Routes 54, 10, and 48, all of which cross the CPS Facility property. Other major highways within the region include Interstate 155 in the west, Interstate 72 in the southeast, Interstate 55 in the northwest, Interstate 74 in the northeast, Interstate 39 in the north, and Interstate 57 in the east (U.S. Census Bureau, 2000).

The nearest railroad is the Canadian National Railroad (formerly Illinois Central) that runs parallel to State Route 54 and traverses the CPS Facility property approximately 1 mi north of the EGC ESP Facility footprint.

The EGC ESP Site is located in DeWitt County in east-central Illinois, about 6 mi east of the City of Clinton (USGS, 1990). The majority of the site is located in the eastern half of DeWitt County with the arms of the lake extending into the northeastern area of the county. The site is located within Townships 19, 20, and 21 North, Range 3 East of the Third Principal Meridian, Townships 19, 20, and 21 North, Range 4 East of the Third Principal Meridian, and Townships 20 and 21 North, Range 5 East of the Third Principal Meridian. The reactor is located in Harp Township but the size and irregular shape of the site place it in several political subdivisions. These are the townships of Harp, Wilson, Rutledge, DeWitt, Creek, Nixon, and Santa Anna.

The EGC ESP Site is located between the cities of Bloomington and Decatur, 22 mi to the north and 22 mi to the south, respectively. In addition, the EGC ESP Site is located between the cities of Lincoln and Champaign-Urbana, 28 mi to the west and 30 mi to the east, respectively. Figure 2.1-1 shows the site in reference to major towns and cities within a 50 mi radius. The EGC ESP Site is also approximately 51 mi northeast of Springfield, and almost equidistant (approximately 150 mi) between St. Louis and Chicago.

2.1.1.2 Site Area Map

Figure 2.1-8 shows the EGC ESP Site Exclusion Area Boundary (EAB), and Low Population Zone (LPZ), as defined in 10 CFR 100. The exclusion area is entirely within the property boundary (Figure 1.2-3) and is the area encompassed by a radius of 1,025 m (3,362 ft) from the center of the ESP Facility footprint area for locating power block structures. The LPZ is the area encompassed by a circle of 4,018 m (2.5 mi) radius.

The EGC ESP Site boundary is the same as the CPS property lines as shown in Figure 1.2-3. The site and its environs consist primarily of the future EGC ESP and CPS facilities, Lake Clinton, woodlands, pasture land, cultivated farmland, and the recreational areas. The total area encompassed by the site boundary is about 14,180 ac. Of this acreage about 452 ac are not owned by AmerGen and consists of Illinois Power property (~363 ac), a Shell oil pumping station (~23 ac), railroad (~20 ac), unimproved areas (~16 ac), residence (~14 ac), state highways (~9 ac), and cemeteries (~7 ac). Except for CPS, the CPS Energy and Environmental Center, and the site recreational facilities, there are no industrial, commercial, or institutional structures on the site property. Four residential structures on the site property are leased by AmerGen.

The site includes an area that extends approximately 14 mi along Salt Creek and approximately 8 mi along the North Fork of Salt Creek. The balance of the site, except for the area around the Lake Clinton dam and spillways and land leased for agriculture, is developed for recreation.

The only other uses of site property not related to electrical production or recreation are for agriculture and water supply. Approximately 1500 ac of land is leased and in agricultural use. A water well located south of the EGC ESP Facility footprint will be a primary source of water for the village of DeWitt.

The CPS facilities and the 3.4 mile discharge flume occupy about 150 ac and 130 ac, respectively. Figure 1.2-4 is a site development drawing showing the location of the EGC ESP Facilities footprint on the CPS site property. The future EGC ESP Facility is expected to occupy about 150 ac.

Lake Clinton, formed by the dam constructed near the confluence of Salt Creek and the North Fork of Salt Creek, has a surface area at normal lake level (690 feet above msl) of approximately 4,895 ac with an average depth of about 15.6 ft. Lake Clinton is totally within the site property boundary. The CPS cooling water intake is about 3 mi northeast of the confluence of Salt Creek and the North Fork of Salt Creek. The intake for the EGC ESP Facility would be located adjacent to the existing intake structure (CPS, 2002).

2.1.1.3 Boundaries for Establishing Effluent Release Limits

For the purpose of evaluating compliance with 10 CFR 20, the boundary of the restricted area for the EGC ESP Site is defined as the EGC ESP Site EAB. This boundary distance is established as a site characteristic (see Table 1.4-1, Section 9.4.4). There are no residential quarters in the restricted area. The radiation dose limits given in 10 CFR 20.1301 and the concentration limits of radioactive material in effluents given in 10 CFR 20.1302 will be met at the restricted area boundary. Access to the restricted area will be controlled by positive means such as fencing and posting of no trespassing signs on land and buoys with posting in Clinton Lake.

The guidelines for keeping the radiation exposures as low as is reasonably achievable (ALARA), as given in 10 CFR 50, Appendix I (10 CFR 50), are applied at the site boundary taken herein to be the EGC ESP Site EAB distance of 1,025 m. The liquid effluents from the station are discharged into Clinton Lake, the outfall of which joins the Sangamon River approximately 56 mi downstream. The Sangamon River joins the Illinois River approximately 80 mi west of the site. The closest sizeable lake is Lake Decatur on the

Sangamon River, located approximately 20 mi south of the site. There is no plausible way for liquid effluents to get to Lake Decatur since the outfall from Clinton Lake enters the Sangamon River downstream of Lake Decatur. The liquid effluents from the ESP Facility will be discharged into Clinton Lake through the existing CPS discharge flume shown on Figures 1.2-3 and 1.2-4.

2.1.2 Exclusion Area Authority and Control

2.1.2.1 Authority

EGC will ensure that it has or will be granted the necessary authority, rights, and control of the EGC ESP Site, including the exclusion area prior to commencing actions allowed pursuant to any ESP granted from this Application.

The exclusion area for the EGC ESP Site meets the requirements of 10 CFR 100 as demonstrated in Section 3.3. The boundary line of the EGC ESP Site exclusion area is shown in Figure 2.1-8. The EGC ESP Site overlaps the CPS Facility exclusion area; however, the two are not concentric.

AmerGen owns the property in the EGC ESP Site exclusion area with the exception of a right-of-way for the township road that traverses the exclusion area. This road provides access to privately owned property which lies outside the EGC ESP Site exclusion area within the peninsula area between the Salt Creek finger and the North Fork of the Salt Creek finger of Clinton Lake. In an emergency, EGC together with the local law enforcement agency (DeWitt County Sheriff's Department) will control access via this road to the exclusion area. The property ownership and mineral rights provide AmerGen the authority to control activities, including exclusion and removal of personnel and property, within the exclusion area.

There are no active pipelines within the EGC ESP Facility exclusion area.

The primary activities in the CPS Facility exclusion area are those associated with the generation and distribution of electricity by the CPS Facility. The primary activities in the EGC ESP Facility exclusion area will be those associated with the generation and distribution of electricity by the EGC ESP Facility and CPS Facility. There are no residences in either exclusion area.

A private rail spur from the Canadian National Railroad track, which is located to the north of the site, was constructed to the existing CPS. AmerGen has the control authority to restrict the use of this rail spur. With the exception of the single township road, there are no other public highways, waterways, or railroads that traverse either exclusion area.

2.1.2.2 Control of Activities Unrelated to Plant Operation

In those areas subject to radiation from the CPS Facility, AmerGen provides surveillance and controls over worker occupancy, as appropriate. EGC will coordinate worker access and occupancy with AmerGen during the construction of the EGC ESP Facility.

None of the land within the EGC ESP Site exclusion area is planned for public recreational use. A small area of Clinton Lake lies within the EGC ESP Site exclusion area and is used for public recreation lake activities. Only those activities will be authorized which provide assurance, under appropriate limitations, that no significant hazards would result to the public health and safety. Details of evacuation times and procedures in case of emergencies are provided in the Illinois Plan for Radiological Accidents (IPRA, 2001) and the Emergency Plan for the EGC ESP.

2.1.2.3 Arrangement for Traffic Control

In an emergency, the DeWitt County Sheriff's Department, as assisted by other law enforcement agencies, will provide area control, communication assistance, and handling of the public should evacuation be necessary. The Sheriff's office located in Clinton, Illinois will be notified of an emergency by the site emergency response organization. Details of evacuation procedures in case of emergencies are provided in the Illinois Plan for Radiological Accidents (IPRA, 2001) and the Emergency Plan (EP) for the EGC ESP.

2.1.2.4 Abandonment or Relocation of Roads

Parts of two township roads, which were located in the exclusion area for CPS Facility, have been vacated. One of these roads has been relocated while the other was abandoned. The abandoned roadway has no public access or usage and is under the complete control of the CPS Facility. The relocated roadway provides access to privately owned property which lies outside the EGC ESP exclusion area within the peninsula area between the Salt Creek finger and the North Fork of the Salt Creek finger of Clinton Lake (CPS, 2002). No abandonment or relocation of roadways is required for the EGC ESP Site.

2.1.3 Population Distribution

This section discusses current, projected, transient and migratory populations within the vicinity and region. Data on population were gathered using U. S. Census Bureau 2000 data. Projected population was determined based upon projection data provided by Illinois State University.

2.1.3.1 Population Within 16 km (10 mi)

The 2000 total residential population within 16 km (10 mi) of the site is 12,358 persons (U.S. Census Bureau, 2001). Figure 2.1-2 shows the significant population groupings (for example, towns and cities) within 16 km (10 mi) of the site. Figure 2.1-2 also shows a 0 to 16 km (0 to 10 mi) sector chart, which is used as a key for the population distribution tables described below.

Table 2.1-1 shows the population and transient population within the sectors shown in Figure 2.1-2. The table indicates that the majority of the population lives in the west sector, 8 to 16 km (5 to 10 mi) from the site. The west sector includes the community of Clinton, which has a population of over 7,000 persons. A Geographic Information System (GIS), in conjunction with the U.S. Census Bureau data from 2000, was used to determine the population by sector. Data was grouped by each census block, which is the smallest unit area of U.S. Census Bureau data collected. There are approximately 290 census blocks within a 16 km (10 mi) radius of the site. It was then assumed that population was evenly distributed within a census block. For example, if a sector made up 50 percent of a census block, it was assumed that the sector had 50 percent of the population in that census block.

For determining transient population, the following categories of transient population were estimated:

- Seasonal Population – This population was based on the number of temporary houses used for recreation or other seasonal work provided by the 2000 census (U.S. Census Bureau, 2001).
- Transient Business Population – For commercial and manufacturing business within the 16 km (10 mi) radius, it was assumed, based on reasonable judgment, that business workers lived outside the 16 km (10 mi) radius. Therefore, to be conservative, employees of businesses within the 16 km (10 mi) radius were considered transients. Approximately 130 small businesses were estimated to have three or less employees, for a total of 390 (CCC, 2002). Larger businesses were surveyed during August and September 2002 and were verified by the DeWitt County Emergency Services and Disaster Agency Coordinator.
- Hotel/Motel Population – Within the 16 km (10 mi) radius, information was collected on the number of rooms for each hotel or motel. To be conservative and based on reasonable judgment, it was assumed that one person occupied each room, on any given day.
- Recreation Areas – Data was obtained from the IDNR on the number of visitors to state parks including Clinton Lake State Recreation Area. These visitors were considered transients. Data was also obtained for smaller recreational facilities in the region by survey during August and September 2002 and verified by the DeWitt County Emergency Services and Disaster Agency Coordinator.
- Special Population (Schools, Hospitals, Nursing Homes, and Correctional Facilities) – To be conservative, special population within the 16 km (10 mi) radius, was assumed to be transient. Population estimates were collected by surveys conducted during August and September 2002 and verified by the DeWitt County Emergency Services and Disaster Agency Coordinator.
- Festivals – Data was obtained from the Clinton Chamber of Commerce on the attendees at the annual Apple and Pork Festival that is held in Clinton. In 2002, 22,000 people, in addition to residents of Clinton, attended this festival. These people were not included, however, in the summary of transients within the 16 km (10 mi) radius, since this event occurs only one weekend each year, the last full weekend of September.
- Migrant Workers – Based on average statewide statistics on the percentage of migrant workers supplied by the Illinois Agricultural Statistics Service, (Illinois Agricultural Statistics Service, 2002), it was estimated that the number of migrant farm workers in the area is 13.6 percent of the agricultural labor force. Data on the amount of agricultural labor was obtained by the county from the Bureau of Economic Analysis, (USDOC, 2002). The migrant workers were considered transients.

Table 2.1-2 shows population projections for 10 yr increments up to 60 years from the latest decennial census. Illinois State University provided population projections for 2010 and 2020 for each county (ISU, 2002). Based on this data, the expected population change rates (percent change) between 2000 and 2010 and between 2010 and 2020 were estimated for each county. It was assumed that the expected population change rate for the four 10 yr increments between 2020 and 2060 would be similar to the estimated population change rate between 2010 and 2020. These population rates were then applied using U.S. Census Bureau data from 2000 to each census block within a county. Population forecasts for each sector were calculated by assuming an even distribution of population throughout the census block. Transient population was forecast using the same growth percentages.

2.1.3.2 Population Between 16 and 80 km (10 and 50 mi)

The total residential population within 80 km (50 mi) of the site is 752,008 (U.S. Census Bureau, 2001). More than 70 percent of this population lives outside of a 40 km (25 mi) radius from the site (U.S. Census Bureau, 2001). Figure 2.1-3 shows the location of communities and cities within 80 km (50 mi) of the site, as well as a 0 to 80 km (0 to 50 mi) sector chart, which is used as a key for the population distribution tables described below.

Table 2.1-3 presents the resident and transient population within the sectors depicted in Figure 2.1-3. The most heavily populated sector within 16 and 80 km (10 and 50 mi) of the site is the east sector. The high population in this sector is due primarily to the cities of Champaign and Urbana with an approximate population of 67,518 and 36,395, respectively. The northeast sector has the lowest population. A GIS, in conjunction with U.S. Census Bureau data, as described in Section 2.1.3.1, was used to determine the population by sector.

For determining transient population, the following categories of transient population were estimated:

- Seasonal Population – The same methodology was used that is described in Section 2.1.3.1.
- Transient Business Population – For commercial and manufacturing business within the 80 km (50 mi) radius, it was assumed, because of the large area and based on reasonable judgment, that there is a no net change in population. In other words, on any given business day, the number of workers commuting into the 80 km (50 mi) radius is the same as the number of workers commuting out of the 80 km (50 mi) radius.
- Hotel/Motel Population – Information was collected on the location and number of hotels or motels within the 16 to 80 km (10 to 50 mi) radius. It was assumed, based on data collected for the 0 to 16 km (0 to 10 mi) and surveys of selected hotels and motels with the 80 km (50 mi) radius that on average 25 rooms were available in each motel and 75 rooms were available in each hotel. Based on reasonable judgment, it was assumed that one person occupied each room.
- Special Population (Schools, Hospitals, Nursing Homes, and Correctional Facilities) – For special population within the 80 km (50 mi) radius, it was assumed, because of the large area and based on reasonable judgment, that there is no net change in population. In other words, students and staff of schools within the region, likely live with in the region. University students living in dormitories or apartments are counted in residential totals, based on U.S. Census Bureau procedure. Staff and residences temporarily in hospitals and nursing homes also likely live within the region. Residence of correctional facilities or long-term residences of nursing homes, hospitals, and other

institutions are counted in residential totals, based on the U.S. Census Bureau procedure.

- Recreation Areas – Data was obtained from the IDNR on the number of visitors to state parks, which was then used to estimate transient population. Visitors to nature preserves and county or local parks were not included in estimates of transient population because it was assumed that these visitors would likely originate from within the area encompassed by an 80 km (50 mi) radius.
- Migrant Workers – The same methodology was used that is described in Section 2.1.3.1

Table 2.1-4 presents population projections starting with 2010, and for 10-yr increments up to 60 years from the latest decennial census. The methodology used to forecast the population in the 16 to 80 km (10 to 50 mi) radii is the same as was used for the 0 to 16 km (0 to 10 mi) radius, see Section 2.1.3.1.

2.1.3.3 Transient Population

Transient population is important in order to determine the number of people in the vicinity of the site that would not normally be counted in census figures. Transient population may include recreational facility population, seasonal residents, special population (for example, schools, hospitals, nursing homes, and correctional facilities) and business and migrant workers that do not normally live in the area. The assumptions used to estimate transient populations are described in Section 2.1.3.1 and Section 2.1.3.2. As noted in those sections, significant variations due to transient land use are not expected. Further, the significant transient population in the region is a result of recreational travel to state parks in the area. The year 2000 and 10 year incremental forecast to 2060 of the transient population surrounding the EGC ESP Facility are included on Tables 2.1-1 through 2.1-4.

2.1.3.4 Low Population Zone

The low population zone, shown in Figure 1.2-3, is the area immediately surrounding the exclusion area encompassed by a circle of 4,018 m (2.5 mi radius) centered on the EGC ESP Facility footprint. Table 2.1-1 gives the population distribution for the LPZ and includes permanent residents and transients. There are no schools, hospitals, or institutions located within the zone and its does not include the city of DeWitt.

The LPZ was selected to provide reasonable probability that appropriate protective measures could be taken on behalf of the permanent and transient residents. The number and density of residents in the LPZ are low and this will enable effective evacuation procedures to be followed in the event of a serious accident.

Figures 1.2-1 and 2.1-1 show the highway network around the site and in the surrounding area. The roads and highways within the area will be the primary transportation routes for evacuation. Table 2.1-5 lists the facilities and institutions in the vicinity of the LPZ that may require special consideration in evaluating emergency plans.

The average and peak daily recreational users at recreational facilities in the vicinity of the EGC ESP Site including Clinton Lake State Park are shown on Tables 2.1-6, 2.1-7, and 2.1-8.

2.1.3.5 Population Center

A population center is defined in 10 CFR 100 as a densely populated center where there are about 25,000 inhabitants or more. The closest such center with the largest population is Decatur, Illinois, located approximately 22 mi south-southwest of the site, which had a 2000 population of 81,860. This distance was determined from the center-point of the corporate boundary and satisfies the 10 CFR 100 criteria that the population center be at least one and one third times the distance from the outer boundary of the LPZ or, in this case, approximately 3.3 mi. Table 2.1-9 shows the 2000 populations, distances, and directions from the site of cities, towns, and villages within approximately 50 mi of the site. Figure 2.1-1 shows major population centers within 50 mi of the CPS site, which are included in Table 2.1-9. Transient population was not considered in establishing the population center. As noted in Tables 2.1-2 and 2.1-4, the population within 50 mi of the plant is not projected to change significantly through 2060; therefore, it is reasonable to expect that there will be no change in the population center.

2.1.3.6 Population Density

The current and projected resident population density in the vicinity and in the regional area surrounding the EGC ESP site is presented in Figures 2.1-4 through 2.1-7. Most of the area within a 16 km (10 mi) radius of the site is rural, with an average population density of 39 people per square mi. The average population density within 80 km (50 mi) of the site is 97 people per square mi. The area between 25 and 37 mi of the site is the most densely populated, with a population of 267,376 and an average population density of 110 per square mi (U.S. Census Bureau, 2001). As noted these values are all well within the Regulatory Guide 1.70 criteria of 500 people per square mi. Also, as seen on Tables 2.1-2 and 2.1-4, the population within 16 km (10 mi) is projected to decrease and the population between 16 km (10 mi) and 80 km (50 mi) is projected to have a nominal increase through 2060. Therefore, the population densities are not projected to significantly change through 2060.

2.2 Nearby Industrial, Transportation, and Military Facilities

2.2.1 Locations and Routes

The location of the EGC ESP Site with respect to principal highway, rail and pipelines is depicted in Figure 2.2-1. Figure 2.2-2 is a regional map of the site and utilities, including electrical transmission lines within a 50 mi radius of the site. The nearest highways to the site are Illinois State Routes 54, 48, and 10 and U.S. Highway 51. Illinois State Route 54 passes through CPS facility property approximately 1 mi north of the EGC ESP Facility. Illinois State Route 10, approximately 3 mi to the south, and Illinois State Route 48, approximately 4.5 mi to the east, also pass through CPS facility property.

U.S. Highway 51, located approximately 6 mi west of the EGC ESP Facility, is the most heavily traveled highway in the vicinity averaging approximately 13,000 cars per day. State Routes 10 and 54 are moderately well traveled having a 24 hour annual average traffic flow of over 2,000 cars/day (SIDOT, 2002).

There is only one rail line within 5 mi of the site. The Gilman Line of the Canadian National Railroad runs parallel to and closely follows State Route 54, traversing the CPS Facility property approximately 1 mi north of the EGC ESP Facility footprint.

There are three National Guard aviation units in the general area of the EGC ESP Site. There is an Army National Guard unit at the Decatur Airport (25 mi south-southwest) with UH-60A Blackhawk and C-12F Twin Engine Pax-10 helicopters. There is an Air National Guard unit at the Springfield Airport (49 mi west-southwest) with F-16C fighters. The Illinois Air National Guard also has a unit at the Peoria Airport (55 mi north-northwest) that operates C-130E aircraft and UH-060A Blackhawk and CH-47D Chinook helicopters.

There are no military bases in the vicinity of the EGC ESP Site. The closest installations are several military reserve unit armories located in the general area as listed in Table 2.2-1. There are no military missile sites within 50 mi of the EGC ESP Site.

The nearest industry to the EGC ESP Facility is the CPS facility. Table 2.2-2 provides a list of other industries within 5 mi of the site.

DeWitt County has no passenger air service or public airports. There are seven private grass strips scattered throughout the county. Three of these strips are within 6 mi of the EGC ESP Site as shown in Figure 2.2-1. The EGC ESP Site lies midway between the Central Illinois Regional Airport (formerly the Bloomington-Normal Airport) and the Decatur Airport, which are located approximately 22.5 mi north and south, respectively. These are the closest airports with commercial traffic. Low altitude federal airways in the vicinity of the EGC ESP Site are shown on Figure 2.2-3.

2.2.2 Descriptions

2.2.2.1 Description of Facilities

The CPS Facility is adjacent to the EGC ESP Facility and is the largest industrial facility in the vicinity of the EGC ESP Facility.

Other industries within 5 mi of the EGC ESP Facility are listed in Table 2.2-2 along with their respective products and approximate employment. As shown in Table 2.2-2, the area within 5 mi of the site is not heavily industrialized.

2.2.2.2 Description of Products and Materials

CPS stores a variety of chemicals and materials to support facility operation as listed in Table 2.2-3.

There are two other industries within 5 mi of the EGC ESP Facility that regularly manufacture, store, or use hazardous material. Van Horn–DeWitt stores agricultural chemicals (herbicides, insecticides, and fertilizers), and Cornbelt FS maintains a large propane tank at their facility in DeWitt. Aside from the propane storage, the limiting hazard from agricultural chemical storage is anhydrous ammonia in DeWitt. In addition, Weldon Fertilizer and Lumber, Inc. also stores lesser quantities of potentially hazardous materials (for instance, agricultural chemicals).

2.2.2.3 Pipelines

There are five pipelines that cross the CPS property and are in the vicinity of the EGC ESP Facility (See Table 2.2-4). One pipeline traverses the CPS exclusion area within 1 mi of the ESP Site. (This closest pipeline was relocated prior to initial operation of the CPS Facility to provide additional distance from the facility.) It is a 14 inch diameter pipeline owned and operated by the Shell Pipeline Company (Equilon). The pipeline is currently used for transporting lower volatility, refined petroleum products such as gasoline and diesel fuel, but the pipeline is configured and has the capacity for the transport of propane and other higher volatility products. The potential for the transport of propane through the pipeline represented a design basis concern during the licensing of CPS, and the aforementioned relocation of the pipeline was performed to address this concern. In addition to its relocation, Shell/Equilon agreed to notify CPS in the event that propane was to be moved through the pipeline. Shell/Equilon also agreed to the implementation of certain safety measures designed to mitigate the risk associated with such transport. These actions are delineated in the CPS USAR (CPS, 2000).

Recent discussions with Shell/Equilon officials as part of the preparation of the EGC ESP application indicate that future transport of propane through this pipeline is unlikely. The pipeline company's current business plan indicates indefinite use of the pipeline for liquid petroleum product(s), and conversion of the pipeline from the current petroleum product to propane would entail a substantial effort. Consequently, the existing location of this pipeline does not represent a design concern for the EGC ESP Site. In the unlikely event that Shell/Equilon or a successive owner of this pipeline were to find it desirable to transport propane, analyses or mitigating factors such as minimizing propane transport or relocation of the pipeline to a safe distance from safety-related ESP facilities would be implemented.

There are three other pipelines that cross the site property approximately 13,700 ft from the EGC ESP Facility. One is a 24 inch diameter line owned and operated by the Explorer Pipeline Company. The Phillips Pipe Line Company owns and operates two parallel 8 inch diameter pipelines. These three pipelines carry refined petroleum products similar to the

Shell/Equilon pipeline on a daily basis. Due to the large separation distance from the site to these pipelines, Explorer and Phillips are not required to notify CPS of pipeline usage.

There is also a 2 inch natural gas pipeline owned by Illinois Power Company that passes within approximately 12,000 ft of the EGC ESP Facility.

Based on the large distances (12,000 and 13,700 ft) between these four pipelines and the CPS facility relative to the distance of the Shell/Equilon pipeline, CPS was deemed adequate to preclude them from presenting an explosion or fire hazard to CPS. This conclusion is also valid for the ESP Site based on similar large distances from the pipelines to the EGC ESP footprint.

Table 2.2-4 lists the size, age, operating pressure, burial depth, and location and type of isolation valves of each line of the pipelines discussed above.

2.2.2.4 Waterways

The ESP Site is located between the two fingers of an impoundment (Clinton Lake) created by the damming of Salt Creek and the North Fork of Salt Creek. Clinton Lake was originally designed to provide cooling water for the CPS Facility and will be used as a source of raw water for the EGC ESP Facility. There is no commercial traffic on Clinton Lake or on either creek. There is some recreational boating and fishing on Clinton Lake. The recreational facilities associated with the CPS Site, which include a marina, are identified in Tables 2.1-6 and 2.1-7.

2.2.2.5 Airports and Airways

2.2.2.5.1 Airports and Heliports

DeWitt County has no passenger air service or public airports. There are seven private airstrips scattered throughout the county. Three of these strips are within 6 mi of the EGC ESP Facility, as shown in Figure 2.2-1. The Martin RLA Airport, located approximately 4 mi south of the site, has one turf runway 2,000 ft long oriented north-south. Martin RLA averages 4 to 5 operations per week or about 250 operations annually (CPS, 2002). Thorp Airport, located approximately 5 mi northwest, has two turf runways; one oriented east-west 2,400 ft long and the other north-south 1,500 ft long. Each runway averages 4 to 5 operations per week each or about 500 operations annually for both runways combined (CPS, 2002). Bakers Strip, located approximately 5.5 mi southeast of the site, has a 2,000 ft turf runway running north-south (Bureau of Transportation Statistics, 2000). Bakers Strip conservatively averages one operation per week based on discussion with the owner, or about 50 operations annually. There is also a non-operational (Spencer) airport owned by AmerGen, located approximately 2 mi west-southwest. These facilities are private strips that can only accommodate small, light single or twin-engine propeller aircraft. They are available for public use only in emergencies.

FAA statistics shows there are no air carrier, air taxi, general aviation, military or ultra-light operations at these airfields (GCR, 2004).

The ESP Site lies midway between the Central Illinois Regional Airport (formerly the Bloomington-Normal Airport) and the Decatur Airport, which are located approximately 22.5 mi north and south, respectively. These are the closest airports with commercial traffic.

A heliport is located on site at CPS for use by company helicopters (CPS, 2002).

2.2.2.5.2 Airways

Low altitude federal airways in the vicinity of the EGC ESP Facility are shown on Figure 2.2-3. The closest low altitude federal airway to the EGC ESP Facility is V313 with its centerline passing within 2 mi east. Other low altitude federal airways in the vicinity of the site are V233 passing within 3 mi northwest, V72 with a centerline approximately 5 mi northeast, and V434 with centerline approximately 6 mi north-northeast. These airways are used by aircraft operating below 18,000 ft (msl) (CSAC, 2001).

2.2.2.5.3 Aircraft Hazards

Hazards associated with aircraft and airways were evaluated against the criteria in Regulatory Guide 1.70 (USNRC, 1978a) and NUREG-0800, Section 3.5.1.6, Aircraft Hazards, (USNRC, 1981). Additionally, aircraft accident probability for the ESP Site was evaluated using criteria delineated in the current draft USNRC Standard Review Plan (SRP), Section 3.5.1.6 (USNRC, 2002).

The three private airstrips within the 6 mi radius do not accommodate routine, commercial, or public traffic. A query of aviation accidents from January, 1988 to April, 2003 indicated that there were no aviation accidents at these facilities (NTSB, 2003). In addition, the Regional Flight Safety Coordinator for the Illinois Department of Transportation (DOT) and the Safety Program Manager for the Federal Aviation Administration (FAA) office in Springfield were contacted during the preparation of the EGC ESP application indicated that they also have no record of recent accidents associated with these facilities.

There are no airports within 10 mi of the site with existing or projected operations greater than the $500d^2$ (d equals distance in mi) movements per year criterion provided in Regulatory Guide 1.70.

There are three airports (two commercial and one municipal) near the EGC ESP Site.

The Central Illinois Regional Airport is located 23 mi north-northwest of the site and is serviced by several commercial, commuter carriers (AirTran, Northwest Airlink, American Connection and United Express). Aircraft currently in use by these carriers include Boeing B 717, MD- DC-9, Saab 340B, BAE J-41 and CRJ-700. Year 2001 air operations at Central Illinois totaled 51,598.

The Decatur Airport (25 mi south) has scheduled commuter service through American Connection, currently flying BAE-J41 aircraft. The airport had 54,000 operations in 2001.

The Rantoul National Aviation Center Airport-Frank Elliott Field is located 37 mi east northeast of the ESP Site. Rantoul is a public airport but has no routinely scheduled commercial flights. The airfield averages 44 operations per day (16,000 per yr).

The incidence of operations for these three facilities lies well within the $1000d^2$ criterion (USNRC, 2002); thus, accident statistics for these operations are not further evaluated.

The low altitude federal airways described above are identical to those in existence at the time of the CPS USAR. The probability of incidence of an aircraft crash from these airways was determined in the CPS USAR to satisfy the criteria given in the NUREG-0800, Section

3.5.1.6 (USNRC, 1981) and did not constitute a design consideration (CPS, 2002). This conclusion is substantiated in Table 3.5-7 of the CPS USAR where it is demonstrated that the impact probability from federal airways is about 10E-7 per year.

Aircraft impact probability for EGC ESP Site is estimated using the following relationship as specified in RS-002 Section 3.5.1.6 (USNRC, 2004):

PFA = C x N x A/w

Where:

C = inflight crash rate per mile for aircraft using the airway = 4 x 10E-10 (USNRC, 2004)

w = width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway, (CPS USAR Table 3.5-7).

N = number of flights per year along the airway projected for the life of the facility (40 years) plus the term of the ESP (20 years).

A = projected site area in square miles; (estimated at approximately 7.17E-02 mi^2 which will envelop the major proposed facility structures)

The results of the probability of aircraft impact from federal airways are provided in Table 2.2-4A. The estimated value reflects a conservative upper bound for the aircraft impact probability at the Exelon ESP Site. The calculated values are consistent with the recommended probability of occurrence guideline criteria of about 10E-7 per year.

2.2.2.6 Projections of Industrial Growth

Current industries in the vicinity of the station are listed in Table 2.2-2. The DeWitt County's Comprehensive Plan identifies industrial growth, including a public airport, as intermediate term objectives. However, there are no pending new industries or anticipated expansion of existing industries within six mile vicinity of the EGC ESP Site. The current lack of expansion is consistent with the observed decrease in regional employment in DeWitt County from 1990 and 2000 (USDOL, 2002).

Table 2.2-4 lists the pipelines within 5 mi of the facility. There is also no planned expansion for any of the existing pipelines.

2.2.3 Evaluation of Potential Accidents

The nearest highway is State Route 54 passing approximately 1 mi from the EGC ESP Facility. U.S. Highway 51 is approximately 6 mi from the site. Effects of accidents on these transportation routes were evaluated in the CPS USAR, which concluded that they need not be considered as design basis events for the CPS. There has been no distinguishable increase in traffic volumes on these routes since the CPS analysis (SIDOT, 2002).

The nearest railroad is the Gilman Line of the Canadian National Railroad that runs parallel to and closely follows State Route 54, traversing the CPS Facility property approximately 1 mi north of the ESP Facility footprint. Railroad transportation hazards were determined based upon patterns of hazardous material shipping for the Gilman Line of the Canadian National Railroad during the licensing of the CPS and subsequent 3 year surveys of hazardous material shipments on this line until 1998, in compliance with the CPS USAR. The triennial surveys have indicated that the conclusion of the initial analysis remains bounding.

The EGC ESP Site is not located near a large navigable waterway. Airway hazards are addressed in Section 2.2.2.5.

2.2.3.1 Determination of Design Basis Events

Hazards associated with flammable, explosive, chemical and toxic material storage at CPS were not considered in the CPS USAR to constitute a design concern (CPS, 2002). Similar conclusions have been made for flammable and explosion accidents for the ESP Facility. Certain toxic chemical hazards will need to be evaluated at the COL stage with consideration of design features such as the ESP Facility control room habitability systems.

External fires, collisions with the intake structure, and liquid spills were determined to not be hazards in the CPS USAR. Similar conclusions are made for the ESP Facility.

2.2.3.1.1 Explosions

Fluids, explosives, munitions, and chemicals stored or being transported in the vicinity of the EGC ESP Site that may pose hazards to the facilities and/or operations of a facility located on the site have been evaluated in the CPS USAR (CPS, 2002).

Cornbelt FS maintains a large propane tank at their facility in DeWitt, located approximately 2.6 mi from the Exelon ESP Site. The transport of propane to this location and the storage of a large quantity of propane constitute a potential explosion concern.

The propane is trucked to the Cornbelt FS location in DeWitt on Highway 54 and Illinois State Route 48. At the closest approach to CPS (approximately 0.75 mi on Highway 54), the risk of an explosion involving approximately 90 tons of hydrocarbon fuel (standard tank trucks are limited to a gross weight of 40 tons) was reviewed in the CPS USAR, and the safety-related structures at the station were demonstrated to be capable of withstanding well in excess of the overpressure. The corresponding peak positive incident overpressure is less than 1 psi, based on Regulatory Guide 1.91, Figure 1 (USNRC, 1978b).

CPS also evaluated the amount of propane (1,000,000 lbs) stored at the Cornbelt FS facility in DeWitt. At a distance of 2.5 miles between the DeWitt facility and CPS, the overpressure was determined to be more than an order of magnitude below the amount (13,240,000 lbs) that would constitute a design concern for CPS (Illinois Power, 1998).

Structures to be located at the EGC ESP Site, by having similar or greater separation (closest approach of Highway 54 is approximately 1 mi) than CPS, will also not be subjected to overpressures greater than 1 psi. This same conclusion is valid for propane storage explosions originating at the Cornbelt FS facility. In both cases, the peak incident pressure is less is less 1 psi, a level at which no significant damage would be expected to occur to safety related SSCs.

2.2.3.1.2 Flammable Vapor Clouds

The shipment of compressed flammable gas on the Gilman Line of the Canadian National Railroad represents the potential for a flammable vapor cloud in the vicinity of the EGC ESP

Site.

An estimate of the probability of a rail accident on the Gilman Line resulting in a flammable vapor cloud and subsequent explosion capable of producing a pressure pulse exceeding the Regulatory Guide 1.91 (USNRC, 1978b) acceptance criteria of one psig at CPS was shown to be less than 1E-06 per year. Consistent with Regulatory Guide 1.91, the low probability of such an accident on the Canadian National Railroad eliminates this source as a design basis event for CPS (CPS, 2002) and for the EGC ESP Facility by virtue of the EGC ESP Facility having a similar or greater separation from such an event.

2.2.3.1.3 Toxic Chemicals

The chemicals and other materials maintained in inventory at CPS were evaluated in the CPS USAR for potential impact on design and operation of the facility. It was concluded that these materials did not constitute a design concern at CPS. This conclusion is expected to be valid for the ESP facility; however, the chemicals and materials used at CPS and ESP facility will need to be analyzed at the COL stage taking into account the control room ventilation design.

Van Horn-DeWitt is the only facility within 5 mi of the EGC ESP Site that manufactures, uses, or stores toxic chemicals. Van Horn-DeWitt is a distributor of agricultural products and chemicals (such as pesticides, herbicides, and fertilizers) and their facility in DeWitt is located approximately 2.6 mi from the EGC ESP Site. A list of chemicals distributed by Van Horn-DeWitt was reviewed in the preparation of the CPS USAR. This review was updated as part of the EGC ESP application development, and it was determined that with the exception of anhydrous ammonia, none of the chemicals in Van Horn-DeWitt's inventory require evaluation for their potential effect on control room habitability (due to an accidental spill or release) in accordance with Regulatory Guide 1.78 (USNRC, 2001).

CPS demonstrated that the postulated accidents of anhydrous ammonia nurse tanks and tanker trucks used by farmers and suppliers do not adversely affect the site (CPS, 2002). The postulated accidents will need to be evaluated at the COL stage with consideration of design features such as the ESP Facility control room habitability systems.

The anhydrous ammonia stored and distributed by Van Horn–DeWitt is transported to the facility by truck on Highway 54. The primary transportation route is generally from the east and does not traverse through the nominal 3 mi of the truck route that are within 5 mi of the ESP Site. The potential of such a spill is small because of the small number of anhydrous ammonia shipments, the fact that there is only one wind direction that could possibly impact the EGC ESP Facility, and that the truck accident rate is fairly small. The potential for hazard was low enough that transportation of ammonia in the area surrounding CPS Facility did not need to be considered in the design. Since the traffic volumes and ammonia storage for the EGC ESP Facility are the same as CPS, ammonia from a trucking accident is not a design basis concern for the EGC ESP Facility.

Since the Van Horn–DeWitt facility is within 5 mi of the ESP Site, the accidental release of a hazardous chemical from the facility is subject to consideration for analysis in accordance with Regulatory Guide 1.78. There are two 40 ton tanks and a number of smaller tanks (nursing tanks) for storage of anhydrous ammonia at the Van Horn–DeWitt facility. Hazards to the CPS Facility from storage of ammonia at Van Horn-DeWitt were evaluated by CPS. The largest single volume (40 ton tank) of anhydrous ammonia stored at Van Horn–DeWitt exceeded the threshold values specified in Table C-2 of Regulatory Guide 1.78 (based on the toxicity limit of anhydrous ammonia, the distance of the tank from the CPS Facility, and the type of control room). The potential effect of an anhydrous ammonia release on control room habitability was evaluated, and it was determined that the probability of an event at this location resulting in uninhabitability of the control room was sufficiently low so as to allow this source to be eliminated from concern. An analysis specific to the location of the EGC ESP Facility control room evaluating the impact of an ammonia release from this source will be required at the COL stage to determine if ammonia detection and isolation capability will be required in the facility design.

The Gilman Rail Line running parallel to State Route 54 is used to transport a wide variety of commodities, including hazardous materials. Illinois Power Company performed a comprehensive survey of the Gilman Line from Illinois Central (prior owner of the Gilman Line) shipping records for the one year period of December 1, 1981 to November 30, 1982. The survey found 19 hazardous materials shipped at least 30 times per year (based on evaluation criteria dictated by Regulatory Guide 1.78). These 19 chemicals are listed in Table 2.2-5. This inventory was used as the basis for determining the potential impact of hazardous materials from this source. The 19 materials and their respective quantities (for example, maximum quantity per shipment) were evaluated in the CPS USAR for impact on control room habitability. This analysis resulted in a determination that rail line shipments did not present the potential for control room habitability concerns. The CPS USAR also identified a commitment to perform a periodic (3 year) survey of hazardous materials moved on the Gilman Line to assure that the conclusions drawn in the initial analysis remained valid and that no new hazardous materials of concern were being transported in proximity to the facility (CPS, 2002).

The COL phase for the EGC ESP Site will require a new analysis of the hazards associated with the Gilman Line that is specific to the control room location of the EGC ESP Facility, includes consideration of the specific control room ventilation system design, and incorporates current (at time of COL preparation) analytical methodology for dispersion and transport of airborne hazardous materials. Periodic review of hazardous material types and quantities being transported will also be required, presumably at the same or similar frequency to those currently being performed in support of the CPS Facility operation.

2.2.3.1.4 Fires

No external fire hazard can threaten facilities located at the EGC ESP Site, since, aside from those materials stored at CPS, no chemical plants or oil storage facilities are located near the site. Forest or brush fires pose negligible danger due to the minimal vegetation remaining from previous site preparation activities.

2.2.3.1.5 Collisions with Intake Structure

The EGC ESP Site is not located near a large navigable waterway. There is no potential for a large ship or a barge to have an impact on the intake structure. The CPS USAR concluded that since only small recreational boats are operated near the site, collisions of watercraft were not capable of interrupting intake structure function (CPS, 2002). The ESP Intake Structure would have similar performance and structural characteristics such that it would not be affected by potential impact from recreational watercraft.

2.2.3.1.6 Liquid Spills

The CPS USAR concluded that there was no potential for an accidental release of oil or other liquids which may be drawn into the intake structure and/or cooling water systems, or which may otherwise affect the safety of such structures supporting that facility (CPS, 2002). No additional sources of such a hazard are evident for the EGC ESP Site and the CPS USAR conclusion is deemed appropriate for the EGC ESP Site.

2.2.3.2 Effects of Design Basis Events

Evaluations were performed of potential hazards near the ESP Facility site. These evaluations concluded that potential accidents involving explosions, flammable vapor clouds, fires, collisions with intake structures, and liquid spills do not pose a threat to the EGC ESP Facility.

The effects of toxic chemical releases near the facility will require evaluation at the COL stage since plant features such as the control room habitability system design must be considered to determine there is no adverse effect from these hazards. Analyses will be required for releases of: (1) chemical materials used at CPS and the EGC ESP Facility; (2) anhydrous ammonia nurse tanks used by farmers and tanker trucks used by suppliers; (3) anhydrous ammonia tank failure at the Van Horn-DeWitt facility; and (4) chemical hazards shipped by railway on the Gilman Line of the Canadian National Railroad.

2.3 Meteorology

2.3.1 Regional Climatology

This section provides a description of the general climate of the EGC ESP Site, as well as the regional meteorological conditions used as a basis for design and operating conditions. A climatological summary of normal and extreme values of several meteorological parameters is presented for the first-order National Weather Service Stations in Peoria, Illinois and Springfield, Illinois. Further information regarding regional climatology was derived from pertinent documents, which are referenced in the text.

2.3.1.1 General Climate

The EGC ESP Site is located near the geographical center of Illinois, approximately 55 mi southeast of the National Weather Service Station in Peoria, and 49 mi east-northeast of the National Weather Service Station in Springfield, Illinois. Both of these stations are considered to be “first-order” weather observing stations because they are fully instrumented and record a complete range of meteorological parameters. Additionally, the observations are recorded continuously, either by automated instruments or by human observer for the 24 hour period, midnight to midnight.

General climatological data for the region surrounding the site area was obtained from several sources of information that contain statistical summaries of historical meteorological data for the region. The climatic data from the Peoria and Springfield observing stations are considered to be representative of the climate at the site. This is due to the relatively close proximity of these two stations to the site as well as similarities of terrain and vegetation features in the area. With the exception of a few low hills in the extreme southern and northwest portions of the state, the terrain throughout Illinois is considered to be flat to gently rolling, with vegetation consisting predominantly of croplands, interspersed with only modest amounts of deciduous forestation. The references that were used to characterize the climatology of the region include Climates of the States, Third Edition (Gale Research Company, 1985); Weather of U.S. Cities, Fourth Edition (Gale Research Company, 1992b); and The Weather Almanac, Sixth Edition (Gale Research Company, 1992a).

The climate of central Illinois is typically continental, with cold winters, warm summers, and frequent short-period fluctuations in temperature, humidity, cloudiness, and wind direction. The great variability in central Illinois climate is due to its location in a confluence zone, particularly during the cooler months, between different air masses. The air masses which affect central Illinois typically include maritime tropical air, which originates in the Gulf of Mexico; continental tropical air, which originates in Mexico and the southern Rockies; Pacific air, which originates in Mexico and eastern North Pacific Ocean; and continental polar and continental arctic air, which originates in Canada. As these air masses migrate from their source regions, they may undergo substantial modification in their characteristics. Monthly streamline analyses of resultant surface winds suggest that air reaching central Illinois most frequently originates over the Gulf of Mexico from April through August, over the southeastern U.S. from September through November, and over both the Pacific Ocean and the Gulf of Mexico from December through March (Bryson, 1966).

The major factors controlling the frequency and variation of weather types in central Illinois are distinctly different during two separate periods of the year. During the fall, winter, and spring months, the frequency and variation of weather types is determined by the movement of synoptic-scale storm systems, which commonly follow paths along a major confluence zone between air masses, and is usually oriented from southwest to northeast through the region. The confluence zone normally shifts in latitude during this period, ranging in position from the central states to the U.S.-Canadian border. The average frequency of passage of storm systems along this zone is about once every five to eight days. The storm systems are most frequent during the winter and spring months, causing a maximum of cloudiness during these seasons. Winter is characterized by alternating periods of steady precipitation (rain, freezing rain, sleet, or snow) and periods of clear, crisp, and cold weather. Springtime precipitation is primarily showery in nature. The frequent passage of storm systems, presence of high winds aloft, and frequent occurrence of unstable conditions caused by the close proximity of warm, moist air masses to cold, dry air masses result in a relatively high frequency of thunderstorms during this period. These thunderstorms, on occasion, are the source of hail, damaging winds, and tornadoes. Although synoptic-scale storm systems also occur during the fall months, their frequency of occurrence is less than in winter or spring. Periods of pleasant, dry weather characterize the fall season, but ends rather abruptly with the returning storminess that usually begins in November.

In contrast, weather during the summer months is characterized by weaker storm systems, which tend to pass to the north of Illinois. A major confluence zone is not present in the region, and the region's weather is characterized by much sunshine interspersed with thunderstorm situations. Showers and thunderstorms are usually of the air mass-type, although occasional outbreaks of cold air bring precipitation and weather typical of that associated with the fronts and storm systems of the spring months.

When southeast and easterly winds are present in central Illinois, they usually bring mild and wet weather. Southerly winds are warm and showery, westerly winds are dry with moderate temperatures, and winds from the northwest and north are cool and dry.

Table 2.3-1 presents a summary of historical climatological observations from the Peoria and Springfield meteorological observing stations.

2.3.1.2 Regional Meteorological Conditions for Design and Operating Basis

2.3.1.2.1 Thunderstorms, Hail, and Lightning

Thunderstorms occurred on an average of 48 days per year in Peoria (1955-1990) and in Springfield (1959-1990) (Gale Research Company, 1992b). Approximately 41 percent of the annual precipitation in the region is estimated to fall during thunderstorms (Changnon, 1957). Thunderstorms occur most frequently during the months of June and July; each with eight days per month in Peoria, and eight and nine days per month, respectively, in Springfield. Peoria and Springfield average five or more thunderstorm days per month throughout the season from April through September. Both stations average two or less thunderstorm days per month from November through February (Gale Research Company, 1992b). A thunderstorm day is normally recorded only if thunder is heard and the observation is independent of whether or not rain and/or lightning are observed concurrent with the thunder (AMS, 1970).

A severe thunderstorm is defined by the National Severe Storms Forecast Center (NSSFC) of the National Weather Service as a thunderstorm that possesses one or more of the following characteristics (USDOC, 1969):

- Winds of 50 knots or more;
- Hail 0.75 in or more in diameter; or
- Cumulonimbus cloud favorable to tornado formation.

The above referenced report by the NSSFC provides values for the total number of hail reports 0.75 in or greater, winds of 50 knots or greater, and the number of tornadoes for the period 1955-1967 by 1° squares (latitude by longitude). The report shows that during this 13-year period, the 1° square containing the site had 15 hailstorms producing hail 0.75 in in diameter or greater, 26 occurrences of winds of 50 knots or greater, and 42 tornadoes.
At least one day of hail is observed per year over approximately 90 percent of Illinois, with the average number of hail days at a point varying from one to four (Huff and Changnon, 1959). Considerable year-to-year variation in the number of hail days is seen to occur; annual extremes at a point vary from no hail in certain years to as many as 14 hail days in other years. About 80 percent of the hail days occur from March through August with spring (March through May) being the primary period of occurrence. In the EGC ESP Site region, Peoria and Springfield average approximately 22 hail days per 10 year period, with about 55 percent of all hail days occurring in the spring (Huff and Changnon, 1959). The maximum number of hail days in a year for Peoria and Springfield is seven (1927, 1950, 1954) and eight (1975), respectively (ISWS, 2003). Total hailstorm life at a point averages about 7 minutes, with maximum storm life reported as generally not over 20 minutes for Illinois (Changnon, 1957).

The frequency of lightning flashes per thunderstorm day over a specific area can be estimated by using Equation 2.3-1, taking into account the distance of the location from the equator (Marshall, 1971):

$$N = (0.1 + 0.35 \sin \varnothing)\ (0.40 +/- 0.20) \qquad \text{Equation 2.3-1}$$

Where: N = Number of flashes to earth per thunderstorm day per km^2

Ø = Geographical latitude

For the EGC ESP Site, which is located at approximately 40° north latitude, the frequency of lightning flashes (N) ranges from 0.065 to 0.195 flashes per thunderstorm day per km^2. The value 0.195 is used as the most conservative estimate of lightning frequency in the calculations that follow.

Taking the annual average number of thunderstorm days in the site region as 48 (in Peoria and Springfield), the mean frequency of lightning flashes per km^2 per year is 9.4 as calculated below:

$$\frac{0.195 \text{ flashes}}{(\text{thunderstorm day})\ (\text{km}^2)} \times \frac{48 \text{ thunderstorm days}}{\text{year}} = \frac{9.4 \text{ flashes}}{(\text{km}^2)\ (\text{year})}$$

The area of the CPS Site is approximately 14,000 ac. Hence, the expected frequency of lightning flashes at the site per year is 533, as calculated below:

$$\frac{9.4 \text{ flashes}}{(\text{km}^2)(\text{year})} \times 56.7 \text{ km}^2 = \frac{533 \text{ flashes}}{\text{year}}$$

The exclusion area for the EGC ESP Facility at the EGC ESP Site has a radius of 3,362 ft. Hence, the expected frequency of lightning flashes in the exclusion area per year is 31, as calculated below:

$$\frac{9.4 \text{ flashes}}{(\text{km}^2)(\text{year})} \times 3.3 \text{ km}^2 = \frac{31 \text{ flashes}}{\text{year}}$$

2.3.1.2.2 Tornadoes and Severe Winds

Illinois ranks eighth in the U.S. in average annual number of tornadoes, based on the period-of-record 1953-1989 (Gale Research Company, 1992b). During the period 1950 to 2003, the average number of tornadoes per year that have occurred in Illinois is 33, based on the Illinois tornado statistics as summarized in Table 2.3-2 (NOAA, 2004). It is important to note that the wind speeds associated with the storm intensities (referenced in the Fujita Tornado Scale) listed in Table 2.3-2 are estimates and have never been verified by actual measurement. The scale is based on estimated winds associated with the amount of damage observed after the storm event.

For DeWitt and the immediately adjacent surrounding counties, the number of tornadoes reported for the same period is summarized in Table 2.3-3.

Approximately 65 percent of Illinois tornadoes have occurred during the months of March through June, with the highest statewide probability of a tornado occurrence being in April. Tornadoes can occur at any hour of the day, but are most common during the afternoon and evening hours. About 50 percent of Illinois tornadoes travel from the southwest to northeast. Slightly over 80 percent exhibit directions of movement toward the northeast through east. Fewer than 2 percent move from a direction with an easterly component (Wilson and Changnon, 1971).

Figure 2.3-1 illustrates the total number of tornadoes recorded during the period (1916-1969) for each county in Illinois. This figure was obtained from the CPS USAR, and it illustrates that 36 tornadoes originated during the 54 year period in the five-county surrounding area and including the EGC ESP Site (specifically DeWitt, McLean, Logan, Macon, and Piatt counties). Three of these tornadoes were recorded in DeWitt County during the 54-yr period. For the period of 1950-2003, 18 tornadoes were recorded in DeWitt County and 212 tornadoes recorded in the 5-county area. In spite of the fact that there was a significant increase in the number of recorded tornadoes in the area for 1950 – 2002 period when compared to the 1916 – 1969 period, there is no reason to believe that the existence of such a large increase actually occurred. Based on a statistical analysis of tornado occurrences in the United States over a 70-year period, Fujita (2003) concluded that the indicated increase in tornado occurrences was a result of increased reporting efficiency and confirmation skill, and that F0 and F1 class tornadoes were typically overlooked during the early data collection years. Additionally, research conducted by Grazulis (Gaya et al., 2003) concluded that the increase in urbanization over the past 50 years has effectively resulted in an increase in the number of reported tornadoes, if for no other reason than there are more targets destroyed or damaged by a tornado in an urban area than in a rural area. As a result, there is a higher frequency of reported incidents in urban areas than in rural areas.

The likelihood of a given point being struck by a tornado can be calculated by using a method developed by H.C.S. Thom (Thom, 1963). Thom presents a map of the continental U.S. showing the mean annual frequency of occurrence of tornadoes for each 1° square (latitude by longitude) for the period of 1953-1962. For the 1° square (3,634 mi^2 in area) containing the EGC ESP Site, Thom computed an annual average of 1.9 tornadoes. Assuming 2.82 mi^2 is the average tornado path area, the mean probability of a tornado occurring at any point within the 1° square containing the site area in any given year, is calculated to be 0.0015. This converts to a mean recurrence interval of 670 years. Using the same annual frequency, but an average area of tornado coverage of 3.5 mi^2 (Wilson and Changnon, 1971), the mean probability of a tornado occurrence is 0.0018. More recent data containing tornado frequencies for the period 1955-1967 indicate an annual tornado frequency of 3.2 for the 1° square containing the site (USDOC, 1969). This frequency, in conjunction with Wilson and Changnon's average path area of 3.5 mi^2, results in an estimated mean tornado probability of 0.0031, with a corresponding mean return period of 325 years.

The annual tornado probability (for a tornado of any intensity) in the EGC ESP Site area is therefore best expressed as being in the range of 0.0015 to 0.0031, with a mean tornado return period of 325 to 670 years. Based on the observed occurrences of worst case tornadoes in Illinois (F4 and F5 on the Fujita Scale), an estimate of worst case tornadic events at the EGC ESP Site area can be made. The distribution of tornadoes in Illinois by intensity, as shown in Table 2.3-3 during the period of 1950-2003, indicates that there were 45 occurrences of F4 and F5 tornadoes out of a total of 1,793 tornadoes (i.e., 2.55 percent). Applying this percentage to the range of annual tornado probabilities for the site area, the probability of occurrence of a worst tornado is therefore 0.000038 to 0.000079.

Design basis tornado parameters have traditionally been based on Regulatory Guide 1.76 (USNRC, 1974a) and WASH-1300 (USNRC, 1974b). WASH-1300 states that the probability of occurrence of a tornado that exceeds the design-basis tornado should be on the order of 1.0E-7 per year per nuclear power plant and Regulatory Guide 1.76 delineates maximum wind speeds of 240 to 360 mph depending on the region of the US in which the site is located. More recent evaluations have resulted in recommendations for reduced design basis tornado wind conditions. ANSI/ANS 2.3 (ANSI, 1983) recommends a maximum tornado wind speed of 260 mph and a tornado recurrence interval of 1.0E-6 years; however, this standard has not been endorsed by the USNRC. However, in SECY-93-087 (USNRC, 1993), the USNRC staff endorsed/recommended use of a maximum tornado wind speed of 483 km/hr (300 mph) in the design of evolutionary and passive advanced light water reactors (ALWRs) for sites east of the Rocky Mountains. The Commission’s subsequent Staff Requirements Memo (SRM) approved the staff's position (USNRC, 1993a). It is important to note that this recommendation did not include and was not based on a specific recurrence interval.

While SECY-93-087 was addressing ALWR issues, the determination of a design basis tornado for a specific area of the United States is not design specific, but is location specific. In other words, for a given geographic location, a tornado with specific properties is related to an acceptable mean recurrence interval. This conclusion is effectively unrelated to the reactor type. Because the EGC ESP Site is east of the Rocky Mountains, the design basis tornado parameters identified in SECY-93-087 are applicable to the site. Further, the maximum wind speed of 300 mph (for sites east of the Rocky Mountains) and other associated parameters have already been evaluated and accepted by the NRC staff as an appropriate design basis tornado (USNRC, 1994).

The SECY-93-087 recommendation was based on an NRC staff and contractor re-evaluation of tornado data as provided in NUREG/CR-4461 (USNRC, 1986). This study was based on a tornado data tape prepared by the National Severe Storm Forecast Center with 30 years of data including the data for approximately 30,000 tornadoes that occurred during the period of 1954 through 1983. Based on discussions between the contractor and the USNRC staff, wind speed values associated with a tornado having a mean recurrence interval of 1.0E-7 per year were estimated to be about 322 km/yr (200 mph) for states west of the Rocky Mountains, and 482 km/yr (300 mph) for states east of the Rocky Mountains. Subsequent discussions with EPRI culminated in eliminating the recurrence interval as a requirement for the design basis tornado (USNRC, 1993 and USNRC, 1994a). Further, it was the USNRC staff position that this recommendation was based on the best available information (USNRC, 1992). An EPRI letter (EPRI, 1992) identified its understanding of the USNRC staff agreement to use this design basis tornado criteria "for design certification *and siting* of evolutionary and passive ALWR designs" (emphasis added). The USNRC acknowledged this understanding in SECY-93-087 by referencing the EPRI letter and stating "EPRI agreed with the staff's position to use a 482 km/hr (300 mph) maximum tornado wind speed and to consider other site-specific hazards in the COL *or early site permit*" (emphasis added). Thus, this tornado criteria is considered to be the site-specific hazard for use in early site permit proceedings.

Other characteristics associated with a maximum wind speed of 300 mph are as identified in the previous USNRC staff position (USNRC, 1988, Table II) for a wind speed of 300 mph, i.e., rotational speed of 240 mph, maximum translational speed of 60 mph, radius of maximum rotational speed of 150 ft, pressure drop of 2.0 psi, and rate of pressure drop of 1.2 psi/sec (USNRC, 1994).

Since actual measurement of site-specific tornado parameters is not practical, the site characteristics for tornado parameters have historically been based on the best available information (which has generally been reflected in the USNRC guidance for the design basis tornado, i.e., Regulatory Guide 1.76). Also, because actual site measurements have not been taken (due to the impracticality), there is no known actual site hazard. Further, NUREG/CR-4461 represents better available information than Regulatory Guide 1.76, and the latest USNRC position on design basis tornados is based on the information in NUREG/CR-4461. Therefore, the EGC ESP Facility site characteristic tornado has been chosen consistent with the SECY-93-087 position, as approved by the Commission and based on the NUREG/CR-4461 information.

Thus, the following site characteristic tornado parameters are established for the EGC ESP Facility (Table 1.4-1 Section 1.6):

- Rotational velocity = 240 mph
- Maximum translational velocity = 60 mph
- Maximum wind speed = 300 mph
- Radius of maximum rotational velocity = 150 ft
- Pressure drop = 2.0 psi
- Rate of pressure drop = 1.2 psi/sec

These parameters are believed to be relatively consistent with expected conditions associated with potential worst-case tornadoes, namely the F4/F5 class of tornadoes. In addition, a site-specific 300-mph tornado wind speed site characteristic is consistent with a 1993 published analysis of tornadoes (Grazulis, 1993) from 1680 through 1991 conducted by The Tornado Project headed by Thomas P. Grazulis. This analysis indicates that the maximum wind speed expected at a probability of 10E-6 (i.e., once in 1,000,000 years) at the Clinton site to be between 200 and 220 mph (Figure 23.4 in Grazulis, 1993). This analysis also indicates the maximum wind speed expected at a probability of 10E-7 (once in 10,000,000 years) at the Clinton site to be between 250 and 300 mph (Figure 23.5 in Grazulis, 1993). Thus, these data indicate a Clinton site characteristic of 300 mph or less even using a 10E-7 recurrence interval.

A site characteristic wind velocity of 75 mph is established for the EGC ESP Site based on the peak wind speed observed at either Peoria or Springfield, IL as identified in Table 2.3-1. An importance factor of 1.11 is applied to this wind speed in the design of safety related structures. In addition, a site characteristic 3-second gust wind speed that represents a 100-year return period for the Clinton early site permit (ESP) site is established as 96 mph because the National Weather Service has phased out the measurement of “fastest-mile” wind speeds. The 3-second gust wind speed is based on the Structural Engineering Institute/American Society of Civil Engineers (SEI/ASCE) 7-98, "Minimum Design Loads for Buildings and Other Structures" (ASCE, 2000). Specifically, this design information was obtained from Figure 6-1 "Basic Wind Speed" from that reference. The wind speed obtained from Figure 6-1 for the Clinton ESP site area is 90 mph and is representative of the nominal design 50-year return 3-second gust at 10 meters above the ground. A correction of this value is provided in Table C6-3 "Conversion Factors for Other Mean Recurrence Intervals." The conversion factor for a 100-year return period is 1.07, resulting in a nominal design 3-second gust wind speed of 96 mph.

2.3.1.2.3 Heavy Snow and Severe Glaze Storms

Severe winter storms, which usually produce snowfall in excess of 6 in and are often accompanied by glaze, are responsible for more damage in Illinois than any other form of severe weather including hail, tornadoes, or lightning (Changnon, 1969). These storms occur on an average of five times per year in the state. The estimated probability of one or more severe winter storms occurring in a given year is virtually 100 percent, while the estimated probability for three or more severe winter storms occurring in Illinois in a year is

87 percent. A typical storm has a median point duration of 14.2 hours. Point durations have ranged from 2 hours to 48 hours during the 61-year period-of-record from 1900 to 1960, which is used in the severe winter storm statistical analyses (Changnon, 1969). Data on the average areal extent of severe winter storms in Illinois show that they deposit at least 4 in. of snow over 15,050 mi^2. Central Illinois (including the EGC ESP Site) had 107 occurrences of a 6 in. snow or glaze damage area during the years from 1900-1960. About 42 of those storms deposited more than 6 in. of snowfall in DeWitt County (Changnon, 1969).

In the Springfield area, the maximum-recorded 24 hour snowfall is 15.0 in., and the maximum monthly snowfall is 24.4 in., both of which occurred in February of 1900. On the average, heavy snows of 4 to 6 in. have occurred one to two times per year (Changnon, 1969).

The 2 day and 7 day maximum snowfall values for selected recurrence intervals in the EGC ESP Site area are as follows (Changnon, 1969):

	2-yr	5-yr	10-yr	20-yr	30-yr	50-yr
2-day:	7.0	8.6	10.2	12.1	13.4	15.2
7-day:	7.6	10.1	12.8	16.3	18.7	22.0

Sleet or freezing rain occurs during the colder months of the year when rain falls through a shallow layer of cold air with a temperature below 32°F from an overlying warm layer of temperature above 32°F. The rain becomes supercooled as it descends through the cold air. If it cools enough to freeze in the air, it descends to the ground as sleet; otherwise, it freezes upon contact with the ground or other objects, causing glaze.

In Illinois, severe glaze storms occur on an average of about three times every 2 years. Statewide statistics indicate that during the 61-year period from 1900-1960, there were 92 recorded glaze storms defined either by the occurrence of glaze damage or by occurrence of glaze over at least 10 percent of Illinois. These 92 glaze storms represent 30 percent of the total winter storms in the period. The greatest number of glaze storms in 1 year is six (1951); in 2 years, nine (1950-1951); in 3 years, ten (1950-1952); and in 5 years, fifteen (1948-1952). In an analysis of these 92 glaze storms, Changnon determined that in 66 storms, the heaviest glaze disappeared within 2 days; in 11 storms, 3 to 5 days; in eight storms, 6 to 8 days; in four storms, 9 to 11 days; and in three storms, 12 to 15 days. Fifteen days was the maximum persistence of glaze (1969). Within the central third of Illinois, 11 localized areas received damaging glaze in an average 10 year period; the EGC ESP Site area averages slightly over 5 days of glaze per year (Changnon, 1969).

Ice measurements recorded in some of the most severe Illinois glaze storms are shown in Table 2.3-4. The listing reveals that severe glaze storms depositing ice of moderate to large radial thickness may occur in any part of Illinois. An average of one storm every 3 years will produce glaze ice 0.75 in or thicker on wires (Changnon, 1969).

Strong winds during and after a glaze storm greatly increase the amount of damage to trees and power lines. Moderate wind speeds (10-24 mph) occurring after glaze storms are most prevalent, although wind speeds of more than 25 mph are not unusual. Observations of

5-minute winds in excess of 40 mph with a glaze thickness of 0.25 in. or more have been reported by Changnon (1969). Table 2.3-5 presents specific glaze thickness data for the five fastest 5-minute speeds and the speeds with the five greatest measured glazed thicknesses for 148 glaze storms throughout the country during the period from 1926-1937. Although these data were collected from various locations throughout the U.S., they are considered applicable design values for locations in Illinois.

Section 2.3.1.2 of Regulatory Guide 1.70 (USNRC, 1978) suggests that applicants provide site vicinity estimates of the weight of the 100-year return period snowpack and the weight of the 48-hour Probable Maximum Winter Precipitation (PMP) for use in estimating the weight of snow and ice on the roofs of safety-related structures. The 100-year return period snowpack, as obtained from the American Society of Civil Engineers (ASCE) building code requirements (ASCE, 2000), is 24.4 pounds per square foot (psf), which corresponds to approximately 24 in. of snowpack. The 48-hour winter PMP for the EGC ESP Site area is 86 psf, which corresponds to approximately 16.6 in. of precipitable water, or 166 in. of fresh snow.

The combined 100-year return snowpack and the estimated winter PMP is 110.4 psf, which is an extremely conservative and highly unlikely snow/ice roof loading for a structure in Illinois. A more realistic, and still conservative, snow load site characteristic for the EGC ESP Site is established based on the snow and ice loads from historical winter maximum precipitation events in conjunction with a 100-year recurrence interval antecedent snow pack. The weight of the accumulation of winter precipitation from a single storm is 15.6 psf. This is based on the assumption that the worst-case storm event would be consistent with the maximum monthly snowfall observed in the area over the past 100 years. The maximum-recorded monthly snowfall in the area is 26.5 in. (Peoria, February, 1900), 24.4 in. (Springfield, February 1900), and 30.5 in. (Decatur, March 1906). The maximum of 30.5 in. translates to the equivalent of about 3 in. of precipitable water and is assumed to be representative of a worst-case storm event during the winter months. Thus, a conservative estimate of the accumulated weight of snow and ice on the roof of each safety-related structure after a worst-case winter storm event is established as the site characteristic of 40.0 psf (24.4 psf + 15.6 psf).

2.3.1.2.4 Ultimate Heat Sink Design Parameters

Mechanical draft cooling towers will be used to provide the Ultimate Heat Sink for the EGC ESP Facility if the selected reactor type does not use passive cooling methods for the safety class cooling function. The cooling water system associated with any required Ultimate Heat Sink, as defined in Regulatory Guide 1.27, is referred to as the Essential Service Water (ESW) System in this document. The controlling meteorological parameters for an Essential Service Water mechanical draft cooling tower are wet bulb temperature and the coincident dry bulb temperature.

As discussed in RG 1.27, the meteorological conditions resulting in the maximum evaporation and drift loss of water from the UHS are the worst 30-day average combination of the controlling parameters, namely the wet-bulb temperature and the coincident 30-day average dry-bulb temperature for the same period. Based on an evaluation of historical meteorological data for both Peoria and Springfield, Illinois, the site characteristic maximum

30-day running average wet-bulb temperature for the 30-yr period from 1961 to 1990 (NCDC, 1993) is 74.7ºF (Springfield). The site characteristic coincident 30-day average dry-bulb temperature for the same period is 82ºF.

As also discussed in RG 1.27, the meteorological conditions resulting in minimal water cooling are be the worst combination of the controlling parameters, namely the worst combinations of the maximum 1-day and 5-day average wet-bulb temperatures and the corresponding 1-day and 5-day average coincident dry-bulb temperatures for the same period. Based on an evaluation of historical meteorological data for both Peoria and Springfield, Illinois, the site characteristic maximum 1-day and 5-day running average wet-bulb temperatures for the 30-yr period from 1961 to 1990 are 81ºF and 79.7ºF, respectively (Springfield). The site characteristic coincident 1-day and 5-day running average dry-bulb temperatures for the same period are 87.6ºF and 86.2ºF, respectively.

The design wet bulb temperature based on the site characteristic wet bulb temperature that is exceeded less than 1% of the time which is 78°F. The maximum wet bulb temperature recorded was 86°F and will produce a cold ESW water temperature of 95°F with a 9 degree approach in the cooling tower. This cold water temperature is equal to the 95°F value given in Table 1.4-1, Section 3.2.1. Wet bulb design temperatures are based on the maximum values for data from Springfield and Peoria, Ill weather data for the period 1961 to 1990. ESW cooling tower approaches greater than 10 degrees would be used for reactor plants designed for a cooling water inlet temperature greater than 95°F.

Modern cooling towers have almost no drift losses and this is not considered to be a critical design parameter. Site wind velocities and direction will be considered in designing the mechanical draft cooling towers to both minimize any recirculation of the air discharge from the tower and to provide adequate tower capacity with any expected recirculation. Figures 2.3-2 through 2.3-15 provide the wind direction data that will be used for the design of the cooling tower.

The UHS cooling towers will be designed structurally for the tornado wind conditions given in section 2.3.1.2.2.

2.3.1.2.5 Inversions and High Air Pollution Potential

Weather records from many U.S. weather stations have been analyzed by Hosler (1961) and Holzworth (1972) with the objective of characterizing atmospheric dispersion potential. The seasonal frequencies of inversions based below 500 ft for the general area of the EGC ESP Site are shown in Table 2.3-6.

Since central Illinois has a primarily continental climate, inversion frequencies are expected to be closely related to the diurnal cycle. The less frequent occurrence of storms in summer and early fall is expected to produce a larger frequency of nights with short-duration inversion conditions.

Holzworth's data give estimates of the average depth of vigorous vertical mixing, which gives an indication of the vertical depth of atmosphere available for mixing and dispersion of effluents. For the EGC ESP Site region, the seasonal values of the mean daily mixing depths are given by Holzworth and shown in Table 2.3-7. In general, when daytime (maximum) mixing depths are shallow (low inversion heights), pollution potential is considered to be greatest.

Holzworth has also presented statistics on the frequency of episodes of high air pollution potential, defined as a combination of low mixing depth and light winds. Holzworth's data indicate that during the 5-year period of 1960-1964, the region, including the EGC ESP Site, did not experience any episodes of two days or longer with mixing depths less than 500 m and winds less than 2 m/sec. There were two such episodes with winds remaining less than 4 m per second. For mixing heights less than 1,000 m and winds less than 4 m/sec, there were about nine episodes in the 5-year period that lasted two days or more. However, there were no episodes lasting five days or more. Holzworth's data indicates that central Illinois is in a relatively favorable dispersion regime in that a relatively low frequency of extended periods of high air pollution potential is expected (Holzworth, 1972).

The EGC ESP Site is located in DeWitt County, Illinois. Based on USEPA's current designation, DeWitt County is in attainment of the national ambient air quality standards (NAAQS) (USEPA, 2004). To determine whether a county is in attainment of the NAAQS, the Illinois Environmental Protection Agency (IEPA) operates a network of ambient air quality monitoring stations throughout the state. DeWitt County is located in the EPA-defined Air Quality Control Region (AQCR) 66 (i.e., the East Central Illinois Interstate AQCR). There are three monitoring sites in AQCR 66, in which there are four air monitoring stations (two in Champaign County and two in McLean County), located to the east and north of DeWitt County. There are also monitoring sites located to the west-southwest and northwest near Springfield and Peoria, respectively. These monitoring stations have consistently demonstrated that the area in the central part of Illinois is in attainment of the NAAQS for the criteria pollutants (i.e., ozone, PM2.5, SO2, PM10, and CO). While there are some areas in Illinois that do not comply with the NAAQS, these areas (the Chicago and St. Louis areas) are not proximal to the EGC ESP site. There are no significant air emission sources known to be in the general vicinity that would indicate that the regional air quality would be different than has been characterized by the existing monitoring network. The air quality characteristics of the site that would be the design and operating bases for the plant that may be constructed would therefore be: "Attainment for All Pollutants."

Prior to construction, the EGC facility will be required to obtain permits from IEPA to construct air emissions equipment. The application for these permits will require a demonstration of compliance with applicable regulations, as well as a demonstration that the ambient air quality standards will not be threatened or exceeded as a result of the operation of the facility.

Detailed information from the statewide ambient air quality monitoring network is provided in the Illinois Annual Air Quality Report, which is published annually by IEPA. Information used in this assessment was obtained from the reports for 2001 - 2003 (IEPA, 2001, 2002, 2003).

2.3.1.2.6 Ambient Air Temperatures

Site characteristic values for ambient temperature, specifically maximum and minimum dry bulb temperatures and maximum wet bulb temperatures that may be used for the design and operating basis of the EGS ESP Facility are provided below.

The maximum ambient dry bulb temperature (along with the concurrent wet bulb temperature) that:

i) will be exceeded no more than 2.0 percent of the time annually is 88°F (74°F concurrent wet bulb) (NCDC, 2000).

ii) will be exceeded no more than 0.4 percent of the time annually is 94°F (77°F concurrent wet bulb) (NCDC, 2000).

iii) represents a 100-year return period is 117°F (NCDC, 2004). The 100-year return period maximum temperature is not readily available in published documents. It may be possible to calculate a 100-year return maximum temperature using statistical methods and long-term data records; however, given that the temperature provided above was obtained from a period of record that exceeds 100 years (i.e., 1896 to 2000) it is therefore proposed as a 100-year return temperature. The coincident wet bulb temperature for the 100-year return period is not readily available; however, the 100-year return period non-coincident wet bulb temperature is 86°F (see below), which establishes an upper limit for this site characteristic.

The minimum ambient dry bulb temperature that:

i) will be exceeded no more than 1.0 percent of the time annually is 0°F (NCDC, 2000).

ii) will be exceeded no more than 0.4 percent of the time annually is -6°F (NCDC, 2000).

iii) represents a 100-year return period is -36°F (NCDC, 2004). The 100-year return period minimum temperature is not readily available in published documents. It may be possible to calculate a 100-year return minimum temperature using statistical methods and long-term data records; however, given that the temperature provided above was obtained from a period of record that exceeds 100 years (i.e., 1896 to 2000) it is therefore proposed as a 100 year return temperature.

The maximum ambient wet bulb temperature that:

i) will be exceeded no more than 0.4% of the time annually is 80°F (NCDC, 2000).

ii) represents a 100-year return period is estimated to approximately 86°F. The 100-year return period minimum temperature is not readily available in published documents. A review of the information from the National Climatic Data Center (2000) indicates that the median of extreme high wet bulb temperatures for Peoria and Springfield is 81°F, and 82°F for Decatur. The 2.0 percent occurrence wet bulb temperatures is 76°F for Peoria, Springfield, and Decatur (NCDC, 2000). Using the difference between the median extreme high of 81°F and the 2 percent occurrence level of 76°F as an indicator of the deviation from the mean, an estimate of the extreme high wet bulb temperature is 86°F (i.e., 81°F + 5°F).

In addition to the above information, temperature and humidity site characteristic values that will likely need to be considered for safety-related design and operation are as follows:

- Maximum ambient dry bulb temperature (0 percent exceedance): 117°F (NCDC, 2004)
- Maximum ambient dry bulb temperature (1 percent exceedance): 91°F(NCDC, 2000)

- Minimum ambient dry bulb temperature (0 percent exceedance): -36ºF (NCDC, 2004)
- Minimum ambient dry bulb temperature (1 percent exceedance): 0ºF (NCDC, 2000)
- Maximum ambient wet bulb temperature (0 percent exceedance): 86ºF (NCDC, 2000)
- Maximum ambient wet bulb temperature (1 percent exceedance): 78ºF (NCDC, 2000).

2.3.2 Local Meteorology

Local meteorological conditions are characterized by data obtained from an on-site meteorological monitoring system that was installed and began operation at the CPS Site on April 13, 1972. The location of the on-site monitoring system is approximately 3,200 ft south-southeast of the CPS containment structure and approximately 1,800 ft south southeast of the center of the EGC ESP Site. Based on its proximity to the ESP site, the meteorological parameters that are monitored by the CPS monitoring station are representative of the EGC ESP Site and are therefore appropriate for use in characterizing local meteorological conditions for use in this report. Local meteorological monitoring results and summaries of the parameters monitored by the on-site system are contained in this section. A detailed description of the physical characteristics of the on-site meteorological monitoring system is provided in Section 2.3.3.

Two periods of record were used to characterize the local meteorological conditions representative of the EGC ESP Site, namely 1972 – 1977 (pre-CPS construction) and 2000 – 2002 (post-CPS construction). The specific dates for each of these periods have been described in Section 2.3.3. The newer data from the period 2000 - 2002 should not be considered to be better, substantially more accurate, or more representative of the ESP Site than the data from the period 1972 - 1972. Rather, the newer data supplements the original data used in the original and updated CPS documentation. Furthermore, it has been effectively demonstrated in the EGC ESP Environmental Report that the effects of changes to the site attributable to the construction and operation of the CPS Facility (including Clinton Lake) are not significant enough to affect meteorological parameters. In the subsections that follow, a comparison of pre- and post-construction winds conditions is described, with the conclusion that differences between the two data periods is consistent with expectations. No comparisons were made for temperature, relative humidity, wet bulb, or dew point temperature since these parameters compared well with long term measurements from Peoria and Springfield.

2.3.2.1 Normal and Extreme Values of Meteorological Parameters

2.3.2.1.1 Wind Summaries

Detailed wind records are available from the CPS meteorological monitoring system for two periods of record, namely 1972-1977 and 2000-2002. Monthly and long-term average wind roses were constructed from wind speed and direction measurements made at the 10-m (33-ft) level of the on-site meteorological tower. A composite wind rose for the period 1972 – 1977 is presented in Figure 2.3-2, and the composite monthly average wind roses for the same period are shown in Figure 2.3-3 through Figure 2.3-14. A composite wind rose for the period 2000 – 2002 is presented in Figure 2.3-15. Seasonal variations are evident from the monthly data for the 1972-1977 period of record. Winds from the south-southeast through west-northwest sectors tend to dominate in most months. Winter months show generally higher wind speeds, fewer calms, and more west-northwest winds than do the summer months. A visual comparison of the composite wind roses for the two periods of record illustrates that the wind speed and direction characteristics of the Site area did not change substantially before (1972 – 1977) and after (2000 – 2002) construction of the CPS Facility. The two data periods are similar in their overall characteristics in that they exhibit a predominance of winds from the northwest through the southwest and south-southeast sectors. The most notable differences include a slight increase in occurrence of winds from the northeast sector in the 2000 – 2002 data period (7% versus a <5% occurrence in the 1972 – 1977 data). There is also an apparent increase in some direction sectors (of less than approximately 1% per sector) in the frequency of occurrence of wind speeds greater than 8 m/s in the 2000 – 2002 period. However, Table 2.3-8 illustrates that, for all sectors combined, there is a general shift towards lower wind speeds in the more recent data. These types of differences are consistent with what can be expected when comparing wind roses and statistical data summaries for periods in the mid-western U.S. Furthermore, such variations should be somewhat more noticeable in the shorter 32 month 2000 – 2002 data period as a result of year-to-year variations that may otherwise be averaged out over a longer 5 year period.

For the 1972-1977 period of record, there were two occurrences of persistence of wind direction for 33 hours (the longest persistence observed). These occurred in two sectors, the south-southwest and the northeast.

2.3.2.1.2 Temperatures

Temperatures at the CPS meteorological monitoring site are measured at the 10 and 60 m level of the tower. For the 1972-1977 period of record, the average daily temperature was 50.9°F (10.5°C). The absolute maximum temperature was 95.4°F (35.2°C), and the absolute minimum temperature was -19.8°F (-28.8°C). The 1972-1977 period of record and composite monthly summaries of the on-site temperature data are presented in Table 2.3-9 through Table 2.3-11. These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

2.3.2.1.3 Atmospheric Moisture

2.3.2.1.3.1 Relative Humidity

The relative humidity for a given moisture content of the air is inversely proportional to the temperature cycle. Maximum relative humidity usually occurs during the early morning hours, and minimum relative humidity is typically observed in the mid-afternoon. For the annual cycle, the lowest humidities occur in mid-spring; the winter months experience the highest. Table 2.3-12 presents a summary of relative humidity at the 10 m level for the CPS during the period from 1972-1977. These data are believed to be representative of the site area, and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

2.3.2.1.3.2 Wet Bulb

Information Deleted.

2.3.2.1.3.3 Dew Point Temperature

Dew point temperature is a measure of absolute humidity in the air. It is the temperature to which air must be cooled to reach saturation/condensation, assuming pressure and water vapor content remain constant. Summaries of composite monthly and period of record 10 m dew point measurements are presented in Table 2.3-14 through Table 2.3-16 for the period from 1972-1977. These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

2.3.2.1.3.4 Precipitation

The average yearly precipitation for the 1972-1977 period of record for the EGC ESP Site is 25.47 in. Period of record and composite monthly precipitation data appear in Table 2.3-17. The months of March and June are the wettest; the months of December, January, and February are the driest. These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

2.3.2.1.3.5 Fog

Fog is an aggregate of minute water droplets suspended in the atmosphere near the surface of the earth. According to international definition, fog reduces visibility to less than 0.62 mi. According to U.S. observing practice, ground fog is a fog that hides less than 60 percent of the sky and does not extend to the base of any clouds that may lie above it. Ice fog is fog composed of suspended particles of ice. It usually occurs in high latitudes in calm, clear weather at temperatures below -20°F and increases in frequency as temperature decreases (AMS, 1970).

Since local data are not available to assess the fog statistics at the EGC ESP Site, data are presented for nearby Springfield and Peoria, Illinois. Fog is a very local phenomenon; thus, this data should be considered only as regional estimates. The average number of days during which heavy fog (visibility less than 0.25 mi) was observed is presented in Table 2.3-18 for the 23 year period 1949 - 1971.

The yearly average number of fog days for this reporting period was 18.5 days in Springfield and 20 days in Peoria, with the highest occurrence of fog being in the winter months in both locations.

Tables 2.3-19 and 2.3-20 also summarize the frequency of occurrence, number of hours, and persistence of all fog for Peoria and Springfield, respectively. These summaries were obtained from the CPS USAR (CPS, 2002) and were originally prepared by processing the digital data tapes for these NWS observing stations. Fog extracted from these tapes included any of the fogs coded as either "fog," "ground fog," or "ice fog," which occurred in column 132, "obstruction to vision," on the Airways Surface Observations tapes.

The percentage of the total observations during which fog was reported for Peoria and Springfield is given in the first column of Tables 2.3-19 and 2.3-20. The hour and the percentage of observations for that hour of the maximum and minimum fog occurrence are given in the next four columns.

Peoria shows a higher frequency of fog in all months. The long-term annual average percent of hourly observations with any intensity of fog for Peoria and Springfield are 11.3 percent and 9.1 percent, respectively. The occurrence of prolonged periods of fog is also greater for Peoria. Although information on fog is generally a very local phenomenon, the expected occurrences at the EGC ESP Site should be within the range represented by these two stations.

A less detailed summary of fog occurrence in Peoria and Springfield available for a 40-year reporting period spanning 1951 – 1990 (Gale Research Company, 1992a), indicates that the average occurrence of fog is 21 times per year in Peoria and 17 times per year in Springfield. The observations of fog in Peoria and Springfield, at approximately 20 - 21 days of occurrence per year, can be considered to be a "baseline" occurrence. This is because they do not account for any occurrences of fog associated with the presence of Clinton Lake or the once-through cooling system used by the CPS. During winter months, cold air passing over the relatively warmer water surface of Clinton Lake can become saturated with respect to water vapor. When sufficient evaporated water vapor condenses into droplets, steam fog occurs. The characteristics of such steam fog will vary with the water temperature, the distance traveled over the water, the low-level ambient air temperature, relative humidity, vertical and horizontal stability, and the transporting wind speed.

In addition to the regional observations of fog obtained from the Springfield and Peoria airports, the impacts of fog associated with the presence of the Clinton Lake and the once-through cooling were previously addressed and documented in Section 2.3.2.2.2, of the CPS USAR (CPS, 2002). An analytical model was used that accounted for the processes of evaporation, condensation, and diffusion downwind. A description of the model that was used was provided in Attachment A2.3 (Analytical Fog Model) of the USAR. The modeling analysis focused on a number of areas surrounding the CPS Facility, including roadways and areas of population. The steam fog prediction model was used to calculate the occurrence of restricted visibility caused by steam fog in each of the specified areas of interest. This process was repeated for each month to account for the monthly difference in water temperature. The results were documented in several hundred maps showing the concentration of water vapor and water droplets for Clinton Lake and adjacent areas. The maps produced by the computer fog model illustrated the horizontal extent of visible water vapor plumes that were predicted to occur with a given wind direction for a specified combination of air temperature and relative humidity. The analyses of these maps as described in the USAR concluded that the maximum extent of reduced visibility beyond Clinton Lake from the lake steam fog would generally be confined to the area that is south of Clinton Lake and east of the town of Lane. Although, steam fog was predicted to occasionally drift over U.S. 54 where it passes near the northern edge of Clinton Lake. The steam fog analysis also concluded that there was no significant probability of lake steam fog extending to the towns of DeWitt or Lane. In addition, the remaining sections of roads around Clinton Lake were not affected significantly by the predicted lake steam fog. In general, the steam fog analysis presented in the USAR concluded that the maximum horizontal extent of steam fog from Clinton Lake would be 1 mi or less. The extent of extremely dense steam fog would be limited to the area immediately adjacent to Clinton Lake, and, in particular, the shallow water discharge flume and the point of discharge to the lake.

2.3.2.1.3.6 Atmospheric Stability

For estimates of average dispersion over extended periods, the joint probability of occurrence of wind speed, wind direction, and atmospheric stability must be known. These probabilities, or frequencies, have been generated from on-site data using the vertical temperature gradient and the variability of the horizontal wind to estimate atmospheric stability in accordance with ANS 2.5-1984 proposed as Regulatory Guide 1.23, Revision 1. Joint frequency distributions of wind speed, wind direction, and atmospheric stability measured at the site are provided in Table 2.3-21 through Table 2.3-28 for the 1972-1977 period of record. Joint frequency distributions for the 2000-2002 period of record are provided in Table 2.3-29 through Table 2.3-36.

Table 2.3-37 summarizes the percent frequencies of occurrence for each stability class (determined on the basis of vertical temperature gradient) recorded at the EGC ESP Site. The upper part of the table summarizes the 1972-1977 period of record, and the lower part summarizes the 2000-2002 period of record.

For the 1972-1977 period of record, the combination of E stability and calm winds (< 0.3 mps) occurred 0.06 percent of the time, F and calm conditions occurred 0.06 percent of the time, and G and calm conditions occurred 0.12 percent of the time. For the 2000-2002 period of record, only 9 hours of calm winds occurred out of 21,430 hours of valid observations and 1,937 hours of missing data (see Table 2.3-29 through Table 2.3-36).

2.3.2.2 Potential Influence of the Plant and Its Facilities on Local Meteorology

The construction and operation of the EGC ESP Facility will have the potential to influence the local micrometeorology of the area in the immediate vicinity of the CPS Facility. This may occur as a result of minor changes to the topography resulting from the construction of additional buildings and supporting infrastructure, and the use of natural and/or mechanical draft cooling towers for system heat rejection to the atmosphere. The minor changes in local topography are not expected to have a significant impact on diffusion characteristics in the area except in the immediate vicinity of the buildings themselves. The use of natural and/or mechanical draft cooling towers for system heat rejection will result in visible moisture plumes from the cooling towers during certain atmospheric conditions. The amount of condensation of evaporated water vapor, and thus, the formation of a visible plume, will be greatest during winter months when ambient air temperatures are cool and the air is moist.

Icing caused by the freezing of condensed water vapor from cooling tower plumes could affect the vertical surfaces (such as buildings and equipment) and horizontal surfaces (such as roadways) in the immediate vicinity of the cooling towers; however, these impacts can be expected to occur only at on-site locations (for example, on EGC ESP or CPS plant property). Except in very cold, dry, and stable atmospheric conditions, fogging and icing conditions in the cooling tower plume is expected to remain primarily on site.

2.3.2.2.1 Topographical Description

Figure 2.3-16 is a topographic map of the area within 5 mi of the site. Figure 2.3-17 shows topographic cross sections in each of the 16 primary compass directions radiating from the site. The crosshatched sections represent the areas associated with Clinton Lake. The EGC ESP Facility will be located at an elevation of approximately 735 ft above msl. Within the 5 mi radius, no land elevation is above 760 ft above msl or below 640 ft above msl. Most of this modest relief is due to the shallow valleys surrounding the North Fork of Salt Creek and Salt Creek. These valleys form the boundaries of the CPS cooling lake (Clinton Lake). The surface of Clinton Lake is approximately 690 ft above msl. Thus, a large portion of the topographical relief in the immediate area is filled by Clinton Lake.

The terrain in central Illinois is relatively flat and differences in elevation should have no significant influence on the general climate. However, the low hills and shallow river valleys that do exist could exert a small effect upon nocturnal wind drainage patterns and fog frequency under certain atmospheric conditions.

In the immediate vicinity of the site, the 4,895 ac Clinton Lake represents a discontinuity in the ground surface over which diffusing gases can travel. Clinton Lake presents a smoother surface than does the land over which the air parcels will travel and, for both east and west winds, there will be up to a maximum of approximately 6,000 ft (1.1 mi) of upwind/downwind fetch that could potentially have an effect on diffusion downwind of the site. Under certain atmospheric conditions, this could reduce the surface- or mechanically-induced turbulence, and thus, the resulting diffusion of any pollutants released from the facility. At the same time however, reduced frictional effects would allow for an increase in wind speed, thus, to some effect mitigating the effects of decreased diffusion due to turbulence. In view of the relatively short distances across Clinton Lake for releases from the plant under most wind directions, no adjustments in the diffusion calculations are proposed to account for the reduction in surface roughness caused by Clinton Lake.

Since Clinton Lake is currently used as a heat sink for the existing CPS reactor, a more potentially significant impact of Clinton Lake is the warm surface that it can present to the atmosphere which, at times, can be significantly warmer than the surrounding ground and air. Under these conditions, this increase in surface temperature could cause the layer of air in contact with Clinton Lake to achieve a neutral or unstable lapse rate in the vertical, especially when thermally stable conditions prevail over the land. Under these conditions, a release from a ground-level source would undergo some additional vertical diffusion over Clinton Lake than would be computed (using a stable delta-T based stability category) from the meteorological tower. However, due to the relatively small dimensions of Clinton Lake and its orientation with respect to the EGC ESP Facility, no adjustments are proposed to the diffusion calculations. Not accounting for any additional dispersion effects attributable to lake temperature effects should add to the conservative nature of the routine and accidental release diffusion estimates that are described in detail later in this section.

The natural topography of the area surrounding the site is considered to be rural in nature and is not expected to significantly affect the diffusion estimates.

2.3.2.2.2 Fogging and Icing Effects Attributable to Cooling Tower Operation

As discussed in Section 2.3.2.2.2.2, 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.

2.3.2.2.2.1 Qualitative Assessment of Water Vapor Plumes

Table 2.3-38 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.

2.3.2.2.2.2 Quantitative Assessment of Heat Dissipation Effects on 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 (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, wet cooling systems can produce visible plumes of varying densities and lengths, at on- and off-site locations.

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 the wet cooling system and associated plant facilities.

Hybrid wet/dry cooling systems are a combination of the wet and dry cooling methods. The extent and length of visible plumes 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 2.3-38 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 impacts of heat dissipation to the atmosphere requires the use of mathematical and/or empirical models to simulate 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 wet cooling tower operation. The EGC ESP Facility will be located on property that is currently owned by CPS, and the distances to the CPS property boundaries are relatively large and necessarily restricted from public access. Because of the relative proximity of the EGC ESP Site to restricted areas and property boundaries, the most significant impacts attributable to the operation of the cooling towers (i.e., visible plumes, fogging/icing, and drift deposition impacts) are expected to be limited primarily to on-site locations. Inasmuch as the nearest public roadway is more than 0.5 mi in any direction, fogging and icing impacts are not expected to significantly impact any public roadway. Additionally, there is no agricultural or public land use in the immediate vicinity of the ESP Site, so 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 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, 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.

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 during or before a later licensing stage.

2.3.2.3 Local Meteorological Conditions for Design and Operating Bases

Design and operating bases, such as, tornado parameters, ice glaze thickness, and winter probable maximum precipitation are statistics that, by definition and necessity, are based upon long-term regional records. While data collected at the on-site meteorological monitoring system can be considered representative of long-term site meteorology, long-term regional data are most appropriate for use as conservative estimates of climatological extremes. Therefore, the design and operating basis conditions were based upon regional meteorological data, as described in Section 2.3.1.2.

2.3.3 On-Site Meteorological Measurements Program

On-site meteorological monitoring began at the site of the CPS on April 13, 1972. The on-site meteorological monitoring system, including details on the location, instrumentation, and data reduction protocols, has previously been described in detail in Section 2 of the USAR (CPS, 2002), Section 6 of the CPS Construction Phase Environmental Report (CPS, 1973), and Section 6 of the CPS Operating License Stage Environmental Report (CPS, 1982). Data from the CPS meteorological monitoring system, as described and documented in these reports, have previously been used in the preparation of the USAR and the Construction and Operating License Environmental Reports for the 5 year period that spans April 13, 1972 through April 30, 1977. This data was also previously used in the assessment of the radiological impacts associated with routine CPS operation (for example, routine radiological releases), as well as the impacts of potential accidental releases that could occur during CPS operation.

The CPS meteorological monitoring tower is located approximately 3,200 ft south-southeast of the CPS containment structure, approximately 1,800 ft south-southeast of the center of the EGC ESP Facility (see Figure 2.3-18), and approximately 2000 ft southeast of the center of the area proposed for the location of the EGC ESP normal heat sink (see Figures 1.2-2 and 1.2-4). Given these large distances, no adverse impacts on the meteorological measurements are expected to occur as a result of the presence of any structures at the EGC ESP facility site. Based on it's proximity to the ESP site, the meteorological parameters that are monitored by the CPS monitoring station are considered to be representative of the EGC ESP Site and are therefore appropriate for use in characterizing local meteorological conditions for use in this report. This monitoring system will also be used as an operational system once the EGC ESP Facility becomes operational. Local meteorological monitoring results and summaries of the parameters monitored by the on-site system are contained in this section. During the 5-year period of record that was reported in the CPS Construction and Operating ERs and the USAR, the meteorological system monitored the following parameters (also summarized in Table 6.1-5 of the CPS Construction Phase ER) (CPS, 1973):

Tower Level	Parameters Measured
Ground:	Precipitation
10 m:	Wind speed and direction Ambient air temperature Dew Point
60 m:	Wind speed and direction Ambient air temperature (for computing Delta-T with 10 m temp) Delta-T Dew Point

Data that are currently available from the CPS on-site meteorological monitoring system are obtained from the same tower system and at the same levels above ground as the original installation described above. It is noted that some of the original monitoring equipment (sensors, data recorders, electronic data loggers, remote interrogation equipment) have undergone routine replacement, repair, and upgrade since the original installation.

Additionally, certain changes in the method of data reduction have been made since the original installation date, with a transition to a more electronic-based system. However, the basic monitoring system hardware that has been in use at the CPS from April of 1972 through October of 2002 is essentially the same, or very similar to, what was originally installed in 1972. Since it began operation, the meteorological monitoring system at CPS has been demonstrated to be compliant with NRC requirements. It is noted that the CPS meteorological monitoring system currently meets the requirements of ANS 2.5-1984 proposed as Regulatory Guide 1.23, Revision 1, with the following exceptions:

1) accuracy of dewpoint temperature;

2) precipitation is not recorded on the digital portion of the data acquisition system;

3) digital accuracies.

Since CPS began operation in 1987, annual reports have been prepared and submitted to the USNRC. The reports contain annual summaries of joint frequency distributions of wind speed, direction, and atmospheric stability of the meteorological data collected by the CPS on-site meteorological monitoring system.

Two different periods of meteorological record have been utilized and referenced, as follows:

04/13/72-04/30/77:	The data from this period of record is representative of the EGC ESP Site prior to construction of the CPS (including the filling of Clinton Lake) and were used in the original construction and operating license environmental reports and the USAR for the CPS. Analyses of this data included joint frequency distributions of wind speed, direction, and atmospheric stability, as well as short- and long-term analyses of accidental and routine radiological releases from the CPS.
01/01/00–8/31/02:	The data from this period of record were used to characterize current site-specific meteorological conditions. They were also used to assess the impacts of long-term routine radiological releases from the EGC ESP Facility using operational software utilized by the CPS personnel.

2.3.3.1 Instrumentation: 1972 – 1977 Period of Operation

The on-site instrumented meteorological tower was installed and placed in operation at the CPS on April 13, 1972. The original tower was 199 ft high, with the base at an elevation of approximately 735 ft above msl. Wind and temperature instrumentation were located at the 10 m and 60 m levels on the tower, and precipitation measurements were made at ground level. The tower was located approximately 3,200 ft south-southeast of the CPS containment structure (see Figure 2.3-18).

2.3.3.1.1 Wind Systems

Lower level (10 m) wind speeds were recorded by a staggered six-cup anemometer assembly and a transmitter with a starting speed of approximately 0.5 mph or about 0.22 m/sec. Wind direction was measured with a direction vane and a wind direction transmitter with a turning threshold of 0.7 mph at 10°. Wind direction and speed were simultaneously recorded.

Upper level (60 m) winds were measured using a six-bladed aerovane, which had a starting speed of approximately 1.7 mph and a stalling speed of approximately 0.8 mph. Wind speeds and directions were simultaneously recorded.

2.3.3.1.2 Temperature Systems

The ambient temperature, delta-T and dew point were measured on a multi-channel recorder. One channel of the recorder was used to print a reference value of zero volts, from which the temperature traces were calibrated. The temperature and delta-T sensors were installed in aspirated shields on the tower. The dew point sensors were installed on the tower in protective weatherhoods.

2.3.3.1.3 Precipitation Systems

A heated tipping bucket rain/snow gauge was installed near the tower to measure liquid precipitation at the CPS monitoring station. The gauge measured liquid precipitation in 0.01 in step increments (tip of the bucket), and the results transmitted electronically to a recording device.

2.3.3.1.4 Equipment Calibration and Data Reduction

The equipment was checked and calibrated prior to installation. A contract vendor was engaged by CPS to service and maintain the CPS meteorological system in compliance with Regulatory Guide 1.23. Every two months, recorded air temperatures were checked against values obtained on the tower with ASTM precision thermometers. On-tower ice bath checks were performed on the temperature systems semi-annually. Dew point sensors were calibrated against values obtained with a Bendix Psychron. Wind systems were checked for normal operation in accordance with manufacturer’s recommendations.

Meteorological parameters recorded on strip chart recorders were reviewed for possible equipment system or component failures prior to processing the data. The hourly data values, the average value for the 30 minutes preceding the hour, were determined directly from the strip charts. This value was manually transferred to a punched card by means of a semi-automatic analog-to-digital transcriber. This device transferred an operator controlled chart coordinate to a punched card. The cards were checked by computer for errors from one hour to the next, and for logical values. After the checks were verified, a punch card was prepared that contained the date, hour, and hourly values for the parameters measured by the system. These cards were used to form the database between 1972-1977.

Values for the standard deviation of wind direction were extracted from the strip charts. For each averaging period, the representative magnitude of the wind direction variability was determined. By assuming that the wind direction has a normal distribution, one-sixth of this range was assumed to be equivalent to the standard deviation of the wind direction.

During periods of low wind speeds, only wind direction fluctuations that occurred with a valid wind speed were used. This procedure was intended to prevent the inclusion of "square wave" data that could occur during periods of calm or very low wind speeds.

2.3.3.2 Instrumentation: 2000 – 2002 Period of Operation

The on-site instrumented meteorological tower that was installed and placed in operation at the CPS on April 13, 1972 has remained in operation at the same location since its original installation. During the course of operation, various electronic components and sensors have been replaced with equivalent or upgraded components as a matter of routine maintenance and repair. Wind and temperature instrumentation are still located at the 10 m and 60 m levels on the tower, and precipitation measurements are still made at the ground level. The tower is located approximately 3,200 ft south-southeast of the CPS containment structure (see Figure 2.3-18).

2.3.3.2.1 Wind Systems

The 10 m and 60 m level wind directions and speeds were measured by a combined cup and vane sensor. The anemometer cups were positioned directly above the azimuth vane so that data may be obtained from a single point in space. Three 4.5 in diameter conical aluminum cups sensed the wind speed, and were linked directly to a LED-photocell transducer. Wind direction was obtained with a single blade aluminum tail vane and incorporates a nose-damping vane with static balance. Vane movement was transferred by a one-to-one gear and idler shaft into the main housing, where a connection is made to the azimuth transducer. The azimuth transducer was a 360° potentiometer whose output signal is interpreted as a 540° signal by the transmuter electronics. The wind speed sensor had a starting threshold of 0.75 mph, a response distance of 18 ft (63 percent recovery), and a range to 100 mph. The wind direction sensor had a starting threshold of 0.75 mph, a delay distance of 4 ft (50° recovery), a damping ratio of 0.5 to 0.6, and a range of 360° (540° output from electronics). Wind speed and direction were recorded on continuous strip chart recorders, which were located in the CPS main control room. In addition to recording the data on strip chart recorders, wind parameters were continuously fed to a microprocessor, which is part of the radiation monitoring system that processes and records meteorological information.

Backup meteorological monitoring instrumentation consists of separate wind direction and wind speed sensors installed at the 10 m level on the CPS microwave tower, the location of which is shown in Figure 2.3-18. The anemometer and the wind direction sensors are both mounted on the same plane. Three 2 in diameter conical molded polycarbonate cups sense wind speed and are linked directly to a photo-chopper assembly that produces a variable-frequency square wave that is directly proportional to the wind speed. Wind direction is sensed with a single-bladed aluminum tail vane. Vane movement is transferred by a high precision shaft and bearing assembly to a low-torque resolver. The resolver rotor is supplied with a precision 1.0 kHz signal from the resolver driver circuit. The two resolver-stator outputs are combined by the resolver output circuit to produce a single 1.0 kHz signal, which has a constant amplitude but whose phase varies. If the resolver rotor signal is used as a fixed reference, then the phase of the combined stator signal lags the rotor signal by an amount that is directly proportional to the rotor shaft clockwise rotation. The wind speed sensor has a threshold of 1.0 mph, a distance constant of 5 ft, an accuracy of

±0.1 percent, and a calibrated range to 100 mph. The wind direction sensor has a threshold of 0.7 mph, a distance constant of 3.7 ft, a damping ratio of 0.4 at 10° initial angle of attack, and a range of 360°.

2.3.3.2.2 Temperature Systems

Ambient temperatures were sensed by an aspirated dual temperature sensor at the 60 m level and an aspirated dual temperature sensor at the 10 m level. One half of the dual sensor at each elevation was used for ambient temperature, and the other half of each sensor was used to provide a differential temperature between the 10 m and 60 m elevation. Aspirated shielded housing was installed, which was designed to provide a high heat transfer from the ambient air to the sensing element. At the same time, it afforded maximum protection from incoming short-wave solar radiation and outgoing long-wave radiation. The aspirated airflow was approximately 15 ft/sec. Each temperature element within the dual sensor was comprised of a dual thermistor and resistor network. Combined with a temperature signal-conditioning module, the circuit provided a linear voltage with respect to the air temperature. The range of temperature measurement was from –22°F to +110°F. The range of the delta-T measurement was from -5.4°F to +12.6°F.

2.3.3.2.3 Dew Point Systems

Lower level (10 m) dew point temperatures were measured with an aspirated dew point sensor. Aspirated shielded housing was used to provide a high heat transfer from the ambient air to the sensing element. At the same time, it afforded maximum protection from incoming short-wave solar radiation and outgoing long-wave radiation. The dew point was determined by a lithium chloride dew point sensor consisting of bifilar wire electrodes wound on a cloth sleeve that covers a hollow bobbin. The electrodes are not interconnected, but depend on conductivity of the atmospherically moistened lithium chloride for current flow. As the moisture content in the air increases, the lithium chloride absorbs water vapor and becomes conductive. Current then begins to flow between the electrodes and heats the bobbin. Some of the moisture is evaporated until an equilibrium temperature is reached on the bobbin. The equilibrium bobbin temperature is, thus, related to the dew point temperature of the air. A thermistor sensor is mounted inside the bobbin to measure cavity temperature, which is converted to actual dew point temperature by the transmuter circuit card. The cavity temperature is higher than the actual dew point temperature, but this factor is taken into account by the transmitter circuit card. The range of the dew point sensor is -22°F to +110°F.

2.3.3.2.4 Precipitation Systems

Precipitation was and continues to be measured by using a tipping bucket rain gauge. The gauge is heated and can be used to measure both rainfall and snowfall. The gauge is mounted near the tower, but clear of any rain-shadow effects from either the tower or the instrument shed. Data was recorded on a multi-point chart recorder in the main control room. An electronic transmitter card increments a 4-mA to 20-mA signal corresponding to 0.01 in steps. Full scale corresponds to 1 in of rainfall.

2.3.3.2.5 Maintenance and Calibration

Emergency maintenance and calibration was performed by a contract vendor, with routine maintenance performed by CPS technicians. Data recovery goals were in excess of

90 percent for all parameters. Semi-annual equipment calibrations were performed by trained technicians. Ice baths were used to check both ambient temperature sensors. The lithium chloride dew cell was checked against calibrated material and test equipment. Wind speed and wind direction sensors were checked for normal operation according to vendor specifications.

2.3.3.2.6 Data Reduction

The meteorological parameters measured were transmitted to the CPS control building via a dedicated telephone line. The signals are received and converted to 4-mA to 20-mA signals, and fed individually to a microprocessor and chart recorders. The microprocessor is part of the CPS radiation monitoring system. This system calculates and stores 10 minute averages of the meteorological parameters.

2.3.3.2.7 Control Room Monitoring

Meteorological data was recorded on a panel in the CPS Facility main control room. Additionally, 10 minute averages are available on the radiation monitoring system cathode ray tube (CRT) terminal in the technical support center (TSC).

The main control room wind recorders were dual 5 in, continuous strip, 3 in per hour chart recorders. They continuously recorded wind direction and speed at the 10 m and 60 m level. A multi-point recorder recorded 10 m and 60 m temperature, delta-T, precipitation, and 10 m dew point.

2.3.4 Short-Term Diffusion Estimates

2.3.4.1 Objective

Conservative estimates of the local atmospheric dilution factors (Chi/Q) for the EGC ESP Facility are available from two sources of information:

- Chi/Q analyses (including 5 and 50 percent probability levels) that are presented in the Updated Safety Analysis Report (USAR) for the CPS Facility (CPS, 2002) are described in Section 2.3.4.2.
- Chi/Q estimates using the PAVAN Computer code (USNRC, 1982) and the on-site meteorological data from the period 2000 – 2002 are described in Section 2.3.4.3.

2.3.4.2 Chi/Q Estimates From the CPS USAR

The short-term Chi/Q analyses presented in the CPS USAR were prepared for the CPS EAB (defined to be 975 m from the release point in all sectors) as well as the LPZ (defined to be 4,018 m from the release point in all directions). Calculations were made for sliding time period windows of 1, 8, 16, 72, and 624 hours using on-site meteorological data obtained from the CPS meteorological monitoring system during the April 4, 1972 through April 30, 1977 meteorological monitoring period. Calculations of the short-term ground-level atmospheric dilution factors for the CPS Facility were performed using Gaussian plume diffusion models for a continuously emitting ground-level source in accordance with guidance provided in Regulatory Guide 1.145 (USNRC, 1983). Hourly centerline Chi/Q values were computed from concurrent hourly mean values of wind speed, wind direction and variability, and Pasquill stability class of the on-site meteorological data. The wind speed at the 10 m level was used in the diffusion estimates for the ground-level release. The Pasquill stability class was determined from the measured vertical temperature difference and the variation of horizontal wind direction, according to ANS 2.5-1984 proposed as Regulatory Guide 1.23, Revision 1. Calms were assigned a wind speed value equal to the starting speed of the wind vane (0.7 mph). Cumulative frequency distributions were prepared to determine the Chi/Q values that are exceeded no more than 5 percent and 50 percent of the time.

The short-term diffusion estimates that were made for the CPS Facility are representative of short-term releases from the EGC ESP Facility, based on the following assumptions:

- The EAB for the EGC ESP Facility is defined to be 1,025 m, which compares with the EAB that was defined for CPS of 975 m. Since the EAB in the USAR analysis for CPS is smaller than the EAB for the EGC ESP Facility by 50 m, the results will be slightly more conservative (higher) than if the larger EAB were used in the analysis. Since the accidental release modeling was performed as a ground-level release, the predicted concentrations decrease with increasing distance from the source.
- The Low Population Zone (LPZ) distance for the EGC ESP Facility of 4,018 m is the same as the LPZ used in the CPS Facility USAR analysis.
- The meteorological data and characteristics used in the original analysis are still representative of current site conditions.

Gaussian plume diffusion models for ground-level concentration were used to describe the downwind spread of effluents (CPS, 2002). A continuous ground-level release of effluents at a constant emission rate was assumed in the diffusion estimates. Total reflection of the plume at ground level was assumed in the diffusion estimates (for instance, no deposition or reaction at the surface). Hourly Chi/Q values were calculated by using the following equations:

$Chi/Q = 1/(u_{10}\,\pi\,\Sigma_y\,\sigma_z)$ Equation 2.3-2

$Chi/Q = 1/[u_{10}\,(\pi\,\sigma_y\,\sigma_z + A/2)]$ Equation 2.3-3

$Chi/Q = 1/[u_{10}\,(3\,\pi\,\sigma_y\,\sigma_z)]$ Equation 2.3-4

Where: Chi/Q = Relative centerline concentration (sec/m^3) at ground level.

π = 3.14159

u_{10} = Wind speed (m/sec) at 10 meters above the ground.

Σ_y = Lateral plume spread (m), a function of atmospheric stability, wind speed, and downwind distance from the point of release. For distances to 800 meters, $\Sigma_y = M\sigma_y$ where M is a function of atmospheric stability and wind speed. For distances greater than 800 meters, $\Sigma_y = (M-1)\,\sigma_{y\,800m} + \sigma_y$.

σ_y = Lateral plume spread as a function of atmospheric stability and distance.

σ_z = Vertical plume spread as a function of atmospheric stability and distance.

A = Smallest vertical plane, cross-sectional area of the building from which the effluent is released (A=2,069 m^2).

For neutral to stable conditions with wind speeds less than 6 m/sec, Equation 2.3-3 and Equation 2.3-4 were calculated and compared, and the higher Chi/Q was selected. This higher value was compared to the Chi/Q resulting from Equation 2.3-2 and the lower was selected. This was done in accordance with Regulatory Guide 1.145 (USNRC, 1983). For other stability and/or wind speed conditions, Chi/Q was selected as the higher value from Equation 2.3-3 and Equation 2.3-4.

From these hourly Chi/Q values, cumulative frequency distributions were prepared from the mean values of sliding time windows of 1, 2, 8, 16, 72, and 624 hours. These intervals correspond to time periods of 0-1 hour, 0-2 hours, 0-8 hours, 8-24 hours, 1-4 days, and 4-30 days. For each time period used, the mean centerline Chi/Q value in each sector was computed. The results of these analyses are presented in Table 2.3-39 through Table 2.3-50.

2.3.4.3 Chi/Q Estimates Using the PAVAN Computer Code and On-Site Data

The PAVAN computer code (USNRC, 1982), was used to calculate short-term accident Chi/Q values attributable to potential accidental releases from the EGC ESP Facility. Values were determined in accordance with USNRC Regulatory Guide 1.145 (USNRC, 1983) for the 0.5 percent maximum sector Chi/Q and the 5 percent direction independent value. In addition, 50 percent direction independent values were determined for use in the environmental report evaluations. The model was run for a two cases using 2 years and 8 months of on-site meteorological data from the period 2000 – 2002, a description of which is provided above. The following two cases were evaluated:

Case 1: CSP Site distances used in CPS USAR (EAB = 975 m, LPZ = 4,018 m)

Case 2: EGC ESP Site distance (EAB =1025 m, LPZ = 4,018 m)

In addition, Case 2 was evaluated with and without building wake effects.

These two cases were modeled to facilitate an evaluation and comparison of the Chi/Q calculations with those presented in the CPS USAR, as well as to examine the relative significance of building wake effects on the calculations.

Input to the PAVAN model consisted of the following:

Meteorological Data:	Joint frequency distribution of wind speed, wind direction, atmospheric stability, 16 standard azimuthal sectors, period of record 1/1/00 – 8/31/02 (Tables 2.3-29 through 2.3-36)
Wind Sensor Height:	10 m
Delta-T Heights:	10 – 60 m
No. Wind Speed Categories:	6
Minimum Building Cross Section:	2,069 m^2 (equivalent to CPS containment structure)
Containment Height:	76.1 m
Release Height:	10.0 m (ground level default height)

The release points and receptor locations in this analysis are defined as the EGC ESP Site EAB (1,025 m) and LPZ (4,018 m).

In addition to the above cases, an additional case was run for the 5% probability short-term diffusion values in response to the staff's request to use the minimum distance from the boundary of the EGC ESP Facility footprint to the EAB distance of 1,025 meters. This minimum distance is 805 meters. This case also uses three years of hourly meteorological data (January 2000 - December 2002) in lieu of the two years and eight months hourly meteorological data (January 2000 - August 2002) previously used. The other parameters are the same as described above. The results are summarized in Table 2.3-51.

Short-term Chi/Q analyses were performed using the PAVAN model. The results of the PAVAN modeling analysis are summarized in Table 2.3-51 and 2.3-52. Table 2.3-51 summarizes in a matrix format the results of the modeling analysis for the two cases discussed above. Maximum sector Chi/Q's from the PAVAN modeling analysis are compared with the maximum sector Chi/Q's in the current CPS USAR. It is noted that the PAVAN results for the EGC ESP Site distances reflect the limiting values based on the 0.5 percent maximum sector Chi/Q. The values from the CPS USAR reflect the 5 percent maximum sector. A review of the results summarized in the table leads to the following conclusions:

- A comparison of the CPS USAR and the PAVAN Chi/Q's for the CPS 975 m EAB distance indicates that the results are similar, with the PAVAN model results being only moderately greater for all averaging periods. Differences are attributed to the different models used, as well as differences in the meteorology used in each analysis (1972 – 1977 for the USAR analysis and 2000 – 2002 for the PAVAN analysis).
- A comparison of the CPS USAR and the PAVAN Chi/Q's for the 4,018 m LPZ distance indicates that the results are similar, with the PAVAN model results being only moderately greater for all averaging periods. Differences are attributed to the different models used, as well as differences in the meteorology used in each analysis (1972 – 1977 for the USAR analysis and 2000 – 2002 for the PAVAN analysis).
- A comparison of the Case 2 results both with and without building wake effects illustrates that building wake effects have very little influence on Chi/Q's, particularly for very short averaging periods. This conclusion is the same for both the EAB distance of 1,025 m and the LPZ distance of 4,018 m. Since the results obtained without building wakes tend to be slightly higher at both distances (for averaging periods greater than 2 hours), these values are used for any further ESP evaluations or analyses.

2.3.4.4 Chi/Q Estimates for Short-Term Diffusion Calculations

Although the results of the Chi/Q analyses discussed above have been demonstrated to compare favorably with one another, the results of the analysis using the PAVAN model and the meteorological data for the period 2000 – 2002 are moderately higher for some scenarios. Since this is a more conservative estimate of the Chi/Q's, the PAVAN values listed on Table 2.3-51 without building wake are established as the site characteristic 5 percent probability short-term diffusion values (Table 1.4-1, Section 9.1).

The 50 percent EAB and LPZ Chi/Q values are determined from the PAVAN output and by logarithmic interpolation. The 0 to 2 hour 50 percent values at the EAB and LPZ without building wake (3.56E-05 sec/m^3 and 5.10E-06 sec/m^3) are provided directly on the PAVAN output. The remaining values for the longer time periods for the LPZ are determined using the 0 to 2 hour 50 percent LPZ value and the LPZ average annual value of 4.72E-07 sec/m^3 from the PAVAN output by logarithmic interpolation at the intermediate time periods of 8 hours, 16 hours, 72 hours, and 624 hours. The values are shown on Table 2.3-52.

2.3.5 Long-Term Diffusion Estimates

2.3.5.1 Objective

Estimates of long-term atmospheric dilution factors (Chi/Q) and relative deposition (D/Q) were made using a straight-line Gaussian model, consistent with the requirements of Regulatory Guides 1.111 (USNRC, 1977) and 1.109 (USNRC, 1977a). The objective was to calculate Chi/Q and D/Q values at the following locations in each of the 16 primary directions, including:

- Nearest Property Boundary
- Exclusion Area Boundary
- Nearest Milk Cow
- Nearest Milk Goat
- Nearest Garden
- Nearest Meat Animal
- Nearest Residence
- Distances of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 8.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, and 47.5 mi from the EGC ESP Facility.

Section 2.3.5.2, provides additional information on the results of long-term Chi/Q estimates for the EGC ESP Facility.

2.3.5.2 Calculations

The calculations were made using the MIDAS© suite of software programs that is licensed and installed at the CPS Facility. Program XDCALC from the Midas software package calculates hourly centerline values of Chi/Q and D/Q and accumulates those values over any specified time period less than 32,760 hours.

The calculations of Chi/Q and D/Q were made by program XDCALC using hourly on-site meteorological data. Hourly meteorological data was obtained using the 15 min observation period that ended on each hour. The program was used to estimate centerline Chi /Qs and D/Qs for a ground-level release, with an assumed height of release of 10 m. The 10 m release height is consistent with the height at which wind speed and direction are measured on the CPS meteorological tower, as well as with USNRC guidance for the modeling of ground-level releases. Assumptions used in the analysis are summarized below:

- Meteorological Data Source - CPS on-site meteorological tower
- Period of Record - 1/1/2000 - 08/31/2002

- Wind Reference Level – 10 m
- Stability Calculation - Delta-Temperature (10 and 60 m tower levels)
- Release Type - Ground level
- Release Height - 10 m
- Building Wake Effects - Included

The results of the long-term diffusion modeling analysis are contained in Table 2.3-53 to represent undepleted Chi/Q calculations from the EGC ESP Facility. Table 2.3-54 represents Chi/Q calculations that account for deposition effects. Table 2.3-55 contains estimates that include radioactive decay with an overall half-life of 2.26 days for short-lived noble gases. Table 2.3-56 contains estimates that also include an 8 day half-life for all iodines released to the atmosphere.

Based on the above analysis, a value of 2.04E-06 sec/m^3 is established at the site characteristic value for the maximum average annual atmospheric dispersion factor at the EAB in any given sector (i.e., NNE sector, refer to Table 2.3-53).

2.4 Hydrologic Engineering

2.4.1 Hydrologic Description

2.4.1.1 Site and Facilities

The EGC ESP Site is located six mi east of the city of Clinton, DeWitt County in central Illinois. Clinton Lake was formed, for the existing CPS Facility, by the construction of an earthen dam across Salt Creek, 1,200 ft downstream from the confluence of the North Fork of Salt Creek with Salt Creek (see Figure 2.4-1). The site is about 3.5 mi northeast of the dam, located between the two fingers of the lake, at a grade elevation of about 735 ft above msl. The drainage area at the dam site is 296 mi^2.

Clinton Lake was designed to provide cooling water to the CPS Facility and remove the design heat load from the circulating water before the water circulates back into the station. The CPS Facility intakes water through the circulating water screen house located on the North Fork of Salt Creek finger. The circulating water is discharged into the Salt Creek finger through a 3.4 mi long (18,040 ft) discharge flume, as shown in Figure 2.4-1.

The dam structure has a length of 3,040 ft, with a 3:1 (horizontal to vertical) slope on both the upstream and downstream faces. The top of the dam is at an elevation of 711.8 ft above msl (about 21.8 ft above the normal pool elevation), with a width of 22 ft and 10 in at the top. The maximum height of the dam is 65 ft above the creek bed. Riprap is provided on the upstream slope of the dam for protection against wind-wave erosion and lake drawdown effects. The downstream slope is seeded and the toe of the dam is provided with riprap for erosion protection (CPS, 1982).

The dam includes three flow components: 1) a concrete service spillway with an ogee-shaped crest on the west abutment of the dam to pass floods; 2) an auxiliary spillway on the east abutment of the dam to pass floods greater than the 100 yr flood; and 3) a lake outlet structure near the west abutment to provide a minimum downstream release of 5 cfs (CPS, 1982). The plan of the dam and appurtenances is shown in Figure 2.4-2.

The lake elevation area capacity curves are shown in Figure 2.4-3. The lake normal pool elevation is 690 ft above msl, with a surface area of 4,895 ac (7.65 mi^2, 2.6 percent of the drainage area), and a storage capacity of 74,200 ac-ft at the normal pool elevation (CPS, 2002).

2.4.1.2 Hydrosphere

The site, including Clinton Lake, is near the confluence of the Salt Creek and the North Fork of Salt Creek, about 56 mi east of where Salt Creek joins the Sangamon River. Clinton Lake was formed by construction of an earthen dam 1,200 ft downstream from the confluence of the North Fork of Salt Creek with Salt Creek. The Salt Creek and North Fork of Salt Creek fingers extend 14 mi and 8 mi, respectively, upstream from the dam.

The general hydrologic features in the Sangamon River Basin and their relation to the dam site are shown in Figure 2.4-4.

Salt Creek, in central Illinois, lies within the Sangamon River Basin, which drains into the Illinois River about 10 mi upstream from Beardstown, Illinois (about 75 mi west of the site). The Sangamon River has a length of 200 mi and a drainage area of 5,400 mi^2 (CPS, 1982).

Salt Creek, the principal tributary of the Sangamon River, has its headwaters 15 mi east of Bloomington in McClean County, and flows in a southwesterly direction into DeWitt County. Thereafter, it pursues a westerly course through Logan County and into Mason and Menard counties to join the Sangamon River, 8 mi east of Oakford. The length of Salt Creek is 92 mi, and the total drainage area to the Sangamon River is 1,860 mi^2. The maximum relief in the basin between the mouth and the high point on the drainage divide, near LeRoy, is 440 ft (CPS, 1982).

Salt Creek flows through rolling country for 40 mi with a fall of 300 ft. Channel slope varies from over 10 ft/mi in the upper reaches, to less than 3 ft/mi near the Town of Rowell. At Clinton Lake, the channel slope is about 5 ft/mi. Downstream from Rowell, Salt Creek flows sluggishly through prairies to its confluence with the Sangamon River. Channel slope in the lower reach of Salt Creek is less than 2 ft/mi. The drainage area of Salt Creek to the Clinton Lake Dam is 296 mi^2 (CPS, 1982).

The cross section of the Salt Creek valley is typically u-shaped with a channel width of 20 ft to 80 ft and a channel depth of 4 ft to 12 ft. The streambed is on relatively thick sand and gravel alluvium underlain by glacial till and deep bedrock formations. Beneath the dam, the bedrock is about 300 ft below the creek bed (CPS, 1982).

The main tributaries of Salt Creek include North Fork of Salt Creek, Lake Fork, Deer Creek, Kickapoo Creek, Tenmile Creek and Sugar Creek (CPS, 1982). The length, drainage area, maximum relief between the mouth and the high point of the drainage divide, and average annual runoff for the Salt Creek tributaries are provided in Table 2.4-1.

There are currently no existing reservoirs or dams upstream or downstream from Clinton Lake that could affect the availability of water to Clinton Lake (CPS, 1982). Four recreational dams were identified, two on the North Fork of Salt Creek upstream of Clinton Lake and two downstream of Clinton Lake (USACOE, 2004a). The information on these four dams is provided in Table 2.4-1A. Because these dams were constructed for recreational purposes and have limited storage capacities, water is not withdrawn from the watershed.

Salt Creek (downstream of Clinton Lake) is not a likely candidate for changes that would result in additional demand since the flow of the creek is often low for long periods of time.

A USGS gauging station on Salt Creek is located near Rowell, 12 mi downstream from the Clinton Lake Dam. The drainage area at the gauging station is 335 mi^2. The station maintains records dating back to October of 1942.

Table 2.4-2 presents the mean monthly runoff, rainfall, and natural lake evaporation data for the Salt Creek basin at the Rowell gauging station, following construction of the Clinton Lake Dam (1978 to 2000) (USGS, 2002). The average discharge of Salt Creek for this 21 yr period is 295 cfs, or about 12 in. of runoff per yr. March has the highest average monthly runoff, amounting to 1.99 in over the drainage area, or 578 cfs. September has the lowest runoff, amounting to 0.21 in, or 63 cfs. A maximum discharge of 7,810 cfs was recorded on April 13, 1994. The lowest mean daily flow was 3.7 cfs, observed on September 8, 1988. The runoff to rainfall ratio for the post-dam conditions is approximately 30 percent (i.e., approximately 30 percent of the rainfall drains out of the basin).

The discharge data for post-dam conditions (after 1978) at Rowell gauging station are shown in Table 2.4-3. There are no existing river control structures located upstream or downstream of the dam site that can affect the safety of the lake and EGC ESP Facility structures or the availability of water supply.

There are no communities either upstream or downstream of the Clinton Lake Dam that draw water from Salt Creek for public water supply. There are no known surface water users of the Sangamon River within 50 river mi downstream from the plant site. The closest surface water user for drinking purposes is in Alton, Illinois on the Mississippi River, 242 river mi downstream from the EGC ESP Site. Within 25 mi of the EGC ESP Site Bloomington (35,000 population) draws water from the Mackinaw River Watershed to the north, and Decatur (95,000 population) draws water from the Sangamon River Watershed to the south.

There is a population of 308,000 in the counties that lie within a 50 mi radius of the facility that use surface water from a public water supply other than Salt Creek. Public water supplies draw about 75 million gallons of water per day from surface waters. There are no private surface water withdrawals for domestic water supply or for agricultural purposes. There are 10 million gallons of private surface water withdrawn for commercial purposes, and 30 million gallons withdrawn for industrial purposes.

2.4.2 Floods

2.4.2.1 Flood History

The review of post-dam conditions indicates that the lake is significantly attenuating flood flows in Salt Creek. There are no discharges over 10,000 cfs recorded at the Rowell gauging station after construction of the Clinton Lake Dam (USGS, 2002).

Flood frequency for the Rowell gauging station was analyzed based on the 22 years of records from January of 1978 to September of 2000. Figure 2.4-5 shows the peak flood frequency curve for Salt Creek at the gauging station under post-dam conditions. The peak flow for various recurrence intervals at the gauging station and at the dam site are also shown in Table 2.4-4. The discharges at the dam site were derived using the drainage area ratio.

At the gauging station, the mean annual flood for post-dam conditions is 3,300 cfs (recurrence interval of 2.33 years). The maximum post-dam discharge of 7,810 cfs (April of 1994) has a recurrence interval of about 25 years (USGS, 2004).

As a result of the dam, the 10-yr recurrence interval flood flow at the Rowell Gauging Station is reduced from 11,400 cfs to 6,000 cfs. The 100-yr recurrence flood flow is reduced from 29,900 cfs to 9,800 cfs (see Table 2.4-4).

2.4.2.2 Flood Design Considerations

The flood design analyses for the lake and ESP site are based on a probable maximum precipitation (PMP) event with a standard project storm (SPS) as an antecedent storm. This design basis is in accordance with the recommendations given by the USNRC Regulatory Guide 1.59 (1977). The PMF is an estimated flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that can reasonably occur in the region. The SPS is estimated to be equal to 40 percent of the PMP, occurring prior to the PMP event. The maximum water level was determined by applying various components of a maximum storm event to unit hydrographs, as described in SSAR Section 2.4.3.

The PMF elevation at Clinton Lake is 709.8 ft above mean sea level (msl) using a 72-hr duration PMP value of 27.8 in. The design of this flood event is described more thoroughly in SSAR Section 2.4.3.1. Wave run-up elevation due to sustained winds acting on the PMF water level is discussed in SSAR Sections 2.4.3.6 and 2.4.10. Wind setup is discussed in SSAR Section 2.4.5.

A concrete service spillway designed to pass floods is located on the west abutment of the dam. The lake water level for a 100 yr flood is at an elevation of 697 ft above msl. The ungated service spillway with an ogee-shaped crest has a semicircular plan, with a crest length of 175 ft and a crest elevation of 690 ft above msl. The height of the concrete ogee is 10 ft. Water passing over the ogee section will discharge through an 80 ft wide concrete chute into a stilling basin, where the energy of flow is dissipated. Riprap is provided downstream from the stilling basin for erosion protection. A discharge channel was excavated to convey the water to the main channel of Salt Creek (CPS, 1982).

An auxiliary spillway is provided on the east abutment of the dam to pass floods up to and including the PMF. The auxiliary spillway is open-cut, with a crest length of 1,200 ft and a crest elevation of 700 ft above msl. The dam crest or control section is 25 ft wide asphalt concrete with riprap provided on the upstream and downstream sides. A 6 ft deep rock trench is provided as a downstream cut-off. This varies in distance from the crest, from 150 ft on the far end to 300 ft near the dam. This rock trench protects the spillway crest against erosion on the discharge channel. The spillway approach channel is excavated to an elevation that varies from 690 ft to 695 ft above msl, and the discharge channel is excavated to an elevation of 695 ft above msl. Both of the channels are vegetated (CPS, 1982).

All safety related structures at the EGC ESP Facility will either be outside the flood elevation or designed to withstand the effects of flooding.

2.4.2.3 Effects of Local Intense Precipitation

The local intense precipitation at the ESP site is equivalent to short-duration, 1 mi^2 PMP (HMR 52). The 1-hour PMP is estimated from HMR 52 along with multiplying factors to establish longer and shorter intensities. Table 2.4-5 lists the multiplication factors recommended in HMR 52 and the corresponding intensities.

The 1 hr PMP ratio is 18.15 in and the 5 minute PMP is 6.08 in. These local PMP values will be used to evaluate local site flooding based on site grading and drainage design at the COL stage for the ESP facility

2.4.3 Probable Maximum Flood on Streams and Rivers

The probable maximum flood is an estimated flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The analyses in the following sections were performed in accordance USNRC Regulatory Guide 1.59.

Historically, the floodwater surface elevations in the lake were determined during the design of the dam for CPS by routing the floods through the lake using the USACOE's *Spillway Rating and Flood Routing* (SPRAT) computer program (CPS, 2002). The results of the CPS modeling indicated that the 100-yr flood level in the lake at the dam site is at an elevation of 697 ft. The routed peak outflow through the service spillway is 11,610 cfs. Based on the flood frequency analysis, the 100-yr flood flow at the dam site (based on records before the dam was built, i.e., before November 1977), was estimated to be 26,400 cfs. As shown by the analysis of the post-dam, however, the attenuation effect of the lake will reduce the expected magnitude of the flood flows downstream from the dam. The CPS PMF level with an antecedent standard project flood is at an elevation of 708.8 ft above msl at the dam and 708.9 ft above msl at the plant sites (CPS, 2002).

The flooding effects on the headwater area of the cooling lake were also evaluated during the dam design and were determined by backwater computations using the USACOE's computer program, "Water Surface Profiles" (CPS, 2002). Figure 2.4-7 and Figure 2.4-8 depict the water surface profiles of the 100-yr flood and the CPS PMF under natural conditions for Salt Creek and the North Fork of Salt Creek, respectively. The Illinois Central Railroad depicted on Figure 2.4-8 was procured by the Canadian National Railroad.

The 100 yr flood level was a criterion used in the property acquisition for the lake area. There is no increase in flooding outside of the lake area property acquisition. The CPS is at a grade elevation of 736 ft above msl and the EGC ESP Facility will be at grade elevation 735 ft. Neither location will be affected by floods in the lake.

The impoundment of Salt Creek and the North Fork of the Salt Creek to form Clinton Lake has altered natural flood levels. Figure 2.4-9 depicts the post-dam construction normal lake level, 100 yr and PMF flood areas, and the CPS and ESP plant sites. No CPS Facility structures were built in the pre-construction 100 yr flood prone area, except for the dam that was built across Salt Creek to create Clinton Lake. Likewise, with the exception of new intake structure for the EGC ESP Facility, structures will not be built in this flood prone area. Several structures have been built along the edges of the post-construction flood prone area (with Clinton Lake in place). These include the intake and discharge structures, modified highway bridges, a marina, and seven boat ramps. Construction of these structures is complete, and their presence will not cause any alteration in flood levels. To date, flood flows downstream of the Clinton Lake Dam have been lower than pre-construction flood flows.

2.4.3.1 Probable Maximum Precipitation

The stepwise procedure of National Weather Service Hydrometeorological Report (HMR) No. 53 (USNRC, 1980) and additional information from HMR 51 (USDOC, 1978) and HMR 52 (USDOC, 1982) were used to estimate the 72-hour PMP (both precipitation volume and temporal distribution). Figures 2.4-10a and 2.4-10b show the Depth-Area and Depth-

Duration relationships for Clinton Lake watershed, respectively.

Based on this analysis, the PMP storm corresponding to Clinton Lake watershed (Area = 296 mi^2) was determined. Further, the PMP storm was distributed according to ANSI/ANS-2.8-1992 as given in Table 2.4-8 (ANSI, 1992). The total rainfall for the 72-hr duration was 27.8 inches. The applicant also applied 6-hour rainfall smoothing according to Figure 2.4-10c.

Using the methodology described above, an antecedent 72-hour storm was developed having a volume that was 40% of the PMP followed by 72-hours of no rain, followed by the full 72-hour PMP rainfall as the storm rainfall input in the HEC-HMS model (USACOE, 2005b). The 40% PMP is based on the requirements of ANSI/ANS 2.8-1992, section 9.2.1.1, "Combined Events."

The maximum potential snow accumulation was studied and estimated to correspond to a weight of 40 psf, which would be attributable to the 100 yr snowpack of 24.4 psf (ASCE, 2000) plus the snow accumulated from the worst-case 100 yr storm event (13 psf), as described in Section 2.3.1.2.3 and is established as the EGC ESP Site characteristic value.

2.4.3.2 Precipitation Losses

The Soil Survey of Dewitt County, Illinois, identifies three major soils in the Clinton Lake watershed: Ipava, Sable, and Catlin (USDA, 1991). For these three soils the saturated permeability ranges from 0.6 to 2.0 inches/hour. By texture this soil can be described as silt loam. This soil type falls under Soil Conservation Service (SCS) hydrologic soil group B for which the infiltration rate under saturated soil conditions ranges from 0.15 to 0.30 inches/hour (Haan et al, 1982). In CPS-USAR (2002) an overall curve number (CN) of 74 was used for the infiltration losses. Two accepted methods were used to understand the effects of runoff at the site: Snyder and the SCS method. While using the Snyder method for calculating runoff during flood events, a constant infiltration rate of 0.1 inch/hour was applied. Infiltration was also calculated using the SCS method, and a CN of 75.

According to the USACOE's handbook *Engineering and Design - Flood-Runoff Analysis* (USACOE, 1994), the SCS CN-based infiltration rate is given as:

$$i = \frac{S^2 r}{\left(P - I_a + S\right)} \qquad \text{Equation 2.4-1}$$

where P is the cumulative rainfall, r is rainfall intensity, S is a retention parameter, and I_a is the initial abstraction of rainfall (i.e., the observed rainfall depth prior to the observation of runoff). The value of S varies with soil type, land use, management practice, slope, and ambient soil water content. The parameter S is related to curve number (CN) by the SCS equation (USACOE, 1994):

$$S = \frac{1000}{CN} - 10 \qquad \text{Equation 2.4-2}$$

The value of S obtained from Equation 2.4-2 is in inches. The curve number is generally provided for average moisture conditions (CN_2), also called the average curve number, and can be obtained by using the SCS methodology (Haan et. al, 1982). The CN tables consider soil type, land use, and antecedent moisture conditions (AMC).

In order to account the antecedent condition due to considerable rainfall prior to rain in question, the curve number (CN_3) for AMC 3 (wet) is used. CN_3 is related to CN_2 with the following equation (Haan et al., 1982):

$$CN_3 = \frac{23CN_2}{10 + 0.13CN_2} \qquad \text{Equation 2.4-3}$$

Using the above equations the hourly infiltration rates were calculated for the SCS method and compared with the assumed constant infiltration rate in Figure 2.4-11.

2.4.3.3 Runoff and Stream Course Models

Synthetic hydrographs are used to determine the runoff hydrographs resulting from the PMP storm. Synthetic hydrographs are based on hydrologic data from a large number of basins and therefore represent typical hydrographs. The synthetic hydrograph can be applied to a watershed using basin parameters such as lag time and area of the watershed. Although there are many different synthetic hydrograph methods, the most commonly used synthetic hydrograph methods are: (1) SCS Unit Hydrograph, and (2) the Snyder's Unit Hydrograph methods. The study used both the SCS and Snyder's synthetic hydrographs through HEC-HMS 3.0.0 model to transform PMP rainfall into PMF runoff. To apply the synthetic hydrograph approach, the Clinton Lake watershed was divided into three sub-basins: the Salt Creek watershed, North Fork watershed, and Clinton Lake itself. This model is called the "Two-Basin + Lake Model." To further understand the effect of number of sub-basins we divided the Clinton lake watershed into eight sub-basins: the Salt Creek head water sub-basin and local sub-basins of the Salt Creek, North Fork head water sub-basin and local sub-basins of the North Fork creek, and Clinton Lake itself. This model is called the "Seven-Basin + Lake Model." These models are discussed further in the following sections.

2.4.3.3.1 Two–Basin + Lake Model

Figure 2.4-12 depicts the schematic of the Two Watershed model in HEC-HMS model.

A Unit Hydrograph (UH) is defined as the direct runoff hydrograph produced by 1 unit (inch) of effective rain uniformly distributed over a basin. Unit hydrographs can be combined with precipitation data and basin data to determine the direct runoff hydrograph for a particular basin.

A UH has meaning only in connection with a specific duration of runoff. A basin may have many different UHs, each associated with a different duration of runoff. Haan et al. (1994) recommends that the duration D of a UH should be between $T_P/5$ and $T_P/3$, where T_P is the time to peak. Further, T_P is a function of D and catchment lag time T_L and defined as $T_P = T_L + D/2$. The catchment lag is a parameter that is used in UH theory to provide a global measure of the response time of a catchment area. This global parameter incorporates various basin characteristics such as hydraulic length, gradient, drainage density, drainage patterns. To determine these characteristics it is necessary to delineate the sub-basins according to their drainage pattern. The sub-basin characteristics of the Clinton Lake watershed are not readily available and thus accurate characterization of sub-basin lag times based on assumptions is difficult. Based on detailed studies of the variations of the individual natural unit hydrographs and their synthetic counterparts in the state of Illinois, Mitchell (IDOW 1948) has suggested empirical equations involving only the drainage area of a sub-basin. These equations, which are specifically developed for the study area, are used in the present analysis rather than calculating lag times based on some assumptions. Table 2.4-9 lists various watershed parameters along with the SCS and Snyder Hydrograph parameters used in the HEC-HMS models.

The unit hydrographs for the Salt Creek, North Fork, and Clinton Lake based on the parameters listed in Table 2.4-9 are shown in Figure 2.4-13.

Table 2.4-10 presents various parameters used for the reach routing using the kinematic wave procedure.

Table 2.4-11 summarizes the maximum water levels in the Clinton Lake obtained from the SCS and Snyder's unit hydrograph methods applied to the Two-Basin model. For the Snyder method the peaking factor was varied from 0.8 to 0.4 and it was observed that the peaking factor of 0.8 gives conservative results which are the same as obtained by using the SCS method. The resulting maximum still water level (or PMF) in Clinton Lake is 709.7 ft above msl.

The detailed results of these model runs are shown in Figures 2.4-14a-d.

2.4.3.3.2 Seven–Basin + Lake Model

An equivalent analysis is conducted by considering eight sub-basins into the Clinton Lake watershed similar to Figure 2.4-7 of the CPS USAR (2002). The model schematic is shown in Figure 2.4-15.

Table 2.4-12 presents the watershed parameters for both the SCS and Snyder method. Figure 2.4-16 depicts the unit hydrographs developed from Table 2.4-12.

Table 2.4-13 presents the hydraulic parameters for the routing. Table 2.4-14 summarizes the overall results in form of maximum water level in the Clinton Lake.

The detailed model results are given in Figures 2.4-17a-d. Using these seven basins, plus the lake, the maximum water elevation (or PMF) in the Clinton Lake is 709.8 ft above msl. The PMF described for the "7-basin+lake" approach is more conservative, and is used to identify the effects of a PMF on Clinton Lake.

2.4.3.4 Probable Maximum Flood (PMF) Flow

The maximum PMF flow from the Salt Creek watershed is 214,175 cfs. Maximum inflows, storage, outflow and PMF elevations are shown in Table 2.4-15.

There are no existing or proposed dams on Salt Creek upstream and downstream of the CPS station site that will affect the water level at the station site, except the cooling lake dam for CPS. The cooling lake dam is designed to withstand the effects of a PMF and a coincident reservoir wind-wave action. Spillways with uncontrolled crests are provided to pass floods.

The dam and the spillways are protected against erosion due to wind-wave action and flood flows (CPS, 2002).

2.4.3.5 Water Level Determination

Given the results of the hydrologic analyses in Section 2.4.3.3 and 2.4.3.4, EGC determined that the estimated maximum flood that can be expected from the most severe conditions at the site is 709.8 ft above msl using the more conservative 7-basin + lake model approach. Both models represent possible flooding conditions for the watershed. The 7-basin + lake model allows for a more fine-tuned analysis, and more conservative conclusions.

This maximum level is a hydrostatic level, so that the level remains the same at the dam and at the ESP Site. The site characteristic for the maximum flood water level is established at 709.8 ft above msl (Table 1.4-1, Section 1.4.1).

2.4.3.6 Coincident Wind Wave Activity

Historically, the significant (33.33 percent) and maximum (1 percent) wave effects of a coincident 40 mph winds were superimposed on the PMF water level at the site. The wave runups were calculated based on deepwater and nonbreaking wave conditions with an effective fetch of 0.8 mi, a water depth of 40.5 ft, and the waves acting on a smooth 3:1(horizontal to vertical) ground slope. The estimated wave runups are 2.95 ft and 4.85 ft for the significant waves and maximum (1 percent) waves, respectively. Superimposing the wave runup values on the probable maximum flood level at the station site resulted in a wave runup elevation of 711.95 ft above msl for significant waves and elevation of 713.8 ft above msl for maximum (1 percent) waves (USACOE, 1966 and USACOE, 1962). The pressure distribution due to the waves is a combination of hydrostatic and hydrodynamic components and the exposed safety-related structures are designed to withstand these effects.

Calculation of runup depends on nearshore bathymetry (depth of toe of the structure, slope of bottom at toe), slope of the structure or bank. Wave runup calculations were initially made using the Corps' Automated Coastal Engineering System, ACES version 1.07. Previous calculations of wave runup assumed that waves would not break on the structure. This is a conservative assumption since the process of breaking dissipates energy and will result in less runup. ACES calculations resulted in significantly less runup than previous calculations because they were made based on the waves breaking on the slope.

With these assumptions regarding fetch, water depth, and shore slope, and assuming non-breaking waves, the wave runup was recalculated with an increased wind velocity from 40 mph to 52 mph (ANSI, 1992). This coincident wind velocity increase showed an increase in the significant (33.3 percent probability) wave runup to 3.8 feet. Similarly for the maximum (1 percent probability) wave runup, the runup value increased to 6.4 feet. Superimposing the wave runup values on the probable maximum flood level at the plant (station) site resulted in a wave runup elevation of 713.6 feet for significant waves and elevation of 716.2 feet for the maximum (1 percent) waves. Both elevations are significantly below the approximate grade elevation of 735 feet above msl.

2.4.4 Potential Dam Failures, Seismically Induced

There are no existing dams upstream or downstream of the cooling lake which can affect the EGC ESP Site safety-related facilities or the availability of the cooling water supply. Furthermore, a postulated failure of the cooling lake dam will not result in the loss of water from the UHS pond as discussed in Section 2.4.8.1.5.

2.4.5 Probable Maximum Surge and Seiche Flooding

As noted in Section 2.4.3.6, the setup conditions for the coincident wind wave activity is based on an effective fetch of 0.8 mi, a water depth of 40.5 ft, and the waves acting on a smooth slope. In order to provide a high level of conservatism, a Probable Maximum Wind Storm (PMWS) of 100 mph was used to calculate the maximum storm surge. Based on the PMWS of 100 mph, the maximum surge for calculating the PMF is 0.14 ft. In addition, an alternative maximum surge was calculated based on an effective fetch of 1.2 mi, a water depth of 30 feet, with the PMWS of 100 mph. This calculation yielded a maximum surge of 0.3 ft. This latter, more conservative, calculation is used as the site characteristic wind setup for purposes of calculating the PMF (0.3 ft).

2.4.6 Probable Maximum Tsunami Flooding

The site will not be subjected to the effects of tsunami flooding because the site is not adjacent to a coastal area (CPS, 2002). However, the impacts to the plant were determined for a lake tsunami generated from hypothetical hillside slope failures. The tsunami analysis was performed using very conservative assumptions that yielded a maximum tsunami wave height estimated to be 0.4 foot. The relatively small landslide velocity, slope angle, and thickness of the landslide contribute to the minimal creation of waves in Clinton Lake. Based on this analysis, it is concluded that landslide-induced tsunamis do not pose a risk to the EGC ESP site.

2.4.7 Ice Effects

The recording station on Salt Creek near Rowell is the only gauging station within the Salt Creek drainage basin. It has maintained a continuous streamflow record since October 1942. The records show intermittent ice effects during the winter months. Most of the recorded ice effects are minor in terms of the stage-discharge relationship, except for the ice jam that occurred on February 11, 1959. The maximum gauge height caused by this ice jam was 24.84 ft with a peak discharge of 7,500 cfs. The datum of gauge is elevation 610 ft above msl. Based on the ice-free stage-discharge relationship, the gauge height corresponding to a discharge of 7500 cfs is 22.14 ft (SWSUS, 1959). The ice jam effect raised the flood level by 2.7 ft. The streamflow records also show that the maximum-recorded ice jam effects were less than the maximum flood stage and discharge values observed during the period of record. The effects of ice formation and the probable maximum winter flood on the lake water level would be less than that of the probable maximum summer flood. The monthly PMP value obtained from the CPS USAR (CPS, 2002) for the month of August is significantly greater than that for the month of February.

Ice thickness calculations were completed for Clinton Lake for a period from 1902 through 2001. The average thickness of sheet-ice calculated over that period is 16.2 in. The maximum thickness calculated was in the 1977-1978 winter of 27.0 in. The ice thickness was calculated using procedures established in U. S. Army Corps of Engineers Engineering ERDC/CRREL Technical Note 04-3 (USACOE, 2004b). The calculations did not consider the influence of waste heat discharge from the power plant. The coefficient of ice cover condition used in the calculation was 0.80. The average number of net accumulated freezing degree (F)–days (AFDD) is 409.9 with a maximum of 1141.5 AFDD calculated from temperature data for Decatur, Illinois (MRCC, 2004; USACOE, 2005a).

Ice jams at bridge crossings are not an issue because of the low velocity situations at the two impoundment crossings at Route 48 across the Salt Creek stream valley and Route 54 across the north branch stream valley. Upstream and downstream ice jams will not impact ESP Facility operations.

The only EGC ESP Facility structure exposed to the effect of ice on Clinton Lake is the new intake structure. The new intake structure will be similar to the existing CPS intake structure except it will be smaller. The intake opening(s) to the ESP intake structure will extend vertically from the normal lake elevation of 690 ft, or higher, down to an inlet elevation of approximately 669 ft, providing a vertical opening of about 21 ft. The maximum estimated formation of ice on Clinton Lake (about 27.0 in or 2.25 ft) would potentially block only a small portion of the intake opening leaving 18.75 ft of vertical opening for water intake which is more than adequate for the intake requirements of the plants. At the minimum lake level of 277 ft msl, the intake opening would be reduced to about 5.75 ft which when combined with a nominal horizontal dimension is still more than adequate for the intake requirements of the plants.

Since there is a potential for ice sheet effects on the ESP intake structure, the final intake structure design at the COL stage will include the effects of the applicable ice forces. The force resulting when a moving ice sheet and a structure interact is limited to the magnitude of force necessary to fail the ice sheet in crushing, bending, buckling, splitting, or a combination of these modes. The total force on the entire structure is important for designing foundations to resist sliding and overturning. Contact forces over small areas, or local contact pressures, are important for designing internal structural members and the external skin of a structure.

No ice formation currently occurs in the discharge channel with the CPS operating. No change is expected to occur with the addition of the proposed ESP facility. The channel capacity is roughly 1,372,000 gpm at 1.5 fps. The CPS discharges about 445,000 gpm of warm cooling water during winter months. Adding the proposed ESP facility warm blowdown water discharge of approximately 12,000 gpm would increase the discharge rate to 457,000 gpm. The combined capacity is well within the capacity of the channel.

There is some potential for ice formation on portions of the discharge channel if the ESP facility is operated alone, without the CPS online. The warm water discharge volume would be significantly reduced to only the ESP warm water blowdown discharge rate of approximately 12,000 gpm. This would result in a lower heat output and flow velocity roughly proportional to the reduction in the flow rate. Under these conditions there is an increased potential for surface ice accumulation particularly at locations away from the point of discharge. The accumulation would be much thinner than the predicted normal lake accumulation because of the heat and velocity components of the ESP facility discharge.

If ice does form, it will tend to be thin and remain in place on the water surface allowing unrestricted flow below the water surface. Therefore, ice movement (and associated jamming or clogging of the discharge channel) is not expected.

2.4.7.1 Frazil Ice and Anchor Ice

At power plants, accumulations of frazil ice or anchor ice can cause blockages of the intakes of water systems by accumulating on any trash racks or screens in the intake path. Frazil ice can be fine, small, needle-like structures or thin, flat circular plates of ice suspended in water. In supercooled water, frazil ice particles can adhere to each other forming clusters or flocs that accumulate. Frazil ice on the surface of supercooled water can form floating ice pans, or on the bottom of solid ice cover can form hanging ice dams. Anchor ice is submerged ice attached or anchored to a streambed. Generally anchor ice forms in shallow turbulent water. These conditions could occur in streams that empty into Clinton Lake but these conditions are not expected in the intake structure area. When the anchor ice breaks loose from the streambed it would flow into Clinton Lake and form or join with the cover ice on the lake. However, this anchor ice would not interfere with the operation of the ESP intake structure.

The current CPS facility water intake is designed to avoid obstruction from surface ice and accumulations of frazil ice. Protection against any probable ice blockage in the intake area is provided by recirculating waste heat through a warming line back to the inlet to the screen house. The warming line is designed to maintain a minimum water temperature of 40 degrees F at the intake during winter operation. The CPS plant has not experienced operational problems with frazil ice accumulation on intake facilities.

The ESP facility intake will be located in the vicinity of the existing CPS intake. A means will be provided in the design of the ESP intake, e.g., a warming line from the hot side of the cooling towers, to prevent the formation of frazil ice at the intake for the essential service water cooling tower make-up to protect against the effects of ice blockage. These features will be designed for operation of the EGC ESP facility independent of the CPS facility.

2.4.7.2. Impact on UHS Volume

The ultimate heat sink for the EGC ESP facility will be safety related cooling towers if the selected reactor type does not use passive cooling methods. Clinton Lake will be used as a make-up water source for the EGC ESP cooling towers, but not as the primary EGC ESP Facility heat sink. If Clinton Dam is lost, the ice is expected to float off the CPS UHS and toward the lake outlet leaving an open water surface on the CPS UHS. If it is postulated that with failure of the Clinton Lake dam, the ice does not float off the CPS UHS but drops with the water surface to the CPS UHS there would be a decrease in the liquid water volume available as a heat sink for CPS and as makeup water for the EGC ESP facility. This loss would be expected to be more than offset by the additional heat removal capacity gained by having the latent heat of fusion of the ice available for heat removal. Adequate water volume for make-up to the EGC ESP cooling towers would be available since the required shutdown of CPS after a dam failure would supply heat to convert the ice back into water. In addition, the ice cover, when present, will reduce the evaporative component of the CPS UHS water balance which is the most significant loss component.

With the ice cover remaining in place and settling down on the ultimate heat sink (in spite of the water gradient toward the dam), the ice would be expected to displace approximately 326 ac-ft (obtained from 158 ac x (27.0 in/12 in/ft) x 0.917 = 326 ac-ft) of water (density of ice/density of water = 0.917).

The normal CPS UHS capacity available for shutdown of both the single, uprated CPS and the EGC ESP Facility (provided in Section 2.4.11.6) is determined using warm weather conditions when atmospheric cooling is limited. During this condition the maximum cooling requirement with both the uprated CPS and EGC ESP in operation is 673 ac-ft. The total available capacity of the CPS UHS is 1,067 ac-ft. This leaves an excess capacity of 395 ac-ft. With total ice cover the available liquid water volume is reduced by the volume of water displaced by the ice (326 ac-ft) and increased by the loss of the evaporative component of the cooling process (327 ac-ft). The net change results in essentially the same excess capacity as that identified for warm weather conditions in Section 2.4.11.6.

If the assumed failure is during a time when CPS is not operating, then the UHS water normally reserved for a CPS shutdown would also be available for use by the EGC ESP facility, i.e., the entire CPS UHS volume would be available to the EGC ESP Facility for UHS makeup.

2.4.8 Cooling Water Canals and Reservoirs

2.4.8.1 Cooling Lake

The cooling lake that was constructed for the CPS Facility will be used as a source of raw water for the EGC ESP Facility. The lake has a normal pool elevation of 690 ft above msl with a surface area of 4,895 ac and a volume of 74,200 ac ft. A new intake structure will be added approximately 65 feet from the existing screen house to supply water to the EGC ESP Facility. The location of the new intake structure is shown on Figure 2.4-19. The EGC ESP Facility will utilize cooling tower(s) for the normal and possibly safety-related cooling functions. The supply of make-up water to replace evaporation and cooling tower blowdown losses from the tower(s) will be taken from the existing lake.

The capacity of the lake was evaluated with a design drought condition for a 100 yr recurrence interval. The evaluation of drought effects on the cooling lake for the CPS is discussed in Section 2.4.11. A lake drawdown analysis will be performed at the design stage, using the cooling tower make-up water requirements for the selected reactor plant, to determine if load reductions or a wet/dry cooling tower will be used for the EGC ESP Facility to reduce the cooling tower make-up requirements to match the raw water supply capacity of the lake under drought conditions. A wet/dry tower or power reduction program will be used for the EGC ESP Facility, if necessary, to assure that the lake will be maintained at or above elevation 677 ft above msl during a 100 yr drought.

2.4.8.1.1 Cooling Lake Dam

The existing CPS dam will not be changed for the EGC ESP Facility. The following explanation of the dam is based on the existing CPS dam design, described more fully in Section 2.4.1.1.

The plan of the cooling lake dam, spillways and outlet works is shown in Figure 2.4-2. The cooling lake dam is a homogeneous earth fill dam with a maximum height of 65 ft above the creek bed and a length of 3,040 ft. The top of the dam is at elevation 711.8 ft above msl.

Both the upstream and downstream face of the dam has a side slope of 3:1 (horizontal to vertical). The upstream face is provided with an 18 in thick riprap laid on two 9 in layers of graded filter materials for protection against wind wave erosion and lake drawdown effects. The riprap is designed for 50 mph wind on lake normal pool. The downstream face is provided with seeded topsoil for protection against the erosive effect of rain falling over the dam. An 18 in thick riprap laid on two 9 in layers of graded filler materials is provided at the toe of the dam for erosion protection against tailwater effects. The riprap is designed for 50 mph wind on 100 yr tailwater flood level.

A cutoff into the Illinoian till and provision of a sand drainage blanket are made for seepage control under the dam and in the abutments.

Based on the analysis in Section 2.4.3, the probable maximum flood elevation is 709.8 ft above msl. The top of the dam is at elevation 711.8 ft above msl. Any wave overtopping that would occur would be in the form of spray because the wave runs up the upstream slope the underlying course riprap; the water would be lifted into the air, thus creating a fine spray. The downstream slope is well protected with grass against gully erosion due to rain and, hence, any overtopping that might occur not cause any significant damage to the downstream slope of the dam.

2.4.8.1.2 Service Spillway

There are no changes to the operation and construction of the service spillway for the EGC ESP Facility. The following description of the service spillway is based on the existing CPS spillway.

A service spillway is provided to pass a design flood of l00 yr frequency with a floodwater surface elevation of 697 ft above msl in the lake. It is located on the west abutment of the dam mainly due to favorable soil conditions. The service spillway is an uncontrolled concrete ogee type, semicircular in plan, with a crest length of 175 ft and a crest elevation of 690 ft above msl. The height of the concrete ogee is 10 ft. From the ogee section, the water will discharge through an 80 ft wide concrete chute and into a stilling basin. A discharge channel is excavated to convey the water from the stilling basin to the main channel of Salt Creek.

The location of the service spillway is shown in Figure 2.4-2. The total length of the spillway from the face of the ogee section to the end of the stilling basin is 603 ft above msl.

The peak discharge through the spillway for the 100 yr flood is 11,450 cfs. The velocity on the spillway crest is 12.9 fps and the water surface elevation downstream of the ogee is 687.6 ft above msl. The peak discharge through the spillway for the CPS PMF is 33,200 cfs with a floodwater surface elevation of 708.8 ft above msl at the crest. The velocity on the crest is 18.2 fps and the water surface elevation downstream of the ogee is 696.5 ft above msl. The spillway-rating curve is shown in Figure 2.4-18.

The chute section is designed considering the natural ground profile and the economics of the structure. It consists of a sloping channel of two different slopes (0.824 percent and 2.98 percent) and an inclined drop with a slope of 2.5:1 (horizontal to vertical), terminating into a horizontal stilling basin. An under drainage system is provided to reduce the uplift conditions. It consists of graded gravel and sand materials with perforated pipes and weep holes located at selected points along the chute.

The horizontal stilling basin is designed on the basis of the U.S. Bureau of Reclamation practices (USDOI, 1964). The tailwater elevations for the l00-yr. flood and the PMF are 660 ft above msl and 678 ft above msl, respectively.

Riprap is provided downstream of the stilling basin for a distance of 80 ft as protection against erosion. The rip rap is 2 ft thick laid on l foot thick gravel filter materials. The rip rap can withstand a maximum velocity of 10 fps.

The top of the retaining walls in the chute section is provided with a minimum freeboard of 1 ft above the PMF water surface profile. The top of the retaining walls for the stilling basin is provided with a freeboard of 4.5 ft above the standard project flood level. The backfill and graded area adjacent to the stilling basin are provided with riprap and seeded topsoil for erosion protection.

The 100 yr flood level in the lake is the basis for determining the auxiliary spillway crest elevation. The auxiliary spillway is designed to function only during floods greater than the 100 yr flood. The crest of the auxiliary spillway is set at elevation 700 ft above msl for the 100 yr flood flow to discharge entirely through the service spillway.

2.4.8.1.3 Auxiliary Spillway

There are no changes to the operation and construction of the auxiliary spillway for the EGC ESP Facility. The following description of the auxiliary spillway is based on the existing CPS auxiliary spillway.

The auxiliary (emergency) spillway is located east of the dam. The location is chosen on the basis of obtaining a better approach condition. The auxiliary spillway is designed to pass floods more severe than the 100 yr flood and up to and including the PMF. The spillway provides protection to the dam against overtopping. The spillway is an open-cut type with a crest length of 1,200 ft and a crest elevation of 700 ft above msl. The floodwater will be discharged back into the main channel of Salt Creek between the dam and the Illinois State Route 10 Bridge. The location of the auxiliary spillway is shown in Figure 2.4-2.

The peak discharge through the auxiliary spillway during the CPS PMF conditions is 102,800 cfs with a corresponding water level in the lake of elevation 708.8 ft above msl. The maximum velocity at the crest is 14 fps. The crest control section consists of 9 in thick asphalt concrete laid on 16 in of compacted aggregate materials. The width of the asphalt concrete crest is 25 ft. Concrete cutoffs and riprap is provided upstream and downstream of the asphalt concrete crest to protect the crest against scouring. A 6 ft deep rock trench is provided at the end of the downstream riprap that varies in distance from the crest from 150 ft at the far end to 300 ft at the area near the dam.

The approach channel is excavated to elevations varying from 690 ft above msl to 695 ft above msl. The length of the approach channel is 1,510 ft along the centerline of the spillway. The bottom of the discharge channel is elevation 695 ft above msl. The length of the discharge channel is 2,120 ft along the centerline of the spillway. The channels are provided with an erosion resistant soil with Bermuda grass cover that can withstand a velocity of 8 fps. Erosion control measures on the auxiliary spillway are provided for the safety of the dam and the spillway structure during extreme flood conditions.

2.4.8.1.4 Outlet Works

There are no changes to the operation and construction of the outlet works for the EGC ESP Facility. The following description of the outlet works is based on the existing CPS.

The lake outlet works is located on the west abutment of the dam, 160 ft east of the service spillway. The location of the outlet works is shown in Figure 2.4-2. The lake outlet works is provided primarily to release a minimum flow of 5 cfs to the creek downstream of the dam to satisfy commitments documented in the CPS Final Environmental Statement (USNRC, 1982). The discharge from the lake outlet works at normal pool elevation, with all the gates fully opened, is 170 cfs.

The plan, section, and details of the lake outlet works are shown in Figure 2.4-2. The lake outlet works consists of a submerged concrete intake structure of the drop inlet type, a 36 in diameter precast, prestressed concrete entrance pipe, a wet well type concrete control house with three cast iron sluice gates at different levels, and a 48 in diameter precast, prestressed concrete outlet pipe terminating at the spillway stilling basin.

The crest of the intake structure is at elevation 668 ft above msl with an inlet diameter of 84 in, transitioning into a 36 in diameter vertical section (throat). The inlet is provided with a trash rack and a vortex breaker. A provision for placing stop logs is made at the inlet of the entrance pipe for inspection or maintenance of the control gates.

The three cast iron sluice gates at the control house regulate the downstream releases of water from the lake. Two gates are 12 in by 12 in size with the centerline of one gate at elevation 686 ft above msl and the other centerline at elevation 684 ft above msl, and one gate 24 in by 36 in size located at the bottom of the control house at elevation 650.88 ft above msl. The upper 12 in by 12 in gate remains open during normal operating conditions. When the lake level falls to elevation 687 ft above msl, the lower 12 in by 12 in gate is opened. The bottom 24 in by 36 in gate is opened when the lake level falls to elevation 685 ft above msl. The gates are manually operated from the top of the control house. Locking devices are provided for the gates to prevent unauthorized personnel from operating the gates. A 15 ft wide concrete bridge is provided for access from the top of the dam to the control house.

The 48 in outlet pipes are located below a good natural soil formation and are provided with concrete anti-seep collars to prevent seepage problems in the body of the dam. The outlet pipe discharges the water into the stilling basin of the service spillway where the energy of flow is dissipated. The discharge channel downstream of the stilling basin conveys the flow to the main channel of Salt Creek.

2.4.8.1.5 Flow Through the Ultimate Heat Sink (UHS) Pond

The EGC ESP Facility will use the existing UHS submerged pond as the supply source of makeup water to any required safety-related cooling tower(s) if Clinton Lake is not available. The makeup water will be supplied from the new intake structure located approximately 65 feet from the existing screen house. The UHS pond capacity has been evaluated and found to have sufficient volume to provide 30-day emergency shutdown cooling for the existing CPS and makeup water to the EGC ESP Facility safety-related cooling tower(s). The CPS safety-related cooling water volume is conservatively based upon the volume established for the original dual 992 MWe plants. The EGC ESP safety related volume for cooling tower make-up water was calculated based on the PPE evaporation rates for the UHS cooling towers plus a 33 percent margin for blowdown, plus an overall 20 percent margin above the value obtained using the PPE values. With the combined CPS and ESP emergency cooling volumes there is enough excess UHS volume to provide for a dredging interval in excess of 20 years.

There are no changes to the flow path through the UHS Pond as a result of the EGC ESP Facility. The following description of the UHS pond is based on the existing CPS UHS pond.

The ultimate heat sink is a submerged pond formed by the construction of a submerged dam across the North Fork channel. The submerged dam is located 1 mi west of the CPS screen house. The location of the ultimate heat sink is shown in Figures 1.2-3 and 2.4-9. Figure 2.4-20 shows the plan of the ultimate heat sink. The cross sections through the ultimate heat sink, submerged dam, and baffle dike are shown in Figure 2.4-21.

The top of the submerged dam is at elevation 675 ft above msl with a width of 30 ft and a length of 2350 ft. The dam consists of homogeneous compacted backfill materials with a side slope of 5:1 (horizontal to vertical) on both faces of the dam. The excavation for foundation of the dam is extended to the Illinoian till. A 2 ft thick compacted soil-cement is provided at the top and side slopes of the dam and extends into a horizontal apron downstream of the toe of the dam. The toe is at elevation 670.3 ft above msl. A random fill is provided to elevation 673.5 ft above msl at the end of the soil-cement apron to a distance of 290 ft from the centerline of the dam. The random fill is placed in areas where the existing grade is lower than elevation 673.5 ft above msl to create a stilling pool downstream of the dam. The baffle dike consists of homogeneous compacted backfill materials with a 30 ft width at the top and a side slope of 5:1 (horizontal to vertical) on both faces of the dike. The top of the baffle dike is at elevation 676 ft above msl and is provided with a 3ft thick compacted soil-cement. The bottom of the dike is founded on the Illinoian till. The length of the baffle dike is 3,300 ft.

The area of the ultimate heat sink at the design water surface elevation of 675 ft above msl is 158 ac with a total volume of 1,067 ac-ft. The UHS for the CPS is designed to provide sufficient water volume and cooling capacity to safely shut down two 992 MWe BWR units and maintain the plant in a shutdown condition for 30 days with no make up water. The minimum UHS volume of 849 ac-ft accounts for the minimum cooling capacity requirement to meet 95° F shutdown service water inlet temperature (590 ac-ft), fire protection (3 ac-ft), sedimentation from a 100-year flood (35 ac-feet), and sediment inflow from liquefaction (221 ac-ft) (CPS, 2002, USAR page A2.5-2). The minimum UHS volume of 849 ac-ft of water, based on the 30-day emergency shut down of the two 992 MWe units is more than sufficient for the existing single uprated 1138.5 MWe CPS Facility and any ESP Facility UHS makeup requirements. See Section 2.4.11.6 for additional details.

Analysis conducted during the design of the submerged UHS dam and the baffle dike included evaluating flow conditions and velocities resulting from a sudden breach in the main dam that was conservatively assumed to occur at the time of the PMF. The flow conditions resulting from an occurrence of a PMF on the North Fork when the lake is at the 100-yr drought were also analyzed as part of the UHS design. As a result of the analysis, a compacted soil-cement was provided over the surface of the submerged dam and baffle dike to protect these structures against the erosive effect of the velocities and flow conditions due to the postulated dam breach and the occurrence of a probable maximum flood on North Fork coincident with the 100-yr drought lake water level of elevation 682.3 ft above msl (CPS, 2002).

2.4.8.2 Station Discharge Flume

The existing CPS discharge flume will be used to receive discharges from the EGC ESP Facility and convey them to the lake. Figure 2.4-19 indicates the approximate discharge point. The existing discharge flume is designed for a maximum flow of 3057 cfs. Since the design was for two CPS units, the current flow to the flume from the CPS is less than 50 percent of the design capacity.

There are no changes to the operation and construction of the station discharge flume for the EGC ESP Facility. The following description of the station discharge flume is based on the existing CPS flume.

The discharge flume is provided to convey the plant discharge from the CPS circulating water pipe discharge structure into the Salt Creek finger of the lake. The flume is located east of the plant area and runs due east toward the lake. The location of the flume provides an effective cooling surface area of 3650 ac in the lake. Figure 1.2-3 shows the location of the flume. The discharge flume is designed for a maximum flow of 3057 cfs with a nonscouring velocity of 1.5 fps. The flume has a bottom width of 120 ft and a side slope of 3:1 (horizontal to vertical). The total length of the flume is 3.4 mi (18,040 ft). A minimum freeboard of 3.8 ft is provided in the flume. A 6 in thick crushed stone layer is provided on the side slopes of the flume for protection against erosion due to wind wave action in the flume. Riprap is provided on the lakeside of the embankment fills for protection against erosion due to wind wave action in the lake.

Drop structures of the baffled apron type are provided at two locations along the flume to adapt the flume design to ground topography and to prevent scouring in the flume during station operations at design drought conditions in the lake. The two-drop structures have the same width of 70 ft; the first one is designed for a drop of 18 ft, and the second is designed for a drop of 26 ft. Provisions against erosion are provided at the end of both structures.

2.4.9 Channel Diversions

There is no historical evidence of channel diversion of Salt Creek and North Fork of Salt Creek upstream of the dam site. The dam site is located on the upper reaches of Salt Creek, 28 mi from its source. Examination of the topographic maps of the Salt Creek and North Fork of Salt Creek did not find evidence for natural channel diversions (e.g., oxbow lakes or broad well-developed floodplains). The creeks and streams in the watershed generally occur in well-defined valleys. Diversions of water out of these valleys into an adjacent drainage basin would require the energy to overcome the topography to cut a new drainage channel. Based on the physical characteristics of the drainage area and creek system, it is unlikely that a potential naturally-occurring channel diversion will shift water out of the Clinton Lake watershed. The topographic characteristics and geological features of the drainage basin indicate that there is no possibility for the occurrence of a landslide that will cut off the streamflow into the lake. The history of ice jam formation discussed in Section 2.4.7, Ice Effects, did not show evidence of flow diversion during winter months.

2.4.10 Flooding Protection Requirements

The flooding effects of a PMF on Salt Creek and a local PMP on the plant area are the design bases for flood protection. The considerations for selecting the PMF on Salt Creek as the design flood are discussed in Section 2.4.2.2, Flood Design Considerations. The effects of the PMF and coincident wind wave activity on the lake at the site are discussed in Section 2.4.3, Probable Maximum Flood on Streams and Rivers.

The maximum (1 percent) wave run-up elevation at the station site is 716.2 ft above msl, produced by a sustained 52 mph overland wind acting on the PMF still water elevation of 709.8 ft above msl. The approximate grade elevation for the EGC ESP Facility of 735 ft above msl is approximately 19 ft above the maximum wave run-up level and 25 ft above the PMF still water level. The safety-related facilities in the station area would not be affected by the PMF conditions in the lake. The only EGC ESP Facility structure that would be affected by the PMF is any safety-related equipment located in the intake structure, which will be designed to consider flood protection of any safety-related equipment located in the intake structure.

The flooding effects of the local intense precipitation (i.e., the local PMP values) are design related (since the effects are dependent on site grading and drainage design) and will be addressed at the COL stage as indicated in Section 2.4.2.3.

2.4.11 Low Water Considerations

2.4.11.1 Low Flow in Salt Creek

Two design droughts were established having a 5-year duration at 50-year and 100-year recurrence intervals. Factors considered in the evaluation include runoff, evaporation, and forced evaporation. Low flow runoff data for both design droughts were obtained from the CPS USAR, which cited the source *Low Flows of Illinois Stream for Impounding Reservoir Design* published as Bulletin 51 by the Illinois State Water Authority (Stall, 1964).

A normal lake elevation level of 690 ft above msl was used as the starting water surface level. Lake stage storage relationships were obtained from CPS ER (OLS) based on the original lake volume of 74,200 ac-ft at normal lake level (CPS, 1982). Inflow to the lake (in ac-ft) was computed on a monthly basis by multiplying the rainfall runoff (in feet) by the watershed area (in acres). Outflow from the lake was assumed to be comprised of downstream discharge; net lake evaporation minus lake precipitation; forced evaporation due to existing plant operations; seepage; and the cooling water consumed by the new facility. Rainfall runoff flows for both drought events were obtained from the CPS USAR. Runoff values were multiplied by the watershed area of 296 square miles to establish a runoff volume. Downstream discharge through the dam was assumed to be a minimum discharge of 5 cubic feet per second (cfs); or 298 ac-ft/month, when lake levels are at or below the 690-foot spill elevation. For the purpose of drought analysis calculations, the lake elevation was not allowed to exceed 690 ft above msl. The discharge was allowed to be greater than 5 cfs if inflows would increase the lake level to a level above the spillway elevation of 690 ft above msl (CPS, 2002).

Net lake evaporation minus precipitation data were obtained from CPS USAR for both the 50-year and 100-year recurrence interval droughts.

Existing plant forced evaporation data used in this analysis were developed from data given in the CPS USAR, which were based upon two originally planned 992 MWe BWR plants at a 70 percent load factor (CPS, 2002). 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 for the two original plants. This factor accounts for the total evaporative loss that results from dissipation of the heat rejected to the lake. The evaporative loss will occur through the cooling loop. The term forced evaporation is used because the rejected heat and associated increase in lake temperature will “force” an increase in the rate of evaporation over ambient levels to dissipate the rejected heat.

Forced evaporation rate for the two proposed plants was revised to reflect the rate for the existing single uprated plant. Only one of the two original plants was constructed at 992 MWe but was uprated in 2002 to an 1138 MWe plant. The forced evaporation rates from the CPS USAR were divided by 0.7 to obtain the evaporation rate for a 100 percent load factor. The forced evaporation rates were then divided by two to account for the fact that only one plant is present. To account for the power uprate, the forced evaporation rates were then multiplied by 1.147 (1138/992). The combination of these three factors is equal to multiplying the original forced evaporation rates by a factor of 0.82.

The forced evaporation values for the original 992 MWe plant operating at 100 percent were recently checked using an independent thermal analysis. The forced evaporation rates determined by that exercise closely matched the CPS USAR forced evaporation rates, but were slightly smaller, so the more conservative CPS USAR forced evaporation rates were used. The method used to check the forced evaporation rates is described below.

Forced and natural evaporation occur simultaneously as the circulating water flows through the cooling loop. In order to differentiate between the amounts of natural and forced evaporation, the equilibrium temperature for the lake was determined on a monthly basis using monthly climactic data over the period of record. The equilibrium temperature is the temperature of the lake water (about 1 foot below the surface) where the heat input to the lake water is exactly balanced by the heat output from the lake water. This equilibrium temperature is determined by performing a heat balance for solar heat gain, heat loss by convection, evaporative cooling and radiant heat transfer from the water to the surroundings. The amount of natural evaporation (per unit area of lake) is determined based on this equilibrium temperature.

To determine the amount of forced evaporation, a model that follows the method of Langhaar (Langhaar, 1953) was developed, and was validated by good agreement with results of an earlier study (Edinger, 1989). The model was then applied to simulate the cooling lake for each month, using monthly average climactic conditions over the period of record. The simulation quantifies the aforementioned modes of heat transfer per unit area of lake. The evaporative cooling that is determined by the model is a "total" value (forced plus natural evaporation). The amount of forced evaporation is simply the difference between the total and natural evaporation determined from the equilibrium temperature.

Existing and proposed plants assume a 100 percent load factor in their operation. It was assumed that each drought event would begin during January of the first year of the drought. As in the CPS USAR, seepage was assumed to be equal to 0.5 percent of the lake volume.

By definition, a 100-year recurrence interval event has a 1 percent exceedance probability to occur in any given year. Similarly, a 50-year recurrence interval event has a 2 percent exceedance probability to occur in any given year. Calculations were carried out to determine the likelihood of 50-year and 100-year recurrence interval events during the 40-year life of the proposed plant. It was determined that there is a 56 percent exceedance probability that at least one 50-year recurrence interval drought will occur during the 40-year life of the plant. There is a 33 percent exceedance probability that at least one, 100-year recurrence interval drought will occur during the same 40-year period.

Calculations were carried out for each month; a net volume gain or loss was calculated by subtracting lake volume losses and adding lake volume gains (both in ac-ft). This net change was then added to the initial volume for that month to obtain the initial volume for the next month. The lake elevation-area capacity and -volume capacity relationships found in the CPS ER (OLS) were then used to estimate the lake elevation level and lake area for the following month (CPS, 1982). These calculations were carried out separately for 60 months (the 5-year duration period) of the 50-year and 100-year recurrence interval droughts.

A determination of the amount of water available for cooling water use during drought periods was also conducted. The amount of water consumed on an average annual basis by the existing CPS plant at 100 percent of its rated capacity is 1,100 ac-ft/month (12.0 MGD or 8,300 gpm). The total amount of water available for consumption for the 100-year drought event is equal to 2,400 ac-ft/month (25.6 MGD or 17,800 gpm). Thus, the amount of water available for use in addition to the amount already used by the existing plant is 1,300 ac-ft/month (13.7 MGD or 9,500 gpm).

A similar analysis was performed for the 50-year drought event. The amount of water consumed on an annual basis by the existing plant was calculated out to a rate of 1,100 ac-ft/month (12.0 MGD or 8,300 gpm). The total amount of water available for consumption is equal to 3,100 ac-ft/month (33.7 MGD or 23,400 gpm). Thus, the amount of water available for use in addition to the amount already used by the existing plant is 2,000 ac-ft/month (21.7 MGD or 15,100 gpm).

The available water quantities maintain the lake level at or above the CPS minimum lake elevation of 677 ft above msl with both the CPS and the EGC ESP Facility in operation.

The available water quantity, for the EGC ESP Facility is sufficient to provide the Cooling Tower Makeup requirements, using evaporative (wet) cooling, for some of the reactors under consideration, for both the non-safety turbine plant cooling and the safety related cooling systems. The bounding Reactor plant cooling system makeup demand would require the use of a wet-/dry-type cooling tower for the turbine plant cooling systems to reduce the evaporation rate or load reductions, so that the demand does not exceed the available water supply from Clinton Lake. The bounding cooling tower makeup water requirements, for evaporative losses in the tower, are shown on Table 2.4-16 for a 100 percent evaporative (wet) tower and for a wet/dry tower with approximately 70 percent of the cooling achieved in the dry surface. The cooling tower makeup water requirements in Table 1.4-1 consist of the quantity of water required to replace both the evaporative and blowdown losses from the tower. Since the blowdown water from the tower is returned to

Clinton Lake it does not represent a demand for additional water from the lake. The other water usage listed in Table 1.4-1 and supplied from the lake is (Potable/Sanitary, Demineralized water and Fire Service) are essentially returned to the lake as liquid waste discharges to the CPS discharge flume and do not result in a loss of lake water.

2.4.11.2 Low Water Resulting From Surges, Seiches, or Tsunami

Surges, seiches, or tsunami conditions are not possible to occur and affect low water conditions in the lake and the CPS UHS pond because there is no large body of water near the site.

2.4.11.3 Historical Low Water

The effect of drought on lake levels has been evaluated to determine if operation of the existing CPS Plant can be sustained during dry periods (CPS, 2002). A minimum safe lake level is established at elevation of 677 ft above msl. Lake levels below this would require plant shutdown to avoid loss of the safe plant cooling capacity. Two 5 yr duration droughts were established based on historical climatic conditions. The 50 yr and 100 yr droughts were selected for the evaluation.

The drawdown analysis accounted for lake inflows generated from direct rainfall and storm water runoff, normal evaporation, forced evaporation due to plant cooling and increased lake water temperature, ground seepage losses of 0.5 percent per month of the lake volume, minimum 5 cfs discharge at the dam to sustain the receiving stream, and dam overflow discharges. The drought analysis was completed based on the existing uprated CPS of one 1,138.5-megawatts electric (MWe) boiling water reactor (BWR) operating at 100 percent of its rated capacity.

The results of the lake level evaluation during drought established minimum lake levels for the 50 yr and 100 yr droughts of elevation 685 ft above msl and elevation 681.4 ft above msl, respectively. Both minimum lake levels are well above the minimum safe lake level of elevation 677 ft above msl. A discussion of lake levels and cooling system impacts based on both the existing CPS and proposed EGC ESP Facility operation is presented in Chapter 5 of the EGC ESP Environmental Report.

2.4.11.4 Future Controls

Based on inquiries made with state and federal regulatory agencies, there are no future plans to use Salt Creek water upstream of the cooling lake. Any future use of Salt Creek water upstream of the site would not affect the availability of shutdown cooling water supply due to the submerged condition of the UHS pond.

2.4.11.5 Plant Requirements

The estimated station water requirements for cooling tower make-up and other plant water uses are shown in Table 2.4-16. The water required for the EGC ESP Facility will be supplied from a new intake structure located approximately 65 feet south of the existing CPS intake structure. The new intake structure will use Clinton Lake as a supply source and will have the capability to take water from the existing submerged UHS pond as an alternate source of make-up water to the safety-related Essential Service Water (ESW) cooling tower(s) for shutdown and to maintain cooling for a period of at least 30 days.

The common intake structure for raw water requirements for the EGC ESP Facility is described in Sections 3.2.1.3 and 3.2.2.3. The location of the Exelon ESP intake structure is shown on Figure 2.4-19. The intake structure will house the traveling screens, fire pumps, cooling tower make-up pumps, and safety-related cooling tower make-up pumps. The make-up water pumps for the safety-related cooling tower(s) will be designed to operate with a suction water elevation at least 1 foot below the lowest level that the existing CPS UHS pond could attain after 30 days of operation without makeup to the UHS pond. The normal plant heat sink and UHS systems for the EGC ESP Facility are discussed in Sections 3.2.1.1 and 3.2.2.1.

The minimum operating condition lake water level is elevation 677 ft above msl. The EGC ESP Facility make-up water pumps will be designed for an operating level equal to or less than this minimum water level. In the event of a severe drought that will reduce the lake water level to elevation 677 ft above msl, station shutdown operation will be followed. The design water level for the safety-related make-up water pumps and the CPS UHS pond are not affected by drought conditions in the lake.

The ESW system flow rate is 26,125 gpm for normal operation and 52,250 gpm for shutdown based on the bounding reactor plant. The ESW cooling tower makeup water requirements range from 350 gpm to 1,400 gpm.

The Ultimate Heat Sink cooling function for the EGC ESP Facility is provided by the Essential Service Water Cooling Tower(s). The cooling tower(s) require makeup from Lake Clinton to replace the water lost due to the evaporative cooling process that takes place in the tower(s). The make up water requirements, for evaporation, range from 250 gpm during normal operation up to a maximum of 700 gpm during a normal shutdown. The total makeup water requirements for post accident shutdown and cooldown for a 30 day period are based on the evaporation rate (411 gpm per Table 1.4-1, PPE section 3.3.7) increased by 33% for blowdown and a 20% margin added, as described in SSAR section 2.4.8.1.5, which results in a make-up water quantity of 28,337,300 gallons for 30 days. This 30 day water requirement converts to 87 ac-ft which is an average makeup requirement of approximately 655.9 gpm over the 30 day period.

2.4.11.6 Heat Sink Dependability Requirements

Clinton Lake is the source of make-up water to the EGC ESP Facility during normal and emergency operation. The design considerations and description of the lake and the main dam are discussed in Section 2.4.8. In the unlikely event of a failure of the main dam and complete loss of the cooling lake, the existing submerged CPS UHS pond will supply the make-up water to the safety-related cooling tower(s) for emergency station operation.

The existing CPS UHS pond is a submerged pond within Clinton Lake formed by the construction of a submerged dam across the North Fork channel. The existing CPS UHS pond is adjacent to the EGC ESP Facility intake structure where the make-up water pumps for the Essential Service Water (ESW) safety-related cooling tower(s), if required, will be located. The return (cold) water temperature from the safety related cooling tower(s) is a maximum of 95 °F (SSAR Section 2.3.1.2.4). The blowdown from the safety-related cooling tower(s) is discharged to the existing discharge flume for the CPS Facility and no credit has been taken for the return of blowdown to the CPS UHS pond in determining its capability to supply water to the EGC ESP Facility.

The CPS UHS pond has sufficient water volume and cooling capability for shutdown operation of the CPS Facility and make-up water for the EGC ESP Facility for shutdown operation for a period of at least 30 days and beyond, if necessary, without requiring makeup water. The current design basis, description and analysis of the UHS pond for the CPS Facility is provided in section 9.2.5 of the CPS USAR. The plan of the CPS UHS pond is shown in EGC ESP SSAR Figure 2.4-20. Figure 2.4-21 shows the cross sections through the UHS pond, submerged dam, and submerged baffle dike

The amount of makeup water required to the EGC ESP Facility safety related Ultimate Heat Sink cooling tower(s) for a 30 day period, 28,337,300 gallons, is defined in SSAR section 2.4.11.5 including blowdown equal to 0.33% of the evaporation which provides for operation with four cycles of concentration for the impurities in the makeup. This number is conservative since it would be expected that blowdown would be terminated during an accident and that normal operation would be at a higher concentration ratio than the assumed ratio of four.

The original design of the Ultimate Heat Sink pond for the CPS was based on the heat load from the shutdown of one unit under LOCA and one unit under LOOP with a total integrated heat load of 180,455 x 10^6 btu for 30 days. This heat load required a total of approximately 590 ac-ft of UHS water volume. The total CPS UHS requirement of 849 ac-ft also included 3 ac-ft for fire protection, 35 ac-ft for sedimentation due to a 100-yr flood and 221 ac-ft for sediment inflow during a Safe Shutdown Earthquake liquefaction event. The heat load for the single CPS unit constructed, with Power Uprate, is 99,973 x 10^6 btu for 30 days under LOCA or LOOP conditions. This value is approximately 55 percent of the CPS UHS Pond design heat load and requires only approximately 327 ac-ft of UHS water. Thus, the required capacity of the single uprated 1138.5 MWe Clinton Power Station is calculated to be 586 acre-ft. This includes the following:

CPS shutdown cooling (LOCA or LOOP) (lost to evaporation)	327 ac-ft
Fire protection	3 ac-ft
Sedimentation due to 100-yr flood	35 ac-ft
Sediment inflow during SSE liquefaction	221 ac-ft

Therefore, with 87 ac-ft required for shutdown of the ESP Facility, the CPS UHS has 394 ac-ft available for sediment accumulation. Recent (1991 through 2004) sediment accumulation reports indicate a general accumulation of approximately 4.85 ac-ft per year, which would allow many years of operation before dredging would be required.

The EGC ESP Facility does not use the existing CPS UHS Pond for heat removal but does use it for a source of makeup water for the EGC ESP UHS cooling tower(s) if Clinton Lake is not available to provide the makeup water.

Reliability of the CPS UHS to provide a supply of water during drought conditions is further enhanced by the CPS UHS pond location with respect to the adjacent groundwater table. Since the CPS UHS pond is normally submerged in the cooling lake and the normal pool elevation sets the base level for the adjacent groundwater during low flow or loss of the main dam, water stored in the upstream alluviums would replenish water in the CPS UHS pond. The Salt Creek water shed would also provide a source of water for long term cooling following a loss of the Clinton Lake dam. The watershed can supply 400 gpm at the minimum mean daily flow from Table 2.4-3 and 16,150 gpm at the lowest mean monthly flow. The required makeup flow to the EGC ESP Facility UHS cooling tower(s) during normal operation is 250 gpm and would bound the requirements after plant shutdown is achieved.

The CPS UHS pond is monitored for sediment accumulation periodically and after a major flood passes through the cooling lake (CPS, 2002). Sediment will be removed as necessary during operation of the ESP Facility to maintain an adequate volume of cooling water.

2.4.12 Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents in Surface Waters

As discussed in Section 2.4.13.3, it is extremely unlikely that the effluents can move out of the buildings containing radioactive liquids due to high groundwater elevation. Recent water level measurements, from within the ESP footprint, indicate that the uppermost groundwater naturally occurs at a shallow depth of about 5 feet below ground surface. Based on the maximum seasonal variation in the groundwater level of 12 ft, the lowest water levels were at about elevation 718 ft above msl or about 17 ft below the ESP Facility grade elevation of 735 ft above msl. Thus, the level of radioactive effluents in the building would have to exceed the groundwater level before seepage out of the building could occur. In addition, tanks located outside of structures potentially containing radioactive fluids will have positive means to collect and prevent uncontrolled releases such as dikes and collection basins. Therefore, it is extremely unlikely for the effluents to reach a surface water body.

Groundwater levels will be measured as part the Pre-Application, Construction, Pre operational, and Operational Hydrologic Monitoring Programs in order to detect impacts to the groundwater system. This issue will be reviewed at the COL stage when an NSSS vendor is selected and the final plant layout of the structures and components is determined to verify that the inward gradient is maintained relative to final plant elevations and layout.

The locations of surface water users are discussed in Section 2.4.1.2. There are no known surface water users of Salt Creek or Sangamon River within 50 river mi downstream from the plant site. The closest surface water user for drinking purposes is in Alton, Illinois on the Mississippi River, 242 river mi downstream from the EGC ESP Site.

2.4.13 Groundwater

2.4.13.1 Description and On-Site Use

2.4.13.1.1 On-Site Use

Groundwater with high methane content was obtained from a test well during the site planning for the CPS Facility; therefore, the CPS Facility's water requirements have been met using surface water sources (Clinton Lake) rather than from groundwater wells. The test well was located approximately 1 mi south of the site (CPS, 1982). Based on the presence of methane in the groundwater and the availability of water from Clinton Lake, groundwater will not be used for operations of the EGC ESP Facility.

2.4.13.1.2 Regional Hydrogeologic Systems

Unconsolidated deposits of Quaternary-age glacial drift and stream alluvium overlie thick sequences of Paleozoic sedimentary rock throughout most of Illinois. Bedrock aquifers within 50 mi of the EGC ESP Site are shown in Figure 2.4-22. The description and characteristics of the geologic and hydrogeologic systems in the vicinity of the site are summarized in Table 2.4-17.

The aquifer systems within 50 mi of the site are found in the following geologic environments, in descending order (CPS, 2002).

- Alluvial deposits along streams;
- Glacial drift including layers and lenses of sand and gravel within and between the various tills;
- Glacial outwash (Kansan Stage) in buried bedrock valleys;
- Bedrock of Pennsylvanian-age, consisting of shale, siltstone, limestone, sandstone, underclay, and coal;
- Bedrock of Silurian-age, Devonian-age, and Mississippian-age, predominantly dolomites and limestones; and
- Bedrock of Cambrian-Ordovician-age, consisting of a sequence of limestone, dolomites, and sandstones.

According to the USEPA, none of the aquifers occurring within a 50 mi radius of the site have been designated as "sole source" aquifers (USEPA, 2002).

Groundwater supplies are obtained chiefly from the glacial outwash in the buried bedrock valleys and shallower unconsolidated deposits. In addition, they are obtained, to a minor extent, from the upper 100 ft of the Pennsylvanian rock sequence beneath the glacial drift. In DeWitt County, the lower bedrock aquifers are not typically used for water supply because adequate supplies for municipal, agricultural, and domestic requirements are more easily obtained from the shallower bedrock or the overlying unconsolidated materials. Poor water quality in the deeper aquifers is also typical in this region (CPS, 2002).

The various aquifer systems are described in the following sections (CPS, 2002).

Alluvial deposits, consisting of varying amounts of clay, silt, sand, and gravel occur in the valleys of many streams in the regional area. The alluvium may be used for groundwater supply in those areas, where thick, permeable sand and gravel deposits are present. Such deposits commonly occur along larger streams having established floodplains, such as Salt Creek and North Fork of Salt Creek. Alluvial aquifers are not used extensively in the regional area because the floodplain areas have undergone only minor development.

The public water supply for Heyworth, in McLean County, is obtained from alluvial deposits along Kickapoo Creek. Pumping tests show the aquifer at this location to be capable of supplying over 200 gpm per well.

With the exception of the surficial alluvium in present stream valleys, the regional area is underlain by a thick sequence of silts of eolian and lacustrine origin, tills, and outwash. This sequence of Wisconsinan-aged, Illinoian-aged, and Kansan-aged deposits are collectively referred to as glacial drift. The total thickness of these deposits varies from less than 50 ft to approximately 400 ft, and averages 200 ft. The silts are often clayey and may contain fine sand. The tills are composed of heterogeneous mixtures of clay, silts, sand, and gravel, but consist predominantly of clayey silts or silty clays. Lenses, and thin discontinuous layers of silt, sand, or gravel are common between and within the tills. Outwash deposits consist of sand and gravel with varying amounts of silt or clay.

Availability of groundwater from the unconsolidated material is governed by the occurrence of permeable sand and gravel deposits within the glacial drift and recharge sources. Sand and gravel deposits may occur above or below the individual tills, as lenses within the tills, or as relatively continuous deposits in bedrock valleys.

The Wisconsinan formations are generally composed of fine-grained sediments with only shallow and very localized deposits of sand and gravel. Thus, they are poor sources of groundwater.

Widespread lenses of sand and gravel intercalated in the Illinoian drift are capable of supplying small to moderate amounts of groundwater. Sand and gravel deposits in the Kansan-aged drift occur primarily as outwash deposits in buried bedrock valleys. The axes of the bedrock valleys in central Illinois are shown in Figure 2.4-23. Specifically important to this area are the Mahomet and Mackinaw bedrock valleys, which are filled with sand and gravel (USGS, 1995a). Deposits filling the valley include the widespread Mahomet Sand Member, and are as much as 200 ft thick (Kempton et. al, 1991). With hydraulic conductivities as high as 2.0E-04 cm/sec (570 ft/day), a gradient of 0.0002 ft/ft, and an assumed porosity of 0.25, average linear groundwater velocities in this material are estimated at 0.45 ft/day. Aquifers associated with the Mahomet Bedrock Valley and the ancient Mississippi Bedrock Valley are the only highly productive, nonalluvial sand and gravel aquifers in southern Illinois. Forty municipalities and water districts obtained groundwater from these aquifers as of 1991. The largest groundwater withdrawals from the valley aquifer occur in the Champaign-Urbana area, averaging 17 mgd (Kempton et. al, 1991).

Groundwater in the Illinoian and Kansan deposits occurs under artesian conditions, whereas, in the Wisconsinan deposits, water table conditions generally prevail (see Figure 2.4-24). Wells in the outwash near the margins of the bedrock valleys may produce as much as 500 gpm. Wells located in the center of the valleys might yield substantially higher quantities of groundwater on a sustained basis given proper well construction and management. Most wells in this area do not produce from this deep outwash because adequate supplies for domestic, agricultural, and most municipal purposes may be developed from the shallow alluvium along stream courses or from small permeable lenses in the upper glacial drift materials (CPS, 2002).

Groundwater in the glacial drift is derived from precipitation, underflow through bedrock and bedrock valleys, and induced infiltration from streambeds. Recharge to the sand and gravel deposits occurs primarily by vertical leakage of infiltrating precipitation, the rate of which is controlled by the vertical permeability of the relatively impermeable tills, the thickness of the tills (confining beds), and the head differential between the source of recharge and the receiving aquifer. Vertical permeability for till with some sand and gravel averages 0.02 gallons per day per square foot (gpd/ft^2). The recharge rate for sand and gravel aquifers overlain by thick glacial drift consisting largely of till is estimated to be 115,000 gpd/mi^2. The recharge rate for the Kansan glacial deposits is estimated to be 107,000 gpd/mi^2 (CPS, 1982).

Groundwater in the glacial drift aquifers is discharged to streams that intersect the aquifers (base flow), to the underlying glacial drift, to the Pennsylvanian bedrock, and to pumping wells. Groundwater base flow for the upper portion of the Salt Creek drainage basin, calculated from hydrologic data collected at the Rowell Gauging Station, averages 0.36 cfs/mi^2 for years that have near-normal precipitation. Groundwater base flow averages 0.13 cfs/mi^2 for years that have below-normal precipitation and 0.58 cfs/mi^2 for years that have above-normal precipitation. In alluvial deposits, bank storage accounts for much of the variability in observed values of groundwater runoff between years of below-normal and above-normal precipitation (CPS, 2002).

Bedrock aquifers within the 50 mi radius of the site are shown in Figure 2.4-22. Most of the glacial drift in the study area is underlain by Pennsylvanian bedrock that consists largely of shale and siltstone interbedded with limestone, sandstone, underclay, and coal. Small amounts of groundwater may be obtained from wells penetrating beds of sandstone, creviced limestone, and fractured shale and coal. Recharge to the Pennsylvanian bedrock occurs by vertical leakage from the overlying glacial drift. Groundwater in the bedrock is under artesian conditions and is discharged to lower bedrock formations or to the glacial drift in those areas where the potentiometric surface of the Pennsylvanian aquifers is higher than that of the drift aquifers. Most wells in the Pennsylvanian bedrock extend less than 100 ft below the bedrock surface because the formations become tighter and mineralization of the groundwater increases with depth. Bedrock is used as a source of domestic water supply in the regional area only where conditions are unfavorable for the development of drift aquifers. The USGS reports that yield of wells in the Pennsylvanian aquifers range from less than 1 to about 100 gpm, with an average well yield of about 10 gpm (USGS, 1995a). Fresh groundwater withdrawals from these aquifers during 1985 accounted for less than 4 percent of the total withdrawals in Illinois.

Bedrock aquifers of the Mississippian-age or Silurian-Devonian-age occur beneath the unconsolidated deposits in the northeast portion of the study area (Figure 2.4-22). Mississippian rocks that are aquifers are generally comprised of thick-bedded limestone and sandstone. However, these aquifers are typically used for water supply when they are less than 200 ft below land surface, and when more water can be obtained from them than from the overlying surficial aquifer system. Water is typically under confined conditions where the water-yielding zones lie beneath clay or shale beds. Recharge to the Mississippian aquifers occurs primarily by water that percolates downward through the unconsolidated materials and the Pennsylvanian bedrock, if present. Reported well yields range from 1 gpm to 100 gpm, with an average of about 10 gpm. Fresh groundwater withdrawals from the Mississippian aquifers during 1985 were less than 3 percent of the total groundwater withdrawn in Illinois (USGS, 1995a).

Dolomites and limestone of Silurian-Devonian-age also constitute some of the aquifers in the northeast portion of the study area (see Figure 2.4-22). The aquifer portion of the rock lies beneath the upper Devonian shale, Mississippian rocks, or Quaternary deposits. This aquifer generally contains freshwater where the aquifer is between land surface and about 500 ft below the land surface. The base of freshwater coincides approximately with the base of the aquifer. Underlying Ordovician shale impedes the downward movement of freshwater. Groundwater is generally under confined conditions and moves through fractures, bedding planes, and solution cavities. Probable well yields in the study area, where this aquifer is used, range from less than 250 gpm to 500 gpm. In 1985, withdrawals from the Silurian-Devonian aquifer account for about 15 percent of the total groundwater withdrawn in Illinois (USGS, 1995a).

2.4.13.1.3 Site Hydrogeologic Systems

The hydrogeologic systems in the site area consist of alluvial deposits along Salt Creek and North Fork of Salt Creek, glacial drift, glacial outwash in the buried Mahomet Bedrock Valley, and Pennsylvanian-age bedrock. General occurrence and characteristics of yield, recharge, and discharge of these systems are discussed in the previous section. The data presented in this section are mainly based upon site investigations conducted for the CPS Facility and are summarized in the CPS USAR (CPS, 2002). In July and August 2002, a limited geological investigation was conducted within the proposed area of the plant to confirm that the underlying subsurface conditions are consistent with those presented in the CPS USAR.

Alluvial deposits (Henry Formation) were encountered in the vicinity of the UHS for the CPS Facility consisting of fine-grained floodplain deposits overlying coarse-grained outwash. Illinoian till (Glasford Formation) underlies the alluvial deposits. The floodplain deposits are commonly silt with some fine sand and clay, whereas the outwash deposits are sand and gravel with varying amounts of silt or clay. The total thickness of the alluvial deposits varies from 6 ft to 48 ft in the UHS borings, and it averages about 18.5 ft. Floodplain deposits range to a maximum thickness of 23 ft and averages about 9 ft. Outwash deposits range to a maximum of 41 ft thick and averages about 9 ft thick; the thickest outwash deposits are located over an apparent terrace on the north side of the valley. Outwash deposits were observed to be continuous in the foundation excavation for the UHS dam. The base of the outwash that was observed in the borings ranges in elevation from 650.5 ft above msl to 678.3 ft above msl, with the most frequently reported base elevations in the interval between 657 ft above msl and 667 ft above msl. Permeability tests were not performed in the UHS borings. However, based upon the results of particle-size analyses for samples from the borings, the permeability of the outwash deposits is approximately 10^{-3} to 10^{-2} cm/sec (2.8 to 28 ft/day). There were no known domestic or farm supply wells in the alluvial deposits in the CPS Facility's UHS area (CPS, 2002).

The CPS Facility excavation exposed the sequence of glacial drift consisting of the Wisconsinan-age Richland Loess, Wedron Formation, and Robein Silt; and the Illinoian-age Glasford Formation. Based on the CPS Facility's borings, the elevation of the top of the Illinoian deposits averaged 698 ft above msl. Fifteen deep borings in the CPS Facility and UHS areas encountered lacustrine deposits and Kansan-age till beneath the Illinoian drift at an average elevation of 572 ft above msl. The total thickness of the glacial drift in the CPS Facility area varies from 230 ft to 250 ft and averages about 237 ft (CPS, 2002). The lithologies of these stratigraphic units are summarized in Table 2.4-17.

Several discontinuous sand lenses, ranging in thickness from several in to 22 ft, were encountered by the CPS Site borings between an elevation of 650 ft above msl and 730 ft above msl. The CPS Facility excavation that extended to an elevation of about 680 ft above msl penetrated some of these lenses. The majority of the sand deposits encountered are discontinuous pockets or lenses. The one exception is a nearly continuous layer of fine sand near the top of the Wedron Formation. Sand is reported at the same position in most of the borings around the plant except those within the triangular area formed by the UHS baffle dike abutment, the screen house, and the southwest corner of the excavation. In general, the base of the sand layer slopes from an elevation of 723 ft above msl at the western limit of the excavation to an elevation of 716 ft above msl on the slope above the cooling lake. In borings, between the excavation and the cooling lake, the thickness of the sand layer varies from 2.0 ft to 16.5 ft. The remainder of the sand deposits encountered occurred as discontinuous seams and localized pockets within the tills of the Wedron and Glasford Formations (CPS, 2002).

Four additional soil borings were advanced in July and August 2002, within the footprint for EGC ESP Facility. These borings confirm that the general stratigraphic sequence depicted in Figure 2.4-24 continues south of the CPS Facility. Two of these borings extend into the Pennsylvanian bedrock. In these borings, unconsolidated deposits encountered include the Richland Loess, the Wedron Formation (Wisconsinan glacial till and outwash), the Robien Silt (Interglacial Zone), the Glasford Formation (Illinoian glacial till and outwash), lacustrine deposits, the Banner Formation (pre-Illinoian glacial till and outwash), and pre-Illinoian alluvial deposits. The continuous fine sand deposit noted in previous site borings near the top of the Wedron Formation apparently continues south of the CPS Facility, tapering out to the southeast. The top of the Glasford Formation drops toward the south, to an average elevation of 678 ft above msl in the four additional borings. Lacustrine deposits were encountered below the Glasford Formation at elevations (566 ft above msl and 574 ft above msl) consistent with previous site borings. Pre-Illinoian alluvial deposits, consisting of interbedded silts, clays, sands, and gravels, were encountered above the top of the bedrock.

The additional borings indicate that the bedrock surface dips to the south of the CPS Facility, from west to east. The top of bedrock was encountered at elevations of 446 ft above msl and 448 ft above msl in these borings, approximately 35 ft lower than at previous site borings to the north and west. This bedrock valley is filled with pre-Illinoian alluvial deposits. The upper 20 ft to 30 ft of bedrock was cored, and consists of interbedded shale, limestone, and siltstone. A 1 ft thick layer of coal was encountered in one coring.

2.4.13.2 Sources

2.4.13.2.1 Present and Future Groundwater Use

Public water supplies in the regional area are derived mainly from groundwater sources. The ISGS GIS database was used to identify water supply and water wells within a 15 mi radius of the site (ISGS, 2002). These wells are shown in Figure 2.4-25.

The CPS USAR reported that within 15 mi of the site, approximately 65 percent of the total public groundwater supplies are pumped from the Mahomet Bedrock Valley aquifer. Except for the alluvial wells at Heyworth, the remaining public water supplies are pumped from wells in the Wisconsinan, Illinoian, and Kansan glacial deposits. Bedrock wells are not used in any of the public water supply systems within 15 mi of the site (CPS, 2002).

The database, maintained by the ISGS, identifies approximately 179 water wells and 18 water test holes within 5 mi of the site. Approximately 40 percent of the records, for many of these wells, were filed before 1980 and a substantial number may no longer be in use. The available data indicate that the depths of the water wells and water test holes range from 36 ft to 413 ft below ground surface. Four wells with depths greater than 400 ft, 12 water wells, and two additional water test holes are owned by Clinton Power Station and occur within a 5 mi radius of the site (ISGS, 2002). The USAR identifies a small test well located about one mile south of the CPS site, 120 feet southeast of the CPS test well, that will be used as a water supply well for the village of DeWitt (see Figure 2.4-26). The well is about 340 feet deep and the produces water from the sand and gravel deposits of the buried Mahomet Bedrock Valley at a depth of 300 to 340 ft (CPS 2002).

Most of the domestic wells are less than 150 ft deep and produce from sand lenses in the upper glacial tills rather than from the deeper Mahomet Bedrock Valley aquifer. Production exceeded 10 gpm in only a few cases. With the exception of wells used by tenant farmers or for monitoring, wells on the site property were abandoned and sealed in accordance with applicable state requirements during plant construction (CPS, 2002).

The area within 15 mi of the site includes most of DeWitt County and portions of Macon, McLean, and Piatt counties (see Figure 2.4-25). Available groundwater supplies for DeWitt County exceed 39 mgd (CPS, 2002). In 1995, public groundwater withdrawals totaled 1.48 mgd in DeWitt County; see Table 2.4-18 (USGS, 1995b). The USGS reported in 1995 that the rural groundwater use in the county was approximately 0.4 MGD. This indicates that the present water demands are less than 2 mgd, or approximately 5 percent of the total available supplies. Thus, groundwater is capable of meeting any foreseeable increase in water demand in DeWitt County. Similar conclusions may be drawn for the rest of the regional area since the hydrogeologic and population characteristics of the other counties are similar to those for DeWitt County.

2.4.13.2.2 Regional Hydrogeologic Conditions

The Wisconsinan formations are generally composed of fine-grained sediments with only shallow and very localized deposits of sand and gravel. Thus, they are poor sources of groundwater. The water table in the upper (Wisconsinan) glacial deposits generally occurs within a few feet of the ground surface. Groundwater levels are deepest over topographically high areas and shallowest in topographically low or flat areas. Groundwater levels have been measured regionally by the ISWS in a statewide network of observation wells. The water table in wells, finished in Wisconsinan deposits, varies from 2 ft to 19 ft below the ground surface. Seasonal fluctuations in individual observation wells range from 1.5 ft to 12 ft and averages approximately 5 ft. Water levels are highest during spring when conditions are most favorable for recharge from precipitation. The water table falls from the spring peak during late spring, summer, and early fall when discharge by evapotranspiration and groundwater runoff exceeds recharge from precipitation. Regional groundwater movement on the Wisconsinan till plain is generally west and southwest toward the Illinois River, under a hydraulic gradient of approximately 2 ft/mi or 3 ft/mi. The water table is locally deflected and steepened toward stream courses that cross the till plain, and are tributaries to the Illinois River (CPS, 2002).

Reversals in the regional hydraulic gradient and regional declines in the potentiometric surface have resulted from intensive pumping in the heavily urbanized Champaign-Urbana district, 32 mi to the east, where pumpage is from the Mahomet Bedrock Valley aquifer. Although no positive evidence of these effects was identified in the CPS USAR for DeWitt County, declines may eventually occur in the eastern portion of the county if pumpage continues to increase in the Champaign-Urbana district (CPS, 2002). These declines will probably not be significant at the site and no changes in the local pattern of groundwater movement are expected to occur.

In DeWitt County, reversals in the hydraulic gradient may also be expected to occur in response to pumping from the City of Clinton municipal well field. Lower potentiometric levels within the cone of influence induce higher recharge rates to the Mahomet Bedrock Valley aquifer. In turn, this may cause potentiometric levels in the overlying aquifers to decline slightly within the cone of influence. However, the cone of influence associated with the City of Clinton municipal well field is much smaller than the cone developed around Champaign-Urbana because pumping at Clinton totals less than one-tenth of that at Champaign-Urbana. The cone of influence at Clinton is likely limited to an area within a few miles of the well field and will have little, if any, effect on groundwater levels at the site. In addition, the main plant borings indicted the buried Mahomet Bedrock Valley is not present beneath the site (CPS, 2002).

2.4.13.2.3 Site Hydrogeologic Conditions

Configuration of the water table in the immediate vicinity of the site was established by measuring water levels in piezometers installed in selected borings during the CPS Site investigations conducted in 1972 and 1973. Additional piezometers were installed in 1976 around the lake during construction (OW-1 through OW-8) and downstream from the dam in 1977 and 1979 (OW-9 through OW-24). Some of the piezometers having been destroyed by construction activities are no longer functional (CPS, 2002). A summary of the installation dates, tested intervals, and status of the piezometers is presented in Table 2.4-19.

Based on the data presented in the CPS USAR, the groundwater table in the upper glacial deposits (Wisconsinan) generally occurs a few feet below the ground surface (CPS, 2002). The highest groundwater level in the CPS Facility area measured during previous investigations was at an elevation of 729.7 ft above msl. The design ground water level for the EGC ESP Site is taken as 730 ft above msl. The water table in the vicinity of the CPS Facility occurs as a ridge-like mound in the Wisconsinan till between Salt Creek and North Fork of Salt Creek (see Figure 2.4-26). The position of the groundwater ridge marks a recharge area from which groundwater flows to the southeast toward Salt Creek and to the northwest, across the plant site, toward North Fork of Salt Creek. The magnitude of the hydraulic gradient at the plant site is approximately 0.09 ft/ft, or 450 ft/mi. This value is based upon a maximum head loss of 55 ft over a minimum distance of 640 ft from the plant site to the edge of the floodplain of North Fork of Salt Creek (CPS, 1982).

Prior to impoundment of the cooling lake, North Fork of Salt Creek served as the local base level for groundwater flow from the plant area to the floodplain. Impoundment of the cooling lake has raised the base level to an elevation of 690 ft above msl, causing the groundwater-surface water interface to shift to the southeast toward the plant (CPS, 1982).

Groundwater exists under water table conditions in the Wisconsinan till and under confinement in the underlying Illinoian and Kansan tills. Piezometer levels measured for the CPS Site investigation ranged from 675 ft above msl to 717 ft above msl and averaged at an elevation of about 713 ft above msl in the Illinoian till. In addition, the piezometer levels measured approximately at an elevation of 680 ft above msl in the Kansan till over a three yr period of observation in the late 1970s. The potentiometric level in the Kansan outwash deposits of the buried Mahomet Bedrock Valley, as measured in the CPS Facility's test well, was at an elevation of approximately 600 ft above msl (CPS, 2002). The head relationships between the Wisconsinan, Illinoian, and Kansan aquifers indicate that the glacial drift aquifers are recharged by vertical seepage from the overlying drift under a net downward hydraulic gradient (CPS, 2002).

Three additional piezometers were installed southwest of the CPS Facility in July of 2002. Two of these piezometers were completed in the upper Wisconsinan glacial deposits (Wedron Formation), and the third was completed in the upper Illinoian glacial deposits (Glasford Formation). In these additional piezometers, water table elevations in the Wedron Formation were between 727.5 ft above msl and 733.5 ft above msl, and the piezometric head elevation in the Glasford Formation was approximately 711 ft above msl. These measurements are generally consistent with groundwater elevations observed in previous site investigations. The design ground water level for the EGC ESP Site is taken as 733.5 ft above msl.

A correlation between daily precipitation volumes and groundwater elevations in site piezometers is not evident from a qualitative review of the figures presenting this data in the CPS USAR. "Typical" seasonal variations (higher groundwater levels in the spring, lower groundwater levels in the fall and summer) are also not apparent. These conditions are consistent with the fine-grained nature of much of the glacial drift that inhibits groundwater flow and, therefore, recharge velocity.

Some groundwater in the upper glacial drift deposits are discharged into streams from springs present within the general vicinity of the CPS Facility and Clinton Lake. As part of the CPS site investigations, a survey was conducted by use of air photo interpretations, field reconnaissance, and personal interviews with local farmers in order to locate springs in the vicinity of the site. The springs found during this survey are shown in Figure 2.4-27. None of these springs are currently being used as a potable water supply (CPS, 2002).

Falling-head and constant-head-type permeability tests were performed in the laboratory on representative soil samples of the Salt Creek Alluvium (Henry Formation), the interglacial zone (weathered material at the top of Illinoian deposits and the bottom of the Wisconsinan till deposits), and the Illinoian glacial till (the Glasford Formation). The tests resulted in measurements of the vertical permeability of each soil formation. The results of these tests are presented in Table 2.4-20. Only one sample of the Salt Creek Alluvium was tested, the results of which indicate a vertical permeability of 1.0E-08 cm/sec (5.1E-05 ft/day) for the fine-grained floodplain deposits; the underlying outwash was not tested. Vertical permeability of sand samples from the interglacial zone (weathered portion of the Glasford

Formation) averages 2.1E-03 cm/sec (6 ft/day), ranging from 1.8 E-04 cm/sec (0.5 ft/day) to 4.7E-03 cm/sec (13 ft/day). In the Illinoian deposits (unaltered Glasford Formation), the vertical permeability ranges from 3.8E-09 cm/sec (1.1E-05 ft/day) to 2.3E-07 cm/sec (6.5E-04 ft/day), and averages 3.8E-08 cm/sec (1.1E-04 ft/day). Also presented in Table 2.4-20 is an estimate of the porosity for each sample. The porosity was calculated using laboratory data that included degree of saturation, wet density, moisture content, and an assumed specific gravity (CPS, 2002).

During the CPS site investigations, falling-head-type field permeability tests were also performed on samples collected from the Clinton Lake Dam Site and the CPS Site. The tests were performed in piezometers to estimate average horizontal permeability within the zone of percolation in the borehole, and the results are provided in Table 2.4-21. Average horizontal permeability values range from 1.5E-06 cm/sec (3.4E-03 ft/day) to 2.6E-06 cm/sec (0.01 ft/day) in the Wisconsinan till and 6.1E-06 cm/sec (0.02 ft/day) to 1.4E-05 cm/sec (0.04 ft/day) in the Illinoian till (CPS, 2002).

Using a hydraulic conductivity of 2.6E-06 cm/sec (0.01 ft/day) from field hydraulic conductivity testing of the Wisconsinan till, a water table gradient of 0.086, and an assumed porosity of 0.25 (based on one value provided for the Wisconsinan till in the USAR report (CPS, 2002); the estimated average linear groundwater velocity for the upper portion of the Wisconsinan till is 2.5E-03 ft/day. Additional laboratory data for Wisconsinan glacial till and Mahomet Bedrock Valley Outwash are provided in Tables 2.4-22 and 2.4-23, respectively.

2.4.13.3 Accident Effects

Following the approach used in the CPS USAR (CPS, 2002), the potential impact of a postulated accidental release of radioactive liquids is evaluated assuming that coincident with the failure of the tank, the walls and foundation of the cubicle in which the tank is located develop cracks through which direct communication is established between the interior of the building and the surrounding groundwater environment. The level of radioactive liquids in the building would have to exceed the groundwater level at the plant before seepage out of the building could occur.

The USAR indicates that the design basis for hydrostatic loading on the power plant foundation for the CPS of 730 ft above msl is based on the highest groundwater level (729.7 ft above msl) measured in the Wisconsinan deposits during site investigations. The water table in individual wells, finished in Wisconsinan deposits, was observed to vary seasonally from 1.5 ft to 12 ft and averaged approximately 5 ft (CPS, 2002). Based on the maximum seasonal variation reported in the CPS USAR of 12 ft, the lowest water levels in the Wisconsinan deposits encountered were at about elevation 718 ft above msl or about 18 ft below the CPS grade elevation of 736 ft above msl. Grade elevation for the EGC ESP Facility is approximately 735 ft above msl. Similar, to the existing Clinton Power Facility, this conservative (lower) groundwater elevation is expected to be higher than the fluid level inside the EGC ESP Facility buildings where radioactive liquids are collected and stored. Therefore, there would be no hydraulic gradient from the interior to the outside and rather than fluids leaking out, groundwater would be forced into the building to relieve the prevailing hydrostatic pressure. Thus, it is extremely unlikely that any radioactive liquids would be released to the surrounding groundwater environment.

Based on the maximum embedment depth of up to approximately 140 ft (elevation 595 ft above msl), a portion of the power plant foundation will be in the Illinoian till. Groundwater in the Illinoan till exists under confined conditions with piezometer levels measured during the CPS Site investigation with elevations from 675 ft above msl to 717 ft above msl, with an average of 713 ft above msl. Thus, piezometric levels in the deeper formations will also limit the potential for radioactive liquids to seep out of the lower portions of the building.

If liquid waste storage tanks are located in structures above grade, it is assumed following a postulated tank failure that the contents would ultimately reach the lower elevations of the buildings and would also be contained therein due to high ambient groundwater level.

For tanks located outside of structures which potentially contain radioactive fluids, positive means to collect and prevent uncontrolled releases such as dikes and collection basins will be provided, thereby, eliminating them from consideration as a source for groundwater contamination.

2.4.13.4 Monitoring

Groundwater levels in the vicinity of Clinton Lake and the CPS Facility have been monitored intermittently since site investigations began in 1972. The present groundwater monitoring system is described in Section 2.4.13.2.3. A Pre-application Monitoring Program for groundwater will be used to support the assessment of site acceptability and to identify the groundwater system impacts that could result from construction and operation of the EGC ESP Facility. A Construction Hydrologic Monitoring Program for groundwater will monitor and provide for control of anticipated impacts from site preparation and construction and to detect any unexpected impacts arising from the construction activities. A Preoperational Monitoring Program will provide the database for evaluating hydrologic changes arising from the operation of the EGC ESP Facility. A limited Operational Hydrologic Monitoring Program will be implemented in order to establish the impacts to the groundwater system from the operation of the EGC ESP Facility and detect any unexpected impacts from plant operation.

2.4.13.5 Design Bases for Subsurface Hydrostatic Loading

Grade elevation for the EGC ESP Facility is approximately 735 ft above msl. The groundwater level site characteristic at the EGC ESP Site is established as 733.5 ft above msl (See Section 2.4.13.2.3) or 1.5 ft below grade (see Table 1.4-1, Section 1.4.2).

2.4.14 Technical Specification and Emergency Operation Requirements

The EGC ESP Facility, together with its associated safety-related facilities, will be designed to function and shutdown in a safe manner despite the occurrence of any of the adverse hydrological events discussed in the preceding sections. Therefore, technical specifications outlining emergency procedures for plant shutdown due to hydrological conditions are not expected to be necessary.

2.5 Geology, Seismology, and Geotechnical Engineering[1]

2.5.1 Site and Regional Geology

This section of the SSAR presents a summary of the regional and site geology for the EGC ESP Site based on the results of a review of published literature dealing with regional and site geology for the area. The intent of this review is to address paragraph (vi) within 10 CFR 52.17 which requires "the seismic, meteorological, hydrologic, and geologic characteristics of the proposed site be provided in the proposed application." As required by paragraph (c) of 10 CFR 100.23, the geologic characteristics of the EGC ESP Site are described:

- to allow an adequate evaluation of the proposed site,
- to provide sufficient information to support evaluations performed to arrive at estimates of the Safe Shutdown Earthquake Ground Motion, and
- to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site.

In addition and in accordance with paragraph (d) of 10 CFR 100.23, the discussions in Sections 2.5.1.1 and 2.5.1.2 also cover geologic characteristics related to the evaluation of surface tectonic and nontectonic deformations, the design bases for seismically induced floods and water waves, and other design condition.

The EGC ESP Site is located within 700 ft of the CPS Site. In view of the proximity of the EGC ESP Site to the CPS Site, the starting point for the evaluation of regional and site geology was Section 2.5.1.1 and Section 2.5.1.2 of the CPS USAR – covering regional and site geology, respectively. Following the guidelines set forth in Regulatory Guide 1.132 (USNRC, 1979) and Regulatory Guide 1.165 (USNRC, 1997), an evaluation of the existing information and newly published information was conducted. Results of this evaluation are summarized in this section of the SSAR and discussed in more detail within Section 5.1 of Appendix A - *Geotechnical Report for the EGC ESP* and within Section 2.1 of Appendix B – *Seismic Hazard*

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1 **Preface to Section 2.5**

The approach taken in Section 2.5 of the SSAR involves summarizing results of the work completed for the EGC ESP Site in Section 2.5 and presenting details in two appendices. This approach was taken because of the large amount of information developed as part of the EGC ESP application. Much of the information for Section 2.5 was developed to support the update of a probabilistic seismic hazard analysis (PSHA) that was conducted for the adjacent CPS Site in the mid-to-late 1980s (EPRI, 1989-1991). The PSHA for the CPS Site was updated as part of the EGC ESP application, in accordance with Regulatory Guide 1.165 (USNRC, 1997). Rather than presenting the details for the update in the main text of this SSAR, supporting details are given in the two appendices, and the presentation in Section 2.5 is limited to summaries of the methodologies followed and the conclusions reached in the areas of geology, seismology, and geotechnical engineering.

Either of two appendices to Section 2.5 of the SSAR should be consulted for details related to Section 2.5 of the EGC ESP application. The first appendix (Appendix A – *Geotechnical Report for the EGC ESP*) covers field explorations, laboratory testing, and engineering analyses completed as part of the EGC ESP Site work. The geotechnical work was conducted in support of the seismic hazard evaluation and to demonstrate similarity in geologic conditions between the EGC ESP and CPS Sites. The second appendix (Appendix B - *Seismic Hazard Report for the EGC ESP*) provides full details for the seismic hazard analyses. These details include updates to seismic source characterization information, ground motion models, rock spectra, ground surface spectra, and design basis spectra.

Report for the EGC ESP. These discussions support a conclusion that both the regional geology and the site geology at the EGC ESP Site are suitable for development and operation of a new EGC ESP Facility.

2.5.1.1 Regional Geology

The regional geologic information in Section 2.5.1.1 of the CPS USAR, as well as literature published since the preparation of the CPS USAR (which is discussed more fully in Section 2.1 and 3.1 of Appendix B), indicate that the EGC ESP Site location in north central United States is one of the most geologically stable areas in the United States. The regional processes that led to current geologic conditions at the EGC ESP Site were the same as those at the CPS Site, and these conditions have remained much the same since the end of the last glaciation.

The available information indicates that the regional surface geology is dominated by relatively thin deposits of Quaternary glacial drift. During the Quaternary, widespread glacial deposition occurred in the regional area, as a result of continental glaciation. The Quaternary deposits are classified as part of the Pleistocene Series. The deposits consist predominantly of glacial or glacially-derived sediments of glacial till, outwash, loess (a wind-blown silt), and glaciolacustrine deposits, as well as alluvium. The same general depositional process would have occurred at the EGC ESP Site as at the CPS Site resulting in the same stratigraphic sequence. As discussed subsequently, results of explorations into rock located nearly 300 ft below the ground surface confirm the similarity in soil deposits at the EGC ESP Site and the CPS Site.

Past evaluations of the regional geology for the area have concluded that there were four major periods of glaciation during the Pleistocene time in the regional area. From youngest to oldest, these periods are known as the Wisconsinan, Illinoian, Kansan, and Nebraskan Stages. Wisconsinan deposits are found throughout the EGC ESP and CPS Sites. Illinoian age deposits are present beyond the limit of Wisconsinan glaciation in northern and central Illinois. Illinoian age deposits are also found beneath the Wisconsinan drift cover. Kansan and Nebraskan age glacial deposits are present at the surface and in the subsurface in areas of Iowa, Missouri, and parts of western and east-central Illinois. These glacial periods resulted in significant ice loading to surficial sediments at the EGC ESP and CPS Sites, which has served to reduce local variations in certain soil properties (for example, soil density, void ratio, and overconsolidation ratio) that influence seismic wave propagation and foundation stability.

The available literature also indicates that most of the regional Quaternary glacial materials are underlain by thick sequences of gently dipping Paleozoic sedimentary rock, although Mesozoic and Cenozoic age deposits lay above Paleozoic rock in a few areas in the Mississippi Embayment, western Illinois, eastern Missouri, and southern Indiana. The bedrock surface throughout much of Illinois is of Paleozoic-age, Pennsylvanian bedrock that ranges from hundreds to thousands of feet in thickness. The Paleozoic sedimentary rock sequence is punctuated by several unconformities of regional importance, reflecting widespread advances and withdrawals of the Paleozoic seas across the interior of North America. Older Paleozoic bedrock up to thousands of feet thick underlay Pennsylvanian bedrock. The thickness of bedrock sequences is dependant on original deposition and subsequent erosion, and Paleozoic bedrock is significantly thicker at the center of structural basins such as the Illinois Basin. Beneath the Paleozoic is a basement complex of Precambrian igneous and metamorphic rock. Basement Precambrian igneous rock is found from 2,000 to 13,000 feet below the ground surface.

Intermittent slow subsidence and gentle uplift through the Paleozoic have resulted in broad regional geologic basins of gently dipping sedimentary rocks, and intervening broad arches or highs. Locally, folds and faults have been superimposed on this pattern. The CPS and EGC ESP Sites are located on the northwest flank of the Illinois Basin, slightly west of the LaSalle Anticlinal Belt or the LaSalle anticlinorium (Figure 2.5-1).

The review of recent literature also determined that there has been no significant change in the understanding of the regional geology in the area since the first regional geologic studies were completed for the CPS Site. More recent information has become available for the Mahomet Bedrock Valley. This information indicates that glacial materials proximate to the site are dominated by fine-grained silts and clays. Therefore, conditions are consistent with geologic profiles described in the CPS USAR and encountered during explorations at the EGC ESP Site.

It was concluded from the review of the regional geology information in the CPS USAR and in more recent publications for the general region that there are no regional geologic conditions, other than seismicity, which constitute a hazard that could affect construction or operation of the EGC ESP Facility. From a regional geologic standpoint, the site is judged suitable for the proposed development.

2.5.1.2 Site Geology

The ground surface topography in the vicinity of the EGC ESP Site is relatively flat, ranging from approximately 730 to 740 ft above mean sea level (msl). The closest distance to Clinton Lake is approximately 800 ft northwest of the EGC ESP Site. Generally, the ground surface at the site is covered by grasses and small bushes, and is transected by a grid of gravel access roads and associated drainage ditches. Localized clusters of small trees are present in some areas. The site is currently clear of construction, except for a fenced-in storage yard and a buried power line. Some remnants of surface grading, filling, and building demolition operations from the construction of the CPS Facility are present at the EGC ESP Site.

The available information in the CPS USAR and the new information collected and reviewed as part of the EGC ESP Site evaluation confirmed that the EGC ESP Site is located in a tectonically stable area of North America. There is no evidence of surface faulting within 25 mi of the EGC ESP Site. Additional discussion of active faulting for the project region is summarized in Section 2.5.3 of this SSAR and described in detail in Chapter 5 of Appendix B.

Approximately 170 to 360 ft of Quaternary deposits overlie an irregular Pennsylvanian bedrock surface within the general CPS and EGC ESP Site areas. The bedrock is largely erosional in origin and characterized by valleys (such as the Mahomet Bedrock Valley) and uplands that developed before glacial time. Similar to the CPS Site, the EGC ESP Site is located a few miles inside the limits of the Wisconsinan glaciation, and is located in the Bloomington Ridged Plain physiographic subsection of the Till Plains section in Central Illinois (Figure 2.5-2).

Surficial deposits in the upland areas consist of a veneer of Richland loess over glacial till of the Wedron Formation, both of the Woodfordian substage of the late Wisconsinan Stage. Other stratigraphic units in the upland area, with increasing depth, consist of the organic Robien silt (of the Farmdalian substage of the Wisconsinan Stage), reworked and weathered Glasford Formation glacial till of the Illinoian Stage (also referred to as the Sangamonian substage Interglacial Zone on CPS Site borehole logs), and unweathered Glasford Formation till. Beneath the Glasford Formation lie Yarmouthian Stage lacustrine deposits and pre-Illinoian Stage glacial tills (Figure 2.5-3).

In areas of low bedrock elevation in the vicinity, sandy glacial outwash of the Kansan Stage (likely the Mahomet Sand Member of the Banner Formation) is present above bedrock. However, because of a local bedrock high, the Mahomet sands are not present at the EGC ESP and CPS Sites. Rather, fine-grained alluvial soils associated with pre-Illinoian glaciations are typically present in immediate contact with bedrock.

With the exception of the upper few tens of feet, soils have been subjected to ice loads from glaciations. These loads have compressed the soils, resulting in a very hard or dense consistency of the soil. Both the EGC ESP and CPS Sites have been affected similarly by the glacial loading.

Bedrock in the vicinity of the EGC ESP and CPS Sites is Pennsylvanian age, and belongs to the Bond and Modesto Formations of the McCleansboro Group. These formations generally consist of alternating bands of limestone, shale, siltstone, sandstone, and some coal seams. The base of the Bond Formation is marked by the Shoal Creek Limestone Member, which corresponds to the top of the Modesto Formation at an approximate elevation of 495 ft msl at the CPS Site. The No. 8 Coal Member within the Modesto Formation was encountered as a 1-ft thick layer at borehole P-38 during the original CPS Site investigation (at an elevation of 431 ft msl).

The long-term location of groundwater is approximately 30 ft below the ground surface at the EGC ESP Site, similar to the CPS Site. Groundwater is also encountered perched on low-permeability layers within the upper 30 ft of soil profile. The location and thickness of the perched layers vary according to the time of year and surface topography. Additional discussions of groundwater are presented in Section 2.4 .13 of this SSAR and in Section 2.4 of the CPS USAR.

More detailed descriptions of the site physiography, stratigraphy, structural geology, surficial geology, geologic history, groundwater conditions, and geologic considerations are summarized in Sections 2.1 and 5.1 of Appendix A and in Section 2.5.1.2 of the CPS USAR. The information in Appendix A includes results of the EGC ESP Site evaluation of published literature that has been written since the original site geology work was completed for the CPS Site. This newer literature includes geologic hazard reports prepared by the Illinois State Geological Survey (ISGS) for DeWitt and surrounding counties, as well as soils information obtained by drilling and sampling four boreholes within the footprint of the EGC ESP Site[2]. Results of the soils exploration were also reviewed and compared to geologic descriptions that are given for the CPS Site. During the review of published

2 Results of field explorations conducted for the EGC ESP Site are summarized in Section 2.5.4.3 of this SSAR and described in detail in Appendix A.

geologic information, particular emphasis was placed on identification of new geologic hazards that may have been reported in the area since the publication of the CPS USAR in the 1970s.

It was concluded from the review of site geology for the EGC ESP Site that:

- The physiography of the EGC ESP Site is the same as the CPS Site. As noted above and in the discussion in Appendix A, the sites are within 700 ft of each other and the ground surface is relatively level. Therefore, similar physiography is to be expected.
- Site stratigraphy across the EGC ESP and CPS Sites is very similar in terms of soil consistency and layering. The primary difference between the two sites is that the depth to bedrock is approximately 50 ft deeper at the EGC ESP Site than at the CPS Site. Otherwise, the overburden and bedrock formations are the same.
- The understanding of site geologic history has not changed since the original site geology work was done for the CPS Site. This history indicates that most of the soil profile was formed during past glaciations, and much has been over-ridden by the glaciers, resulting in very hard or dense soil conditions.
- Site groundwater conditions are consistent with previous reports that have been prepared since the filling of Clinton Lake. The groundwater piezometric surface within the Illinoian till is approximately 30 ft below the ground surface, and perched groundwater is located above this depth.
- There are no other geologic considerations, such as karst terrain, mine subsidence, natural gas and oil field production, groundwater springs, and landslides that pose a hazard to the construction or operation of a new generating system at the EGC ESP Site.

These conclusions indicate that no geologic conditions were found at the site that result in a hazard which could affect construction or operation of the EGC ESP Facility. From a site geology point-of-view, the site is judged suitable for the proposed development.

2.5.2 Vibratory Ground Motions

An evaluation of vibratory ground motions was made for the EGC ESP Site to estimate the SSE for the site. This evaluation was performed to address seismic hazard update requirements in Regulatory Guide 1.165 (USNRC, 1997) and to meet the SSE requirements given in paragraph (d) of 10 CFR 100.23. Later sections of this SSAR address the potential for surface tectonic and nontectonic deformations, the design bases for seismically induced floods and water waves, and other design conditions, as also required in paragraph (d) of 10 CFR 100.23.

Regulatory Guide 1.165 provides the framework for assessing the appropriate SSE ground motion levels for new power generating plants. As noted in Regulatory Guide 1.165, an acceptable starting point for the SSE assessment at sites in the central and eastern United States (CEUS) is the PSHA conducted by the Electric Power Research Institute (EPRI) for the Seismicity Owners' Group (SOG) in the 1980's. Regulatory Guide 1.165 further specifies that the adequacy of the EPRI-SOG hazard results must be evaluated in light of more recent data and evolving knowledge pertaining to seismic hazard evaluation in the CEUS.

Appendix E, Section E.3 of Regulatory Guide 1.165 outlines a three-step process for the seismic hazard evaluation:

Step 1: Evaluate whether recent information suggests significant differences from the previous seismic hazard input characterizations developed for the EPRI-SOG PSHA study.

Step 2: If potentially significant differences are identified, perform sensitivity analyses to assess whether those differences have a significant impact on the site hazard.

Step 3: If Step 2 indicates that there are significant differences in the site hazard, then the PSHA for the site is revised by either updating the previous calculations or, if necessary, performing a new PSHA. If not, the previous EPRI-SOG results may be used to assess the appropriate SSE ground motions.

Implementation of the three-step process at the EGC ESP Site included a review of literature published since completion of the EPRI-SOG hazard analysis in the mid-to-late 1980s. An evaluation of the EPRI-SOG PSHA seismic source characterizations consistent with Step 1 using the results of the literature review identified the need for changes in some the EPRI-SOG expert teams' seismic source characterization parameters. Sensitivity analyses were conducted consistent with Step 2 to evaluate the potential effects of the new information on the site hazard. These sensitivity analyses showed a change in the hazard, warranting an update to the SSE. The update was needed to address new information identified as significant in Step 2. As part of the development of the updated SSE ground motion, a new ground motion model for the CEUS was used, and site-specific response analyses were conducted to obtain surface SSE ground motions that are hazard-consistent with motions derived from the updated PSHA at rock level.

The following subsections summarize the procedure followed and results from the vibratory ground motion studies that were carried out for the EGC ESP Site. Additional details for each component of these seismic hazard evaluations are provided in Appendix B. Supporting information about the geotechnical conditions at the site, including the results of field explorations and laboratory testing is provided in Appendix A.

As discussed below in Section 2.5.2.6, the SSE spectra for the EGC ESP site are developed using the graded performance-based, risk-consistent method described in ASCE Standard 43-05 (ASCE, 2005)[3]. The method specifies the level of conservatism and rigor in the seismic design process such that the performance of structures, systems, and components (SSCs) of the plant achieve a uniform seismic safety performance consistent with the NRC's safety goal policy statement (USNRC, 1986; USNRC, 2001a). This approach for development of the site SSE design response spectra is discussed in detail in Section 2.5.4.9.

2.5.2.1 Seismicity

The starting point for the development of a current earthquake catalog relevant to the EGC ESP Site was the EPRI-SOG study (EPRI, 1989-1991). The earthquake catalog used in the

[3] ASCE Standard 43-05 (2005) provides a detailed methodology and commentary on procedures required to achieve risk-consistent seismic design of SSCs for nuclear facilities. This Standard is a national consensus standard developed by the Dynamic Analysis of Nuclear Structures Subcommittee of the Nuclear Standards Committee of the American Society of Civil Engineers. The Dynamic Analysis Subcommittee comprises a group of leading designers, researchers, owners, and regulatory staff who are involved in the design and operations of nuclear facilities.

EPRI-SOG study covered the time period from 1777 to the beginning of 1985 within the region of the EGC ESP Site. This earthquake catalog is plotted on Figure 2.5-4.

For this study, the earthquake catalog was updated using information from the following sources.

- The National Center for Earthquake Engineering Research (NCEER) Earthquake Catalog (1991),
- The United States Geological Survey (USGS) National Hazard Mapping Catalog (1995),
- The Center for Earthquake Research and Information (CERI) New Madrid Catalog (1974 - 8/1/2002), and
- The Council of the National Seismic System (CNSS) Composite Catalog (1985 - 8/1/2002).

An updated earthquake catalog for the EGC ESP Site region was created by adding post-1984 data to the EPRI-SOG catalog. The two principal catalog sources were USGS National Hazard Mapping Catalog (Mueller et al., 1997) for the period of 1985 through June 1995 and the CNSS catalog for the time period of July 1995 through June 2002. Figure 2.5-5 compares the map distribution of earthquakes in the EPRI-SOG catalog to the distribution of earthquakes recorded post 1984. The spatial distribution of earthquakes is very similar for the two time periods. Additional details of this work, including consideration of the CERI New Madrid catalog, are found in Section 2.1.3 of Appendix B.

The catalog update determined that since 1985, two earthquakes larger than magnitude 4.0 have occurred in the study region: (1) a **M** 5.0 earthquake on June 10, 1987 east of Olney, Illinois; and (2) a **M** 4.45 earthquake on June 18, 2002 in southern Indiana near Evansville. Additional information about both earthquakes, including information on the likely focal depths and mechanisms, is discussed in Section 2.1.3 of Appendix B. The focal mechanisms and depths are similar to other earthquakes in the region over the past 28 years.

In addition to updating the EPRI-SOG earthquake catalog for more recent information, an evaluation of prehistoric liquefaction information for evidence of prehistoric earthquakes also was made. This evaluation involved a review of publications dealing with paleoliquefaction[4]. Previous investigations of paleoliquefaction features at sites in the southern Illinois basin and in parts of Indiana, Illinois, and Missouri have identified a number of episodes of paleoliquefaction occurrence that have been interpreted to have been caused by Holocene and latest Pleistocene earthquakes with estimated moment magnitudes of **M** 6 to ~7.8 (Figure 2.5-6). One set of these features located approximately 30 mi southwest of the EGC ESP Site, has been interpreted by scientists involved in these investigations to have been caused by an earthquake centered there between 5,900 and 7,400 yr before present. The magnitude of this earthquake, called the Springfield Earthquake, has been estimated through the evaluation of the spatial distribution of

[4] Paleoliquefaction refers to liquefaction that occurred in prehistoric times. These occurrences are identified by relic liquefaction features, such as sand boils (or blows), dikes, and sills. By establishing the date and geographical distribution of these features, it is possible to estimate the earthquake magnitude that caused the feature.

paleoliquefaction features to range from **M** 6.2 to 6.8 with the most recent estimate based on a revised magnitude-bound relation for the region suggesting a magnitude of approximately **M** 6.3. Evidence for the location, size, and timing of the Springfield Earthquake, as well as other earthquakes, is summarized in Attachment 1 to Appendix B.

This published information on prehistoric seismicity was augmented by a field reconnaissance to search for additional paleoliquefaction features within the near region (that is, approximately 25- to 30-mi radius of the EGC ESP Site). Results of the reconnaissance of paleoliquefaction for the EGC ESP Site are described in Attachment 1 of Appendix B. The primary conclusions from the paleoliquefaction reconnaissance are listed below.

- Evidence for a hypsithermic (post-mid-Holocene) earthquake comparable to the postulated Springfield event was not observed in the study area. Sufficient exposures of pre-hypsithermic (> 6,000 to 7,000 years before present) deposits were observed to demonstrate the absence of paleoliquefaction features indicative of an energy source for a comparable event (estimated to be **M** 6.2 to 6.8) in the vicinity of the site.

- Isolated features of mid-Holocene and latest Pleistocene/early Holocene age were observed in the study area that may be interpreted as evidence of seismically induced paleoliquefaction. Features of probable mid-to-early Holocene age were observed approximately 11.5 to 13 mi from the EGC ESP Site. The small scale of the features and lack of evidence for similar features elsewhere in the area studied suggest either a more distant source (possibly related to one of the previously reported events) or a low magnitude event [at or close to threshold of paleoliquefaction, estimated Modified Mercalli Intensity (MMI) VI or VII]. Radiocarbon ages for samples from one location indicate these features formed after 9,550 ± 40 yr before present.

- Older features were observed approximately 17 mi from the EGC ESP Site. The dike injection features are inferred to be latest Pleistocene to early Holocene in age (<17,000 to 10,000 years before present). Sedimentary and stratigraphic characteristics of host deposits and material source as well as conduit morphology are consistent with a seismic origin for these features. It is estimated that if seismically triggered, clastic dikes observed at this location would imply MMI values of at least VII -VIII at that location.

- Clastic dikes observed in till deposits approximately 29 mi north-northeast of the EGC ESP Site appear to have formed during the latest glacial advance in that region (~ 17,700 ± 1,000 years before present). The triggering event that caused the injection of the clastic dikes at this location is uncertain. Both dewatering related to glacial processes and seismic shaking are viable mechanisms.

- The extensive Mahomet gravel pit exposures provide strong evidence for the absence of strong ground motion that would produce significant liquefaction since deposition of the upper silt approximately 17,000 to 18,000 years before present.

Additional details about the paleoliquefaction reconnaissance carried out for the EGC ESP Site seismic hazard evaluation are given in Section 2.1.4 and Attachment 1 of Appendix B. These details include a discussion of each of the identified features, pictures of the features, results of radiocarbon dating, and criteria for differentiating seismic versus non-seismic liquefaction features.

It was concluded from these evaluations of recent and prehistoric earthquakes that the range of maximum magnitude earthquakes assigned to a random background earthquake in the PSHA for the EGC ESP Site must include events comparable to that estimated for the Springfield earthquake (that is, **M** 6.2 to 6.8).

2.5.2.2 Geologic Structure and Tectonic Activity

This subsection of the SSAR summarizes the geologic structure and activity that could potentially result in seismic-induced, vibratory ground motions at the EGC ESP Site. The summary addresses Regulatory Positions 1 and 2 within Regulatory Guide 1.165 (USNRC, 1997), which requires that investigation of seismic sources be performed within a 200-mi radius of the site. Two major sources of potential earthquakes are located within or just beyond this distance: (1) the New Madrid seismic zone (NMSZ) and (2) the Wabash Valley seismic zone (WVSZ) in southern Illinois and southern Indiana. The New Madrid region was the location of three earthquakes in 1811-1812, which are the largest earthquakes recorded in the CEUS. The Wabash Valley region is a zone of elevated seismicity in which a number of paleo-earthquakes have been identified.

Extensive new data sets have been compiled and interpreted from numerous site-specific and regional studies throughout the CEUS in the time interval since the completion of the EPRI-SOG study. Many of these studies, funded under the National Earthquake Hazards Reduction Program (NEHRP), have focused on the NMSZ and WVSZ. The studies have included extensive paleoliquefaction investigations, acquisition and reprocessing of shallow high-resolution and industry seismic reflection data, paleoseismic trenching and mapping investigations, and seismological studies. These studies have used a variety of techniques to characterize the location, extent, and activity of tectonic features; the location, magnitude, and rates of seismic activity; and the general characteristics of the continental crust throughout the central U.S.

This new information includes identification of new seismic sources as well as revisions to the characterization of previously identified seismic sources. In addition to individual articles, reports, and maps published by state and federal agencies and in professional/academic journals, several major compilations of new data have been published in the past few years. A summary of geologic and geophysical data and seismicity catalogs relevant to the EGC ESP Site is provided in Section 2.1 of Appendix B to this SSAR.

The regional tectonic information shows that the Illinois Basin is in the stable continental region of the North American craton, which is characterized by low rates of historical seismicity (Figure 2.5-4). The Illinois Basin is bounded on the north by the Wisconsin Arch, on the east by the Kankakee and Cincinnati Arches, on the south by the Mississippi Embayment, and on the west by the Ozark Dome and Mississippi River Arch (Figure 2.5-7). Two major structural elements characterize the basin: a cratonic depression and a rift system. Basement elevation ranges from approximately –2,950 ft in the northern part of the basin to –14,100 ft in southeastern Indiana. Section 2.1.1 of Appendix B provides a summary of recent publications describing the major structures in the depression, including the tectonic history and crustal architecture of the southern part of the Illinois Basin as they relate to neotectonic activity in the region. This summary includes discussions of the regional stress fields and present tectonic strains, including the rate of strain accumulation based on geodetic measurements.

The evaluation of the geologic structure and tectonic activity for the EGC ESP Site included a detailed update of structural features (folds and faults) within the site region. The starting point for this review was the CPS USAR, which describes the regional structural geology and provides a description of the important structures (folds and faults) within a 200-mi radius of the site. Results of this update indicate that the general structural picture remains the same, but new information (Nelson, 1995; Kolata and Hildenbrand, 1997; McBride and Kolata, 1999; Harrison and Schultz, 2002*)* is available regarding the style and timing of most recent deformation. Tables 2.1-1 and 2.1-2 of Appendix B list folds and faults in the region (that is, Illinois, Iowa, Missouri, and Wisconsin). These tables provide updated information for those features where evidence of neotectonic activity has been reported, or where new data have implications for seismic source characterization and models relevant to seismic hazard analysis for the EGC ESP Site region. These summary tables identify key features of the fold or fault, such as means of identification, recency of movement, and comparison to information in the CPS USAR. Section 2.1.2 of Appendix B includes detailed discussions of the seismogenic potential of specific features. This information formed the basis of updating the EPRI-SOG study.

2.5.2.3 Correlation of Earthquake Activity with Geology Structure or Tectonic Province

Pursuant to the guidance given in Regulatory Guide 1.165 (USNRC, 1997) and 10 CFR 100.23, a PSHA was selected as the means to determine the SSE and to account for uncertainties in the seismological and geological evaluations for the EGC ESP Site. The probabilistic approach was based on the PSHA conducted by the EPRI for CEUS in the mid-to-late 1980s (EPRI, 1989-1991) – updated to include new information that has become available since the EPRI study, as required by Regulatory Guide 1.165. Sections 2.1.5.1 and 2.2.1 of Appendix B provide summaries of the ERPI-SOG source and ground motion characterization, respectively, from the work that was conducted by the EPRI in the 1980s.

The EPRI-SOG evaluation indicated that the most significant contributors to hazard at the EGC ESP Site are the NMSZ, the WVSZ, and the random background event in the local zone. New information relative to characterization of each of these zones is summarized below and discussed in detail within Section 2.1.5 and 2.2.2 of Appendix B:

- The New Madrid region is the source of the 1811-1812 New Madrid earthquakes, which includes the three largest earthquakes to have occurred in historical time in CEUS. Extensive geologic, geophysical, and seismologic studies have been conducted to characterize the location and extent of the likely causative faults of each of these earthquakes, and to assess the maximum magnitude and recurrence of earthquakes in this region. Table 2.1-3 in Appendix B provides a summary of recent publications pertinent to the identification and characterization of seismic sources in this region. These data have been incorporated into recent source characterizations for seismic hazard analyses (for example, Cramer, 2001; Toro and Silva, 2001; Atkinson and Beresnev, 2002; Frankel et al., 2002). Further discussion of alternative source geometries, the northern boundary of the NMSZ, major structures that are pertinent to the source, as well maximum magnitudes, are provided in Section 2.1.5.2.1 of Appendix B.

- Recent publications pertinent to the identification and characterization of seismic sources in the WVSZ are provided in Table 2.1-6 of Appendix B. These data have been incorporated into recent source characterizations for seismic hazard analyses (for example, Frankel et al., 2002; Toro and Silva, 2001; Wheeler and Cramer, 2002). Causative structures within the WVSZ have been interpreted from paleoliquefaction data and recently acquired industry seismic reflection data. Further discussions of recent studies conducted for the WVFS are provided in Section 2.1.5.2.2 of Appendix B.
- Evidence from recent paleoliquefaction studies and seismic reflection data suggests that significant earthquakes may occur in parts of the Illinois basin where there are no obvious faults or folds at the surface. The location, size, and recurrence of such events are not well constrained by available data. The presence of paleoliquefaction features, however, suggests that the range of maximum magnitudes assigned to a random background (that is, not associated with specific source) earthquake must include events comparable to that estimated for the postulated Springfield earthquake (that is, **M** 6.2 to 6.8). Further discussion of background seismicity in the Illinois Basin is provided in Section 2.1.5.2.3 of Appendix B.

The PSHA conducted in the EPRI-SOG study characterized earthquake ground motions using three strong ground motion attenuation relationships developed by Boore and Atkinson (1987) and McGuire et al. (1988), combined with the response spectral relationships of Newmark and Hall (1982). These relationships were based to a large extent on modeling of earthquake ground motions using simplified physical models of earthquake sources and wave propagation. Estimation of earthquake ground motions for the EGC ESP Site focused on research that has taken place since completion of the EPRI-SOG studies. This research has resulted in the development of a number of ground motion attenuation relationships. A discussion of the relevant features of these new models is presented in Section 2.2.2 of Appendix B.

The recently-developed ground motion attenuation models predict lower levels of low frequency ground motion than does the Newmark and Hall (1982) model based on an improved understanding of the effects of crustal properties on ground motion amplitudes. The Newmark and Hall (1982) spectral shapes are based primarily on western North America ground motion recordings. Recent studies have shown that significant differences in the crustal properties between western and eastern North America lead to significant differences in the frequency content of ground motions in the two regions. For this reason, the current consensus is that the Newmark and Hall (1982) western North America spectral shape is not appropriate for ground motions on hard rock in the CEUS. The recently-developed ground motion attenuation models typically have a greater degree of variability in ground motion about the median attenuation relationships (larger standard deviation) than the values used in the EPRI-SOG study.

From the data obtained post the EPRI-SOG study, it was concluded that: (1) there are no additional specific seismic sources in the site region, (2) with the exception of large earthquakes occurring on the central faults in the NMSZ, the EPRI-SOG recurrence parameters provide a good estimate of the current rate of seismicity in the study region,

(3) the maximum magnitude distributions for the central Illinois and Wabash Valley/Southern Illinois source zones developed by the EPRI-SOG expert teams likely underestimate what would be assessed given the present state-of-knowledge, and
(4) current ground motion models for the CEUS are generally consistent with the median models used in the EPRI-SOG study. However, the aleatory variability about the median ground motions used in the EPRI-SOG study is generally lower than current estimates. Furthermore, a significant amount of research on ground motion modeling in the CEUS has been conducted since the completion of the EPRI-SOG study. Additional discussions of each of these conclusions are provided in Sections 3.1.1 through 3.1.4 of Appendix B.
Based on the above assessments, the following adjustments were made to the source parameters and the ground motion relationship in PSHA sensitivity tests for the EGC ESP Site:

- The mean return period for large characteristic earthquakes on the central faults of the NMSZ was set to 500 - 1,000 years.
- The maximum magnitude for the WVSZ was adjusted upward.
- A large upward shift in the maximum magnitude distribution for central Illinois sources was made.
- Newer attenuation models were introduced.

The sensitivity tests conducted for the EGC ESP Site are described in Section 3.2 of Appendix B. Section 3.2.1 presents sensitivity tests conducted using the full EPRI-SOG source model, and Section 3.2.2 presents sensitivity tests conducted using a simplified source model. The sensitivity test results are presented in the form of graphical comparisons of the levels of exceedance in peak ground acceleration (pga) and spectral velocity at 1 Hz for the original EPRI-SOG and modified models.

It was concluded from these sensitivity tests that the post-EPRI-SOG information results in changes in site hazard that may be considered significant – requiring an updated PSHA for the EGC ESP Site to determine the SSE. Use of this information in the evaluation of maximum earthquake potential at the EGC ESP Site is provided in the next section of this SSAR.

2.5.2.4 Maximum Earthquake Potential

The maximum earthquake potential for the EGC ESP Site was determined by updating the EPRI-SOG PSHA that had been conducted for the CPS Site in the mid-to-late 1980s. The intent of the update was to incorporate new information related to the original EPRI-SOG experts' assessment, as required by Position 3 of Regulatory Guide 1.165. This update involved re-running the PSHA for the EGC ESP Site, using the updated seismic source and ground motion models, to define the response spectra on hard rock.

Based on the evaluation of new information and data, as well as the results of the sensitivity tests described in the previous section, four specific areas of the EPRI-SOG model were updated: (1) characteristic earthquakes occurring on the central faults of the New Madrid region with an average repeat time of approximately 500 years were added to the EPRI-SOG characterization of the NMSZ, (2) the maximum magnitude distribution for the Wabash

Valley/Southern Illinois sources was modified to shift the probability mass to higher values, (3) the maximum magnitude distribution for the local background source zone was modified to shift the probability mass to higher values, and (4) the ground motion attenuation models recently developed by EPRI (2004) were used. The revisions to the EPRI-SOG model are described in detail in Section 4.1 of Appendix B.

The update of the ground motion attenuation model requires special note. The procedure used to update the ground motion attenuation model involved a SSHAC[5] Level 3 elicitation process (SSHAC, 1997). This evaluation process was managed by EPRI and carried out between the fall of 2002 and the summer of 2003. In the SSHAC Level 3 process experts (Expert Panel) were contacted regarding their views and recommendations on the ground motion attenuation models suitable for use in CEUS and the appropriate criteria for assessing the relative merits of the different models. A Technical Integrator (TI) team evaluated the models after receiving input from the Expert Panel, grouped the models into a limited number of categories, and then assessed relative weights for each group of models. The Expert Panel reviewed the recommendations from the TI team, and then the TI team evaluated the Expert Panel's comments to develop the recommended ground motion attenuation model for the CEUS. Results of this SSHAC Level 3 elicitation process were incorporated into the update of the PSHA. The development of the ground motion models is documented in EPRI (2004) and the models are described in Section 4.1.4 of Appendix B.

The PSHA was conducted by combining the hazard from EPRI-SOG seismic sources (with updated maximum magnitude distributions) with the hazard from the New Madrid characteristic earthquake sources. Earthquakes occurring within the seismic sources for the EPRI-SOG model were treated as point sources consistent with the EPRI-SOG analysis. Appropriate adjustments to the ground motion models to account for this point-source representation were made using the approach developed in EPRI (2004). The characteristic earthquake ruptures on the central New Madrid faults were assumed to rupture the entire fault, and the closest approach of the fault to the EGC ESP Site was used as the distance to rupture. Characteristic earthquakes occurring on the central New Madrid faults were assumed to rupture as clustered events within a short time period relative to the return period for the events. Results of these analyses are presented in Section 4.1.5 of Appendix B. These results show the contributions of different model components to the mean and median probabilities of exceedance for peak ground acceleration and spectral acceleration at frequencies of 5 and 1 Hz.

The development of uniform hazard spectra and identification of controlling earthquakes is presented in Section 4.1.6 of Appendix B. PSHA calculations were performed for peak ground acceleration and spectral acceleration at periods of 0.04, 0.1, 0.2, 0.4, 1.0, and 2.0 seconds. Peak ground acceleration is assumed to be at a period of 0.01 seconds (a frequency of 100 Hz) following guidance given in EPRI (1993a). The hazard results were interpolated to obtain uniform hazard spectra for rock site conditions. Figure 2.5-8 shows the uniform hazard spectra for the mean 10^{-4} and 10^{-5} exceedance frequency. The mean 10^{-4} and 10^{-5} spectra form the basis for determining the risk-consistent, design response spectrum (DRS), as discussed in Section 2.5.4.9 of the SSAR.

[5] Senior Seismic Hazard Analysis Committee (SSHAC) refers to the group of individuals who developed the four-level methodology for resolving uncertainty and using expert opinion during seismic hazard evaluations.

Deaggregation of the hazard results indicated that the high frequency ground motion hazard (5 to 10 Hz) results from contributions from a wide range of magnitudes and seismic sources, with nearby earthquakes in the magnitude range of m_b 5 to 6.5 becoming the dominant contributor to the hazard, as the probability of exceedance decreases (the ground motion amplitude increases). The characteristic earthquakes on the central faults of the NMSZ dominate the hazard for low frequency ground motions (1 to 2.5 Hz).

2.5.2.5 Seismic Wave Transmission Characteristics of the Site

The uniform hazard spectra described in the preceding section are defined on hard rock, which is located several thousand feet or more below the ground surface at the EGC ESP Site. To determine the SSE at the ground surface, it was necessary to adjust the uniform hazard spectra for amplification or deamplification as the vibratory ground motion propagated to the ground surface. The adjustment was made by conducting site response analyses following Approach 2B described in NUREG/CR-6728 (McGuire et al., 2001). The steps in these analyses included defining the shear wave velocity and material damping characteristics in the soil and rock profile between the ground surface and the depth of hard rock, and then conducting site response studies using a one-dimensional, equivalent linear computer code.

The soil profile at the EGC ESP Site is shown in Figure 2.5-3, summarized in Section 2.5.4.2 of this SSAR, and described in Appendix A. As discussed, the surface soils consist of a thin layer of loess underlain by interbedded glacial tills and lacustrine deposits of Quaternary age to a depth of nearly 300 ft. The upper 30 ft of bedrock encountered at the EGC ESP Site consists of limestone, shale, sandstone, siltstone, and a single 1-foot thick interval of coal. The bedrock is of Pennsylvanian age.

The dynamic properties of the soil profile were characterized during a field and laboratory testing program, as summarized in Sections 2.5.4.2 and 2.5.4.3 of this SSAR. The results of these programs include:

- Shear wave velocity data measured at the EGC ESP Site. These results are shown in Figure 2.5-9. The data consist of one borehole velocity profile to a depth of 310 ft and two seismic cone velocity profiles to depths of 55 and 76 feet. The CPS USAR shear wave velocity results are consistent with the velocity data from the EGC ESP Site.

- A set of shear modulus reduction and damping data obtained in the laboratory on samples taken from boreholes drilled and sampled at the EGC ESP Site. In general, the modulus and damping data are consistent with the EPRI (1993a) relationships, except that the resonant column data tend to show higher damping levels at very low shearing strains. The higher damping from the resonant column tests is attributed to rate-of-loading effects. Damping values from torsional shear tests, which are conducted at frequencies of loading more consistent with predominant free-field ground motions, are very consistent with EPRI damping values.

As noted in the previous section, the uniform hazard spectra were established on hard rock. The consistency of rock used in the CEUS ground motion relationships is defined as hard rock. Based on EPRI (1993a), CEUS hard rock conditions correspond to a shear wave velocity of at least 9,300 fps. Since the shear wave velocity of the rock encountered at a depth of 300 ft at the EGC ESP Site is approximately 4,000 fps, the shear wave velocity profile between 300 ft and hard rock conditions was estimated from results of borehole compression wave velocity surveys conducted in the area. A number of compression wave velocity profiles have been obtained in deep boreholes drilled within about 10 mi of the EGC ESP Site. The compression wave velocities (V_P) measured in these surveys were converted into shear wave velocities (V_S) using representative values of the ratio V_P/V_S ranging from 1.7 to 2.0. Results of these conversions are shown in Figure 2.5-10. Additional discussion of the deep velocity determinations is provided in Section 4.2.1 of Appendix B.

The site response analyses were conducted using randomized shear wave velocity profiles and soil modulus reduction and material damping relationships to account for variation in the dynamic soil properties across the EGC ESP Site. Material damping in the randomized sets of material damping curves was capped at 15 percent, as recommended by NRC. The depth to hard rock was also randomized to reflect its uncertainty. This randomization process resulted in 60 independent soil columns that were used in evaluating site response effects. The site response also assumed that the sedimentary rock below 300 ft remains linear during earthquake shaking. Damping in the rock was based on published information. Additional details about the generation of profiles for the site response analyses are included in Section 4.2.1 and 4.2.2 of Appendix B.

Following the recommended procedure for site response method 2B outlined in NUREG/CR-6728 (McGuire et al., 2001), representative rock site response spectra were developed for the controlling earthquakes. Time histories for the site response analyses were obtained from the CEUS time history library provided with NUREG/CR-6728 (McGuire et al., 2001). These records were adjusted to match the controlling earthquake response spectra. The development of the controlling earthquake response spectra and the selection and scaling of time histories are described in Section 4.2.3 of Appendix B.

A total of 180 site response analyses were conducted to develop the soil amplification function for each controlling earthquake rock spectrum using the computer program SHAKE (Schnabel et al., 1972). The weighted mean of the site amplification functions of the individual site response analyses was used to develop site amplification factors for the EGC ESP Site, as recommended in NUREG/CR-6728 (McGuire et al., 2001). The site amplification factors indicate a maximum amplification of about 3 for periods between 0.3 and 1.0 seconds and deamplification of high-frequency ground motions due to soil non-linearity. For reference, the EPRI-SOG generic amplification factors in this period range for site category IV were about 1.65 to 2 for comparable levels of input motion. Discussions of the results of the site response analyses for the EGC ESP Site are provided in Section 4.2.4 of Appendix B. These amplification factors were used to adjust the spectra on hard rock to the ground surface, as discussed in Section 2.5.2.6.

2.5.2.6 Safe Shutdown Earthquake

The design response spectrum (DRS) for horizontal motions was developed following the graded performance-based, risk-consistent method described in ASCE Standard 43-05 (ASCE, 2005). This approach uses the mean 10^{-4} and 10^{-5} spectra to develop the DRS.

- The first step is to develop the appropriate mean 10^{-4} and mean 10^{-5} spectra for the ground surface. Following the procedure described in Regulatory Position 4 of Regulatory Guide 1.165 (USNRC, 1997), the soil amplification functions described above in Section 2.5.2.5 were used to scale the rock controlling earthquake response spectra to ground surface conditions. Smooth envelope response spectra were then constructed to provide soil surface motions representative of 10^{-4} and mean 10^{-5} mean hazard. These envelope ground surface response spectra are shown on Figure 2.5-11.

- The second step is to construct the DRS by scaling the mean 10^{-4} spectrum by a frequency dependent design factor (DF) that is based on the relative amplitude of the mean 10^{-4} and 10^{-5} spectra. The basis for DF is described in Section 2.5.4.9. Based on the mean 10^{-4} and mean 10^{-5} soil surface spectra shown on Figure 2.5-11, the DF values ranged from a minimum of 1.0 for frequencies greater than or equal to 3.3 Hz to a maximum of approximately 1.4 for frequencies less than or equal to 0.67 Hz. The resulting horizontal DRS is shown on Figure 2.5-11. A smooth envelope of the DRS was constructed to define the horizontal SSE spectrum. This spectrum is shown on Figure 2.5-12. Details of the development of the horizontal DRS are presented in Section 4.3.1 of Appendix B.

The corresponding vertical DRS was developed using the vertical-to-horizontal spectral ratios recommended in NUREG/CR-6728 (McGuire et al., 2001) for rock site conditions in the central and eastern United States and consideration of the effects of the site soil conditions on vertical motions. The result is a frequency-dependent set of vertical-to-horizontal spectral ratios that are used to develop the vertical DRS from the horizontal DRS. A smooth envelope of the vertical DRS was constructed to define the vertical SSE spectrum. The horizontal and vertical SSE spectra are shown on Figure 2.5-12, along with the Regulatory Guide 1.60 spectrum anchored at 0.3g peak acceleration. Section 4.3.2 of Appendix B provides a detailed description of the development of the vertical SSE spectrum.

2.5.2.7 Operating Basis Earthquake

The Operating Basis Earthquake (OBE) for the EGC ESP Site was not determined as part of the EGC ESP Application. Paragraph IV.a.2 of Appendix S to 10 CFR Part 50 indicates that the OBE must be characterized by response spectra and that the value of the OBE must be set to one of the following choices:

- One-third or less of the SSE ground motion design response spectra. In this case the requirements associated with the OBE can be satisfied without the applicant performing explicit response or design analyses.
- A value greater than one-third of the SSE design response spectra. Analyses and design must be performed to demonstrate that SSCs of the nuclear plant remain functional and are within applicable stress, strain, and deformation limits – thereby not resulting in undue risk to the health and safety of the public. In this case the design must take into account soil-structure interaction effects and the duration of vibratory ground motion.

In either case the plant must shut down if the vibratory ground motion exceeds that of the OBE or if significant plant damage occurs. Appendix S to 10 CFR Part 50 also requires that prior to resuming operations "the licensee must demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operations without undue risk to the health and safety of the public."

Since the OBE is related to design and performance of the generating system, it will be determined during the COL stage based on the level of peak ground acceleration and associated response spectrum that could cause damage to the selected generating facility.

2.5.3 Surface Faulting

There is no evidence for surface faulting or fold deformation at the EGC ESP Site. Recent detailed geotechnical investigations of the EGC ESP Site were used to develop a site-specific geologic cross section. Irregularities in the upper units (that is, Illinoian glacial till and younger strata) are not reflected in the older units. In particular, the contact between a lacustrine unit and the overlying Illinoian till is flat-lying across the entire site. Previous investigations of the CPS Site are consistent with these conclusions, as discussed in Section 2.5.3 of the CPS USAR.

There have been no historically reported earthquakes within 25 mi of the site that reasonably can be associated with a local structure. Historical earthquakes have been postulated to be associated with faults and inferred structures at greater distances within the site region discussed in Section 5.2 of Appendix B. The evidence for capable tectonic sources inferred from the possible association of historical seismicity is considered in the characterization of alternative seismic sources included in the updated PSHA for the EGC ESP Site.

Paleoliquefaction studies were conducted as part of the EGC ESP Site study to search for evidence of nearby prehistoric earthquakes. The results of these investigations (Section 2.1.4 of Appendix B and Attachment 1 to Appendix B) suggest that there have not been repeated moderate to large (for example, comparable to the postulated **M** 6.2 to 6.8 Springfield earthquake) events in the vicinity of the site in latest Pleistocene to Holocene time that would indicate the presence of a capable tectonic structure within 25 mi of the site. More detailed discussions of surface faulting evaluations conducted for the EGC ESP Site are provided in Section 5 of Appendix B.

2.5.4 Stability of Subsurface Materials and Foundations

This section of the SSAR presents the evaluation of the stability of subsurface materials that underlie the site. The subsurface stability information is based on soil studies conducted as part of the EGC ESP Site evaluation and on information presented in the CPS USAR. The intent of these studies is to meet the regulatory requirements cited in 10 CFR 100.23.

The scope of these subsurface stability studies included:

- Establishing that the soil conditions at the CPS and EGC ESP Sites are consistent by conducting field explorations and laboratory tests on samples of soil recovered from the EGC ESP Site and then comparing information collected from the field and laboratory programs to similar information reported in the CPS USAR.
- Performing geotechnical engineering evaluations for the EGC ESP Site to estimate liquefaction potential and to make conclusions regarding static stability.
- Assessing other requirements of design and construction based on information reported in the CPS USAR and observed during explorations, laboratory testing, and geotechnical

evaluations for the EGC ESP Site.

The work described in this section of the SSAR followed the guidelines given in Regulatory Guide 1.132 (USNRC, 1979) and 1.138 (USNRC, 1978) dealing with Site Investigations and Laboratory Investigations, respectively. Guidance provided in Draft Regulatory Guide 1101 (USNRC, 2001b) and Draft Regulatory Guide 1109 (USNRC, 2001d) which are proposed updates to Regulatory Guide 1.132 and 1.138, respectively, as well as a new guidance on liquefaction (Draft Regulatory Guide 1105 -- USNRC, 2001c) were also considered during the evaluation of the stability of subsurface materials and foundations.

As discussed previously, the EGC ESP Site is located within 700 ft of the CPS Site. The CPS Site was investigated extensively in the early-to-late 1970s as part of the CPS plant site licensing efforts. These investigations included a large number of field explorations, laboratory tests, and geotechnical analyses to demonstrate that the site was suitable for development. As noted in Section 2.5.1 of this SSAR, conditions at the EGC ESP and CPS Sites are also the same from the standpoint of site and regional geology. These conditions consist of nearly 300 ft of hard soils over rock with a groundwater table approximately 30 ft below the ground surface (Figure 2.5-3). The information presented in the following subsections provides a basis for concluding that the EGC ESP and CPS Sites are the same from a foundation engineering standpoint. By providing this justification, it is possible to use information presented in the CPS USAR to address subsurface stability issues such as allowable bearing pressures. It is also possible to estimate how a new facility at the EGC ESP Site can be designed or will perform, without key information regarding loads and dimensions of the EGC ESP facility being known.

The information presented in Section 2.5.4 of this SSAR also provides an update to dynamic property information required for site response analyses summarized in Section 2.5.2.5 of this SSAR and described in detail in Appendix B. In the area of dynamic property characterization, significant advances in field and laboratory dynamic testing methods have occurred since the original work was conducted at the CPS Site. These updated methods allow more precise determination of the in situ (that is, in-place) shear wave velocities of the soil, and they allow more accurate determination of the modulus and damping properties of the soil in the laboratory. This information was used in developing the site model that was used to estimate how ground motions propagated from hard rock to the ground surface, as required within Regulatory Guide 1.165 (USNRC, 1997).

2.5.4.1 Geologic Features

The geologic features at the EGC ESP Site and the CPS Site are very similar. The ground surface is relatively flat, with the closest slopes being located along the shores of Clinton Lake which is located 800 ft northwest of the EGC ESP Site.

The subsurface geology at the EGC ESP Site consists of nearly 300 ft of hard or dense soil overlying rock. Other than the upper few tens of feet, the soils have been overridden during past glaciations. As shown in Figure 2.5-3, there are seven primary soil layers at the EGC ESP Site. The soils within each layer are generally silts and clays with varying amounts of sand and some gravel. From a spatial variability standpoint, each layer is relative consistent in thickness, soil classification, and density or hardness. Boundaries between layers are relatively horizontal.

The groundwater piezometric surface in the Illinoian till is located approximately 30 feet below the ground surface. Perched water is located within 30 ft of the ground surface on shallower soil layers. No faults or other geologic hazards, such as karsts or underground mine openings, were identified at or near the EGC ESP Site during the review of site geology (Section 2.5.1.2 of this SSAR).

Additional discussions of the regional and site geologic features for the EGC ESP Site are summarized in Section 2.5.1 of this SSAR, and reported in more detail in Appendix A and Appendix B and in Section 2.5.1 of the CPS USAR.

2.5.4.2 Properties of Subsurface Materials

The properties of subsurface materials at the EGC ESP Site have been established by conducting field and laboratory measurements following guidelines in Regulatory Guide 1.132 and Regulatory Guide 1.138, and by drawing upon the extensive database of information that was developed for the CPS Site. The property information includes strength, consolidation, dynamic/cyclic, and physical test results from soil samples recovered from the EGC ESP and CPS Sites. These properties were established from the ground surface to the top of rock located nearly 300 ft below the ground surface.

The purpose of the EGC ESP Site material property characterization testing was (1) to show that soil characteristics at the EGC ESP Site are consistent with those at the CPS Site and (2) to update the dynamic property information for the site. To meet this second requirement, the EGC ESP Site material property testing program included six sets of resonant column/cyclic torsional shear tests. These tests were conducted to determine the variation in shear modulus and material damping ratio with shearing strain amplitude. The results of the resonant column/cyclic torsional shear tests also provided information about the variation of shear modulus and material damping ratio with effective confining pressure and frequency of loading.

The resonant column/cyclic torsional shear test results were used to show that the behavior of representative soil from the EGC ESP Site during cyclic (dynamic) loading is consistent with published relationships defining the variation of dynamic properties with shearing strain level. As discussed more fully in Section 5.2.4 of Appendix A, comparisons were not made between dynamic properties reported in the CPS USAR for the CPS Site and the results of the EGC ESP Site cyclic testing program. Significant advances have been made in the area of cyclic testing since cyclic tests were conducted on soils from the CPS Site, limiting the value of any comparison.

Dynamic properties obtained for the EGC ESP Site were considered but not used explicitly for the site response studies described previously in Section 2.5.2.6. Rather, the EPRI modulus and damping curves were used as the base case for the site response analyses. According to EPRI (1993a), the EPRI modulus reduction and material damping curves were developed to account for the variations in soil shear modulus and material damping that occur with shearing strain and soil confining pressure—with soil confining pressure being approximated within the set of curves by the depth below the ground surface. EPRI (1993a) indicates that these curves are appropriate for use in “gravelly sands to low plasticity silty or sandy clays,” which is consistent with the soil conditions at the EGC ESP Site. The rationale for using the EPRI curves rather than the EGC ESP Site data was that a much larger database was used to develop the EPRI curves and, therefore, average EPRI results are expected to be representative of conditions at the EGC ESP Site. It is important to note that the dynamic test results for the EGC ESP Site are very consistent with the EPRI curves, indicating that use of the EPRI curves is acceptable. A comparison of the EPRI and EGC ESP Site cyclic test results is included in Figures 5-20 and 5-21 of Appendix A. During site response analyses, material damping was capped at 15 percent, as recommended by NRC.

The following conclusions were reached regarding the properties of subsurface materials existing at the EGC ESP Site based on the material property tests:

- The physical property tests indicate that the soil profile consists primarily of low plasticity silts and clays. Sands and occasionally gravels are found in the predominantly fine-grained soil profile. Average physical properties for the predominant soil layers are summarized in Table 2.5-1.
- Results of compressibility and strength tests indicate that the soil has low compressibility and very high strength. The compression indices for tests on samples from the Illinoian till and deeper soils at the EGC ESP Site range from 0.08 to 0.09, the recompression indices range from 0.006 to 0.009, and the preconsolidation pressure ranges from 5 to 7 tsf. Unconfined compressive strengths vary from 1 to 15 tsf, unconsolidated undrained strengths vary from 2 to 9 tsf, and the effective strength friction angle from a consolidated undrained triaxial test is 32.6 degrees.
- The modulus and damping properties of soil from resonant column/cyclic torsion shear tests indicate that the low-strain shear wave velocity of samples ranges from approximately 800 fps to over 2,000 fps, depending on the specific layer from which the soil sample was obtained. Low-strain material damping ratios for the same samples vary from approximately 5 percent to less than 1 percent. The changes in shear modulus and material damping ratios with the level of shearing strain are consistent with published modulus and damping characteristics of low plasticity soil.

Results of testing on samples from the EGC ESP Site are presented in Section 5.2 of Appendix A. Attachments to Appendix A include supporting information for the test results.

As noted above, part of the purpose of the EGC ESP Site laboratory testing program was to show that the properties from the EGC ESP Site are similar to those reported in the CPS USAR. If similar conditions could be demonstrated, then the extensive database summarized in the CPS USAR could be used to augment the information collected at the EGC ESP Site. Furthermore, some of the conclusions regarding stability for the CPS Site could be extrapolated to the EGC ESP Site.

The existing database of soil property information in the CPS USAR includes static and dynamic properties of the subsurface materials. The CPS USAR information was developed from results of exploration programs conducted at the site and from laboratory testing of materials obtained during the exploration program and imported for construction. The scope of the material testing reported in the CPS USAR includes the following tests:

- Strength tests on soil and rock. Tests were conducted on intact samples of soil and rock using unconsolidated undrained, unconfined, and consolidated undrained (with pore pressure measurements) triaxial shear testing methods. Results of these tests were used to characterize the undrained strength and effective strength properties of soils from the site, as well as unconfined compressive strengths and modulus of elasticity of rock.

- Dynamic tests on intact and remolded samples of soil from the CPS Site. These tests involved use of cyclic triaxial, resonant column, and shockscope testing methods. Results of the cyclic triaxial and resonant column tests were used to determine the shear modulus and material damping characteristics of soils from the CPS Site. Results of the shockscope tests were used to determine the compression wave velocity in the unconfined state.
- Other physical tests including Atterberg limits, consolidation, in situ moisture and density, laboratory permeability, and relative density. These tests were conducted to determine soil types and to obtain information necessary for estimating settlement and dewatering requirements.
- Chemical tests on groundwater samples and coal samples.
- Tests on soils excavated and placed during construction of the CPS Facilities. This program included additional strength, dynamic, and physical property tests. Liquefaction tests were conducted using cyclic triaxial testing methods to evaluate the liquefaction resistance of backfill material. Hundreds of physical property tests (for example, Atterberg limits, compaction, moisture/density, particle size, and relative density) were conducted as part of the CPS construction quality control program.

Results of the laboratory testing program conducted for the CPS Site are summarized in Section 2.5.4.2 of the CPS USAR. These results provide full characterization of soil at the CPS Site from the ground surface into the top of rock located up to 250 ft below the ground surface. The spatial coverage of the CPS Site testing program extends beyond the planned footprint of the EGC ESP Site.

The soil classification, strength, and consolidation test results from the EGC ESP and CPS Site laboratory testing programs were compared during EGC ESP Site characterization review to show the similarity of conditions between the sites. These comparisons are provided in Section 5.2 of Appendix A. The comparisons demonstrate that soil conditions at the EGC ESP and CPS Site locations are consistent. Average values of water content, Atterberg limits, density, strength, and compressibility are similar for samples obtained at similar depths from each site. This similarity is not surprising, in view of the regional geology of each site and the proximity of the two sites.

2.5.4.3 Explorations

Subsurface explorations were carried out as part of the EGC ESP Site characterization effort. This exploration program consisted of drilling and sampling four boreholes and conducting four electric cone penetrometer tests (CPT) with pore pressure measurements within the footprint of the proposed EGC ESP Site. The purpose of the exploration work was to establish the location and consistency of soil layers, to collect soil samples for laboratory testing, and to install piezometers for groundwater monitoring.

As discussed in Section 2.5.4.2 of this SSAR, one of the objectives of the EGC ESP Site explorations was to collect information that could be used to confirm that the EGC ESP and CPS Sites are similar from the standpoint of soil layering and soil consistency. Geological information for the region and the site suggest that the soil conditions are similar; however, it was necessary to obtain quantitative information to validate this view.

The drilling and sampling program for the EGC ESP Site followed guidelines given in Regulatory Guide 1.132, with the exception of the number and depth of explorations. Fewer explorations were justified by the similarity of soil conditions at the EGC ESP Site with those at the CPS Site. Section 3.1.1 of Appendix A provides additional discussions of the number and depth of explorations relative to guidelines given in Appendix C of Regulatory Guide 1.132 (USNRC, 1979).

The four explorations were drilled at the EGC ESP Site using mud rotary drilling methods. Two of the explorations extended to 100 ft below the ground surface, and the other two extended 20 to 30 ft into rock at nearly 300 ft below the ground surface. Standard Penetration Test (SPT), Shelby, and Pitcher tube sampling methods were used to collect representative soil samples. SPT blowcounts were obtained in each borehole. The hammer system used to obtain the SPT blowcounts was calibrated in one borehole. Details of this work, including the resulting borehole logs, are included in Section 3.1 of Appendix A.

A CPT program was also conducted at the EGC ESP Site. Results of the CPT soundings were used to evaluate the consistency of soils in the upper 50 to 80 ft of soil in the EGC ESP Site area. The CPT soundings included pore water pressure measurements, and during two of the soundings, shear wave velocity data were obtained. Details of these tests, including the test methods used and the sounding results, are provided in Section 3.3 of Appendix A.

The exploration program for the EGC ESP Site was augmented by results from similar programs conducted at the CPS Site. An extensive drilling and sampling program was conducted during work on the CPS Site. Seventy-six locations were drilled and sampled for the CPS Site investigation, some of which were located within or adjacent to the footprint of the ESP EGC Site. A number of these explorations extended into rock located nearly 250 ft below the ground surface. Soil samples were recovered using Dames & Moore, Pitcher, Shelby, Osterberg, and double tube core methods. Piezometers were installed in a number of the boreholes. The results of these explorations are shown on borehole logs included in the CPS USAR.

Comparisons were made between results of the drilling and sampling programs for the EGC ESP and CPS Sites. Both visual descriptions of recovered soil samples and SPT blowcounts were considered during this evaluation. Section 5.2 of Appendix A includes plots showing the similarity in blowcounts from the SPT, as well as soil cross sections showing the similarity in soil descriptions. Results of these comparisons show that both sites consist of over 250 feet of predominantly silts and clays overlying rock. The silts and clays are very stiff to hard in consistency – as a result of past glaciations. Rock is slightly deeper at the EGC ESP Site (specifically, nearly 250 ft below ground surface at the CPS Site versus over 280 ft at the EGC ESP Site); however, rock descriptions and quality are consistent between the sites. It was concluded from this comparison that the engineering characteristics of the two sites are consistent; therefore, the database from the CPS Site can be used in evaluating site response to gravity and seismic loading at the EGC ESP Site.

2.5.4.4 Geophysical Surveys

A series of geophysical surveys was conducted at the EGC ESP Site. The purpose of these tests was to determine the low-strain shear wave velocity of the soil and the upper layer of rock. This information was used to develop the site model for evaluating the effects of the soil profile on the propagation of seismic motions from the top of rock to the ground surface, as discussed in Section 2.5.2.5 of this SSAR. Information from the shear wave velocity tests may also be used during the COL stage of design to evaluate spring constants required for soil-structure interaction studies.

Two types of geophysical seismic tests were conducted during the EGC ESP Site geophysical program. First, a P-S suspension logging test was performed in one borehole. Shear and compression wave velocities were obtained by conducting P-S suspension logging tests at approximately 1.5 ft depth intervals to approximately 20 ft into the top of rock. The second method involved use of the cone penetrometer. Shear wave velocities were obtained at two locations in the upper 50 to 80 ft of soil profile at approximately 3-ft intervals. The seismic cone penetrometer test (seismic cone) involved a testing method that was similar to the downhole seismic technique. An energy source was created at the ground surface by striking a board with a sledge hammer, and the wave arrivals were detected by a velocity-sensitive transducer mounted in the tip of the cone penetrometer rod. Details for these velocity testing methods, including plots of velocity versus depth from the two methods, are provided in Sections 3.3 and 3.4 of Appendix A.

Results of the shear wave velocity measurements made during the EGC ESP Site geophysical program are shown in Figure 2.5-9. These measurements were used to establish the minimum site characteristic shear wave velocities, which are summarized as follows:

- 820 fps in the upper 50 ft of soil profile,
- 1,090 fps to nearly 3,000 fps at depths of 50 ft to the top of rock, and
- 2,580 fps in the upper 20 ft of rock.

In comparison, the subsurface evaluation at the CPS Site included multiple geophysical exploration programs, including refraction, uphole, surface wave, and downhole velocity measurements, as well as ambient vibration measurements. These methods were used to investigate the subsurface soil layering across the site and to determine shear and compression wave velocities at the center of the CPS Site. Explosive methods were used to generate the source motions for the uphole and downhole measurements. Results of these surveys determined that the shear wave velocity varied from approximately 900 fps near the ground surface to 2,100 fps immediately above the rock. The shear wave velocity in rock was reported to be 5,700 fps. Compression wave velocities ranged from 2,000 fps in the upper 16 ft (above water table) to 7,500 fps above the rock, and 10,500 fps in rock. These velocities were used during the dynamic modeling of structures planned for the CPS Site.

A comparison of the velocities between the CPS Site and EGC ESP Site shows very similar average conditions. A much smaller depth interval was used for the measurements during the EGC ESP Site program and, therefore, the EGC ESP Site velocity results provide a much better indication of the variation in velocity within each of the predominant stratigraphic units. The much larger spacing used during geophysical tests at the CPS Site resulted in greater averaging of measured soil velocity with depth. As discussed in Section 4.2.1 of Appendix B, the more detailed results from the P-S suspension logging test were used in the assessment of site effects at the EGC ESP Site. Uncertainties associated with the variation in velocity both with depth and spatially were accounted for in the site response studies by evaluating different potential realizations of the measured velocity profile, as discussed in Section 4.2.2 of Appendix B.

2.5.4.5 Excavation and Backfill

Construction of the facilities at the EGC ESP Site will likely require excavations to a depth of approximately 55 to 60 ft below the ground surface to avoid potential settlement and liquefaction concerns, as discussed in a later section. Information given in the CPS USAR provides valuable insight into the likely conditions that will be encountered during the excavation. The excavation information for the CPS USAR also provides a large-scale calibration of borehole information collected during the exploratory phase of the program at the CPS Site. For these reasons, the following summary of excavation and backfill information from the CPS Site is presented.

The excavation and backfill work for the CPS Site was completed at the station, the circulating water screen house, and the Essential Service Water (ESW) outlet structure and pipeline. The discussions for the CPS Site cover materials encountered when excavations were made to approximately 56 ft below the ground surface, dewatering requirements, excavation base treatment, structural fill and backfill, and general fill requirements.

The following observations were made during excavations at the CPS Site:

- The excavation work at the CPS Site shows that the drilling and sampling program provided a good description of soil conditions in the upper 56 ft at the site, confirming that the boreholes completed within the EGC ESP Site footprint for both the CPS and EGC ESP Sites will be representative of conditions in the upper 56 ft of soil profile.
- Seepage into the construction excavation was very limited at the CPS Site. This observation indicates that dewatering requirements within the upper 56 ft at the EGC ESP Site will be minimal – because of the similarity in groundwater location and soil types.
- Some localized pockets of sand were encountered at the base of the excavation at a depth of 56 ft. These pockets were either compacted or removed and replaced with a flyash-backfill mixture. Similar conditions could be encountered at the EGC ESP Site.

Nothing discussed within Section 2.5.4.5 of the CPS USAR indicates a condition that would significantly affect the construction or operation of a new generating facility at the EGC ESP Site.

2.5.4.6 Groundwater Conditions

Three piezometers were installed during the EGC ESP Site exploration to obtain more specific information about groundwater conditions at the EGC ESP Site. Methods used to install the piezometers and results of three sets of readings from the piezometers are included in Section 3.2 of Appendix A.

The groundwater measurements indicate that the static groundwater table within the Illinoian till is approximately 30 ft below the ground surface, but that there are shallower perched groundwater layers closer to the surface. Although the monitoring period for the new groundwater measurements is limited to less than a year, the results of the monitoring appear to be consistent with groundwater information shown on borehole logs in the CPS USAR and discussed in Sections 2.4 of the CPS USAR and this SSAR.

Groundwater conditions for the general site and for the EGC ESP Site are discussed more extensively in Section 2.4 of the CPS USAR and this SSAR. These sections should be reviewed to obtain a more complete understanding of groundwater conditions for the general site region and for the CPS and EGC ESP Sites.

2.5.4.7 Response of Soil and Rock to Dynamic Loading

No attempt has been made to define information needed for soil-rock-structure interaction analyses for the EGC ESP Site. These properties will depend on the geometry and weight of the selected power generating system, and on the method that will be used during the COL stage to evaluate soil-structure interaction, if such analyses are necessary[6].

The CPS USAR includes a discussion of properties to use in developing spring constants for soil-rock-structure interaction analyses. These properties include values for soil density, Poisson’s ratio, static modulus of elasticity, dynamic modulus of rigidity (shear modulus), and material damping. Results of laboratory and geophysical tests were used when determining these properties.

While the site conditions between the CPS and EGC ESP Sites are the same, some of the details from the dynamic field and laboratory testing carried out during the original investigation for the CPS Site in the mid-to-late 1970s are not necessarily accepted at this time. Thus, before adopting any of the dynamic property information given in the CPS USAR for evaluation of a structure at the EGC ESP Site, the preferred approach for future design work will be to re-derive dynamic properties based on the results of field and laboratory information collected during the EGC ESP Site program and future programs, and then to use the latest published information on dynamic property representation. The potential uncertainty in these property determinations must be established as part of these future evaluations.

2.5.4.8 Liquefaction Potential

An evaluation of liquefaction potential was conducted at the EGC ESP Site. The empirical blowcount procedure was used to perform this evaluation. This approach, which was not available at the time of the original work for the CPS Site, was developed with correlations between the blowcounts recorded during the SPT and liquefaction observations at sites that did or did not liquefy. Draft Regulatory Guide 1105 (USNRC, 2001c) provides a general description of the empirical method. For the EGC ESP Site liquefaction evaluation, the latest correction factors and chart for liquefaction strength, as reported by Youd et al. (2001), were

[6] The modulus and damping properties obtained for the EGC ESP Site and presented in Appendix A are for free-field conditions. Soil beneath and alongside a generating system will likely differ from these properties due to changes in mean confining pressure (below the power generating system) or changes in material type (imported granular material for backfill). Once the generating system and the likely construction method are defined, the determination of these properties can be made.

used. The method used for the EGC ESP Site liquefaction evaluation is an update of the methods reported in Draft Regulatory Guide 1105.

The liquefaction assessment was made using a peak ground acceleration of 0.3g consistent with the value set forth in Regulatory Guide 1.60 (USAEC, 1973), which represents the peak acceptable value for the plant that form the basis of the Plant Parameter Envelope (see Section 1.4), and using a range of earthquake magnitudes (**M** = 5.5, 6.5, and 8) consistent with the range of source mechanisms potentially causing ground shaking at the EGC ESP Site. Figure 2.5-13 presents typical results of the liquefaction analysis conducted for the EGC ESP Site. Additional results of the liquefaction analyses are summarized in Section 6.1 of Appendix A. These results indicate that the factor of safety (FOS) against liquefaction is greater than 1.1 for liquefiable soil layers below a depth of 60 ft bgs based on a conservative assumption on pga (that is, 0.3g versus 0.26g for the DRS) and an upper bound earthquake magnitude (that is **M**8 versus a more likely level of **M**6.5). The FOS against liquefaction is less than 1.1 for some soil intervals within 60 ft of ground surface, for the modeled conditions. However, these soils will need to be excavated and replaced or improved for settlement considerations, thereby mitigating any liquefaction potential.

These conclusions regarding liquefaction potential at the EGC ESP Site are consistent with the results of liquefaction evaluations reported in the CPS USAR. The liquefaction potential of structural fill and native material located beneath the containment structure is reported in the CPS USAR. As discussed in Section 2.5.4.8 of the CPS USAR, the approach used for evaluating the liquefaction potential in the structural fill involved determining the liquefaction strengths of the granular fill using cyclic triaxial testing methods and comparing these strengths (that is, resistance to development of liquefaction) to the shearing stresses that would be imposed by the SSE. Simplified methods, rather than computer modeling, were used to estimate the shearing stresses. Results of these analyses indicated that the factor of safety with respect to liquefaction was greater than 2; therefore, liquefaction was not an issue for the CPS Site. In the native materials below a depth of 56 ft, the liquefaction of sand lenses was evaluated on the basis of relative densities expected to occur. It was concluded from these evaluations that liquefaction potential in materials beneath the CPS excavation was very low, since the factor of safety was greater than 2.0.

Normal design requirements preclude location of a critical structure on material that could liquefy. As noted previously, potentially liquefiable soils in the upper 60 ft at the EGC ESP Site will likely have to be removed to meet settlement requirements. In this situation, characteristics of the fill material can be selected to be stronger than the material removed, similar to the situation reported in the CPS USAR.

Based on the liquefaction evaluations for the EGC ESP Site, the conclusion for the liquefaction site characteristic is that liquefaction is not a design consideration for the EGC ESP Site.

2.5.4.9 Earthquake Design Basis

Regulatory Guide 1.165 (USNRC, 1997) calls for the SSE ground motions to be based on the site PSHA results for a suggested reference probability of the median 10^{-5} hazard level. The basis for the selected reference probability is described in Appendix B of Regulatory Guide 1.165. The reference probability corresponds to the median annual frequency of exceeding the SSE ground motions for a specific set of licensed nuclear power plants. These probabilities were computed using ground motion models developed in the mid-to-late 1980's. As discussed in Regulatory Position 3 in Regulatory Guide 1.165, significant changes to the overall database for assessing seismic hazard in the CEUS warrants a change in the reference probability. The availability of the recently developed EPRI ground motion characterization for the CEUS (EPRI, 2004) represents a significant advancement in the seismic hazard database for the CEUS. Appendix B of Regulatory Guide 1.165 discusses that selection of another reference probability may be appropriate, such as one founded on risk-base considerations. That is the approach taken for developing the EGC ESP SSE design ground motions.

The SSE design response spectra (DSR) have been developed using the graded performance-based, risk-consistent method described in ASCE Standard 43-05 (ASCE, 2005). The method specifies the level of conservatism and rigor in the seismic design process, such that the performance of plant SSCs achieves a uniform seismic safety performance consistent with the NRC's safety goal policy statement (USNRC, 1986; USNRC, 2001a). The ASCE Standard 43-05 aims to achieve a quantitative safety performance goal, P_F, together with qualitative performance limit states such that SSCs are designed depending on their importance to overall seismic safety performance of the plant, to assure that the plant level seismic performance target is met. The method is based on site-specific mean seismic hazard and the seismic design criteria and procedures contained in NUREG-0800.

The NRC's safety goal policy statement establishes recognition that nuclear plant safety regulation is a societal risk management activity and provides the foundation for equitably managing the nuclear facility risk in the context of other societal risks. Subsequent to adopting the policy statement the NRC has continued to develop and evolve supporting policies for a comprehensive risk management framework for nuclear regulation together with supporting implementation guidelines (USNRC, 1998; USNRC, 2002). The seismic design methodology provided in ASCE Standard 43-05 is a further step in the development of a risk-based standard for seismic design and regulation. The graded performance-based approach is compatible with the direction provided by the NRC's Risk-informed, Performance-based Regulation guidance (USNRC, 1998; USNRC, 1998a) and with developing NRC guidance for the determination of DRS (McGuire et al., 2001; McGuire et al., 2002).

The ASCE Standard 43-05 seismic design method and criteria are intended to implement the NRC's established qualitative safety goals and the companion quantitative implementation objectives. The qualitative safety goals provide that the consequences of nuclear power plant operation should cause no significant additional risk to the life and health of individuals and that the societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks posed by generating electricity by viable competing technologies and should not be a significant addition to other societal risks. The NRC's quantitative objectives for implementation of the safety goals are stated in terms of risk to individuals and to society. For an average individual in the vicinity of a nuclear power plant the risk that might result from a reactor accident should not exceed one-tenth of one percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the population are generally exposed. The risk to the public of cancer due to nuclear power plant operation should not exceed one-tenth of one percent (0.1

percent) of the sum of cancer fatality risks resulting from all other causes (USNRC, 2001a).

A target 10^{-4} mean annual risk of core damage due to all accident initiators can implement these quantitative safety goals. The ASCE Standard 43-05 assumes that seismic initiators contribute about 10 percent of the risk of core damage posed by all accident initiators. Thus the Standard is intended to conservatively achieve a mean 10^{-5} per yr risk of core damage due to seismic initiators. The NRC's seismic design criteria contained in NUREG-0800 conservatively assure a risk reduction factor of at least 10, as discussed further in the next paragraph. Thus, a mean ground motion hazard of 10^{-4} per yr is appropriate for determining the site-specific DRS for the EGC ESP Site. The seismic safety performance goal, P_F, for Category 1 (Design Category 5 in the ASCE Standard 43-05) (that is, mean 10^{-5} per yr) is the same as established in DOE-STD-1020-94 (USDOE, 1996) for seismic design of PC-4 SSCs in U.S. Department of Energy's nuclear facilities, which have comparable radiological safety performance requirements.

The target mean annual performance goal for nuclear plants of mean 10^{-5} per yr is achieved by coupling site-specific DRS with the deterministic seismic design criteria and procedures specified by NUREG-0800. The ASCE Standard 43-05 criteria for deriving a site-specific DRS are based on the conservative assumption that the seismic design criteria specified by NUREG-0800 achieve less than a one percent chance of failure for a given DRS. The conservatism of this assumption is demonstrated by analyses described in McGuire, et al. (2002), which show plant level risk reduction factors ranging from about 20 to about 40 are attained by the NRC's seismic design criteria. The method is based on use of mean hazard results consistent with the recommendation contained in McGuire, et al. (2002) and with the NRC's general policy on use of seismic hazard in risk-informed regulation.

The site-specific DRS is defined in terms of the site-specific Uniform Hazard Response Spectrum (UHRS) as:

$$DRS = DF * UHRS \qquad \text{Equation 2.5-1}$$

where UHRS is the site-specific UHRS at the ground surface, defined for ASCE Seismic Design Category SDC-5 at the mean 10^{-4} per yr annual frequency of exceedance, and DF is the Design Factor that is based on the slope of the mean hazard curve. When used to scale the UHRS, the derived DRS is a uniform risk spectrum, which used with the NRC's seismic design criteria assures a consistent risk against failure across all SSCs. The procedure for derivation of the DRS is as follows.

For each spectral frequency at which the UHRS is defined, a slope factor A_R is determined from:

$$A_R = \frac{SA_{0.1H_D}}{SA_{H_D}} \qquad \text{Equation 2.5-2}$$

where SA_{H_D} is the spectral acceleration at the target mean UHRS exceedance frequency H_D (that is, 10^{-4} per yr) and $SA_{0.1H_D}$ is the spectral acceleration at $0.1H_D$ (that is, 10^{-5}/yr). Then the Design Factor, DF, at this spectral frequency is given by:

$DF = \text{Maximum}(DF_1, DF_2)$. Equation 2.5-3

For ASCE SDC-5:

$DF_1 = 1.0$ Equation 2.5-3a

$DF_2 = 0.6(A_R)^{0.80}$ Equation 2.5-3b

The derivation of DF is described in detail in Commentary to the ASCE Standard 43-05 (ASCE, 2005). Implementation of the ASCE Standard 43-05 approach for the EGC ESP is also described in Section 4.3.1 of Appendix B. The resulting DRS are shown on Figure 2.5-12.

The resulting DRS for the EGC ESP site are generally enveloped by the Regulatory Guide 1.60 response spectrum anchored to a peak acceleration of 0.3g except at some frequencies above 16 Hz. EPRI (1993b) presents an assessment of the significance of high frequency ground motions to the seismic safety performance of nuclear power plants. That study indicates that there are two factors that lead to reduced effectiveness of high frequency motions to adversely affect performance at high frequencies: (1) the increased incoherence of ground motions at frequencies greater than 10 Hz compared to those at lower frequencies and (2) the capacity of structures and equipment in nuclear power plants to in-elastically absorb the small displacements associated with high frequency ground motions without significant effect. The incoherence reductions are consistent with those recommended in ASCE 4 *Seismic Analysis of Safety-Related Nuclear Structures and Commentary on Standard for Seismic Analysis of Safety-Related Nuclear Structures* (ASCE, 1998).

EPRI (1993b) recommends procedures for reducing the high-frequency portion of DRS to account for these effects. The recommended reduction factors for ground motion incoherency are 10 percent at a frequency of 10 Hz increasing to 20 percent for frequencies of 25 Hz and larger. These factors are appropriate for a building width of approximately 150 ft. For a 75 ft dimension, such as might be associated with a diesel generator building or pump house, these reductions are approximately 50 percent of those for a 150-ft dimension. The reduction factors due to in-elastic absorption of small displacements are of comparable magnitude.

When modified by the high frequency adjustment factors recommended by EPRI (1993b), the vertical and horizontal DRS in Figure 2.5-12 either will be enveloped by the Regulatory Guide 1.60 response spectrum, in the case of a large structure (that is, dimensions equal to approximately 150 ft), or result in only minor exceedances at frequencies in excess of 25 Hz for structures where dimensions are on the order of 75 ft. Based on these results, it is concluded that the high-frequency exceedances of the Regulatory Guide 1.60 response spectrum anchored to 0.3g peak acceleration by the EGC ESP DRS are not significant – indicating that the EGC ESP Site is suitable for any design based on a Regulatory Guide 1.60 response spectrum.

2.5.4.10 Static Stability

Independent estimates of bearing capacity, settlement, and lateral earth pressures were not made for the EGC ESP Site, since a generating system has not been selected. The candidate generating systems have different footprint sizes, depths of embedment, and effective weights, and these variables will affect the determination of bearing pressures, settlement, and lateral earth pressures. For this reason the determination of this stability information will be performed at the COL stage.

While static stability considerations are not explicitly addressed for the EGC ESP Site, high allowable bearing values and low compressibility are expected at the EGC ESP Site because of the similarity in soil conditions to those occurring at the CPS Site. This is also due to the assumption that the foundation levels and the net weights of the structures at the EGC ESP Site will generally be the same as those at the CPS Site. These conditions will have to be evaluated after the power generating system is selected.

The static stability discussions in the CPS USAR cover bearing capacities, settlement, and lateral earth pressure recommendations appropriate for design of the CPS structures. Ultimate bearing capacities for the CPS structures were computed with conventional methods assuming a local shear failure condition, as described in Section 2.5.4.10.2 of the CPS USAR. The resulting ultimate bearing capacities for the category I structures (except for the ultimate heat sink outlet structure, which is located near the shore of Lake Clinton) range from 39.9 to 60.6 tsf. Section 2.5.4 of the CPS USAR also indicates that post-construction settlements were less than predicted, and that conventional methods were used to estimate lateral earth pressures. The very high bearing capacities and the low settlement values are related to the general consistency of soils supporting the CPS Site facilities, as well as the geometry and net loads introduced by the structures. The soils at both the CPS and EGC ESP Sites at the CPS Site foundation level (that is, approximately 55 ft below the ground surface) have been overconsolidated by glaciers that once overrode the site. The weight of the glaciers compressed the soils, thereby resulting in soils that have very high strength and very low compressibility.

Based on the bearing values given in the CPS USAR, the minimum characteristic value for bearing capacity at the EGC ESP Site is 25 tsf. Additional discussions of Static Stability are presented in Section 6.2 of Appendix A.

2.5.4.11 Design Criteria

The design criteria for EGC ESP Site Category I structures will be established during the COL stage when the physical characteristics of the operating system are known. The following sections of this SSAR provide preliminary information that will be considered when design criteria are developed for the EGC ESP Site:

- Liquefaction potential in Section 2.5.4.8;
- Bearing capacity in Section 2.5.4.10;
- Settlement in Section 2.5.4.10;
- Static slope stability in Section 2.5.5;
- Dynamic slope stability in Section 2.5.5.

Additional valuable information relevant to each of these areas is presented under the same section numbers in the CPS USAR. In view of the similarity in soil conditions at the EGC

ESP Site and the CPS Site, design criteria given in the CPS USAR serve as a reasonable starting point for developing design criteria for the EGC ESP Site.

2.5.4.12 Techniques to Improve Subsurface Conditions

Localized areas and pockets of loose granular materials were encountered in the base of excavations for the CPS Category I structures (approximately 55 ft below the ground surface) during construction at the CPS Site. These materials were either compacted or removed and replaced with a flyash backfill material. Additional discussion of the replacement work is described in Section 2.5.4.5 of the CPS USAR.

Until the power generating system is selected, the need for ground improvement for the EGC ESP Site is unknown. Some of the generating systems being considered extend to as deep as 140 ft below the ground surface. It is unlikely that these systems would require any improvement. Systems that are founded at depths of 55 ft or above could require ground improvement as discussed for the CPS Site in the CPS USAR. Alternatives other than the ground improvement used at the CPS Site (that is, excavation and replacement of approximately 20 feet of soil between depths of 35 ft and 55 ft) exist. These include use of stone columns, cement soil mixing, or grouting, and could be considered if the excavation approach discussed in the CPS USAR is found to be inappropriate.

In view of the soil conditions discussed in the CPS USAR, in this section of the SSAR, and in Appendix A, nothing was identified that would result in unreasonable requirements relative to construction or operation of a new power generating system at the EGC ESP Site. Decisions regarding the need for and type of ground improvement will be made during the COL stage after a generating system is selected.

2.5.4.13 Subsurface Instrumentation

A settlement instrumentation system was installed during construction of the CPS plant structures. These settlement points were monitored every 4 months until the movement of the structures stabilized. Graphical recordings of the measurements are included in the CPS USAR. The amount of movement was less than was predicted using conventional settlement prediction methods.

These settlement measurements provide valuable calibration data for future settlement predictions at the EGC ESP Site. Since soil conditions are consistent between the EGC ESP and CPS Sites, conventional methods can be used with considerable confidence to estimate the settlement of future facilities at the EGC ESP Site. This assumes that the new facilities are reasonably similar in size, load, and foundation level to those constructed at the CPS Site.

2.5.4.14 Construction Notes

The CPS USAR provides valuable information from the construction of the CPS Facilities. This information was reviewed as part of the EGC ESP Site work. While this information does not have direct relevance to the EGC ESP Site application, it provides information that will be considered again during the COL stage of the project.

Any future excavation associated with the construction of a new generating system will be mapped to confirm that soil types and consistency are in general accord with the conditions identified during previous construction at the site and that have been interpreted from the field explorations carried out at the EGC ESP Site. This field mapping will involve inspecting excavated slopes for the presence of previously unknown fault offsets.

In addition to mapping excavations for EGC ESP Seismic Category I structures, a commitment is made in this SSAR to

- notify the NRC staff immediately if previously unknown geologic features that could represent a hazard to the plant are encountered during excavation, and
- notify the NRC staff when the excavations are open for examination and evaluation.

2.5.5 Stability of Slopes

Slope stability analyses were not carried out for the EGC ESP Site Application – either for the CPS UHS or any other slopes that could be associated with future development. The closest existing natural slopes to the site are located nearly 800 ft to the north. If a new intake structure into Clinton Lake is required for a future design, additional assessment of slope stability at the point of entry into the lake could be required. The slopes for the existing CPS Unit 2 Facility are approximately 30-ft deep and are located over 500 ft from the EGC ESP Site, and therefore, they don’t pose a hazard.

The foundation depths of the new generating system are also unknown. These depths are needed to assess the potential height of slopes required for construction. Once the generating system is selected, the requirements for additional slope stability studies related to either construction of the power block or the outfall will be determined and provided at the COL stage.

A starting point for any future stability assessments will be the information in the CPS USAR. Extensive evaluation of the stability of slopes was conducted during design work for the CPS Site. Slopes associated with the Lake Clinton main dam and the CPS UHS were evaluated for stability under gravity and seismic loading conditions. As discussed in Section 2.5.5 of the CPS USAR, only the CPS UHS was evaluated for the SSE. The downstream dam was not considered a Category I structure.

It was concluded from the review of the stability information in the CPS USAR that potential future issues associated with slope stability will not, for the most part, result in any unusual construction requirements or constraints. The strength of soils at the EGC ESP and CPS Sites are generally very high, thereby allowing relatively steep construction slopes. The slopes along a future intake structure alignment also will be in soils that can be cut or worked on without significant construction difficulty. A number of ground improvement methods are also available for mitigating slope stability concerns, if they were to be found. These evaluations can be conducted during the COL stage once the characteristics of the generating system are established.

Additional studies may be required during the COL stage to show that the CPS UHS meets stability requirement under the updated SSE. The existing slopes for the CPS UHS appear to have some reserve capacity because of their flatness. Nevertheless, detailed analyses would have to be conducted to confirm the adequacy of these slopes.

2.5.6 Embankments and Dams

Two areas related to dams and embankments were considered. The first involves the Clinton Lake main dam and CPS UHS. The second deals with the potential for seismically induced floods and water waves. As will be discussed, the only potential source of seismically induced floods and water waves is a seiche on Clinton Lake.

2.5.6.1 Design of Main Dam and CPS UHS

The CPS USAR includes an extensive discussion of the explorations and design of the CPS UHS and the Clinton Lake main dam. As noted previously, the main dam is not considered a Category I structure. Emergency cooling water needs for the CPS facilities are provided by the CPS UHS. Since there are no plans to modify or rely on the Clinton Lake main dam for emergency cooling water for the EGC ESP Site facilities, information in the CPS USAR regarding the design, construction, and performance of the dam was not reviewed.

The EGC ESP Facility will use cooling towers for cooling with Clinton Lake being used to provide make-up water to the cooling towers. Additional description and discussion of the use of the UHS to supply shutdown-cooling water for the existing CPS Facility and makeup water to the EGC ESP Facility safety-related cooling towers are provided in Section 2.4.8.1.5. If appropriate, evaluations will be made at the COL stage to assess performance of the submerged dam forming the UHS under the updated SSE and OBE.

The starting point for the COL stage assessment will be Section 2.5.6 of the CPS USAR. This section includes a detailed summary of the design of the CPS UHS. The description in Section 2.5.6 indicates that embankments were constructed before filling Clinton Lake. The design effort for the CPS UHS involved evaluations of slope stability, seepage control, and monitoring. Both static and dynamic methods of analysis were used when evaluating the stability of the slopes. Liquefaction potential was considered during these evaluations. The CPS UHS discussions also indicate that monitoring of the CPS UHS since construction and flooding of Clinton Lake has included periodic fathometer surveys and underwater inspections.

2.5.6.2 Seismically Induced Floods and Water Waves

The design basis for seismically induced floods and water waves is considered because they could affect a site if the source of water were to inundate the site. Generally, the source of flooding is from failure of dams located upstream of the facility or large water retaining structures (steel and concrete tanks) located near the facility. Another potential source of water inundation is from a seiche. These water waves result from sloshing of water in a lake.

The potential for seismically induced floods and water waves at the EGC ESP Site is negligible. There are no dams located upstream of the site, and there are no large water retaining structures (tanks) located in proximity to the existing facilities. Potential flooding from a seiche is also minimal because of the configuration of Clinton Lake and the relative elevation difference between the water level in the lake and the plant site grade. The ground surface at the EGC ESP Site is located at approximate elevation 730 ft msl, while the normal operating pool for Clinton Lake is at approximate elevation 690 ft msl, resulting in 40 ft of elevation change. The EGC ESP Site is also approximately 800 ft from the shoreline of

Clinton Lake. Any seiche caused by an SSE would be too small to reach the site because of the distance and the height above the normal lake elevation. Additional discussion of maximum surge and seiche flooding is provided in Section 2.4.5 of this SSAR.

CHAPTER 2

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CHAPTER 2

Tables

TABLE 2.1-1
2000 Resident and Transient Population Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
North-Residential	0	10	16	30	25	51	**132**
North-Transient	0	0	0	3	1	3	**7**
North North East-Residential	0	9	12	49	33	88	**191**
North North East-Transient	0	0	0	7	1	3	**11**
North East-Residential	1	5	4	11	8	85	**114**
North East-Transient	1,115	0	0	0	1	3	**1,119**
East North East-Residential	1	3	194	16	27	164	**405**
East North East-Transient	0	0	264	0	1	3	**268**
East-Residential	0	3	10	42	11	43	**109**
East-Transient	0	0	864	0	1	2	**867**
East South East-Residential	0	0	12	5	39	58	**114**
East South East-Transient	0	0	0	0	1	2	**3**
South East-Residential	0	1	15	11	440	35	**502**
South East-Transient	0	1,848	0	0	162	2	**2,012**
South South East-Residential	0	8	8	11	15	69	**111**
South South East-Transient	0	0	0	0	1	9	**10**
South-Residential	0	2	19	10	13	73	**117**
South-Transient	630	0	3	0	1	3	**637**
South South West-Residential	0	0	92	21	12	60	**185**
South South West-Transient	0	0	0	0	1	3	**4**
South West-Residential	0	0	24	46	68	161	**299**
South West-Transient	0	437	0	1	677	403	**1,518**
West South West-Residential	0	8	29	22	198	2,147	**2,404**
West South West-Transient	0	821	0	0	4	537	**1,362**
West-Residential	0	55	37	23	1,245	5,207	**6,567**
West-Transient	0	3	0	1	11	3,749	**3,764**
West North West-Residential	1	16	8	10	23	743	**801**
West North West-Transient	0	0	0	1	1	19	**21**
North West-Residential	5	11	11	12	11	150	**200**
North West-Transient	0	0	0	0	1	153	**154**
North North West-Residential	0	11	14	9	13	60	**107**
North North West-Transient	73	0	0	0	1	3	**77**
Residential Total	**8**	**142**	**505**	**328**	**2,181**	**9,194**	**12,358**
Cumulative Total (Residential plus Transient)	**1,826**	**3,251**	**1,636**	**341**	**3,047**	**14,091**	**24,192**

Source: Residential Population is from U.S. Census Bureau, 2001. Transient Population is from U.S. Census Bureau, 2001; USDOC, 2002

TABLE 2.1-2
Resident and Transient Population Projections Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
North-Residential							
2010 population	0	9	15	29	24	52	**129**
2020 population	0	9	15	28	24	53	**129**
2030 population	0	9	15	27	23	55	**129**
2040 population	0	9	14	27	22	57	**129**
2050 population	0	8	14	26	22	59	**129**
2060 population	0	8	14	25	21	60	**128**
North-Transient							
2010 population	0	0	0	3	1	3	**7**
2020 population	0	0	0	3	1	3	**7**
2030 population	0	0	0	3	1	3	**7**
2040 population	0	0	0	3	1	3	**7**
2050 population	0	0	0	3	1	3	**7**
2060 population	0	0	0	3	1	4	**7**
North North East-Residential							
2010 population	0	9	11	47	31	86	**184**
2020 population	0	9	11	46	30	86	**182**
2030 population	0	8	11	44	30	86	**179**
2040 population	0	8	10	43	29	85	**175**
2050 population	0	8	10	42	28	85	**173**
2060 population	0	8	10	41	27	85	**171**
North North East-Transient							
2010 population	0	0	0	7	1	3	**11**
2020 population	0	0	0	7	1	3	**10**
2030 population	0	0	0	6	1	3	**10**
2040 population	0	0	0	6	1	3	**10**
2050 population	0	0	0	6	1	3	**10**
2060 population	0	0	0	6	1	3	**10**
North East-Residential							
2010 population	1	5	4	10	8	81	**109**
2020 population	1	5	4	10	8	79	**107**
2030 population	1	4	4	10	8	77	**104**
2040 population	1	4	4	10	7	76	**102**
2050 population	1	4	4	9	7	74	**99**
2060 population	1	4	4	9	7	72	**97**
North East-Transient							
2010 population	1,115	0	0	0	1	3	**1,119**
2020 population	1,115	0	0	0	1	3	**1,119**
2030 population	1,115	0	0	0	1	3	**1,119**
2040 population	1,115	0	0	0	1	3	**1,119**
2050 population	1,115	0	0	0	1	3	**1,118**
2060 population	1,115	0	0	0	1	3	**1,118**
East North East-Residential							
2010 population	1	3	184	16	26	155	**385**
2020 population	1	3	180	15	25	152	**376**
2030 population	1	3	175	15	25	148	**367**
2040 population	1	3	171	15	24	145	**359**
2050 population	1	3	167	14	24	141	**350**
2060 population	1	3	163	14	23	137	**341**

TABLE 2.1-2
Resident and Transient Population Projections Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
East North East-Transient							
2010 population	0	0	250	0	1	3	**254**
2020 population	0	0	245	0	1	3	**249**
2030 population	0	0	238	0	1	3	**242**
2040 population	0	0	233	0	1	3	**236**
2050 population	0	0	227	0	1	3	**231**
2060 population	0	0	222	0	1	3	**225**
East-Residential							
2010 population	0	3	10	40	10	41	**104**
2020 population	0	3	9	39	10	41	**102**
2030 population	0	2	9	38	10	41	**100**
2040 population	0	2	9	37	9	41	**98**
2050 population	0	2	9	36	9	41	**97**
2060 population	0	2	8	35	9	40	**94**
East-Transient							
2010 population	0	0	864	0	1	2	**867**
2020 population	0	0	778	0	1	2	**780**
2030 population	0	0	778	0	1	2	**780**
2040 population	0	0	778	0	1	2	**780**
2050 population	0	0	778	0	1	2	**780**
2060 population	0	0	691	0	1	2	**694**
East South East-Residential							
2010 population	0	0	11	5	37	57	**110**
2020 population	0	0	11	5	37	57	**110**
2030 population	0	0	11	5	36	57	**109**
2040 population	0	0	10	5	35	57	**107**
2050 population	0	0	10	5	34	58	**107**
2060 population	0	0	10	5	33	58	**106**
East South East-Transient							
2010 population	0	0	0	0	1	2	**3**
2020 population	0	0	0	0	1	2	**3**
2030 population	0	0	0	0	1	2	**3**
2040 population	0	0	0	0	1	2	**3**
2050 population	0	0	0	0	1	2	**3**
2060 population	0	0	0	0	1	2	**3**
South East-Residential							
2010 population	0	1	14	10	418	35	**478**
2020 population	0	1	14	10	408	35	**468**
2030 population	0	1	13	10	398	36	**458**
2040 population	0	1	13	10	389	36	**449**
2050 population	0	1	13	9	379	37	**439**
2060 population	0	1	12	9	369	37	**428**
South East-Transient							
2010 population	0	1,848	0	0	154	2	**2,004**
2020 population	0	1,848	0	0	150	2	**2,000**
2030 population	0	1,848	0	0	147	2	**1,997**
2040 population	0	1,848	0	0	143	2	**1993**
2050 population	0	1,848	0	0	140	2	**1,990**
2060 population	0	1,848	0	0	136	2	**1,986**

TABLE 2.1-2
Resident and Transient Population Projections Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
South South East-Residential							
2010 population	0	8	7	10	14	69	**108**
2020 population	0	8	7	10	14	68	**107**
2030 population	0	7	7	10	13	68	**105**
2040 population	0	7	7	9	13	68	**104**
2050 population	0	7	7	9	13	67	**103**
2060 population	0	7	7	9	12	67	**102**
South South East-Transient							
2010 population	0	0	0	0	1	9	**10**
2020 population	0	0	0	0	1	9	**10**
2030 population	0	0	0	0	1	9	**10**
2040 population	0	0	0	0	1	9	**10**
2050 population	0	0	0	0	1	9	**10**
2060 population	0	0	0	0	1	9	**10**
South-Residential							
2010 population	0	1	18	10	12	73	**114**
2020 population	0	1	18	9	12	73	**113**
2030 population	0	1	17	9	12	73	**112**
2040 population	0	1	17	9	11	73	**111**
2050 population	0	1	17	9	11	72	**110**
2060 population	0	1	16	9	11	72	**109**
South-Transient							
2010 population	630	0	3	0	1	3	**637**
2020 population	630	0	3	0	1	3	**637**
2030 population	630	0	3	0	1	3	**637**
2040 population	630	0	3	0	1	3	**637**
2050 population	630	0	3	0	1	3	**636**
2060 population	630	0	3	0	1	3	**636**
South South West-Residential							
2010 population	0	0	87	20	12	59	**178**
2020 population	0	0	85	20	12	58	**175**
2030 population	0	0	83	19	11	57	**170**
2040 population	0	0	81	19	11	57	**168**
2050 population	0	0	79	18	11	56	**164**
2060 population	0	0	77	18	10	56	**161**
South South West-Transient							
2010 population	0	0	0	0	1	3	**4**
2020 population	0	0	0	0	1	3	**4**
2030 population	0	0	0	0	1	3	**4**
2040 population	0	0	0	0	1	3	**4**
2050 population	0	0	0	0	1	3	**4**
2060 population	0	0	0	0	1	3	**4**
South West-Residential							
2010 population	0	0	22	44	65	154	**285**
2020 population	0	0	22	43	63	150	**278**
2030 population	0	0	21	42	62	147	**272**
2040 population	0	0	21	41	60	143	**265**
2050 population	0	0	20	40	59	139	**258**
2060 population	0	0	20	39	57	136	**252**

TABLE 2.1-2
Resident and Transient Population Projections Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
South West-Transient							
2010 population	0	437	0	1	647	385	**1,471**
2020 population	0	437	0	1	627	375	**1,441**
2030 population	0	437	0	1	617	368	**1,423**
2040 population	0	437	0	1	597	358	**1,393**
2050 population	0	437	0	1	587	348	**1,373**
2060 population	0	437	0	1	567	340	**1,346**
West South West-Residential							
2010 population	0	8	27	21	188	2,041	**2,285**
2020 population	0	7	27	20	184	1,993	**2,231**
2030 population	0	7	26	20	180	1,945	**2,178**
2040 population	0	7	26	19	175	1,898	**2,125**
2050 population	0	7	25	19	171	1,850	**2,072**
2060 population	0	7	24	18	166	1,802	**2,017**
West South West-Transient							
2010 population	0	821	0	0	4	510	**1,335**
2020 population	0	718	0	0	4	498	**1,221**
2030 population	0	718	0	0	4	486	**1,208**
2040 population	0	718	0	0	4	475	**1,197**
2050 population	0	718	0	0	3	463	**1,185**
2060 population	0	718	0	0	3	451	**1,172**
West-Residential							
2010 population	0	52	36	22	1,183	4,950	**6,243**
2020 population	0	51	35	21	1,155	4,834	**6,096**
2030 population	0	50	34	21	1,128	4,719	**5,952**
2040 population	0	48	33	20	1,100	4,603	**5,804**
2050 population	0	47	32	20	1,073	4,487	**5,659**
2060 population	0	46	31	19	1,045	4,372	**5,513**
West-Transient							
2010 population	0	3	0	1	10	3,564	**3,578**
2020 population	0	3	0	1	10	3,480	**3,494**
2030 population	0	3	0	1	10	3,398	**3,411**
2040 population	0	3	0	1	10	3,314	**3,327**
2050 population	0	3	0	1	9	3,231	**3,244**
2060 population	0	3	0	1	9	3,148	**3,160**
West North West-Residential							
2010 population	1	15	8	10	22	706	**762**
2020 population	1	15	8	9	22	689	**744**
2030 population	1	14	7	9	21	673	**725**
2040 population	1	14	7	9	21	656	**708**
2050 population	1	14	7	9	20	640	**691**
2060 population	1	13	7	9	20	624	**674**
West North West-Transient							
2010 population	0	0	0	1	1	18	**20**
2020 population	0	0	0	1	1	18	**19**
2030 population	0	0	0	1	1	17	**19**
2040 population	0	0	0	1	1	17	**19**
2050 population	0	0	0	1	1	16	**18**
2060 population	0	0	0	1	1	16	**18**

TABLE 2.1-2
Resident and Transient Population Projections Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
North West-Residential							
2010 population	4	10	11	12	11	142	**190**
2020 population	4	10	10	11	10	139	**184**
2030 population	4	10	10	11	10	136	**181**
2040 population	4	10	10	11	10	132	**177**
2050 population	4	9	10	11	10	129	**173**
2060 population	4	9	9	10	9	126	**167**
North West-Transient							
2010 population	0	0	0	0	1	145	**146**
2020 population	0	0	0	0	1	142	**143**
2030 population	0	0	0	0	1	139	**140**
2040 population	0	0	0	0	1	135	**136**
2050 population	0	0	0	0	1	132	**132**
2060 population	0	0	0	0	1	129	**129**
North North West-Residential							
2010 population	0	10	13	9	12	59	**103**
2020 population	0	10	13	9	12	60	**104**
2030 population	0	10	12	8	12	61	**103**
2040 population	0	9	12	8	11	62	**102**
2050 population	0	9	12	8	11	63	**103**
2060 population	0	9	11	8	11	63	**102**
North North West-Transient							
2010 population	73	0	0	0	1	3	**77**
2020 population	73	0	0	0	1	3	**77**
2030 population	73	0	0	0	1	3	**77**
2040 population	73	0	0	0	1	3	**77**
2050 population	73	0	0	0	1	3	**77**
2060 population	73	0	0	0	1	3	**77**
2010 population							
Residential Total	7	134	478	315	2,073	8,760	**11,767**
Cumulative Total (Residential plus Transient)	1,825	3,243	1,595	328	2,900	13,423	**23,309**
2020 population							
Residential Total	7	132	469	305	2,026	8,567	**11,506**
Cumulative Total (Residential plus Transient)	1,825	3,138	1,494	317	2,829	13,123	**22,719**
2030 population							
Residential Total	7	126	455	298	1,979	8,379	**11,244**
Cumulative Total (Residential plus Transient)	1,825	3,132	1,473	310	2,767	12,834	**22,330**
2040 population							
Residential Total	7	123	445	292	1,927	8,189	**10,983**
Cumulative Total (Residential plus Transient)	1,825	3,129	1,458	304	2,691	12,537	**21,929**
2050 population							
Residential Total	7	120	436	284	1,882	7,998	**10,727**
Cumulative Total (Residential plus Transient)	1,825	3,126	1,444	295	2,632	12,242	**21,544**

TABLE 2.1-2
Resident and Transient Population Projections Within 16 km (10 mi)

km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
2060 population							
Residential Total	7	118	423	277	1,830	7,807	**10,462**
Cumulative Total (Residential plus Transient)	1,825	3,124	1,339	288	2,556	11,947	**21,057**

Source: ISU, 2002

Notes: 2010 and 2020 projections are based on a methodology determined by the Illinois State University. They are based on 1990 populations and fertility, mortality, and migration rates from the early 1990s. They have not been adjusted for the 2000 Census population. Population projections from the 2000 Census are being prepared by the State of Illinois and is expected to be released in 2004 to 2006. A ratio of the population in 2010 and 2020 was used to determine the projected population for 2030, 2040, 2050, and 2060. Transient population was assumed to follow the same population trends as residential population.

TABLE 2.1-3
2000 Resident and Transient Population Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
North-Residential	10,558	5,161	6,645	22,364
North-Transient	39	329	81	449
North North East-Residential	4,874	2,426	12,357	19,657
North North East-Transient	4,063	40	124	4,227
North East-Residential	1,852	4,552	3,665	10,069
North East-Transient	21	52	78	151
East North East-Residential	3,987	7,622	18,845	30,454
East North East-Transient	133	230	421	784
East-Residential	9,734	114,051	8,157	131,942
East-Transient	63	1,934	60	2,057
East South East-Residential	3,266	22,665	8,686	34,617
East South East-Transient	37	235	82	354
South East-Residential	7,436	3,381	11,508	22,325
South East-Transient	58	63	262	383
South South East-Residential	2,526	5,910	9,581	18,017
South South East-Transient	33	51	132	216
South-Residential	14,620	12,296	3,125	30,041
South-Transient	196	1,958	34,287	36,441
South South West-Residential	69,848	15,636	19,275	104,759
South South West-Transient	1,094	1,056	104	2,254
South West-Residential	4,058	3,324	11,585	18,967
South West-Transient	40	45	11,418	11,503
West South West-Residential	1,585	3,483	58,674	63,742
West South West-Transient	34	43	241	318
West-Residential	1,381	20,729	5,931	28,041
West-Transient	26	1,196	71	1,293
West North West-Residential	3,770	3,724	12,702	20,196
West North West-Transient	67	54	101	222
North West-Residential	3,010	6,786	56,991	66,787
North West-Transient	27	294	412	733
North North West-Residential	79,919	35,630	14,481	130,030
North North West-Transient	1,423	1,097	155	2,675
Residential Total	**222,424**	**267,376**	**262,208**	**752,008**
Cumulative Total (Residential plus Transient)	**229,778**	**276,053**	**310,237**	**816,068**

Source: Residential Population is from U.S. Census Bureau, 2001. Transient Population is from U.S. Census Bureau, 2001; USDOC, 2002

TABLE 2.1-4
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
North-Residential				
2010 population	10,972	5,363	6,809	**23,144**
2020 population	11,599	5,670	7,085	**24,354**
2030 population	12,227	5,977	7,361	**25,565**
2040 population	12,854	6,283	7,637	**26,774**
2050 population	13,481	6,590	7,913	**27,984**
2060 population	14,109	6,897	8,189	**29,195**
North-Transient				
2010 population	41	342	83	**465**
2020 population	43	361	86	**491**
2030 population	45	381	90	**516**
2040 population	47	401	93	**541**
2050 population	50	420	96	**566**
2060 population	52	440	100	**592**
North North East-Residential				
2010 population	5,065	2,518	12,207	**19,790**
2020 population	5,354	2,659	12,185	**20,198**
2030 population	5,644	2,800	12,163	**20,607**
2040 population	5,934	2,941	12,141	**21,016**
2050 population	6,223	3,082	12,119	**21,424**
2060 population	6,513	3,223	12,097	**21,833**
North North East-Transient				
2010 population	4,222	42	122	**4,386**
2020 population	4,463	44	122	**4,629**
2030 population	4,705	46	122	**4,873**
2040 population	4,947	48	122	**5,117**
2050 population	5,188	51	122	**5,360**
2060 population	5,429	53	121	**5,604**
North East-Residential				
2010 population	1,920	4,509	3,613	**10,042**
2020 population	2,026	4,446	3,572	**10,044**
2030 population	2,132	4,383	3,530	**10,045**
2040 population	2,237	4,320	3,489	**10,046**
2050 population	2,343	4,258	3,448	**10,049**
2060 population	2,449	4,195	3,406	**10,050**
North East-Transient				
2010 population	22	52	77	**150**
2020 population	23	51	76	**150**
2030 population	24	50	75	**149**
2040 population	25	49	74	**149**
2050 population	27	49	73	**149**
2060 population	28	48	72	**148**
East North East-Residential				
2010 population	3,981	8,208	19,670	**31,859**
2020 population	4,026	8,656	20,297	**32,979**
2030 population	4,070	9,104	20,925	**34,099**
2040 population	4,115	9,552	21,552	**35,219**
2050 population	4,159	10,000	22,179	**36,338**
2060 population	4,204	10,448	22,807	**37,459**

TABLE 2.1-4
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
East North East-Transient				
2010 population	133	248	439	**820**
2020 population	134	261	453	**849**
2030 population	136	275	467	**878**
2040 population	137	288	481	**907**
2050 population	139	302	495	**936**
2060 population	140	315	510	**965**
East -Residential				
2010 population	10,430	123,506	8,818	**142,754**
2020 population	11,014	130,812	9,325	**151,151**
2030 population	11,598	138,118	9,833	**159,549**
2040 population	12,182	145,423	10,341	**167,946**
2050 population	12,766	152,729	10,849	**176,344**
2060 population	13,350	160,035	11,356	**184,741**
East -Transient				
2010 population	68	2,094	65	**2,227**
2020 population	71	2,218	69	**2,358**
2030 population	75	2,342	72	**2,490**
2040 population	79	2,466	76	**2,621**
2050 population	83	2,590	80	**2,752**
2060 population	86	2,714	84	**2,884**
East South East-Residential				
2010 population	3,348	24,544	9,119	**37,011**
2020 population	3,489	25,996	9,488	**38,973**
2030 population	3,631	27,447	9,858	**40,936**
2040 population	3,773	28,899	10,228	**42,900**
2050 population	3,914	30,351	10,597	**44,862**
2060 population	4,056	31,803	10,967	**46,826**
East South East-Transient				
2010 population	38	254	86	**378**
2020 population	40	270	90	**399**
2030 population	41	285	93	**419**
2040 population	43	300	97	**439**
2050 population	44	315	100	**459**
2060 population	46	330	104	**479**
South East-Residential				
2010 population	7,538	3,424	11,427	**22,389**
2020 population	7,830	3,505	11,515	**22,850**
2030 population	8,123	3,587	11,603	**23,313**
2040 population	8,415	3,668	11,691	**23,774**
2050 population	8,707	3,750	11,779	**24,236**
2060 population	9,000	3,831	11,868	**24,699**
South East-Transient				
2010 population	59	64	260	**383**
2020 population	61	65	262	**389**
2030 population	63	67	264	**394**
2040 population	66	68	266	**400**
2050 population	68	70	268	**406**
2060 population	70	71	270	**412**

TABLE 2.1-4
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
South South East-Residential				
2010 population	2,563	5,901	9,614	**18,078**
2020 population	2,655	6,006	9,830	**18,491**
2030 population	2,748	6,111	10,046	**18,905**
2040 population	2,840	6,215	10,262	**19,317**
2050 population	2,932	6,320	10,478	**19,730**
2060 population	3,024	6,425	10,694	**20,143**
South South East-Transient				
2010 population	33	51	132	**217**
2020 population	35	52	135	**222**
2030 population	36	53	138	**227**
2040 population	37	54	141	**232**
2050 population	38	55	144	**237**
2060 population	40	55	147	**242**
South-Residential				
2010 population	14,988	12,540	3,174	**30,702**
2020 population	15,068	12,636	3,359	**31,063**
2030 population	15,147	12,733	3,543	**31,423**
2040 population	15,226	12,829	3,728	**31,783**
2050 population	15,305	12,926	3,912	**32,143**
2060 population	15,385	13,022	4,097	**32,504**
South-Transient				
2010 population	201	1,997	34,825	**37,022**
2020 population	202	2,012	36,854	**39,069**
2030 population	203	2,028	38,873	**41,104**
2040 population	204	2,043	40,903	**43,150**
2050 population	205	2,058	42,922	**45,485**
2060 population	206	2,074	44,952	**47,231**
South South West-Residential				
2010 population	71,610	16,027	19,193	**106,830**
2020 population	71,988	16,114	19,463	**107,565**
2030 population	72,366	16,202	19,733	**108,301**
2040 population	72,744	16,290	20,003	**109,037**
2050 population	73,122	16,378	20,273	**109,773**
2060 population	73,500	16,466	20,542	**110,508**
South South West-Transient				
2010 population	1,122	1,082	104	**2,308**
2020 population	1,128	1,088	105	**2,321**
2030 population	1,133	1,094	106	**2,334**
2040 population	1,139	1,100	108	**2,347**
2050 population	1,145	1,106	109	**2,361**
2060 population	1,151	1,112	111	**2,374**
South West-Residential				
2010 population	4,180	3,453	12,191	**19,824**
2020 population	4,207	3,508	12,467	**20,182**
2030 population	4,233	3,563	12,744	**20,540**
2040 population	4,260	3,618	13,021	**20,899**
2050 population	4,286	3,673	13,298	**21,257**
2060 population	4,313	3,729	13,575	**21,617**

TABLE 2.1-4
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
South West-Transient				
2010 population	41	47	12,015	**12,103**
2020 population	41	47	12,287	**12,376**
2030 population	42	48	12,560	**12,650**
2040 population	42	49	12,833	**12,924**
2050 population	42	50	13,106	**13,198**
2060 population	43	50	13,379	**13,472**
West South West-Residential				
2010 population	1,595	3,727	63,458	**68,780**
2020 population	1,589	3,787	65,682	**71,058**
2030 population	1,583	3,847	67,906	**73,336**
2040 population	1,577	3,907	70,130	**75,614**
2050 population	1,571	3,967	72,354	**77,892**
2060 population	1,565	4,028	74,578	**80,171**
West South West-Transient				
2010 population	34	46	261	**341**
2020 population	34	47	270	**351**
2030 population	34	47	279	**360**
2040 population	34	48	288	**370**
2050 population	34	49	297	**380**
2060 population	34	50	306	**390**
West -Residential				
2010 population	1,413	22,179	6,300	**29,892**
2020 population	1,415	22,525	6,631	**30,571**
2030 population	1,417	22,871	6,963	**31,251**
2040 population	1,419	23,218	7,294	**31,931**
2050 population	1,421	23,564	7,626	**32,611**
2060 population	1,423	23,910	7,957	**33,290**
West -Transient				
2010 population	27	1,280	75	**1,382**
2020 population	27	1,300	79	**1,406**
2030 population	27	1,320	83	**1,430**
2040 population	27	1,340	87	**1,454**
2050 population	27	1,360	91	**1,478**
2060 population	27	1,380	95	**1,502**
West North West-Residential				
2010 population	3,912	3,880	12,941	**20,733**
2020 population	3,991	3,945	13,134	**21,070**
2030 population	4,070	4,010	13,327	**21,407**
2040 population	4,149	4,074	13,519	**21,742**
2050 population	4,228	4,139	13,712	**22,079**
2060 population	4,307	4,204	13,904	**22,415**
West North West-Transient				
2010 population	70	56	103	**229**
2020 population	71	57	104	**233**
2030 population	72	58	106	**236**
2040 population	74	59	107	**240**
2050 population	75	60	109	**244**
2060 population	77	61	111	**248**

TABLE 2.1-4
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
North West-Residential				
2010 population	3,116	6,994	58,417	**68,527**
2020 population	3,284	7,237	59,515	**70,036**
2030 population	3,451	7,480	60,613	**71,544**
2040 population	3,619	7,723	61,712	**73,054**
2050 population	3,787	7,966	62,810	**74,563**
2060 population	3,955	8,209	63,908	**76,072**
North West-Transient				
2010 population	28	303	422	**753**
2020 population	29	314	430	**773**
2030 population	31	324	438	**793**
2040 population	32	335	446	**813**
2050 population	34	345	454	**833**
2060 population	35	356	462	**853**
North North West-Residential				
2010 population	83,049	37,128	16,035	**136,212**
2020 population	87,798	39,354	17,933	**145,085**
2030 population	92,547	41,579	19,830	**153,956**
2040 population	97,296	43,804	21,728	**162,828**
2050 population	102,044	46,030	23,625	**171,699**
2060 population	106,793	48,255	25,523	**180,571**
North North West-Transient				
2010 population	1,479	1,143	172	**2,793**
2020 population	1,563	1,212	192	**2,967**
2030 population	1,648	1,280	212	**3,140**
2040 population	1,732	1,349	233	**3,314**
2050 population	1,817	1,417	253	**3,487**
2060 population	1,902	1,486	273	**3,660**
2010 population				
Residential Total	229,680	283,901	272,986	**786,567**
Cumulative Total (Residential plus Transient)	237,296	293,001	322,228	**852,525**
2020 population				
Residential Total	237,333	296,856	281,481	**815,670**
Cumulative Total (Residential plus Transient)	245,298	306,255	333,097	**884,650**
2030 population				
Residential Total	244,987	309,812	289,978	**844,777**
Cumulative Total (Residential plus Transient)	253,302	319,510	343,959	**916,771**
2040 population				
Residential Total	252,640	322,764	298,476	**873,880**
Cumulative Total (Residential plus Transient)	261,306	332,760	354,833	**948,899**
2050 population				
Residential Total	260,289	335,723	306,972	**902,984**
Cumulative Total (Residential plus Transient)	269,304	346,018	365,693	**981,016**

TABLE 2.1-4
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

km mi	16-40 10-25	40-60 25-37	60-80 37-50	Total for Sector
2060 population				
Residential Total	267,946	348,680	315,468	**932,094**
Cumulative Total (Residential plus Transient)	277,311	359,274	376,565	**1,013,150**

Source: ISU, 2002

Notes: 2010 and 2020 projections are based on a methodology determined by the Illinois State University. They are based on 1990 populations and fertility, mortality, and migration rates from the early 1990s. They have not been adjusted for the 2000 Census population. Population projections from the 2000 Census are being prepared by the State of Illinois and are expected to be released 2004 to 2006. A ratio of the population in 2010 and 2020 was used to determine the projected population for 2030, 2040, 2050, and 2060. Transient population was assumed to follow the same population trends as residential population.

TABLE 2.1-5
Facilities and Institutions Within the Vicinity of the Low Population Zone

Facility/Institution	Type	Sector	Approximate Distance from LPZ (mi)	Estimated Daily Population
Douglas Elementary School	Educational	W	2.3	269
Webster Elementary School	Educational	W	2.3	274
Clinton Junior High School	Educational	W	2.7	508
Lincoln Elementary School	Educational	W	2.9	260
Washington Elementary School	Educational	W	2.9	319
Clinton Christian Academy	Educational	W	3.2	100
Clinton High School	Educational	W	3.5	791
Richland Community College	Educational	W	3.5	230
DeLand Elementary	Educational	SE	4.8	130
DeLand Weldon Middle School	Educational	SE	4.8	28
Head Start	Educational	W	2.6	15
Dora's Daycare	Educational	WNW	3.1	10
John Warner Hospital	Medical	W	3.0	217
Crestview Nursing Home	Medical	W	2.8	163
Clinton High Rise	Medical	W	7.5	50
Allen Court 1829 E. Main	Medical	W	2.5	25
Allen Court 1650 E. Main	Medical	W	2.5	25
DeWitt County Jail	Government	W	2.8	68

TABLE 2.1-5
Facilities and Institutions Within the Vicinity of the Low Population Zone

Facility/Institution	**Type**	**Sector**	**Approximate Distance from LPZ (mi)**	**Estimated Daily Population**
Arrowhead Acres Park	Recreational	SW	4.0	100
Clinton Country Club	Recreational	W	4.1	50
Little Galilee Christian Camp	Recreational	SW	3.5	300
Weldon Springs State Recreation Area	Recreational	SW	.3.0	676
Calvary United Church Camp	Recreational	NW	6.5	150
Green Acres Campground	Recreational	E	1	120

Source: NCES, 2002. IDCCA, 2002.

TABLE 2.1-6
Recreational Facilities in the Vicinity of the EGC ESP Site

Area	Attendance		Approximate Distance and Direction
	Average Daily	Peak Daily	
Clinton Lake State Park	1,253	4,813	--
Arrowhead Acres	50	100	6.5 mi SW
Clinton County Club	50	50	6.6 mi W
Little Galilee Christian Assembly Church Camp	300	300	6.0 mi SW
Weldon Springs State Recreation Area	325	676	5.5 mi SW
Calvary United Church Camp	150	150	9 mi NW
Green Acres Campground	75	120	3.5 mi W
TOTAL	2,353	6,909	

TABLE 2.1-7
Peak Day Uses of Clinton Lake State Recreation Area

Area	**Attendance**	
	Average Daily	**Peak Daily**
Clinton Marine	176	630
Mascoutin State Rec Area	483	1,848
Northfork Boat and Canoe Access	56	73
Parnell Boat Access	64	261
Penninsula Area	44	134
Spillway Access Area	103	303
Weldon Boat Access	126	744
Westside Boat Access	201	820
TOTAL	1,253	4,813

TABLE 2.1-8
Peak Recreational Usage Clinton Lake State Recreation Area

Sector	0-2 km	2-4 km	4-6 km	6 - 8 km	0-8 km
N	0	0	0	73	73
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	261	0	261
E	0	0	744	0	744
ESE	0	0	0	0	0
SE	0	1848	0	0	1848
SSE	0	0	0	0	0
S	0	630	0	0	630
SSW	0	0	0	0	0
SW	0	0	134	303	437
WSW	0	0	820	0	820
W	0	0	0	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	0
NNW	0	0	0	0	0
TOTAL	0	2,478	1,959	376	4,813

Note: Some facilities in Clinton Lake State Recreation Area are not included in the 8 km (5 mi) radius

TABLE 2.1-9
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

Local	Place Name	Total Population in 2000	Distance (mi)	Direction
Vicinity	DeWitt	188	2.6	ENE
	Weldon	440	5.6	SE
	Clinton	7,485	7.0	W
	Wapella	651	7.6	WNW
Region	DeLand	475	10.6	ESE
	Maroa	1,654	11.3	SW
	Farmer City	2,055	11.3	ENE
	Le Roy	3,332	12.1	NNE
	Cisco	264	12.2	SSE
	Heyworth	2,431	12.5	NW
	Argenta	921	12.8	S
	Kenney	374	14.3	WSW
	Downs	776	16.0	N
	Waynesville	452	16.2	WNW
	Oreana	892	16.3	S
	Monticello	5,138	16.9	SE
	Mansfield	949	17.3	E
	Forsyth	2,434	18.4	SSW
	Bellflower	408	20.0	NE
	Ellsworth	271	20.2	NNE
	Cerro Gordo	1,436	20.2	SSE
	McLean	808	20.4	WNW
	Warrensburg	1,289	20.5	SW
	Arrowsmith	298	21.9	NNE
	Atlanta	1,649	22.0	WNW
	Bement	1,784	22.0	SE
	Bloomington	64,808	22.4	NNW
	Decatur	81,860	22.4	SSW
	Latham	371	22.5	SW
	Mahomet	4,877	23.3	E
	Saybrook	764	24.0	NE

TABLE 2.1-9
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

Local	Place Name	Total Population in 2000	Distance (mi)	Direction
	Lake of the Woods	3,026	24.5	E
	Bondville	455	24.9	E
	Foosland	90	25.0	ENE
	Long Creek	1,364	25.2	S
	Ivesdale	288	25.3	SE
	Normal	45,386	25.4	NNW
	Harristown	1,338	25.7	SSW
	Cooksville	213	26.4	NNE
	Mount Pulaski	1,701	26.4	WSW
	Mount Zion	4,845	27.1	S
	Towanda	493	27.3	N
	Stanford	670	27.4	NW
	Fisher	1,647	27.5	ENE
	Armington	368	28.0	WNW
	Niantic	738	28.1	SW
	Lincoln	15,369	28.4	W
	Hammond	518	28.7	SSE
	Sadorus	426	29.5	ESE
	Colfax	989	29.6	NNE
	Champaign	67,518	30.2	E
	Danvers	1,183	30.6	NW
	Illiopolis	916	31.2	SW
	Hudson	1,510	31.2	NNW
	Minier	1,244	31.2	NW
	Dalton City	581	31.4	S
	Gibson City	3,373	31.4	NE
	Anchor	175	31.5	NNE
	Savoy	4,476	31.7	ESE
	Atwood	1,290	32.3	SE
	Carlock	456	32.5	NNW
	Hartsburg	358	32.6	WNW
	Lexington	1,912	32.7	N

TABLE 2.1-9
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

Local	Place Name	Total Population in 2000	Distance (mi)	Direction
	Tolono	2,700	32.7	ESE
	Broadwell	169	33.1	WSW
	Macon	1,213	33.2	SSW
	Lovington	1,222	33.3	SSE
	Garrett	198	33.7	SE
	Urbana	36,395	33.9	E
	Thomasboro	1,233	34.5	E
	Pesotum	521	34.6	ESE
	Emden	515	35.6	WNW
	Hopedale	929	35.6	WNW
	Elliott	341	35.7	ENE
	Blue Mound	1,129	35.8	SSW
	Elkhart	443	35.9	WSW
	Kappa	170	36.0	NNW
	Mount Auburn	515	36.1	SW
	Congerville	466	36.5	NNW
	Bethany	1,287	36.6	S
	Arthur	2,203	37.0	SSE
	Rantoul	12,857	37.0	ENE
	Mackinaw	1,452	37.4	NW
	Sibley	329	37.4	NE
	Philo	1,314	37.5	ESE
	Buffalo	491	37.8	SW
	Goodfield	686	39.0	NW
	Tuscola	4,448	39.0	SE
	Mechanicsburg	456	39.0	SW
	Moweaqua	1,923	39.1	SSW
	Gridley	1,411	39.6	N
	New Holland	318	39.7	W
	Chenoa	1,845	40.0	N
	Dawson	466	40.0	WSW
	Delavan	1,825	40.1	WNW

TABLE 2.1-9
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

Local	Place Name	Total Population in 2000	Distance (mi)	Direction
	Ludlow	324	40.1	ENE
	El Paso	2,695	40.3	NNW
	Strawn	104	40.3	NE
	Middletown	434	40.5	W
	Williamsville	1,439	40.9	WSW
	Deer Creek	605	41.2	NW
	Melvin	465	41.4	NE
	Stonington	960	41.4	SSW
	Sullivan	4,326	41.4	SSE
	Villa Grove	2,553	41.5	ESE
	Sidney	1,062	41.6	ESE
	San Jose	696	41.8	WNW
	St. Joseph	2,912	42.3	E
	Secor	379	42.4	NNW
	Tremont	2,029	42.4	NW
	Fairbury	3,968	43.1	NNE
	Spaulding	559	43.3	WSW
	Panola	33	43.5	NNW
	Paxton	4,525	43.5	ENE
	Camargo	469	43.7	SE
	Arcola	2,652	43.8	SE
	Gifford	815	43.8	ENE
	Riverton	3,048	43.9	WSW
	Eureka	4,871	44.2	NNW
	Findlay	723	45.0	S
	Allenville	154	45.1	SSE
	Longview	153	45.2	ESE
	Morton	15,198	45.3	NW
	Royal	279	45.5	E
	Sherman	2,871	45.5	WSW
	Forrest	1,225	45.7	NNE
	Mason City	2,558	45.8	W

TABLE 2.1-9
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

Local	Place Name	Total Population in 2000	Distance (mi)	Direction
	Green Valley	728	45.8	WNW
	Roberts	387	45.9	NE
	Edinburg	1,135	46.2	SW
	Clear Lake	267	46.2	WSW
	Loda	419	46.5	ENE
	Assumption	1,261	46.5	SSW
	Ogden	743	46.6	E
	Homer	1,200	47.3	ESE
	Roanoke	1,994	47.4	NNW
	Humboldt	481	47.7	SE
	Cantrall	139	47.7	WSW
	Rochester	2,893	47.8	SW
	Broadlands	312	47.9	ESE
	Grandview	1,537	48.3	WSW
	Greenview	862	48.5	W
	Washington	10,841	48.5	NW
	Flanagan	1,083	48.7	N
	South Pekin	1,162	48.8	WNW
	Chatsworth	1,265	49.1	NE
	Benson	408	49.2	NNW
	Athens	1,726	49.5	WSW
	Pontiac	11,864	49.7	NNE
	Hindsboro	361	50.0	SE

Source: U.S. Census Bureau, 2001.

TABLE 2.2-1
Military Armories Within 50 Miles - Illinois Air/Army National Guard Units

Location	No. of Units	Distance and Direction
Air National Guard		
Decatur (AASF)	4	25 mi SSW
Springfield	3	49 mi WSW
Army National Guard		
Bloomington Armory	2	23 mi NNW
Champaign Armory	1	30 mi E

TABLE 2.2-2
Industries Within Five Miles and Industries that May Impact the EGC ESP Site

Industry	Number of Employees (approx.)	Product(s)
Cornbelt FS (DeWitt)	Not Available	Propane storage
Van Horn – DeWitt	7 FT; 4-5 PT	Agricultural chemicals and fertilizers
Weldon Fertilizer and Lumber Co.	8 FT	Agricultural chemicals and fertilizers; lumber products

FT = Full Time
PT = Part Time

TABLE 2.2-3
Chemical and Material Storage at CPS

Chemical	Nominal Quantity
Caustic (50% & 25% Solution)	10,000 gal
Sulfuric Acid	10,500 gal
Polyacrylamide	165 gal
Trisodium Phosphate	1,000 lb
Sodium Nitrite	500 lb
Fuel Oil	148,350 gal
Lubrication Oil	42,000 gal
Glycol	1,000 gal
Hydrogen	73,000 ft^3
Carbon Dioxide	34,000 lb (3 tanks)
Acetylene	3,000 ft^3 (20 tanks)
Oxygen	7,000 ft^3 (23 tanks)
Nitrogen	11,300 ft^3 (50 tanks)
Argon	9,000 ft^3 (30 tanks)
Halon 1301	2,200 lb
Polymer/Coagulant	500 gal
Scale Inhibitor	2,700 gal
Sodium Bisulfite	2,850 gal
Sodium Hypochlorite	5,500 gal

Source: CPS, 2002

TABLE 2.2-4
Pipelines Within Five Miles of EGC ESP Site

Pipeline Company	Pipe Diameter (inches)	Material Carried	Year Pipe Installed	Operating Pressure (psi)	Depth of Burial (inches)	Location and Type of Isolation Valve	Approximate Distance (ft)
Equilon Oil Company	14	Refined petroleum products	1976	1000-1100	> 36	Manual control both sides of Clinton Lake	4,000
Illinois Power Co.	2	Natural Gas	1966	450	36	None	12,000
Explorer Pipeline Company	24	Refined petroleum products	1976	750-900	> 36	Manual control both sides of Clinton Lake	13,700
Phillips Pipeline Company	2 8-in. pipes	Refined petroleum products	1976	750-1100	> 36	Manual control both sides of Clinton Lake	13,700

Source: CPS, 2002

TABLE 2.2-4A
Probability of Aircraft Impact From Federal Airways

Airway	Airway Width	Present Traffic np	Projected Traffic $N = np(1.21)^{60/12}$	Probability of Impact per Year
V313	9.2	7,300	18,934	5.90E-08
V233	9.2	7,300	18,934	5.90E-08
V434	12	5,475	14,201	3.39E-08
V72	9.5	3,650	9,467	2.86E-08
Total				1.81E-07

Source: CPS USAR Table 3.5-7 (CPS, 2002)

TABLE 2.2-5
Hazardous Materials Shipments on Gilman Rail Line

Description of Commodity	Carloads	Tons
Butane	443	31,146
Propylene	801	57,132
Liquefied Petroleum Gas (butene gas, liquefied)	345	24,459
Isobutane	793	57,001
Propane	164	11,559
Liquefied Petroleum Gas	885	61,816
Sulfuric Acid	156	13,831
Monoethanolamine	44	3,391
Corrosive Liquid, N.O.S.	34	2,621
Sodium Nitrate	34	1,980
Propylene Oxide	77	5,164
Vinyl Acetate	137	10,769
Carbon Tetrachloride	185	16,560
Petroleum Naphtha	47	3,468
Formaldehyde (or) formalin solution (in containers over 100 gallons)	38	3,227
Denatured Alcohol	56	3,874
Alcohol, N.O.S. (ethyl alcohol, anhydrous, denatured in part with petroleum products and/or chemicals not to exceed 5%t)	60	4,817
Anhydrous Ammonia	37	3,119
Bromine	34	1,340

Source: CPS, 2002

Note: Hazardous Materials Shipments with a Frequency of 30 or More Cars Per Year Over the Illinois Central Gulf-Gilman Line from December 1, 1981 to November 30, 1982.

TABLE 2.3-1
Climatological Data from Peoria and Springfield, Illinois

Parameter	Station: Peoria	Station: Springfield
Location		
Distance (mi)	55	49
Direction from CPS	Northwest	West-Southwest
Temperature		
Annual (°F)	51.1	53.2
Maximum (°F)	105 (July 1988)	112 (July 1954)
Minimum (°F)	-25 (January 1977)	-22 (February 1963)
Degree days (heating)	6,226	5,654
Degree days (cooling)	948	1,165
Relative Humidity (%)		
Annual average at 6 A.M.	83	82
Annual average at Noon	61	61
Wind		
Annual average speed (mph)	10.1	11.2
Prevailing direction	South	South Southwest
Fastest mile/**Peak gust**		
Speed (mph)	75 (July 1953)	75 (June 1957)
Direction	Northwest	Southwest
Precipitation (in.)		
Annual average	34.89	33.78
Monthly maximum	13.09 (September 1961)	10.76 (July 1981)
Monthly minimum	0.03 (September 1979)	Trace amount (September 1979)
24-hour maximum	5.06 (April 1950)	6.12 (December 1982)
Maximum Annual	55.35 (1990)	52.67 (1990)
Snowfall (in.)		
Annual average	25.1	23.9
Monthly maximum	26.5 (February 1900)	24.4 (February 1900)
Maximum 24-hour	18.0 (February 1900)	15.0 (February 1900)
Mean Annual (number of days)		
Precipitation > 0.01 in	113	113
Snow, sleet, hail > 1.0 in	8	8

TABLE 2.3-1
Climatological Data from Peoria and Springfield, Illinois

	Station	
Parameter	**Peoria**	**Springfield**
Heavy fog (visibility 0.25 mi or less)	21	17
Maximum temperature > 90°F	20	31
Minimum temperature < 32°F	129	117

Source: Gale Research Company, 1985, 1992a, 1992b; NOAA, 2004a and 2004b
Notes: These statistics are based on periods of record ranging from 22 to 50 years in length. The ranges span the years 1941 to 1990.

TABLE 2.3-2
Summary of Illinois Tornado Occurrences

Tornado Intensity (Fujita Tornado Scale)	Number of Reported Occurrences January 1, 1950 - December 31, 2003
≥ F0	1793
> F1	1079
≥ F2	530
≥ F3	171
≥ F4	45
F5	3

Source: NOAA, 2004c
Notes: F0: 40-72 mph F1: 73 - 112 mph F2: 113 - 157 mph F3: 158 - 206 mph F4: 207 - 260 mph
F5: 261 - 318 mph

TABLE 2.3-3
Reported Tornado Occurrences in DeWitt and Surrounding Counties

County	No. of Reported Tornadoes (1950 – 2003)
DeWitt	18
Piatt	20
Macon	42
Logan	44
McLean	88

Source: NOAA, 2004c

TABLE 2.3-4
Measures of Ice Glazing in Various Severe Winter Storms for the State of Illinois

Storm Date	Radial Thickness of Ice on Wire (in)	Ratio of Ice Weight to Weight of 0.25-in Twig	Weight of Ice (oz) on 1 ft of Standard (No. 12) Wire	City	State Section
2 – 4 February 1883	---[a]	---[a]	11	Springfield	WSW
20 March 1912	0.5	---[a]	---[a]	Decatur	C
21 February 1913	2.0	---[a]	---[a]	La Salle	NE
12 March 1923	1.6	---[a]	12	Marengo	NE
17 – 19 December 1924	1.2	15:1	8	Springfield	WSW
22 – 23 January 1927	1.1	---[a]	2	Cairo	SE
31 March 1929	0.5	---[a]	---[a]	Moline	NW
7 – 8 January 1930	1.2	---[a]	---[a]	Carlinville	WSW
1 – 2 March 1932	0.5	---[a]	---[a]	Galena	NW
7 – 8 January 1937	1.5	---[a]	---[a]	Quincy	W
31 Dec 1947 – 1 January 1948	1.0	---[a]	72	Chicago	NE
10 January 1949	0.8	---[a]	---[a]	Macomb	W
8 December 1956	---[a]	---[a]	---[a]	Alton	WSW
20 – 22 January 1959	0.7	12:1	---[a]	Urbana	E
26 – 27 January 1967	1.7	17:1	40	Urbana	E

Source: Changnon, 1969

[a] Data not available

Notes: C=Central, E=East, N=North, S=South, W=West

TABLE 2.3-5
Wind-Glaze Thickness Relations for Five Periods of Greatest Speed and Greatest Thickness

	Five Periods When Five Fastest 5-minute Speeds Were Registered		Five Periods When Five Greatest Ice Thicknesses Were Measured	
Rank	**Speed (mph)**	**Ice Thickness (in)**	**Ice Thickness (in)**	**Speed (mph)**
1	50	0.19	2.87	30
2	46	0.79	1.71	18
3	45	0.26	1.50	21
4	40	0.30	1.10	28
5	35	0.78	1.00	18

Source: Changnon, 1969
Notes: From data collected throughout the United States during period 1926-1937.

TABLE 2.3-6
Seasonal Frequencies of Inversions Below 500 ft in Central Illinois

	Inversions Below 500 ft	
Season	**Percent of Total Hours**	**Percent of 24-Hour Periods with at Least 1 Hour of Inversion**
Winter	29%	53%
Spring	29%	67%
Summer	33%	81%
Fall	39%	82%

Source: Hosler, 1961

TABLE 2.3-7
Seasonal Values of Mean Daily Mixing Depth in Central Illinois

	Mean Daily Mixing Depths (m)	
Season	**Morning**	**Afternoon**
Winter	400	690
Spring	490	1,500
Summer	330	1,600
Fall	390	1,200

Source: Holzworth, 1972

TABLE 2.3-8
Frequency of Occurrence of Wind Speed in the Site Area

Wind Speed (m/sec)	Percent of Occurrence	
	1972 – 1977	**2000 – 2002**
< 0.3 (calm)	0.3	0.03
0.3 to 1.4	7.7	13.83
1.5 to 3.0	28.2	40.40
3.1 to 5.0	30.7	31.41
5.1 to 8.0	23.7	12.21
> 8.0	9.4	2.16

Source: CPS, 2002; Campbell, 2002

TABLE 2.3-9
Summary of 10 m Ambient Temperature Measurements at CPS Facility (1972-1977)

	Average Daily	Average Daily Maximum	Average Daily Minimum	Absolute Maximum	Absolute Minimum
January	-5.1	-1.3	-8.9	15.5	-28.8
February	-1.3	1.9	-4.4	15.8	-23.6
March	5.9	10.5	1.6	25.5	-15.1
April	11.4	16.7	6.1	29.3	-6.5
May	16.4	21.2	11.2	32.1	0.0
June	21.2	26.1	16.0	33.0	5.0
July	23.6	28.4	18.5	35.2	8.1
August	22.1	26.8	17.4	23.2	9.1
September	17.7	22.8	12.7	33.3	0.8
October	11.9	17.1	6.9	30.0	-4.8
November	4.5	8.4	0.8	23.0	-15.8
December	-2.3	1.3	-5.9	17.8	-23.8
Period of Record	10.5	15.0	6.0	35.2	-28.8

Source: CPS, 2002
Notes: Temperatures in ^{o}C.

TABLE 2.3-10
Hourly Temperature Distribution at CPS Facility (1972-1977)

	> 32.2 °C		< 0.0 °C		< -12.2 °C		< -17.8 °C	
	Hrs	**Percent**	**Hrs**	**Percent**	**Hrs**	**Percent**	**Hrs**	**Percent**
January	0	0.0%	2,628	72.5%	730	20.1%	225	6.2%
February	0	0.0%	2,019	60.5%	203	6.1%	48	1.4%
March	0	0.0%	808	21.9%	19	0.5%	0	0.0%
April	0	0.0%	188	4.7%	0	0.0%	0	0.0%
May	0	0.0%	1	0.0%	0	0.0%	0	0.0%
June	8	0.2%	0	0.0%	0	0.0%	0	0.0%
July	67	1.9%	0	0.0%	0	0.0%	0	0.0%
August	0	0.0%	0	0.0%	0	0.0%	0	0.0%
September	3	0.1%	0	0.0%	0	0.0%	0	0.0%
October	0	0.0%	82	2.3%	0	0.0%	0	0.0%
November	0	0.0%	948	26.4%	28	0.8%	0	0.0%
December	0	0.0%	2,414	65.9%	302	8.2%	56	1.5%
Period of Record	78	0.2%	9,088	21.0%	1,282	3.0%	329	0.8%

Source: CPS, 2002

TABLE 2.3-11
Daily Temperature Distribution at CPS Facility (1972-1977)

	> 32.2 °C		< 0.0 °C		< -12.2 °C		< -17.8 °C	
	Days	**Percent**	**Days**	**Percent**	**Days**	**Percent**	**Days**	**Percent**
January	0	0.0%	132	86.3%	55	35.9%	24	15.7%
February	0	0.0%	116	82.3%	21	14.9%	6	4.3%
March	0	0.0%	65	41.9%	2	1.3%	0	0.0%
April	0	0.0%	27	16.2%	0	0.0%	0	0.0%
May	0	0.0%	1	0.6%	0	0.0%	0	0.0%
June	3	2.0%	0	0.0%	0	0.0%	0	0.0%
July	15	10.0%	0	0.0%	0	0.0%	0	0.0%
August	0	0.0%	0	0.0%	0	0.0%	0	0.0%
September	1	0.7%	0	0.0%	0	0.0%	0	0.0%
October	0	0.0%	15	9.9%	0	0.0%	0	0.0%
November	0	0.0%	73	48.7%	3	2.0%	0	0.0%
December	0	0.0%	129	83.8%	29	18.8%	8	5.2%
Period of Record	19	1.0%	558	30.5%	110	6.0%	38	2.1%

Source: CPS, 2002

TABLE 2.3-12
Summary of Relative Humidity Measurements at CPS Facility (1972-1977)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period of Record
Average	85.94	82.04	77.29	68.01	64.44	68.24	70.00	74.04	72.15	67.15	77.58	85.71	68.28
Average Daily Max.	92.10	89.77	87.75	83.96	80.77	83.26	85.13	86.04	85.33	80.75	86.61	90.47	79.01
Average Daily Min.	71.04	65.71	56.91	46.43	43.89	47.52	49.03	53.84	49.40	45.57	60.44	71.64	50.63
Absolute Max.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Absolute Min.	38.34	14.11	22.26	16.80	15.78	19.22	27.20	23.93	15.91	14.86	23.13	21.40	14.11
Average by Hour of Day													
00	83.15	80.78	74.30	69.75	68.25	70.72	69.96	76.71	73.91	67.56	76.45	82.07	68.35
03	84.00	81.27	75.53	74.31	73.88	75.17	75.54	80.02	78.10	71.51	78.10	82.49	71.15
06	84.88	82.23	79.17	77.55	75.88	76.23	77.75	82.62	80.27	74.87	79.87	83.10	73.04
09	84.31	79.85	71.60	66.35	61.19	64.77	66.22	73.67	73.38	68.40	77.39	82.10	66.35
12	78.10	75.28	63.31	54.95	52.41	53.97	55.67	61.81	59.77	56.74	67.48	77.51	57.85
15	74.32	71.11	59.83	53.07	49.43	50.32	50.25	56.39	51.12	49.93	63.62	74.12	53.79
18	78.53	75.99	64.18	54.48	52.14	52.18	54.35	61.51	56.89	53.79	69.04	79.07	57.52
21	81.66	78.76	63.76	63.76	61.91	61.11	65.27	70.98	67.38	62.08	74.42	81.32	64.26

Source: CPS, 2002

Notes: Period of Record: 4/14/72-4/30/77.

TABLE 2.3-13
Summary of Wet Bulb Temperature Measurements at CPS Facility (1972-1977)

Information deleted.

TABLE 2.3-14
Summary of 10-m Dew Point Measurements at CPS Facility (1972-1977)

	Average Daily	Average Daily Maximum	Average Daily Minimum	Absolute Maximum	Absolute Minimum
January	-7.8	-4.4	-11.1	14.1	-29.5
February	-4.0	-0.7	-7.5	13.6	-24.1
March	1.8	5.4	-1.2	17.7	-17.8
April	4.2	7.4	1.3	19.0	-10.0
May	8.1	11.0	5.2	22.7	-9.0
June	13.5	16.4	10.6	25.6	-0.3
July	16.5	19.3	14.0	25.	3.5
August	15.9	18.1	13.6	24.5	2.5
September	11.4	14.0	8.5	23.3	-7.1
October	4.2	7.1	1.4	9.1	-11.3
November	-0.1	2.8	-2.7	16.3	-17.5
December	-5.2	-2.1	-8.3	13.1	-25.7
Period of Record	4.7	7.8	1.9	25.6	-29.5

Source: CPS, 2002
Notes: Temperatures in °C. Period of Record: 4/14/72-4/30/77.

TABLE 2.3-15
Hourly Dew Point Temperature at CPS Facility (1972-1977)-*Percent of Hours with Dew Point*

	> 18.3 °C	**> 12.8 °C**	**> 7.2 °C**	**> 0.0 °C**
January	0.0	0.1	2.0	16.5
February	0.0	0.2	3.5	27.9
March	0.0	5.9	21.7	58.9
April	0.1	9.9	32.8	73.7
May	3.0	22.1	59.1	89.5
June	19.3	54.1	89.0	99.9
July	38.1	79.3	98.1	100.0
August	37.7	73.9	94.3	100.0
September	20.3	41.1	73.0	96.2
October	0.4	13.5	34.1	72.5
November	0.0	4.6	15.0	47.3
December	0.0	0.1	2.5	17.9
Period of Record	9.5	24.9	43.3	66.3

Source: CPS, 2002
Notes: Period of Record: 4/14/72-4/30/77.

TABLE 2.3-16
Summary of Dew Point Variability at CPS Facility (1972-1977)-*Percent of Hours with Dew Point Spread*

	0.0 to 0.7 °C	0.8 to 2.2 °C	2.3 to 4.4 °C	≥ 4.5 °C
January	15.8%	33.0%	37.3%	14.0%
February	20.1%	20.7%	26.8%	32.3%
March	6.6%	18.0%	29.0%	46.5%
April	3.4%	14.2%	21.1%	61.2%
May	1.4%	9.0%	22.7%	66.9%
June	3.0%	11.1%	20.5%	65.4%
July	2.6%	8.3%	22.0%	67.1%
August	3.0%	16.3%	25.9%	54.8%
September	5.0%	16.8%	23.5%	54.7%
October	4.5%	14.9%	16.2%	64.4%
November	7.6%	20.8%	31.1%	40.6%
December	12.7%	26.7%	31.8%	18.8%
Period of Record	7.0%	18.4%	25.8%	48.8%

Source: CPS, 2002

Notes: Period of Record: 4/14/72-4/30/77.

TABLE 2.3-17

Summary of Precipitation Measurements at CPS Facility (1972-1977)

				Percent Hours With Precipitation		Percent Days With Precipitation		Max. Consecutive Hours		Max. Consecutive Days	
	Average Monthly and Annual	Maximum 1 hr	Maximum 1 Day	0.01 or More	1.00 or More	0.01 or More	1.00 or More	With Precip.	Without Precip.	With Precip.	Without Precip.
January	1.40	0.50	2.53	3.4%	0.0%	21.3%	0.6%	14	356	5	14
February	1.15	0.26	0.97	3.3%	0.0%	19.9%	0.0%	9	470	3	19
March	3.44	0.69	1.29	5.9%	0.0%	23.3%	1.9%	10	408	3	16
April	1.67	0.69	1.63	3.4%	0.0%	25.1%	0.6%	14	455	5	18
May	1.80	0.52	0.62	3.6%	0.0%	26.0%	0.0%	6	293	5	12
June	4.16	1.15	2.72	4.7%	0.0%	31.3%	3.3%	14	545	5	22
July	2.27	0.43	1.74	3.1%	0.0%	25.2%	0.6%	7	365	4	14
August	2.52	0.80	1.34	2.9%	0.0%	21.9%	0.6%	8	476	3	21
September	2.44	0.81	1.26	3.8%	0.0%	28.0%	2.0%	11	372	8	15
October	1.53	0.45	0.94	3.7%	0.0%	20.6%	0.0%	12	332	3	13
November	1.83	0.40	1.06	4.4%	0.0%	22.0%	0.7%	11	620	5	25
December	1.33	0.34	0.93	3.7%	0.0%	21.9%	0.0%	8	406	8	16
Period of Record	25.47	1.15	2.72	3.8%	0.0%	24.6%	0.9%	14	807	8	33

Source: CPS, 2002

Notes: Precipitation is measured in inches. Period of Record: 4/14/72-4/30/77.

TABLE 2.3-18
Average Number of Days of Fog Occurrence at Peoria and Springfield, Illinois

	Average Number of Days of Fog (Observed)	
	Springfield, IL	**Peoria, IL**
January	2	3
February	3	3
March	2	2
April	1	1
May	1	1
June	1/2	1
July	1	1
August	1	1
September	1	1
October	1	1
November	2	2
December	3	3
Year	18.5	20
Period of Record	1951-1961; 1963-1970	1949-1951; 1957-1971

Source: CPS, 2002
Notes: Originally obtained from NOAA, Local Climatological Data Summaries for Peoria and Springfield, Illinois.

TABLE 2.3-19
Monthly Frequency of Fog Occurrence, Hours of Maximum and Minimum, and Fog Persistence for Peoria, Illinois (1949-1951; 1957-1971)

Month	Percent Total Frequency of Occurrences	Daily Maximum		Daily Minimum		Number of Times In 15 Years Fog Persisted For At Least:		
		Hour	Percent	Hour	Percent	12 Hours	24 Hours	Max.
January	17.8%	8 AM	25.1%	6 PM	14.0%	38	15	95
February	17.1%	8 AM	26.8%	3 PM	11.6%	32	8	42
March	14.9%	6 AM	24.1%	3 PM	9.5%	33	8	74
April	8.2%	6 AM	18.0%	2 PM	4.1%	10	4	36
May	7.4%	6 AM	17.2%	5 PM	2.5%	11	2	34
June	5.7%	5 AM	17.4%	6 PM	0.9%	3	1	42
July	7.3%	5 AM	27.6%	5 PM	0.7%	7	0	15
August	8.6%	6 AM	35.7%	4 PM	0.4%	5	0	19
September	9.1%	6 AM	27.3%	2 PM	1.9%	10	1	33
October	10.3%	7 AM	23.3%	3 PM	5.4%	15	3	34
November	13.8%	8 AM	23.0%	1 PM	8.5%	25	7	43
December	15.5%	9 AM	21.5%	4 PM	10.0%	38	9	48

Source: CPS, 2002

TABLE 2.3-20
Monthly Frequency of Fog Occurrence, Hours of Maximum and Minimum, and Fog Persistence for Springfield, Illinois (1951-1961; 1963-1970)

Month	Percent Total Frequency of Occurrences	Daily Maximum		Daily Minimum		Number of Times In 15 Years Fog Persisted for at Least:		
		Hour	Percent	Hour	Percent	12 Hours	24 Hours	Max.
January	17.2%	7 AM	25.1%	3 PM	13.4%	49	17	90
February	15.0%	7 AM	23.9%	3 PM	10.8%	39	15	53
March	12.7%	6 AM	21.4%	3 PM	8.7%	36	8	36
April	6.4%	6 AM	16.1%	4 PM	2.3%	16	2	26
May	5.5%	5 AM	14.6%	4 PM	1.5%	8	1	27
June	3.7%	6 AM	12.4%	5 PM	0.8%	1	1	29
July	5.0%	5 AM	22.3%	3 PM	0.2%	6	0	19
August	6.1%	6 AM	27.0%	4 PM	0.2%	2	0	13
September	5.5%	6 AM	23.9%	4 PM	0.3%	3	0	22
October	6.7%	6 AM	15.8%	4 PM	4.0%	14	3	47
November	9.4%	7 AM	17.4%	2 PM	4.9%	25	5	51
December	15.4%	8 AM	20.8%	2 PM	12.2%	37	17	75

Source: CPS, 2002

TABLE 2.3-21

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category A (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: A (Delta-T Less Than -1.8 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3- 1.4	1	4	3	2	2	7	9	5	5	6	2	3	4	3	4	5	65
(1)	0.06	0.23	0.17	0.11	0.11	0.40	0.51	0.28	0.28	0.34	0.11	0.17	0.23	0.17	0.23	0.28	3.68
(2)	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.05	0.16
1.5- 3.0	23	24	12	14	8	19	34	41	31	37	13	24	30	27	18	24	379
(1)	1.30	1.36	0.68	0.79	0.45	1.08	1.93	2.32	1.76	2.10	0.74	1.36	1.70	1.53	1.02	1.36	21.46
(2)	0.06	0.06	0.03	0.03	0.02	0.05	0.08	0.10	0.08	0.09	0.03	0.06	0.07	0.07	0.04	0.06	0.93
3.1- 5.0	39	43	26	19	8	17	38	61	40	65	32	44	37	57	24	29	579
(1)	2.21	2.43	1.47	1.08	0.45	0.96	2.15	3.45	2.27	3.68	1.81	2.49	2.10	3.23	1.36	1.64	32.79
(2)	0.10	0.11	0.06	0.05	0.02	0.04	0.09	0.15	0.10	0.16	0.08	0.11	0.09	0.14	0.06	0.07	1.42
5.1- 8.0	28	59	27	8	4	10	22	46	38	52	46	71	65	48	49	26	594
(1)	1.59	3.34	1.25	0.45	0.23	0.57	1.25	2.60	2.15	2.94	2.60	4.02	3.68	2.72	2.77	1.47	33.64
(2)	0.07	0.15	0.05	0.02	0.01	0.02	0.05	0.11	0.09	0.13	0.11	0.17	0.16	0.12	0.12	0.06	1.46
8.1-10.4	4	2	2	0	0	0	1	9	6	11	13	19	8	5	13	6	104
(1)	0.23	0.11	0.11	0.00	0.00	0.00	0.06	0.51	0.34	0.62	1.02	1.08	0.45	0.28	0.74	0.34	5.89
(2)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.03	0.04	0.05	0.02	0.01	0.03	0.01	0.26
OVER 10.4	0	12	1	1	2	0	1	0	2	2	3	7	2	4	2	5	44
(1)	0.00	0.68	0.06	0.06	0.11	0.00	0.06	0.00	0.11	0.11	0.17	0.40	0.11	0.23	0.11	0.28	2.49
(2)	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.00	0.01	0.11
All Speeds (4)	95	144	66	44	24	53	105	162	122	173	114	168	146	144	110	95	1765
(1)	5.38	8.15	3.74	2.49	1.36	3.00	5.95	9.17	6.91	9.80	6.46	9.51	8.27	8.15	6.23	5.38	99.94
(2)	0.23	0.35	0.16	0.11	0.06	0.13	0.26	0.40	0.30	0.43	0.28	0.41	0.36	0.35	0.27	0.23	4.34

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 1,766 hrs on this page, with 1 hrs (0.1 percent) at less than 0.3 m/s (0.0 percent of all hrs).

TABLE 2.3-22

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category B (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: B (Delta-T Range = -1.8 to -1.7 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3- 1.4	0	4	5	1	0	1	1	2	1	6	2	5	4	2	2	0	36
(1)	0.00	0.27	0.34	0.07	0.00	0.07	0.07	0.14	0.07	0.41	0.14	0.34	0.27	0.14	0.14	0.00	2.47
(2)	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.09
1.5- 3.0	12	24	8	13	10	10	14	22	13	36	22	15	18	15	13	15	260
(1)	0.82	1.65	0.55	0.89	0.69	0.69	0.96	1.51	0.69	2.47	1.51	1.03	1.24	1.03	0.89	1.03	17.86
(2)	0.03	0.06	0.02	0.03	0.02	0.02	0.03	0.05	0.03	0.09	0.05	0.04	0.04	0.04	0.03	0.04	0.64
3.1- 5.0	35	32	18	14	17	24	29	41	45	61	40	46	40	43	28	27	541
(1)	2.40	2.20	1.24	0.96	1.17	1.72	1.99	2.82	3.09	4.19	2.75	3.16	2.75	2.95	1.92	1.85	37.16
(2)	0.09	0.08	0.04	0.03	0.04	0.06	0.07	0.10	0.11	0.15	0-.10	0.11	0.10	0.11	0.07	0.07	1.33
5.1- 8.0	20	34	16	20	6	16	31	27	35	46	42	40	47	47	22	26	475
(1)	1.37	2.34	1.10	1.37	0.41	1.10	2.13	1.85	2.40	3.16	2.88	2.76	3.23	3.23	1.51	1.79	32.62
(2)	0.05	0.08	0.04	0.05	0.01	0.04	0.08	0.07	0.09	0.11	0.10	0.10	0.12	0.12	0.05	0.06	1.17
8.1-10.4	3	0	0	1	0	0	2	7	5	5	9	24	16	4	3	3	82
(1)	0.21	0.00	0.00	0.07	0.00	0.00	0.14	0.48	0.34	0.34	0.62	1.65	1.10	0.27	0.21	0.21	5.63
(2)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.02	0.06	0.04	0.01	0.01	0.01	0.20
Over 10.4	2	1	0	2	6	2	1	6	3	4	5	8	15	1	0	5	61
(1)	0.14	0.07	0.00	0.14	0.41	0.14	0.07	0.41	0.21	0.27	0.34	0.55	1.03	0.07	0.00	0.34	4.19
(2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.04	0.00	0.00	0.01	0.15
All Speeds (4)	72	95	47	51	39	54	78	105	102	158	120	138	140	112	68	76	1455
(1)	4.95	6.52	3.23	3.50	2.68	3.71	5.36	7.21	7.01	10.85	8.24	9.48	9.62	7.69	4.67	5.22	99.93
(2)	0.18	0.23	0.12	0.13	0.10	0.13	0.19	0.26	0.25	0.39	0.30	0.34	0.34	0.28	0.17	0.19	3.58

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 1,766 hrs on this page, with 1 hrs (0.1 percent) at less than 0.3 m/s (0.0 percent of all hrs).

TABLE 2.3-23

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category C (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: C (Delta-T Range = -1.6 to -1.5 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3-1.4	0	5	4	1	1	3	7	7	7	4	5	5	6	4	3	2	64
(1)	0.00	0.23	0.18	0.05	0.05	0.14	0.32	0.32	0.32	0.18	0.23	0.23	0.27	0.18	0.14	0.09	2.92
(2)	0.00	0.01	0.01	0.00	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.16
1.5- 3.0	27	31	31	18	12	25	29	36	29	32	22	28	35	18	28	22	423
(1)	1.23	1.42	1.42	0.82	0.55	1.14	1.32	1.64	1.32	1.46	1.01	1.28	1.60	0.82	1.28	1.01	19.32
(2)	0.07	0.08	0.08	0.04	0.03	0.06	0.07	0.09	0.07	0.08	0.05	0.07	0.09	0.04	0.07	0.05	1.04
3.1- 5.0	42	46	40	31	31	24	51	55	47	83	67	38	62	50	52	27	746
I (1)	1.92	2.10	1.83	1.42	1.42	1.10	2.33	2.51	2.15	3.79	3.06	1.74	2.83	2.28	2.38	1.23	34.08
(2)	0.10	0.11	0.10	0.08	0.08	0.06	0.13	0.14	0.12	0.20	0.16	0.09	0.15	0.12	0.13	0.07	1.83
5.1- 8.0	35	34	19	20	20	31	40	33	43	88	62	61	72	55	33	29	675
(1)	1.60	1.55	0.87	0.91	0.91	1.42	1.83	1.51	1.96	4.02	2.83	2.79	3.29	2.51	1.51	1.32	30.84
(2)	0.09	0.08	0.05	0.05	0.05	0.08	0.10	0.08	0.11	0.22	0.15	0.15	0.18	0.14	0.08	0.07	1.66
8.1-10.4	8	3	0	1	0	2	2	9	14	12	17	36	20	13	5	7	149
(1)	0.37	0.14	0.00	0.05	0.00	0.09	0.09	0.41	0.64	0.55	0.78	1.64	0.91	0.59	0.23	0.32	6.81
(2)	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.04	0.09	0.05	0.03	0.01	0.02	0.37
Over 10.4	1	3	1	8	7	9	10	3	12	9	19	23	12	4	4	5	130
(1)	0.05	0.14	0.05	0.37	0.32	0.41	0.46	0.14	0.55	0.41	0.87	1.05	0.55	0.18	0.18	0.23	5.94
(2)	0.00	0.01	0.00	0.02	0.02	0.02	0.02	0.01	0.03	0.02	0.05	0.06	0.03	0.01	0.01	0.01	0.32
All Speeds (4)	113	122	95	79	71	94	139	143	152	228	192	191	207	144	125	92	2187
(1)	5.16	5.57	4.34	3.61	3.24	4.29	6.35	6.53	6.94	10.42	8.77	8.73	9.46	6.58	5.71	4.20	99.91
(2)	0.28	0.30	0.23	0.19	0.17	0.23	0.34	0.35	0.37	0.56	0.47	0.47	0.51	0.35	0.31	0.23	5.38

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3)E=East, N=North, S=South, W=West
(4) 2,189 hrs on this page, with 2 hrs (0.1 percent) at less than 0.3 m/s (0.0 percent of all hrs).

TABLE 2.3-24

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category D (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: D (Delta-T Range = -1.4 to -0.5 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3-1.4	30	34	31	37	40	25	46	50	46	52	37	36	46	26	35	31	602
(1)	0.18	0.21	0.19	0.23	0.25	0.15	0.28	0.31	0.28	0.32	0.23	0.22	0.28	0.16	0.21	0.19	3.69
(2)	0.07	0.08	0.08	0.09	0.10	0.06	0.11	0.12	0.11	0.13	0.09	0.09	0.11	0.06	0.09	0.08	1.48
1.5- 3.0	126	178	204	197	147	173	250	249	218	229	160	162	190	166	155	135	2,939
(1)	0.77	1.09	1.25	1.21	0.90	1.06	1.53	1.53	1.34	1.40	0.98	0.99	1.16	1.02	0.95	0.83	18.01
(2)	0.31	0.44	0.50	0.48	0.36	0.43	0.61	0.61	0.54	0.56	0.39	0.40	0.47	0.41	0.38	0.33	7.23
3.1- 5.0	269	289	291	286	248	231	302	416	466	396	314	360	450	406	316	294	5,334
(1)	1.65	1.77	1.78	1.75	1.52	1.42	1.85	2.55	2.86	2.43	1.92	2.21	2.76	2.49	1.94	1.80	32.69 4
(2)	0.66	0.71	0.72	0.70	0.61	0.57	0.74	1.02	1.15	0.97	0.77	0.89	1.11	1.00	0.78	0.72	13.11
5.1- 8.0	240	263	138	134	170	193	228	439	515	428	323	535	679	457	319	269	5,330
(1)	1.47	1.61	0.85	0.82	1.04	1.18	1.40	2.69	3.16	2.62	1.98	3.28	4.16	2.80	1.96	1.65	32.67
(2)	0.59	0.65	0.34	0.33	0.42	0.47	0.56	1.08	1.27	1.05	0.79	1.32	1.67	1.12	0.78	0.66	13.10
8.1-10.4	65	63	11	16	16	23	40	152	139	119	137	200	204	102	86	73	1,446
(1)	0.40	0.39	0.07	0.10	0.10	0.14	0.25	0.93	0.85	0.73	0.84	1.23	1.25	0.63	0.53	0.85	8.86
(2)	0.16	0.15	0.03	0.04	0.04	0.06	0.10	0.37	0.34	0.29	0.34	0.42	0.50	0.25	0.21	0.18	3.55
Over 10.4	25	19	13	21	18	22	17	39	58	52	95	132	80	24	24	23	662
(1)	0.15	0.12	0.08	0.13	0.11	0.13	0.10	0.24	0.36	0.32	0.58	0.81	0.49	0.15	0.15	0.14	4.06
(2)	0.06	0.05	0.03	0.05	0.04	0.05	0.04	0.10	0.14	0.13	0.23	0.32	0.20	0.06	0.06	0.06	1.63
All Speeds (4)	755	846	688	691	639	667	883	1,345	1,442	1,276	1,066	1,425	1,649	1,181	935	825	16,313
(1)	4.63	5.18	4.22	4.23	3.92	4.09	5.41	8.24	8.84	7.82	6.53	8.73	10.11	7.24	5.73	5.06	99.98
(2)	1.86	2.08	1.69	1.70	1.57	1.64	26.17	3.31	3.55	3.14	2.62	3.50	4.05	2.90	2.30	2.03	40.10

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 16,317 hrs on this page, with 4 hrs (0.0 percent) at less than 0.3 m/s (0.0 percent of all hrs).

TABLE 2.3-25

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category E (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: E (Delta-T Range = -0.4 to +1.5 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3-1.4	38	42	49	47	33	53	62	69	60	60	48	44	41	28	19	32	725
(1)	0.35	0.39	0.45	0.43	0.31	0.49	0.57	0.64	0.55	0.55	0.44	0.41	0.38	0.26	0.15	0.30	6.70
(2)	0.09	0.10	0.12	0.12	0.08	0.13	0.15	0.17	0.15	0.15	0.12	0.11	0.10	0.07	0.05	0.08	1.78
1.5- 3.0	95	170	188	204	201	255	308	312	299	218	197	173	175	159	113	98	3,165
(1)	0.88	1.57	1.74	1.89	1.86	2.36	2.85	2.88	2.76	2.02	1.82	1.60	1.62	1.47	1.04	0.91	29.26
(2)	0.23	0.42	0.46	0.50	0.49	0.63	0.76	0.77	0.74	0.54	0.48	0.43	0.43	0.39	0.28	0.24	7.78
3.1- 5.0	119	156	162	187	197	246	367	530	518	343	241	242	223	148	116	151	3,946
(1)	1.10	1.44	1.50	1.73	1.82	2.27	3.39	4.90	4.79	3.17	2.23	2.24	2.06	1.37	1.07	1.40	36.49
(2)	0.29	0.38	0.40	0.46	0.48	0.60	0.90	1.30	1.27	0.84	0.59	0.59	0.55	0.36	0.29	0.37	9.70
5.1- 8.0	48	72	33	56	100	148	174	402	386	193	188	197	124	56	42	65	2,284
(1)	0.44	0.67	0.31	0.52	0.92	1.37	1.61	3.72	3.57	1.78	1.74	1.82	1.15	0.52	0.39	0.60	21.12
(2)	0.12	0.18	0.08	0.14	0.25	0.36	0.43	0.99	0.95	0.47	0.46	0.48	0.30	0.14	0.10	0.16	5.61
8.1-10.4	15	10	5	2	21	26	19	56	43	32	46	51	25	9	20	14	394
(1)	0.14	0.09	0.05	0.02	0.19	0.24	0.18	0.52	0.40	0.30	0.43	0.47	0.23	0.08	0.18	0.13	3.64
(2)	0.04	0.02	0.01	0.00	0.05	0.06	0.05	0.14	0.11	0.08	0.11	0.13	0.06	0.02	0.05	0.03	0.97
Over 10.4	4	9	9	17	24	15	20	31	36	24	24	23	13	13	4	9	275
(1)	0.04	0.08	0.08	0.16	0.22	0.14	0.18	0.29	0.33	0.22	0.22	0.21	0.12	0.12	0.04	0.08	2.54
(2)	0.01	0.02	0.02	0.04	0.06	0.04	0.05	0.08	0.09	0.06	0.06	0.06	0.03	0.03	0.01	0.02	0.68
All Speeds (4)	319	459	446	513	576	743	950	1,480	1,342	870	744	730	601	413	314	369	10,789
(1)	2.95	4.24	4.12	4.74	5.33	6.87	8.78	12.94	12.41	8.04	6.88	6.75	5.56	3.82	2.90	3.41	99.76
(2)	0.78	1.13	1.10	1.26	1.42	1.83	2.34	3.44	3.30	2.14	1.83	1.79	1.48	1.02	0.77	0.91	26.52

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 10,815 hrs on this page, with 26 hrs (0.2 percent) at less than 0.3 m/s (0.1 percent of all hrs).

TABLE 2.3-26

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category F (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: F (Delta-T Range = 1.6 To 4.0 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total
0.3-1.4	30	50	50	42	36	49	54	59	36	44	35	44	29	25	33	39	655
(1)	0.67	1.12	1.12	0.94	0.80	1.10	1.21	1.32	0.80	0.98	0.78	0.98	0.65	0.56	0.74	0.87	14.64
(2)	0.07	0.12	0.12	0.10	0.09	0.12	0.13	0.15	0.09	0.11	0.09	0.11	0.07	0.06	0.08	0.10	1.61
1.5- 3.0	75	125	134	153	161	197	216	222	248	209	152	139	163	113	63	83	2,453
(1)	1.68	2.79	3.00	3.42	3.60	4.40	4.83	4.96	5.54	4.67	3.40	3.11	3.64	2.53	1.41	1.86	54.83
(2)	0.18	0.31	0.33	0.38	0.40	0.48	0.53	0.55	0.61	0.51	0.37	0.34	0.40	0.28	0.15	0.20	6.03
3.1- 5.0	26	24	22	28	40	56	101	114	148	120	96	73	75	57	24	27	1,031
(1)	0.58	0.54	0.49	0.63	0.89	1.25	2.26	2.55	3.31	2.68	2.15	1.63	1.68	1.27	0.54	0.60	23.04
(2)	0.06	0.06	0.05	0.07	0.10	0.14	0.25	0.28	0.36	0.30	0.24	0.18	0.18	0.14	0.06	0.07	2.53
5.1- 8.0	0	0	0	0	0	5	4	4	8	14	10	16	10	3	4	2	80
(1)	0.00	0.00	0.00	0.00	0.00	0.11	0.09	0.09	0.18	0.31	0.22	0.36	0.22	0.07	0.09	0.04	1.79
(2)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.02	0.04	0.02	0.01	0.01	0.00	0.20
8.1-10.4	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	5
(1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.04	0.00	0.11
(2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Over 10.4	11	21	14	22	9	13	23	18	23	17	15	12	8	5	4	9	224
(1)	0.25	0.47	0.31	0.49	0.20	0.29	0.51	0.40	0.51	0.38	0.34	0.27	0.18	0.11	0.09	0.20	5.01
(2)	0.03	0.05	0.03	0.05	0.02	0.03	0.06	0.04	0.06	0.04	0.04	0.03	0.02	0.01	0.01	0.02	0.55
All Speeds (4)	142	220	220	245	246	320	398	417	463	404	308	285	286	204	130	160	4,448
(1)	3.17	4.92	4.92	5.48	5.50	7.15	8.90	9.32	10.35	9.03	6.88	6.37	6.39	4.56	2.91	3.58	99.42
(2)	0.35	0.54	0.54	0.60	0.60	0.79	0.98	1.03	1.14	0.99	0.76	0.70	0.70	0.50	0.32	0.39	10.93

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 4,474 hrs on this page, with 24 hrs (0.6 percent) at less than 0.3 m/s (0.1 percent of all hrs).

TABLE 2.3-27

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category G (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: G (Delta-T Greater Than 4.0 °C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3-1.4	53	73	73	79	52	57	69	98	78	63	58	58	55	49	41	37	993
(1)	1.45	1.99	1.99	2.16	1.42	1.56	1.89	2.68	2.13	1.72	1.58	1.58	1.50	1.34	1.12	1.01	27.13
(2)	0.13	0.18	0.18	0.19	0.13	0.14	0.17	0.24	0.19	0.15	0.14	0.14	0.14	0.12	0.10	0.09	2.44
1.5- 3.0	75	138	94	93	90	160	182	189	216	151	88	94	92	96	43	57	1,858
(1)	2.05	3.77	2.57	2.54	2.46	4.37	4.97	5.16	5.90	4.13	2.40	2.57	2.51	2.62	1.17	1.56	50.77
(2)	0.18	0.34	0.23	0.23	0.22	0.39	0.45	0.46	0.53	0.37	0.22	0.23	0.23	0.24	0.11	0.14	4.57
3.1- 5.0	8	9	9	10	13	19	23	23	55	28	13	17	22	27	12	7	295
(1)	0.22	0.25	0.25	0.27	0.36	0.52	0.63	0.63	1.50	0.77	0.36	0.46	0.60	0.74	0.33	0.19	8.06
(2)	0.02	0.02	0.02	0.02	0.03	0.05	0.06	0.06	0.14	0.07	0.03	0.04	0.05	0.07	0.03	0.02	0.73
5.1- 8.0	6	10	1	5	14	15	4	35	55	13	2	17	14	2	1	3	197
(1)	0.16	0.27	0.03	0.14	0.38	0.41	0.11	0.96	1.50	0.36	0.05	0.46	0.38	0.05	0.03	0.08	5.38
(2)	0.01	0.02	0.00	0.01	0.03	0.04	0.01	0.09	0.14	0.03	0.00	0.04	0.03	0.00	0.00	0.01	0.48
8.1-10.4	1	1	1	0	0	0	0	0	20	4	1	8	6	0	2	3	47
(1)	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.55	0.11	0.03	0.22	0.16	0.00	0.05	0.08	1.28
(2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.00	0.02	0.01	0.00	0.00	0.01	0.12
Over 10.4	8	30	27	25	15	9	16	27	16	13	16	2	5	5	2	5	221
(1)	0.22	0.82	0.74	0.68	0.41	0.25	0.44	0.74	0.44	0.36	0.44	0.05	0.14	0.14	0.05	0.14	6.04
(2)	0.02	0.07	0.07	0.06	0.04	0.02	0.04	0.07	0.04	0.03	0.04	0.00	0.01	0.01	0.00	0.01	0.54
All Speeds (4)	151	261	205	212	184	260	294	372	440	272	178	196	194	179	101	112	3,611
(1)	4.13	7.13	5.60	5.79	5.03	7.10	8.03	10.16	12.02	7.43	4.86	5.36	5.30	4.89	2.76	3.06	98.66
(2)	0.37	0.64	0.50	0.52	0.45	0.64	0.72	0.91	1.08	0.67	0.44	0.48	0.48	0.44	0.25	0.28	8.88

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 3,660 hrs on this page, with 49 hrs (1.3 percent) at less than 0.3 m/s (0.1 percent of all hrs).

TABLE 2.3-28

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – All Stability Categories (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: ALL Stabilities Combined

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
0.3-1.4	152	212	215	209	164	195	248	290	233	235	187	195	185	137	137	146	3,140
(1)	0.37	0.52	0.53	0.51	0.40	0.48	0.61	0.71	0.57	0.58	0.46	0.48	0.45	0.34	0.34	0.36	7.72
(2)	0.37	0.52	0.53	0.51	0.40	0.48	0.61	0.71	0.57	0.58	0.46	0.48	0.45	0.34	0.34	0.36	7.72
1.5- 3.0	433	690	671	692	629	839	1,033	1,071	1,054	912	654	635	703	594	433	434	11,477
(1)	1.06	1.70	1.65	1.70	1.55	2.06	2.54	2.63	2.59	2.24	1.61	1.56	1.73	1.46	1.06	1.07	28.21
(2)	1.06	1.70	1.65	1.70	1.55	2.06	2.54	2.63	2.59	2.24	1.61	1.56	1.73	1.46	1.06	1.07	28.21
3.1- 5.0	538	599	568	575	554	618	911	1,240	1,319	1,096	803	820	909	788	572	562	12,472
(1)	1.32	1.47	1.40	1.41	1.36	1.52	2.24	3.05	3.24	2.69	1.97	2.02	2.23	1.94	1.41	1.38	30.66
(2)	1.32	1.47	1.40	1.41	1.36	1.52	2.24	3.05	3.24	2.69	1.97	2.02	2.23	1.94	1.41	1.38	30.66
5.1- 8.0	377	472	229	243	314	418	503	956	1,000	834	673	937	1,011	668	470	420	9,635
(1)	0.93	1.16	0.56	0.60	0.77	1.03	1.24	2.42	2.66	2.05	1.65	2.30	2.49	1.64	1.16	1.03	23.69
(2)	0.93	1.16	0.56	0.60	0.77	1.03	1.24	2.42	2.66	2.05	1.65	2.30	2.49	1.64	1.16	1.03	23.69
8.1-10.4	96	79	19	20	37	51	64	233	227	183	228	339	280	134	131	106	2227
(1)	0.24	0.19	0.05	0.05	0.09	0.13	0.16	0.57	0.56	0.45	0.56	0.83	0.69	0.33	0.32	0.26	5.47
(2)	0.24	0.19	0.05	0.05	0.09	0.13	0.16	0.57	0.56	0.45	0.56	0.83	0.69	0.33	0.32	0.26	5.47
Over 10.4	51	95	65	96	81	70	88	124	150	121	177	207	135	56	40	61	1,617
(1)	0.13	0.23	0.16	0.24	0.20	0.17	0.22	0.30	0.37	0.30	0.44	0.51	0.33	0.14	0.10	0.15	3.98
(2)	0.13	0.23	0.16	0.24	0.20	0.17	0.22	0.30	0.37	0.30	0.44	0.51	0.33	0.14	0.10	0.15	3.98
All Speeds (4)	1,647	2,147	1,767	1,835	1,779	2,191	2,847	3,944	4,063	3,381	2,722	3,133	3,223	2,377	1,783	1,729	40,568
(1)	4.05	5.28	4.34	4.51	4.37	5.39	7.00	9.70	9.99	8.31	6.69	7.70	7.92	5.84	4.38	4.25	99.73
(2)	4.05	5.28	4.34	4.51	4.37	5.39	7.00	9.70	9.99	8.31	6.69	7.70	7.92	5.84	4.38	4.25	99.73

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West
(4) 40,677 good hrs, with 109 hrs (0.3 percent) at less than 0.3 m/s, 44,208 hrs in the time period, 92.0 pct data recovery.

TABLE 2.3-29

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category A (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: A (Delta-T Less Than -1.8 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
≤ 1.5	0	3	6	3	9	12	19	6	4	7	6	3	1	3	1	2	85
1.6 – 3.3	6	59	56	62	82	89	94	128	83	95	38	36	40	40	17	15	940
3.4 – 5.5	28	90	25	22	12	42	32	130	129	113	64	84	77	85	35	34	1,002
5.6 – 8.2	12	22	3	3	0	9	25	67	58	56	38	73	79	51	19	16	531
8.3 – 10.9	0	1	0	0	0	1	2	8	1	2	4	18	20	9	5	1	72
≥ 11.0	0	0	0	0	0	0	1	0	0	0	2	3	0	0	0	0	6
All Speeds	46	175	90	90	103	153	173	339	275	273	152	217	217	188	77	68	2,636

Source: Campbell, 2002

Notes: 2,636 hrs on this page, 2 hrs calm winds (less than 0.3 m/s), 0.1 percent of all hrs.

TABLE 2.3-30

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category B (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: B (Delta-T Range = -1.8 to –1.7 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
≤ 1.5	0	4	5	6	12	14	7	12	8	9	7	3	4	2	0	2	95
1.6 – 3.3	17	43	28	18	16	38	36	52	49	48	30	37	38	36	14	23	523
3.4 – 5.5	29	28	14	6	1	12	33	43	55	75	55	51	55	57	21	23	558
5.6 – 8.2	5	10	1	2	1	2	17	28	41	17	22	25	23	16	6	12	228
8.3 – 10.9	1	0	0	0	0	0	2	7	2	2	3	8	7	2	3	1	38
≥ 11.0	0	0	0	0	0	0	0	1	0	0	1	4	0	0	0	0	6
All Speeds	52	85	48	32	30	66	95	143	155	151	118	128	127	113	44	61	1,448

Source: Campbell, 2002

Notes: 1,448 hrs on this page, 2 hrs calm winds (less than 0.3 m/s), 0.1 percent of all hrs.

TABLE 2.3-31

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category C (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: C (Delta-T Range = -1.6 to –1.5 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total
≤ 1.5	2	8	5	5	9	6	9	8	5	10	6	2	7	8	3	2	95
1.6 – 3.3	16	49	34	17	20	34	30	34	24	33	22	30	38	36	35	21	473
3.4 – 5.5	35	27	15	5	8	19	32	57	44	51	41	49	49	36	25	30	523
5.6 – 8.2	16	16	0	1	0	7	10	21	20	16	23	29	51	28	11	15	264
8.3 – 10.9	8	5	0	0	0	0	1	8	4	2	13	5	12	6	1	0	65
≥ 11.0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3
All Speeds	77	105	54	28	37	66	82	128	97	112	106	116	158	114	75	68	1,423

Source: Campbell, 2002

Notes: 1,423 hrs on this page, 0 hrs calm winds (less than 0.3 m/s), 0.0 percent of all hrs.

TABLE 2.3-32

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category D (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: D (Delta-T Range = -1.4 to -0.5 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
≤ 1.5	23	32	39	54	71	36	41	22	32	38	20	32	29	26	21	20	536
1.6 – 3.3	131	198	152	145	177	202	227	170	169	143	96	152	137	154	121	124	2,498
3.4 – 5.5	186	206	74	35	57	128	237	347	319	156	156	262	296	244	157	166	3,026
5.6 – 8.2	53	60	4	1	2	25	64	176	177	50	70	187	195	113	36	51	1,264
8.3 – 10.9	9	8	0	0	0	0	3	44	24	9	24	38	35	10	4	1	209
≥ 11.0	1	0	0	0	0	0	0	0	0	1	1	6	0	0	0	0	9
All Speeds	403	504	269	235	307	391	572	759	721	397	367	677	692	547	339	362	7,542

Source: Campbell, 2002

Notes: 7,542 hrs on this page, 0 hrs calm winds (less than 0.3 m/s), 0.0 percent of all hrs.

TABLE 2.3-33

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category E (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: E (Delta-T Range = -0.4 to +1.5 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
≤ 1.5	35	67	69	82	104	88	69	62	68	53	53	39	30	30	23	15	887
1.6 – 3.3	82	184	137	131	147	204	338	383	300	185	153	147	151	112	91	65	2,810
3.4 – 5.5	29	25	17	10	12	57	148	311	305	125	83	107	89	31	45	22	1,416
5.6 – 8.2	4	1	0	0	0	5	14	99	61	26	17	32	7	10	13	0	289
8.3 – 10.9	0	0	0	0	0	0	2	18	6	0	1	1	2	2	0	0	32
≥ 11.0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
All Speeds	153	280	223	223	263	354	571	873	740	389	307	326	279	185	172	102	5,440

Source: Campbell, 2002

Notes: 5,440 hrs on this page, 0 hrs calm winds (less than 0.3 m/s), 0.0 percent of all hrs.

TABLE 2.3-34

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category F (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: F (Delta-T Range = 1.6 to 4.0 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
≤ 1.5	43	78	46	52	51	50	49	45	59	44	49	45	38	32	14	19	714
1.6 – 3.3	73	114	61	29	16	79	88	88	106	88	73	72	49	71	23	27	1,057
3.4 – 5.5	7	8	16	11	1	3	10	23	20	17	30	5	12	11	6	1	181
5.6 – 8.2	0	0	1	0	0	0	0	0	0	4	13	2	0	1	4	1	26
8.3 – 10.9	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3
≥ 11.0	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	4	9
All Speeds	124	203	124	92	68	132	147	157	185	153	168	124	99	115	47	52	1,990

Source: Campbell, 2002

Notes: 1,990 hrs on this page, 3 hrs calm winds (less than 0.3 m/s), 0.2 percent of all hrs.

TABLE 2.3-35

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category G (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: G (Delta-T Greater Than 4.0 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total
< 1.5	52	88	35	35	31	25	21	20	23	28	39	38	46	41	15	14	551
1.6 – 3.3	50	70	13	15	2	14	13	19	13	22	24	14	22	51	7	7	356
3.4 – 5.5	1	1	5	4	0	0	0	0	0	4	3	0	0	5	2	0	25
5.6 – 8.2	0	0	2	4	0	0	0	0	0	4	4	0	0	0	0	1	15
8.3 – 10.9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
> 11.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
All Speeds	103	159	55	58	33	39	34	39	36	58	71	52	68	97	24	25	951

Source: Campbell, 2002

Notes: 951 hrs on this page, 2 hrs calm winds (less than 0.3 m/s), 0.2 percent of all hrs.

TABLE 2.3-36

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – All Stability Categories (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: ALL Stabilities Combined

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

	Direction																
Speed (m/s)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
≤ 1.5	155	280	205	237	287	231	215	175	199	189	180	162	155	142	77	74	2,963
1.6 – 3.3	375	717	481	417	460	660	826	874	744	614	436	488	475	500	308	282	8,657
3.4 – 5.5	315	385	166	93	91	261	492	911	872	541	432	558	578	469	291	276	6,731
5.6 – 8.2	90	109	11	11	3	48	130	391	357	173	187	348	355	219	89	96	2,617
8.3 – 10.9	18	14	0	0	0	1	10	85	37	15	49	70	76	29	13	3	420
≥ 11.0	5	6	0	0	0	0	1	2	0	1	5	14	1	0	0	7	42
All Speeds	958	1,511	863	758	841	1,201	1,674	2,438	2,209	1,533	1,289	1,640	1,640	1,359	778	738	21,430

Source: Campbell, 2002

Notes: 21,430 hrs on this page, 9 hrs calm winds (less than 0.3 m/s), 0.03 percent of all hrs.

TABLE 2.3-37
Summary of Frequency of Occurrence of Stability Class at CPS Facility

A	B	C	D	E	F	G
1972 – 1977 Period of Record [a]						
4.34	3.58	5.38	40.10	26.52	10.93	8.88
Summary						
Unstable (A, B, C) 13.30%						
Neutral (D) 40.10%						
Stable (E, F, G) 46.33%						
2000 – 2002 Period of Record [b]						
12.30	6.75	6.64	35.19	25.39	9.29	4.44
Summary						
Unstable (A, B, C) 25.69%						
Neutral (D) 35.19%						
Stable (E, F, G) 39.12%						

[a] Source: CPS, 2002
[b] Source: Campbell, 2002
EV2

TABLE 2.3-38
Qualitative Assessment of the Magnitude and Extent of Visible 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, visible 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 into the cooling tower plume. 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 Exelon 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 2.3-39
CPS Site EAB Accident Chi/Q Calculations
1-Hour Averaging Period

Downwind Sector	Exclusion Area Boundary (EAB) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	975	0.163E-03	0.291E-04
NNE	975	0.151E-03	0.311E-04
NE	975	0.154E-03	0.289E-04
ENE	975	0.153E-03	0.279E-04
E	975	0.150E-03	0.254E-04
ESE	975	0.143E-03	0.248E-04
SE	975	0.149E-03	0.258E-04
SSE	975	0.164E-03	0.254E-04
S	975	0.156E-03	0.277E-04
SSW	975	0.182E-03	0.274E-04
SW	975	0.190E-03	0.294E-04
WSW	975	0.210E-03	0.349E-04
W	975	0.211E-03	0.376E-04
WNW	975	0.169E-03	0.361E-04
NW	975	0.177E-03	0.377E-04
NNW	975	0.168E-03	0.350E-04
All Direction Case		0.178E-03	0.305E-04

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-40
CPS Site LPZ Accident Chi/Q Calculations
1-Hour Averaging Period

Downwind Sector	Low Population Zone (LPZ) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	4,018	0.342E-04	0.377E-05
NNE	4,018	0.336E-04	0.425E-05
NE	4,018	0.344E-04	0.374E-05
ENE	4,018	0.354E-04	0.363E-05
E	4,018	0.310E-04	0.315E-05
ESE	4,018	0.282E-04	0.303E-05
SE	4,018	0.331E-04	0.313E-05
SSE	4,018	0.372E-04	0.304E-05
S	4,018	0.367E-04	0.353E-05
SSW	4,018	0.427E-04	0.347E-05
SW	4,018	0.449E-04	0.379E-05
WSW	4,018	0.475E-04	0.488E-05
W	4,018	0.476E-04	0.528E-05
WNW	4,018	0.379E-04	0.505E-05
NW	4,018	0.401E-04	0.527E-05
NNW	4,018	0.379E-04	0.473E-05
All Direction Case		0.415E-04	0.426E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-41
CPS Site EAB Accident Chi/Q Calculations
2-Hour Averaging Period

Downwind Sector	Exclusion Area Boundary (EAB) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	975	0.124E-03	0.214E-04
NNE	975	0.115E-03	0.226E-04
NE	975	0.113E-03	0.198E-04
ENE	975	0.101E-03	0.197E-04
E	975	0.982E-04	0.181E-04
ESE	975	0.945E-04	0.177E-04
SE	975	0.102E-03	0.173E-04
SSE	975	0.107E-03	0.169E-04
S	975	0.112E-03	0.200E-04
SSW	975	0.120E-03	0.193E-04
SW	975	0.137E-03	0.223E-04
WSW	975	0.141E-03	0.247E-04
W	975	0.141E-03	0.251E-04
WNW	975	0.118E-03	0.247E-04
NW	975	0.137E-03	0.247E-04
NNW	975	0.131E-03	0.241E-04
All Direction Case		0.126E-03	0.231E-04

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-42
CPS Site LPZ Accident Chi/Q Calculations
2-Hour Averaging Period

Downwind Sector	Low Population Zone (LPZ) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	4,018	0.247E-04	0.279E-05
NNE	4,018	0.246E-04	0.299E-05
NE	4,018	0.247E-04	0.261E-05
ENE	4,018	0.230E-04	0.264E-05
E	4,018	0.217E-04	0.236E-05
ESE	4,018	0.194E-04	0.229E-05
SE	4,018	0.217E-04	0.220E-05
SSE	4,018	0.234E-04	0.216E-05
S	4,018	0..237E-04	0.264E-05
SSW	4,018	0.284E-04	0.256E-05
SW	4,018	0.315E-04	0.287E-05
WSW	4,018	0.317E-04	0.346E-05
W	4,018	0.305E-04	0.366E-05
WNW	4,018	0.248E-04	0.356E-05
NW	4,018	0.294E-04	0.357E-05
NNW	4,018	0.266E-04	0.331E-05
All Direction Case		0.272E-04	0.308E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-43
CPS Site EAB Accident Chi/Q Calculations
8-Hour Averaging Period

Downwind Sector	Exclusion Area Boundary (EAB) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	975	0.596E-04	0.108E-04
NNE	975	0.605E-04	0.102E-04
NE	975	0.548E-04	0.890E-05
ENE	975	0.489E-04	0.804E-05
E	975	0.464E-04	0.833E-05
ESE	975	0.490E-04	0.887E-05
SE	975	0.450E-04	0.836E-05
SSE	975	0.431E-04	0.734E-05
S	975	0.488E-04	0.890E-05
SSW	975	0.517E-04	0.891E-05
SW	975	0.660E-04	0.104E-04
WSW	975	0.606E-04	0.113E-04
W	975	0.647E-04	0.124E-04
WNW	975	0.529E-04	0.111E-04
NW	975	0.605E-04	0.111E-04
NNW	975	0.621E-04	0.111E-04
All Direction Case		0.600E-04	0.104E-04

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-44
CPS Site LPZ Accident Chi/Q Calculations
8-Hour Averaging Period

Downwind Sector	Low Population Zone (LPZ) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	4,018	0.118E-04	0.147E-05
NNE	4,018	0.117E-04	0.139E-05
NE	4,018	0.112E-04	0.121E-05
ENE	4,018	0.964E-05	0.113E-05
E	4,018	0.946E-05	0.115E-05
ESE	4,018	0.100E-04	0.118E-05
SE	4,018	0.931E-05	0.114E-05
SSE	4,018	0.943E-05	0.101E-05
S	4,018	0.921E-05	0.123E-05
SSW	4,018	0.118E-04	0.123E-05
SW	4,018	0.142E-04	0.147E-05
WSW	4,018	0.129E-04	0.162E-05
W	4,018	0.134E-04	0.179E-05
WNW	4,018	0.104E-04	0.162E-05
NW	4,018	0.125E-04	0.160E-05
NNW	4,018	0.124E-04	0.155E-05
All Direction Case		0.125E-04	0.147E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-45
CPS Site EAB Accident Chi/Q Calculations
16-Hour Averaging Period

Downwind Sector	Exclusion Area Boundary (EAB) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	975	0.407E-04	0.771E-05
NNE	975	0.403E-04	0.693E-05
NE	975	0.380E-04	0.580E-05
ENE	975	0.320E-04	0.513E-05
E	975	0.312E-04	0.565E-05
ESE	975	0.342E-04	0.602E-05
SE	975	0.307E-04	0.537E-05
SSE	975	0.289E-04	0.469E-05
S	975	0.290E-04	0.584E-05
SSW	975	0.327E-04	0.588E-05
SW	975	0.403E-04	0.719E-05
WSW	975	0.396E-04	0.714E-05
W	975	0.434E-04	0.859E-05
WNW	975	0.332E-04	0.727E-05
NW	975	0.393E-04	0.725E-05
NNW	975	0.406E-04	0.753E-05
All Direction Case		0.403E-04	0.710E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-46
CPS Site LPZ Accident Chi/Q Calculations
16-Hour Averaging Period

Downwind Sector	Low Population Zone (LPZ) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	4,018	0.797E-05	0.111E-05
NNE	4,018	0.770E-05	0.997E-06
NE	4,018	0.758E-05	0.815E-06
ENE	4,018	0.647E-05	0.736E-06
E	4,018	0.661E-05	0.792E-06
ESE	4,018	0.673E-05	0.841E-06
SE	4,018	0.610E-05	0.740E-06
SSE	4,018	0.596E-05	0.633E-06
S	4,018	0.579E-05	0.810E-06
SSW	4,018	0.712E-05	0.860E-06
SW	4,018	0.869E-05	0.107E-05
WSW	4,018	0.824E-05	0.105E-05
W	4,018	0.905E-05	0.131E-05
WNW	4,018	0.669E-05	0.112E-05
NW	4,018	0.775E-05	0.109E-05
NNW	4,018	0.764E-05	0.113E-05
All Direction Case		0.820E-05	0.100E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-47
CPS Site EAB Accident Chi/Q Calculations
72-Hour Averaging Period

Downwind Sector	Exclusion Area Boundary (EAB) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	975	0.185E-04	0.399E-05
NNE	975	0.182E-04	0.370E-05
NE	975	0.157E-04	0.307E-05
ENE	975	0.135E-04	0.244E-05
E	975	0.128E-04	0.269E-05
ESE	975	0.144E-04	0.269E-05
SE	975	0.136E-04	0.228E-05
SSE	975	0.123E-04	0.191E-05
S	975	0.130E-04	0.204E-05
SSW	975	0.125E-04	0.228E-05
SW	975	0.174E-04	0.318E-05
WSW	975	0.148E-04	0.303E-05
W	975	0.162E-04	0.350E-05
WNW	975	0.132E-04	0.305E-05
NW	975	0.151E-04	0.312E-05
NNW	975	0.181E-04	0.358E-05
All Direction Case		0.171E-04	0.320E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-48
CPS Site LPZ Accident Chi/Q Calculations
72-Hour Averaging Period

Downwind Sector	Low Population Zone (LPZ) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	4,018	0.343E-05	0.600E-06
NNE	4,018	0.335E-05	0.575E-06
NE	4,018	0.329E-05	0.457E-06
ENE	4,018	0.268E-05	0.392E-06
E	4,018	0.254E-05	0.391E-06
ESE	4,018	0.277E-05	0.390E-06
SE	4,018	0.262E-05	0.327E-06
SSE	4,018	0.239E-05	0.267E-06
S	4,018	0.246E-05	0.317E-06
SSW	4,018	0.258E-05	0.360E-06
SW	4,018	0.348E-05	0.478E-06
WSW	4,018	0.317E-05	0.489E-06
W	4,018	0.354E-05	0.551E-06
WNW	4,018	0.248E-05	0.487E-06
NW	4,018	0.292E-05	0.521E-06
NNW	4,018	0.356E-05	0.541E-06
All Direction Case		0.330E-05	0.490E-06

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-49
CPS Site EAB Accident Chi/Q Calculations
624-Hour Averaging Period

Downwind Sector	Exclusion Area Boundary (EAB) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	975	0.984E-05	0.402E-05
NNE	975	0.886E-05	0.401E-05
NE	975	0.750E-05	0.351E-05
ENE	975	0.706E-05	0.229E-05
E	975	0.654E-05	0.287E-05
ESE	975	0.826E-05	0.275E-05
SE	975	0.568E-05	0.215E-05
SSE	975	0.493E-05	0.152E-05
S	975	0.551E-05	0.153E-05
SSW	975	0.488E-05	0.159E-05
SW	975	0.670E-05	0.229E-05
WSW	975	0.643E-05	0.244E-05
W	975	0.711E-05	0.258E-05
WNW	975	0.584E-05	0.235E-05
NW	975	0.746E-05	0.312E-05
NNW	975	0.888E-05	0.322E-05
All Direction Case		0.810E-05	0.296E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-50
CPS Site LPZ Accident Chi/Q Calculations
624-Hour Averaging Period

Downwind Sector	Low Population Zone (LPZ) Distance (m)	5 Percent Chi/Q	50 Percent Chi/Q
N	4,018	0.178E-05	0.661E-06
NNE	4,018	0.155E-05	0.664E-06
NE	4,018	0.149E-05	0.605E-06
ENE	4,018	0.139E-05	0.386E-06
E	4,018	0.122E-05	0.491E-06
ESE	4,018	0.153E-05	0.422E-06
SE	4,018	0.104E-05	0.333E-06
SSE	4,018	0.926E-06	0.231E-06
S	4,018	0.103E-05	0.246E-06
SSW	4,018	0.101E-05	0.270E-06
SW	4,018	0.138E-05	0.382E-06
WSW	4,018	0.120E-05	0.402E-06
W	4,018	0.149E-05	0.435E-06
WNW	4,018	0.114E-05	0.391E-06
NW	4,018	0.145E-05	0.533E-06
NNW	4,018	0.167E-05	0.552E-06
All Direction Case		0.155E-05	0.480E-06

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m^3

TABLE 2.3-51

Summary and Comparison of Short-Term Chi/Q Calculations (5% Probability Level)

Averaging Period	Maximum Sector Values (sec/m^3)								
	PAVAN Results [a]	CPS USAR Results [b]	PAVAN Results [c]	PAVAN Results [c]	PAVAN Results [c]	CPS USAR Results [b]	PAVAN Results [c]	PAVAN Results [c]	PAVAN Results [a]
	EAB 805 m	EAB 975 m		EAB 1025 m		LPZ 4018 m	LPZ 4018 m	LPZ 4018 m	LPZ 4018 m
	No Building Wake	Building Wake	No Building Wake	Building Wake	No Building Wake	Building Wake	Building Wake	No Building Wake	No Building Wake
0 - 2 Hr	2.52E-04	1.78E-04	1.98E-04	1.85E-04	1.85E-04	4.15E-05	5.47E-05	5.47E-05	6.65E-05
0 - 8 Hr	1.41E-04	6.00E-05	9.78E-05	9.09E-05	9.89E-05	1.25E-05	2.36E-05	2.49E-05	3.00E-05
8 – 24 Hr	1.05E-04	4.03E-05	6.87E-05	6.37E-05	7.23E-05	8.20E-06	1.55E-05	1.68E-05	2.02E-05
1 - 4 Days	5.58E-05	1.71E-05	3.20E-05	2.95E-05	3.66E-05	3.30E-06	6.24E-06	7.18E-06	8.53E-06
4 – 30 Days	2.25E-05	0.81E-05	1.06E-05	0.98E-05	1.38E-05	1.55E-06	1.68E-06	2.11E-06	2.48E-06

[a] PAVAN results based on 3 years of meteorological data (January 2000 – December 2002).
[b] CPS, 2002
[c] PAVAN results based on 2 years 8 months of meteorological data (January 2000 – August 2002).

TABLE 2.3-52
Summary of EGC ESP Facility Chi/Q Calculations at EAB and LPZ Distance (50% Probability Level)

Averaging Period	Exelon ESP Site Chi/Q Values (50% Probability Value, [sec/m^3])		Source
	EAB Distance	**LPZ Distance**	
0 - 2 Hr	3.56E-05	5.10E-06	PAVAN Model
0 - 8 Hr	--	3.40E-06	Interpolation
8 - 24 Hr	--	2.85E-06	Interpolation
1 - 4 Days	--	1.85E-06	Interpolation
4 - 30 Days	--	1.00E-06	Interpolation
Annual Average	--	4.72E-07	PAVAN Model

TABLE 2.3-53
Long-Term Average Chi/Q (sec/m^3) Calculations for Routine Releases
EGC ESP Facility

	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
Downwind Sector	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q
N	1,767	8.61E-07	1,025	1.96E-06	4,018	2.54E-07	1,500	1.10E-06	8,000	9.47E-08	1,500.0	1.10E-06
NNE	1,527	1.11E-06	1,025	2.04E-06	4,018	2.65E-07	2,050	7.20E-07	8,000	9.90E-08	4,610.0	2.16E-07
NE	1,400	1.12E-06	1,025	1.81E-06	4,018	2.35E-07	5,530	1.47E-07	8,000	8.88E-08	3,460.0	2.93E-07
ENE	1,297	1.07E-06	1,025	1.55E-06	4,018	2.02E-07	7,740	8.06E-08	8,000	7.71E-08	4,210.0	1.89E-07
E	1,710	6.93E-07	1,025	1.52E-06	4,018	1.97E-07	1,670	7.18E-07	8,000	7.52E-08	1,670.0	7.18E-07
ESE	4,540	1.65E-07	1,025	1.54E-06	4,,018	1.97E-07	8,000	7.47E-08	8,000	7.47E-08	5,300.0	1.32E-07
SE	3,184	2.66E-07	1,025	1.49E-06	4,018	1.90E-07	8,000	7.22E-08	7,010	8.64E-08	7,010.0	8.64E-08
SSE	3,084	2.02E-07	1,025	1.08E-06	4,018	1.37E-07	8,000	5.17E-08	8,000	5.17E-08	4,450.0	1.18E-07
S	3,032	1.49E-07	1,025	7.76E-07	4,018	9.79E-08	8,000	3.65E-08	8,000	3.65E-08	4,840.0	7.43E-08
SSW	4,353	1.28E-07	1,025	1.12E-06	4,018	1.44E-07	5,470	9.22E-08	8,000	5.50E-08	8,000.0	5.50E-08
SW	4,891	1.82E-07	1,025	1.85E-06	4,018	2.41E-07	5,870	1.42E-07	8,000	9.36E-08	5,870.0	1.42E-07
WSW	3,784	2.39E-07	1,025	1.69E-06	4,018	2.20E-07	5,530	1.39E-07	8,000	8.44E-08	3,620.0	2.55E-07
W	2,277	3.92E-07	1,025	1.32E-06	4,018	1.72E-07	3,310	2.27E-07	8,000	6.53E-08	3,320.0	2.26E-07
WNW	1,934	5.21E-07	1,025	1.37E-06	4,018	1.77E-07	8,000	6.69E-08	8,000	6.69E-08	2,640.0	3.28E-07
NW	1,356	9.73E-07	1,025	1.50E-06	4,018	1.94E-07	3,850	2.07E-07	8,000	7.30E-08	4,700.0	1.54E-07
NNW	2,023	6.18E-07	1,025	1.73E-06	4,018	2.24E-07	2,050	6.06E-07	8,000	8.42E-08	8,000.0	8.42E-08

TABLE 2.3-53
Long-Term Average Chi/Q (sec/m^3) Calculations for Routine Releases
EGC ESP Facility

	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
Downwind Sector	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
N	1,500.0	1.10E-06	1,500.0	1.10E-06	2.88E-06	9.89E-07	5.42E-07	3.53E-07	2.53E-07	1.93E-07	1.54E-07	1.28E-07
NNE	2,050.0	7.20E-07	1,590.0	1.05E-06	3.00E-06	1.91E-06	5.65E-07	3.68E-07	2.64E-07	2.02E-07	1.60E-07	1.34E-07
NE	5,530.0	1.47E-07	2,070.0	6.24E-07	2.67E-06	1.69E-06	4.96E-07	3.26E-07	2.35E-07	1.80E-07	1.44E-07	1.20E-07
ENE	7,740.0	8.06E-08	2,860.0	3.29E-07	2.30E-06	1.45E-06	4.21E-07	2.78E-07	2.01E-07	1.55E-07	1.24E-07	1.03E-07
E	1,670.0	7.18E-07	1,670.0	7.18E-07	2.25E-06	1.42E-06	4.12E-07	2.72E-07	1.97E-07	1.51E-07	1.21E-07	1.01E-07
ESE	8,000.0	7.47E-08	5,140.0	1.38E-07	2.27E-06	1.44E-06	4.15E-07	2.73E-07	1.97E-07	1.51E-07	1.21E-07	1.01E-07
SE	7,010.0	8.64E-08	4,440.0	1.64E-07	2.20E-06	1.40E-06	3.97E-07	2.62E-07	1.89E-07	1.45E-07	1.16E-07	9.70E-08
SSE	4,890.0	1.03E-07	2,900.0	2.21E-07	1.59E-06	1.01E-06	2.89E-07	1.90E-07	1.37E-07	1.05E-07	8.37E-08	6.97E-08
S	8,000.0	3.65E-08	4,780.0	7.57E-08	1.14E-06	7.26E-07	2.08E-07	1.36E-07	9.77E-08	7.46E-08	5.94E-08	4.93E-08
SSW	5,470.0	9.22E-08	4,680.0	1.15E-07	1.65E-06	1.05E-06	2.99E-07	1.98E-07	1.43E-07	1.10E-07	8.85E-08	7.38E-08
SW	5,870.0	1.42E-07	1,170.0	1.50E-06	2.74E-06	1.73E-06	4.95E-07	3.29E-07	2.40E-07	1.86E-07	1.50E-07	1.25E-07
WSW	4,600.0	1.81E-07	2,520.0	4.28E-07	2.49E-06	1.58E-06	4.56E-07	3.02E-07	2.19E-07	1.69E-07	1.36E-07	1.13E-07
W	3,310.0	2.27E-07	2,630.0	3.17E-07	1.94E-06	1.23E-06	3.59E-07	2.37E-07	1.71E-07	1.31E-07	1.05E-07	8.77E-08
WNW	8,000.0	6.69E-08	2,630.0	3.30E-07	2.01E-06	1.28E-06	3.74E-07	2.45E-07	1.77E-07	1.35E-07	1.08E-07	9.00E-08
NW	3,850.0	2.07E-07	2,650.0	3.58E-07	2.20E-06	1.40E-06	4.11E-07	2.69E-07	1.94E-07	1.48E-07	1.18E-07	9.83E-08
NNW	2,050.0	6.06E-07	2,780.0	3.86E-07	2.54E-06	1.62E-06	4.76E-07	3.11E-07	2.24E-07	1.71E-07	1.36E-07	1.14E-07
All		4.586E-06		7.848E-06	3.582E-05	2.192E-05	6.612E-06	4.347E-06	3.140E-06	2.407E-06	1.924E-06	1.603E-06

TABLE 2.3-53
Long-Term Average Chi/Q (sec/m^3) Calculations for Routine Releases
EGC ESP Facility

Downwind Sector	Downwind Distance (mi)												
	4.5	5.0	6.0	8.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	47.5
N	1.09E-07	9.39E-08	7.31E-08	5.01E-08	3.72E-08	2.12E-08	1.44E-08	1.07E-08	8.39E-09	6.86E-09	5.76E-09	4.94E-09	4.60E-09
NNE	1.14E-07	9.82E-08	7.64E-08	5.24E-08	3.89E-08	2.22E-08	1.50E-08	1.12E-08	8.79E-09	7.19E-09	6.04E-09	5.18E-09	4.82E-09
NE	1.02E-07	8.81E-08	6.87E-08	4.73E-08	3.52E-08	2.02E-08	1.37E-08	1.02E-08	8.04E-09	6.58E-09	5.54E-09	4.76E-09	4.43E-09
ENE	8.82E-08	7.65E-08	5.98E-08	4.13E-08	3.09E-08	1.78E-08	1.21E-08	9.05E-09	7.13E-09	5.85E-09	4.93E-09	4.24E-09	3.96E-09
E	8.60E-08	7.46E-08	5.82E-08	4.02E-08	3.00E-08	1.73E-08	1.18E-08	8.75E-09	6.90E-09	5.65E-09	4.76E-09	4.09E-09	3.82E-09
ESE	8.56E-08	7.41E-08	5.78E-08	3.98E-08	2.96E-08	1.70E-08	1.16E-08	8.58E-09	6.75E-09	5.53E-09	4.65E-09	4.00E-09	3.73E-09
SE	8.27E-08	7.16E-08	5.59E-08	3.86E-08	2.88E-08	1.66E-08	1.13E-08	8.38E-09	6.59E-09	5.40E-09	4.55E-09	3.91E-09	3.65E-09
SSE	5.93E-08	5.13E-08	4.00E-08	2.75E-08	2.05E-08	1.17E-08	7.96E-09	5.91E-09	4.64E-09	3.80E-09	3.20E-09	2.75E-09	2.56E-09
S	4.19E-08	3.62E-08	2.81E-08	1.92E-08	1.43E-08	8.13E-09	5.49E-09	4.07E-09	3.20E-09	2.61E-09	2.19E-09	1.88E-09	1.75E-09
SSW	6.29E-08	5.45E-08	4.26E-08	2.94E-08	2.20E-08	1.27E-08	8.62E-09	6.40E-09	5.04E-09	4.13E-09	3.48E-09	2.99E-09	2.79E-09
SW	1.07E-07	9.29E-08	7.28E-08	5.06E-08	3.80E-08	2.21E-08	1.51E-08	1.12E-08	8.85E-09	7.26E-09	6.13E-09	5.28E-09	4.93E-09
WSW	9.66E-08	8.38E-08	6.55E-08	4.53E-08	3.39E-08	1.96E-08	1.34E-08	9.96E-09	7.85E-09	6.44E-09	5.42E-09	4.67E-09	4.35E-09
W	7.47E-08	6.47E-08	5.05E-08	3.48E-08	2.60E-08	1.50E-08	1.02E-08	7.57E-09	5.96E-09	4.88E-09	4.11E-09	3.53E-09	3.29E-09
WNW	7.67E-08	6.64E-08	5.18E-08	3.56E-08	2.65E-08	1.52E-08	1.03E-08	7.67E-09	6.03E-09	4.93E-09	4.15E-09	3.56E-09	3.32E-09
NW	8.37E-08	7.24E-08	5.64E-08	3.88E-08	2.89E-08	1.65E-08	1.12E-08	8.32E-09	6.54E-09	5.35E-09	4.50E-09	3.86E-09	3.60E-09
NNW	9.65E-08	8.35E-08	6.50E-08	4.46E-08	3.32E-08	1.90E-08	1.29E-08	9.57E-09	7.53E-09	6.16E-09	5.17E-09	4.44E-09	4.13E-09

Source: Campbell, 2002
Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m^2

TABLE 2.3-54
Long-Term Average D/Q (m^{-2}) Calculations for Routine Releases
EGC ESP Facility

	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
Downwind Sector	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q
N	1,767	5.08E-09	1,025	1.28E-08	4,018	1.24E-09	1,500	6.76E-09	8,000	3.69E-10	1,500.0	6.76E-09
NNE	1,527	7.47E-09	1,025	1.46E-08	4,018	1.42E-09	2,050	4.47E-09	8,000	4.21E-10	4,610.0	1.13E-09
NE	1,400	6.87E-09	1,025	1.16E-08	4,018	1.12E-09	5,530	6.53E-10	8,000	3.33E-10	3,460.0	1.45E-09
ENE	1,297	6.01E-09	1,025	8.85E-09	4,018	8.59E-10	7,740	2.71E-10	8,000	2.55E-10	4,210.0	7.94E-10
E	1,710	3.86E-09	1,025	9.20E-09	4,018	8.93E-10	1,670	4.02E-09	8,000	2.65E-10	1,670.0	4.02E-09
ESE	4,540	8.17E-10	1,025	1.04E-08	4,018	1.01E-09	8,000	2.98E-10	8,000	2.98E-10	5,300.0	6.29E-10
SE	3,184	1.35E-09	1,025	9.41E-09	4,018	9.13E-10	8,000	2.71E-10	7,010	3.45E-10	7,010.0	3.45E-10
SSE	3,084	9.82E-10	1,025	6.46E-09	4,018	6.27E-10	8,000	1.86E-10	8,000	1.86E-10	4,450.0	5.28E-10
S	3,032	7.50E-10	1,025	4.80E-09	4,018	4.66E-10	8,000	1.38E-10	8,000	1.38E-10	4,840.0	3.40E-10
SSW	4,353	4.67E-10	1,025	5.51E-09	4,018	5.35E-10	5,470	3.17E-10	8,000	1.59E-10	8,000.0	1.59E-10
SW	4,891	5.44E-10	1,025	7.82E-09	4,018	7.59E-10	5,870	3.97E-10	8,000	2.25E-10	5,870.0	3.97E-10
WSW	3,784	7.56E-10	1,025	7.04E-09	4,018	6.83E-10	5,530	3.98E-10	8,000	2.03E-10	3,620.0	8.15E-10
W	2,277	1.30E-09	1,025	5.09E-09	4,018	4.94E-10	3,310	6.86E-10	8,000	1.47E-10	3,320.0	6.82E-10
WNW	1,934	1.71E-09	1,025	5.06E-09	4,018	4.91E-10	8,000	1.46E-10	8,000	1.46E-10	2,640.0	1.00E-09
NW	1,356	4.02E-09	1,025	6.39E-09	4,018	6.21E-10	3,850	6.67E-10	8,000	1.84E-10	4,700.0	4.76E-10
NNW	2,023	2.82E-09	1,025	9.00E-09	4,018	8.74E-10	2,050	2.75E-09	8,000	2.59E-10	8,000.0	2.59E-10

TABLE 2.3-54
Long-Term Average D/Q (m^{-2}) Calculations for Routine Releases
EGC ESP Facility

	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
Downwind Sector	**Distance (m)**	**D/Q**	**Distance (m)**	**D/Q**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
N	1,500.0	6.76E-09	1,500.0	6.76E-09	1.88E-08	5.98E-09	2.95E-09	1.81E-09	1.24E-09	9.12E-10	7.02E-10	5.50E-10
NNE	2,050.0	4.47E-09	1,590.0	6.96E-09	2.15E-08	1.37E-08	3.36E-09	2.07E-09	1.42E-09	1.04E-09	8.01E-10	6.27E-10
NE	5,530.0	6.53E-10	2,070.0	3.47E-09	1.70E-08	1.08E-08	2.66E-09	1.63E-09	1.12E-09	8.22E-10	6.33E-10	4.96E-10
ENE	7,740.0	2.71E-10	2,860.0	1.53E-09	1.30E-08	8.27E-09	2.04E-09	1.25E-09	8.57E-10	6.30E-10	4.85E-10	3.80E-10
E	1,670.0	4.02E-09	1,670.0	4.02E-09	1.35E-08	8.60E-09	2.11E-09	1.30E-09	8.91E-10	6.54E-10	5.04E-10	3.94E-10
ESE	8,000.0	2.98E-10	5,140.0	6.62E-10	1.52E-08	9.67E-09	2.38E-09	1.46E-09	1.00E-09	7.36E-10	5.67E-10	4.44E-10
SE	7,010.0	3.45E-10	4,440.0	7.71E-10	1.38E-08	8.79E-09	2.16E-09	1.33E-09	9.11E-10	6.69E-10	5.15E-10	4.04E-10
SSE	4,890.0	4.50E-10	2,900.0	1.09E-09	9.50E-09	6.04E-09	1.49E-09	9.13E-10	6.26E-10	4.60E-10	3.54E-10	2.77E-10
S	8,000.0	1.38E-10	4,780.0	3.47E-10	7.05E-09	4.48E-09	1.10E-09	6.78E-10	4.65E-10	3.41E-10	2.63E-10	2.06E-10
SSW	5,470.0	3.17E-10	4,680.0	4.13E-10	8.09E-09	5.15E-09	1.27E-09	7.78E-10	5.33E-10	3.92E-10	3.02E-10	2.36E-10
SW	5,870.0	3.97E-10	1,170.0	6.33E-09	1.15E-08	7.31E-09	1.80E-09	1.10E-09	7.57E-10	5.56E-10	4.28E-10	3.35E-10
WSW	4,600.0	5.43E-10	2,520.0	1.50E-09	1.03E-08	6.58E-09	1.62E-09	9.94E-10	6.82E-10	5.01E-10	3.85E-10	3.02E-10
W	3,310.0	6.86E-10	2,630.0	1.01E-09	7.48E-09	4.76E-09	1.17E-09	7.19E-10	4.93E-10	3.62E-10	2.79E-10	2.18E-10
WNW	8,000.0	1.46E-10	2,630.0	1.01E-09	7.44E-09	4.73E-09	1.16E-09	7.15E-10	4.90E-10	3.60E-10	2.77E-10	2.17E-10
NW	3,850.0	6.67E-10	2,650.0	1.26E-09	9.40E-09	5.98E-09	1.47E-09	9.03E-10	6.19E-10	4.55E-10	3.50E-10	2.74E-10
NNW	2,050.0	2.75E-09	2,780.0	1.63E-09	1.32E-08	8.41E-09	2.07E-09	1.27E-09	8.72E-10	6.40E-10	4.93E-10	3.86E-10

TABLE 2.3-54
Long-Term Average D/Q (m^{-2}) Calculations for Routine Releases
EGC ESP Facility

Downwind Sector	Downward Distance (mi)												
	4.5	**5.0**	**6.0**	**8.0**	**10.0**	**15.0**	**20.0**	**25.0**	**30.0**	**35.0**	**40.0**	**45.0**	**47.5**
N	4.43E-10	3.65E-10	2.62E-10	1.70E-10	1.19E-10	5.67E-11	3.35E-11	2.23E-11	1.60E-11	1.20E-11	9.36E-12	7.43E-12	6.68E-12
NNE	5.05E-10	4.17E-10	2.98E-10	1.94E-10	1.36E-10	6.47E-11	3.82E-11	2.54E-11	1.82E-11	1.37E-11	1.07E-11	8.48E-12	7.62E-12
NE	3.99E-10	3.29E-10	2.36E-10	1.53E-10	1.08E-10	5.12E-11	3.02E-11	2.01E-11	1.44E-11	1.09E-11	8.44E-12	6.70E-12	6.02E-12
ENE	3.06E-10	2.52E-10	1.81E-10	1.17E-10	8.24E-11	3.92E-11	2.31E-11	1.54E-11	1.10E-11	8.31E-12	6.46E-12	5.13E-12	4.61E-12
E	3.18E-10	2.62E-10	1.88E-10	1.22E-10	8.56E-11	4.07E-11	2.40E-11	1.60E-11	1.14E-11	8.64E-12	6.71E-12	5.33E-12	4.79E-12
ESE	3.58E-10	2.95E-10	2.11E-10	1.37E-10	9.64E-11	4.58E-11	2.70E-11	1.80E-11	1.29E-11	9.72E-12	7.56E-12	6.00E-12	5.39E-12
SE	3.25E-10	2.68E-10	1.92E-10	1.25E-10	8.76E-11	4.16E-11	2.46E-11	1.63E-11	1.17E-11	8.84E-12	6.87E-12	5.46E-12	4.90E-12
SSE	2.23E-10	1.84E-10	1.32E-10	8.57E-11	6.02E-11	2.86E-11	1.69E-11	1.12E-11	8.04E-12	6.07E-12	4.72E-12	3.75E-12	3.37E-12
S	1.66E-10	1.37E-10	9.79E-11	6.36E-11	4.47E-11	2.12E-11	1.25E-11	8.33E-12	5.97E-12	4.51E-12	3.50E-12	2.78E-12	2.50E-12
SSW	1.90E-10	1.57E-10	1.12E-10	7.30E-11	5.13E-11	2.44E-11	1.44E-11	9.56E-12	6.85E-12	5.17E-12	4.02E-12	3.19E-12	2.87E-12
SW	2.70E-10	2.23E-10	1.60E-10	1.04E-10	7.28E-11	3.46E-11	2.04E-11	1.36E-11	9.73E-12	7.34E-12	5.71E-12	4.53E-12	4.07E-12
WSW	2.43E-10	2.01E-10	1.44E-10	9.33E-11	6.55E-11	3.12E-11	1.84E-11	1.22E-11	8.76E-12	6.61E-12	5.14E-12	4.08E-12	3.67E-12
W	1.76E-10	1.45E-10	1.04E-10	6.75E-11	4.74E-11	2.25E-11	1.33E-11	8.84E-12	6.33E-12	4.78E-12	3.72E-12	2.95E-12	2.65E-12
WNW	1.75E-10	1.44E-10	1.03E-10	6.71E-11	4.71E-11	2.24E-11	1.32E-11	8.79E-12	6.30E-12	4.75E-12	3.69E-12	2.93E-12	2.64E-12
NW	2.21E-10	1.82E-10	1.31E-10	8.48E-11	5.95E-11	2.83E-11	1.67E-11	1.11E-11	7.96E-12	6.01E-12	4.67E-12	3.71E-12	3.33E-12
NNW	3.11E-10	2.57E-10	1.84E-10	1.19E-10	8.38E-11	3.98E-11	2.35E-11	1.56E-11	1.12E-11	8.46E-12	6.57E-12	5.22E-12	4.69E-12

Source: Campbell, 2002
Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m^2

TABLE 2.3-55
Long-Term Average Chi/Q (sec/m³) Calculations (2.26 Day Decay) for Routine Releases
EGC ESP Facility

	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
Downwind Sector	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**
N	1,767	8.58E-07	1,025	1.96E-06	4,018	2.51E-07	1,500	1.10E-06	8,000	9.29E-08	1,500.0	1.10E-06
NNE	1,527	1.11E-06	1,025	2.04E-06	4,018	2.62E-07	2,050	7.16E-07	8,000	9.72E-08	4,610.0	2.14E-07
NE	1,400	1.12E-06	1,025	1.81E-06	4,018	2.33E-07	5,530	1.45E-07	8,000	8.69E-08	3,460.0	2.90E-07
ENE	1,297	1.07E-06	1,025	1.55E-06	4,018	1.99E-07	7,740	7.88E-08	8,000	7.53E-08	4,210.0	1.86E-07
E	1,710	6.90E-07	1,025	1.52E-06	4,018	1.95E-07	1,670	7.15E-07	8,000	7.35E-08	1,670.0	7.15E-07
ESE	4,540	1.63E-07	1,025	1.54E-06	4,018	1.95E-07	8,000	7.31E-08	8,000	7.31E-08	5,300.0	1.30E-07
SE	3,184	2.64E-07	1,025	1.49E-06	4,018	1.88E-07	8,000	7.06E-08	7,010	8.48E-08	7,010.0	8.48E-08
SSE	3,084	2.00E-07	1,025	1.08E-06	4,018	1.36E-07	8,000	5.06E-08	8,000	5.06E-08	4,450.0	1.17E-07
S	3,032	1.47E-07	1,025	7.74E-07	4,018	9.67E-08	8,000	3.56E-08	8,000	3.56E-08	4,840.0	7.33E-08
SSW	4,353	1.26E-07	1,025	1.12E-06	4,018	1.42E-07	5,470	9.08E-08	8,000	5.37E-08	8,000.0	5.37E-08
SW	4,891	1.80E-07	1,025	1.85E-06	4,018	2.38E-07	5,870	1.39E-07	8,000	9.14E-08	5,870.0	1.39E-07
WSW	3,784	2.37E-07	1,025	1.68E-06	4,018	2.17E-07	5,530	1.37E-07	8,000	8.25E-08	3,620.0	2.52E-07
W	2,277	3.89E-07	1,025	1.31E-06	4,018	1.69E-07	3,310	2.25E-07	8,000	6.37E-08	3,320.0	2.24E-07
WNW	1,934	5.18E-07	1,025	1.36E-06	4,018	1.75E-07	8,000	6.52E-08	8,000	6.52E-08	2,640.0	3.25E-07
NW	1,356	9.69E-07	1,025	1.49E-06	4,018	1.92E-07	3,850	2.04E-07	8,000	7.12E-08	4,700.0	1.52E-07
NNW	2,023	6.15E-07	1,025	1.72E-06	4,018	2.22E-07	2,050	6.03E-07	8,000	8.23E-08	8,000.0	8.23E-08

TABLE 2.3-55
Long-Term Average Chi/Q (sec/m^3) Calculations (2.26 Day Decay) for Routine Releases
EGC ESP Facility

	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
Downwind Sector	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
N	1,500.0	1.10E-06	1,500.0	1.10E-06	2.87E-06	9.86E-07	5.39E-07	3.50E-07	2.51E-07	1.91E-07	1.52E-07	1.26E-07
NNE	2,050.0	7.16E-07	1,590.0	1.05E-06	2.99E-06	1.91E-06	5.62E-07	3.66E-07	2.62E-07	1.99E-07	1.59E-07	1.32E-07
NE	5,530.0	1.45E-07	2,070.0	6.21E-07	2.66E-06	1.69E-06	4.93E-07	3.23E-07	2.32E-07	1.78E-07	1.42E-07	1.18E-07
ENE	7,740.0	7.88E-08	2,860.0	3.27E-07	2.29E-06	1.45E-06	4.18E-07	2.75E-07	1.99E-07	1.53E-07	1.22E-07	1.02E-07
E	1,670.0	7.15E-07	1,670.0	7.15E-07	2.24E-06	1.42E-06	4.09E-07	2.69E-07	1.95E-07	1.49E-07	1.19E-07	9.92E-08
ESE	8,000.0	7.31E-08	5,140.0	1.36E-07	2.27E-06	1.44E-06	4.12E-07	2.70E-07	1.95E-07	1.49E-07	1.19E-07	9.88E-08
SE	7,010.0	8.48E-08	4,440.0	1.62E-07	2.19E-06	1.39E-06	3.95E-07	2.59E-07	1.87E-07	1.44E-07	1.15E-07	9.53E-08
SSE	4,890.0	1.01E-07	2,900.0	2.19E-07	1.58E-06	1.01E-06	2.87E-07	1.88E-07	1.35E-07	1.03E-07	8.24E-08	6.84E-08
S	8,000.0	3.56E-08	4,780.0	7.47E-08	1.13E-06	7.24E-07	2.07E-07	1.35E-07	9.65E-08	7.35E-08	5.85E-08	4.84E-08
SSW	5,470.0	9.08E-08	4,680.0	1.14E-07	1.64E-06	1.04E-06	2.97E-07	1.96E-07	1.42E-07	1.09E-07	8.71E-08	7.24E-08
SW	5,870.0	1.39E-07	1,170.0	1.49E-06	2.73E-06	1.73E-06	4.91E-07	3.26E-07	2.38E-07	1.83E-07	1.47E-07	1.23E-07
WSW	4,600.0	1.79E-07	2,520.0	4.25E-07	2.48E-06	1.57E-06	4.53E-07	2.99E-07	2.17E-07	1.67E-07	1.33E-07	1.11E-07
W	3,310.0	2.25E-07	2,630.0	3.15E-07	1.93E-06	1.23E-06	3.57E-07	2.34E-07	1.69E-07	1.30E-07	1.03E-07	8.60E-08
WNW	8,000.0	6.52E-08	2,630.0	3.27E-07	2.00E-06	1.27E-06	3.71E-07	2.42E-07	1.74E-07	1.33E-07	1.06E-07	8.81E-08
NW	3,850.0	2.04E-07	2,650.0	3.55E-07	2.19E-06	1.40E-06	4.08E-07	2.66E-07	1.91E-07	1.46E-07	1.16E-07	9.64E-08
NNW	2,050.0	6.03E-07	2,780.0	3.83E-07	2.53E-06	1.61E-06	4.73E-07	3.08E-07	2.21E-07	1.69E-07	1.34E-07	1.12E-07

TABLE 2.3-55
Long-Term Average Chi/Q (sec/m^3) Calculations (2.26 Day Decay) for Routine Releases
EGC ESP Facility

Downwind Sector	Downwind Distance (mi)												
	4.5	**5.0**	**6.0**	**8.0**	**10.0**	**15.0**	**20.0**	**25.0**	**30.0**	**35.0**	**40.0**	**45.0**	**47.5**
N	1.07E-07	9.21E-08	7.14E-08	4.86E-08	3.58E-08	2.00E-08	1.33E-08	9.71E-09	7.50E-09	6.02E-09	4.96E-09	4.18E-09	3.86E-09
NNE	1.12E-07	9.64E-08	7.48E-08	5.09E-08	3.75E-08	2.10E-08	1.40E-08	1.02E-08	7.89E-09	6.34E-09	5.23E-09	4.41E-09	4.07E-09
NE	9.98E-08	8.62E-08	6.69E-08	4.57E-08	3.37E-08	1.89E-08	1.26E-08	9.17E-09	7.08E-09	5.68E-09	4.68E-09	3.94E-09	3.64E-09
ENE	8.64E-08	7.47E-08	5.81E-08	3.98E-08	2.95E-08	1.66E-08	1.11E-08	8.07E-09	6.23E-09	5.00E-09	4.12E-09	3.47E-09	3.20E-09
E	8.43E-08	7.29E-08	5.67E-08	3.88E-08	2.87E-08	1.61E-08	1.07E-08	7.82E-09	6.03E-09	4.83E-09	3.98E-09	3.35E-09	3.09E-09
ESE	8.39E-08	7.25E-08	5.63E-08	3.84E-08	2.83E-08	1.59E-08	1.06E-08	7.67E-09	5.91E-09	4.73E-09	3.89E-09	3.27E-09	3.02E-09
SE	8.10E-08	7.01E-08	5.45E-08	3.72E-08	2.75E-08	1.55E-08	1.03E-08	7.50E-09	5.78E-09	4.63E-09	3.82E-09	3.22E-09	2.97E-09
SSE	5.81E-08	5.02E-08	3.89E-08	2.65E-08	1.95E-08	1.09E-08	7.25E-09	5.26E-09	4.05E-09	3.24E-09	2.67E-09	2.24E-09	2.07E-09
S	4.10E-08	3.54E-08	2.73E-08	1.85E-08	1.36E-08	7.56E-09	4.99E-09	3.62E-09	2.77E-09	2.21E-09	1.82E-09	1.52E-09	1.40E-09
SSW	6.16E-08	5.32E-08	4.14E-08	2.83E-08	2.09E-08	1.18E-08	7.83E-09	5.69E-09	4.37E-09	3.50E-09	2.88E-09	2.42E-09	2.24E-09
SW	1.05E-07	9.07E-08	7.08E-08	4.87E-08	3.62E-08	2.06E-08	1.37E-08	9.98E-09	7.70E-09	6.18E-09	5.10E-09	4.29E-09	3.97E-09
WSW	9.46E-08	8.18E-08	6.37E-08	4.37E-08	3.24E-08	1.83E-08	1.22E-08	8.88E-09	6.85E-09	5.50E-09	4.53E-09	3.82E-09	3.52E-09
W	7.31E-08	6.32E-08	4.91E-08	3.35E-08	2.48E-08	1.39E-08	9.23E-09	6.71E-09	5.16E-09	4.13E-09	3.40E-09	2.86E-09	2.63E-09
WNW	7.48E-08	6.46E-08	5.02E-08	3.42E-08	2.52E-08	1.41E-08	9.29E-09	6.73E-09	5.16E-09	4.12E-09	3.38E-09	2.83E-09	2.60E-09
NW	8.18E-08	7.06E-08	5.48E-08	3.73E-08	2.74E-08	1.53E-08	1.01E-08	7.34E-09	5.64E-09	4.50E-09	3.69E-09	3.09E-09	2.85E-09
NNW	9.46E-08	8.17E-08	6.33E-08	4.31E-08	3.18E-08	1.78E-08	1.18E-08	8.56E-09	6.60E-09	5.28E-09	4.35E-09	3.65E-09	3.37E-09

Source: Campbell, 2002
Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m^2

TABLE 2.3-56
Long-Term Average Chi/Q (sec/m^3) Calculations (Depleted and 8-Day Decayed) for Routine Releases
EGC ESP Facility

	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
Downwind Sector	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**
N	1,767	7.46E-07	1,025	1.77E-06	4,018	2.04E-07	1,500	9.63E-07	8,000	6.96E-08	1,500.0	9.63E-07
NNE	1,527	9.76E-07	1,025	1.84E-06	4,018	2.13E-07	2,050	6.17E-07	8,000	7.28E-08	4,610.0	1.71E-07
NE	1,400	9.86E-07	1,025	1.63E-06	4,018	1.89E-07	5,530	1.14E-07	8,000	6.53E-08	3,460.0	2.39E-07
ENE	1,297	9.50E-07	1,025	1.40E-06	4,018	1.62E-07	7,740	5.95E-08	8,000	5.66E-08	4,210.0	1.51E-07
E	1,710	6.02E-07	1,025	1.37E-06	4,018	1.58E-07	1,670	6.25E-07	8,000	5.52E-08	1,670.0	6.25E-07
ESE	4,540	1.31E-07	1,025	1.39E-06	4,018	1.58E-07	8,000	5.49E-08	8,000	5.49E-08	5,300.0	1.03E-07
SE	3,184	2.19E-07	1,025	1.34E-06	4,018	1.52E-07	8,000	5.30E-08	7,010	6.48E-08	7,010.0	6.48E-08
SSE	3,084	1.67E-07	1,025	9.72E-07	4,018	1.10E-07	8,000	3.80E-08	8,000	3.80E-08	4,450.0	9.37E-08
S	3,032	1.23E-07	1,025	6.98E-07	4,018	7.86E-08	8,000	2.68E-08	8,000	2.68E-08	4,840.0	5.85E-08
SSW	4,353	1.02E-07	1,025	1.01E-06	4,018	1.15E-07	5,470	7.17E-08	8,000	4.04E-08	8,000.0	4.04E-08
SW	4,891	1.43E-07	1,025	1.67E-06	4,018	1.93E-07	5,870	1.09E-07	8,000	6.88E-08	5,870.0	1.09E-07
WSW	3,784	1.93E-07	1,025	1.52E-06	4,018	1.76E-07	5,530	1.08E-07	8,000	6.20E-08	3,620.0	2.07E-07
W	2,277	3.33E-07	1,025	1.18E-06	4,018	1.38E-07	3,310	1.86E-07	8,000	4.79E-08	3,320.0	1.85E-07
WNW	1,934	4.48E-07	1,025	1.23E-06	4,018	1.42E-07	8,000	4.91E-08	8,000	4.91E-08	2,640.0	2.75E-07
NW	1,356	8.59E-07	1,025	1.35E-06	4,018	1.56E-07	3,850	1.67E-07	8,000	5.36E-08	4,700.0	1.22E-07
NNW	2,023	5.31E-07	1,025	1.55E-06	4,018	1.80E-07	2,050	5.20E-07	8,000	6.19E-08	8,000.0	6.19E-08

TABLE 2.3-56
Long-Term Average Chi/Q (sec/m^3) Calculations (Depleted and 8-Day Decayed) for Routine Releases
EGR ESP Facility

	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
Downwind Sector	**Distance (m)**	**Chi/Q**	**Distance (m)**	**Chi/Q**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
N	1,500.0	9.63E-07	1,500.0	9.63E-07	2.62E-06	8.63E-07	4.59E-07	2.90E-07	2.03E-07	1.52E-07	1.19E-07	9.70E-08
NNE	2,050.0	6.17E-07	1,590.0	9.16E-07	2.73E-06	1.72E-06	4.78E-07	3.03E-07	2.12E-07	1.59E-07	1.24E-07	1.01E-07
NE	5,530.0	1.14E-07	2,070.0	5.35E-07	2.43E-06	1.52E-06	4.20E-07	2.68E-07	1.89E-07	1.42E-07	1.11E-07	9.08E-08
ENE	7,740.0	5.95E-08	2,860.0	2.74E-07	2.09E-06	1.30E-06	3.56E-07	2.28E-07	1.62E-07	1.22E-07	9.60E-08	7.85E-08
E	1,670.0	6.25E-07	1,670.0	6.25E-07	2.05E-06	1.28E-06	3.49E-07	2.23E-07	1.58E-07	1.19E-07	9.37E-08	7.66E-08
ESE	8,000.0	5.49E-08	5,140.0	1.08E-07	2.07E-06	1.30E-06	3.51E-07	2.24E-07	1.58E-07	1.19E-07	9.35E-08	7.63E-08
SE	7,010.0	6.48E-08	4,440.0	1.30E-07	2.00E-06	1.25E-06	3.36E-07	2.15E-07	1.52E-07	1.14E-07	9.01E-08	7.36E-08
SSE	4,890.0	8.09E-08	2,900.0	1.84E-07	1.45E-06	9.07E-07	2.45E-07	1.56E-07	1.10E-07	8.25E-08	6.48E-08	5.29E-08
S	8,000.0	2.68E-08	4,780.0	5.96E-08	1.04E-06	6.51E-07	1.76E-07	1.12E-07	7.84E-08	5.87E-08	4.60E-08	3.74E-08
SSW	5,470.0	7.17E-08	4,680.0	9.11E-08	1.50E-06	9.38E-07	2.53E-07	1.62E-07	1.15E-07	8.69E-08	6.85E-08	5.60E-08
SW	5,870.0	1.09E-07	1,170.0	1.34E-06	2.49E-06	1.55E-06	4.19E-07	2.71E-07	1.93E-07	1.46E-07	1.16E-07	9.49E-08
WSW	4,600.0	1.43E-07	2,520.0	3.61E-07	2.27E-06	1.41E-06	3.86E-07	2.48E-07	1.76E-07	1.33E-07	1.05E-07	8.59E-08
W	3,310.0	1.86E-07	2,630.0	2.66E-07	1.76E-06	1.10E-06	3.04E-07	1.94E-07	1.37E-07	1.03E-07	8.14E-08	6.65E-08
WNW	8,000.0	4.91E-08	2,630.0	2.76E-07	1.83E-06	1.15E-06	3.16E-07	2.01E-07	1.42E-07	1.06E-07	8.36E-08	6.83E-08
NW	3,850.0	1.67E-07	2,650.0	3.00E-07	2.00E-06	1.26E-06	3.48E-07	2.21E-07	1.55E-07	1.17E-07	9.14E-08	7.46E-08
NNW	2,050.0	5.20E-07	2,780.0	3.22E-07	2.31E-06	1.45E-06	4.03E-07	2.56E-07	1.80E-07	1.35E-07	1.06E-07	8.62E-08

TABLE 2.3-56
Long-Term Average Chi/Q (sec/m^3) Calculations (Depleted and 8-Day Decayed) for Routine Releases
EGR ESP Facility

Downwind Sector	Downwind Distance (mi)												
	4.5	**5.0**	**6.0**	**8.0**	**10.0**	**15.0**	**20.0**	**25.0**	**30.0**	**35.0**	**40.0**	**45.0**	**47.5**
N	8.11E-08	6.90E-08	5.22E-08	3.45E-08	2.47E-08	1.29E-08	8.17E-09	5.72E-09	4.26E-09	3.31E-09	2.64E-09	2.16E-09	1.96E-09
NNE	8.47E-08	7.21E-08	5.46E-08	3.61E-08	2.59E-08	1.36E-08	8.57E-09	6.00E-09	4.47E-09	3.47E-09	2.78E-09	2.27E-09	2.06E-09
NE	7.59E-08	6.47E-08	4.91E-08	3.25E-08	2.34E-08	1.23E-08	7.78E-09	5.45E-09	4.06E-09	3.16E-09	2.53E-09	2.06E-09	1.88E-09
ENE	6.58E-08	5.61E-08	4.27E-08	2.84E-08	2.05E-08	1.08E-08	6.88E-09	4.82E-09	3.60E-09	2.80E-09	2.24E-09	1.83E-09	1.67E-09
E	6.42E-08	5.47E-08	4.16E-08	2.76E-08	1.99E-08	1.05E-08	6.67E-09	4.67E-09	3.48E-09	2.70E-09	2.16E-09	1.77E-09	1.61E-09
ESE	6.38E-08	5.44E-08	4.13E-08	2.74E-08	1.97E-08	1.04E-08	6.55E-09	4.58E-09	3.41E-09	2.65E-09	2.12E-09	1.73E-09	1.57E-09
SE	6.16E-08	5.26E-08	3.99E-08	2.65E-08	1.91E-08	1.01E-08	6.39E-09	4.47E-09	3.33E-09	2.59E-09	2.07E-09	1.69E-09	1.54E-09
SSE	4.42E-08	3.77E-08	2.86E-08	1.89E-08	1.36E-08	7.14E-09	4.51E-09	3.15E-09	2.34E-09	1.82E-09	1.45E-09	1.19E-09	1.08E-09
S	3.12E-08	2.66E-08	2.01E-08	1.32E-08	9.46E-09	4.94E-09	3.11E-09	2.17E-09	1.61E-09	1.25E-09	9.94E-10	8.10E-10	7.36E-10
SSW	4.69E-08	4.00E-08	3.04E-08	2.02E-08	1.46E-08	7.70E-09	4.88E-09	3.41E-09	2.54E-09	1.97E-09	1.58E-09	1.29E-09	1.17E-09
SW	7.97E-08	6.82E-08	5.20E-08	3.48E-08	2.52E-08	1.34E-08	8.54E-09	5.98E-09	4.46E-09	3.47E-09	2.78E-09	2.28E-09	2.08E-09
WSW	7.20E-08	6.15E-08	4.68E-08	3.12E-08	2.25E-08	1.19E-08	7.58E-09	5.31E-09	3.96E-09	3.08E-09	2.47E-09	2.02E-09	1.84E-09
W	5.57E-08	4.75E-08	3.61E-08	2.40E-08	1.72E-08	9.09E-09	5.76E-09	4.03E-09	3.00E-09	2.33E-09	1.86E-09	1.52E-09	1.39E-09
WNW	5.71E-08	4.87E-08	3.69E-08	2.45E-08	1.76E-08	9.23E-09	5.83E-09	4.07E-09	3.02E-09	2.34E-09	1.87E-09	1.53E-09	1.39E-09
NW	6.24E-08	5.31E-08	4.03E-08	2.67E-08	1.91E-08	1.00E-08	6.33E-09	4.42E-09	3.29E-09	2.55E-09	2.04E-09	1.66E-09	1.51E-09
NNW	7.20E-08	6.13E-08	4.64E-08	3.07E-08	2.20E-08	1.16E-08	7.30E-09	5.10E-09	3.80E-09	2.95E-09	2.36E-09	1.92E-09	1.75E-09

Source: Campbell, 2002
Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m^2

TABLE 2.4-1
Drainage Characteristics of Salt Creek and its Tributaries to the Sangamon River

Creek	Length (mi)	Drainage Area (mi^2)	Maximum Relief (ft)	Average Annual Runoff (in)
North Fork	26	128	270	9.73
Lake Fork	40	280	210	8.88
Deer Creek	25	81	240	10.30
Kickapoo Creek	55	330	380	8.91
Sugar Creek	55	480	380	8.63
Tenmile Creek	19	41	250	10.10
Salt Creek	92	1860	440	9.17

Source: CPS, 1982 and Knapp, 1999

TABLE 2.4-1A
Dams Upstream and Downstream of Clinton Lake

Dam Name	Location	Owner/ Purpose	Date Built	Dam Height	Storage and Drainage Area
Moraine View Dam (or Dawson Lake)	Near the city of Leroy in McLean County (about 25 miles upstream of Clinton Lake)	Illinois DNR/ Recreation	1963	42 ft	Storage (acre-feet): Maximum = 4,133 Normal = 1,620 Drainage area: 4.5 acres
Vance Lake Dam (or Clyde Vance Lake)	DeWitt County (about 15 miles upstream of Clinton Lake)	John M. Clark/ Recreation	1955	20 ft	Storage (acre-feet): Maximum = 313 Normal = 134 Drainage area: not provided
Weldon Springs State Park Lake Dam	DeWitt County (about 2.5 miles downstream of Clinton Lake)	Illinois DNR/ Recreation	1900	30 ft	Storage (acre-feet): Maximum = 532 Normal = 303 Drainage area: 1.4 acres
Little Galilee Lake Dam	DeWitt County (about 10 miles downstream of Clinton Lake)	Little Galilee Christian	1954	35 ft	Storage (acre-feet): Maximum = 60 Normal = 41 Drainage area: not provided

SOURCE: USACOE, 2004a

TABLE 2.4-2
Mean Monthly Runoff, Rainfall, and Natural Lake Evaporation Data for Salt Creek Basin (Post-dam)

Month	Mean Runoff (in)	Mean Rainfall (in)	Percent of Rainfall as Runoff	Mean Lake Evaporation (in)
January	0.80	1.91	41.7%	--[a]
February	1.01	1.99	50.4%	--[a]
March	1.99	3.13	63.6%	1.17
April	1.76	4.31	40.8%	3.34
May	1.86	4.50	41.3%	5.19
June	1.21	3.82	31.6%	6.41
July	0.84	4.43	18.9%	6.24
August	0.50	3.78	13.2%	5.26
September	0.21	2.51	8.4%	4.14
October	0.35	3.36	10.5%	2.47
November	0.57	3.63	15.8%	0.52
December	0.87	2.80	31.2%	--[a]
Total	**11.97**	**40.17**		**34.74**
Average			**29.8%**	

Source: USGS, 2002; MRCC, 2002a and 2002b;

--[a] Data not available

TABLE 2.4-3
Discharge Data for Salt Creek at Rowell

Discharge	Pre-dam Magnitude (cfs)	Post-dam Magnitude (1978-1999) [a] (cfs)
Mean Annual	241 [b]	295
Highest Mean Monthly	521 [b] (April)	578 (March)
Lowest Mean Monthly (September)	36 [b]	63
Maximum Mean Daily Peak	18,200	6960
Minimum Mean Daily Low	0.9	3.7

[a] USGS, 2002
[b] CPS, 1982

TABLE 2.4-4
Calculated Peak Flood Magnitudes and Frequencies at Rowell Gauging Station and at Dam Site

Recurrence Interval (year)	Pre-dam Magnitude of Flood [a] (cfs)		Post-dam Magnitude of Flood [b] (cfs)	
	Rowell Gage	Clinton Lake Dam	Rowell Gage	Clinton Lake Dam
2.33	4,300	3,800	3,300	2,900
10	11,400	10,100	6,000	5,300
25	17,500	15,500	7,600	6,700
50	23,200	20,500	8,700	7,700
100	29,900	26,400	9,800	8,700

[a] CPS, 1982
[b] USGS, 2004

TABLE 2.4-5
Local Intense Precipitation

Duration	Factor	Intensity
5 min	0.335	6.08
15 min	0.528	9.58
30 min	0.759	13.78
1 hr	1.00	18.15
6 hr	1.493	27.10

TABLE 2.4-6
48-Hour Local Probable Maximum Precipitation 6-Hour Increments

Information has been deleted.

TABLE 2.4-7
Time Distribution of Maximum 6-Hour Rainfall

Information has been deleted.

TABLE 2.4-8
TIME DISTRIBUTION OF PMP ACCORDING TO ANSI/ANS-2.8-1992

6-hour Period	Time (hours)	Accumulated Average PMP (inches)	Incremental Average PMP (inches)	6-Hour Sequence No.	ANSI Storm Distribution	Storm Pattern
1	6	17.46	17.46	1	0.80	0.70
2	12	20.98	3.52		3.52	0.70
3	18	22.08	1.10		17.46	0.70
4	24	22.88	0.80		1.10	0.80
5	30	23.67	0.80	2	0.80	0.80
6	36	24.37	0.70		0.70	3.52
7	42	25.07	0.70		0.70	17.46
8	48	25.76	0.70		0.70	1.10
9	54	26.26	0.50	3	0.50	0.50
10	60	26.76	0.50		0.50	0.50
11	66	27.26	0.50		0.50	0.50
12	72	27.76	0.50		0.50	0.50

TABLE 2.4-9
Hydrologic Parameters for the "Two–Basin + Lake Model"

Parameter	Units	Salt Creek	North Fork	Clinton Lake
Watershed Parameters				
A	sq. miles	162.5	126	8
$t = 1.05A^{0.6}$	hr	22.3	19.1	3.7
$T_L = (t/2.8)^{1/0.81}$	hr	12.9	10.7	1.4
Max D = $T_P/3$	hr	5.0	4.1	0.5
Min D = $T_P/5$	hr	3.0	2.4	0.3
D (selected)	hr	4	3	0.5
Peak flow (CPS 2002)	cfs	NA	NA	2500
Peak flow	cfs	5266	4993	2361
Unit Hydrograph Vol. Check	inches	1.0	1.0	1.0
SCS Hydrograph Parameters				
SCS lag time	hr	14.9	12.2	1.6
Initial Loss	in	1.5	1.5	0
Constant Infiltration Rate	in/hr	0.1	0.1	0
Snyder Hydrograph Parameters				
Snyder peaking factor	-	0.6	0.6	0.6
Snyder lag time	hr	11.8	9.7	1.3
Initial Loss	in	1.5	1.5	0
Constant Infiltration Rate	in/hr	0.1	0.1	0

Note:
Lag Time: time interval in hours from the center of mass of excess rainfall to the peak of the resulting hydrograph
Time to Peak: time interval in hours from the start of excess rainfall to the peak of the resulting hydrograph

TABLE 2.4-10
Hydraulic Routing Parameters for the "Two-Basin + Lake Model"

Element	Method	Length (ft)	Slope (ft/ft)	Manning's n	Width (ft)	Shape
North Fork Reach	Kinematic Wave	35000	0.002	0.03	1400	Deep
Salt Creek Reach	Kinematic Wave	75000	0.002	0.03	2500	Deep

TABLE 2.4-11
HEC-HMS Results for the "Two-Basin + Lake" Model

Method	Max Clinton Lake Water Level (ft)	Peaking Factor
SCS Hydrograph	709.7	-
Snyder's Hydrograph	708.7	0.6
	709.6	0.8
	708.3	0.4

TABLE 2.4-12
Hydrologic Parameters for the "Seven–Basin + Lake Model"

Parameter	Units	Salt Ck Head Water	Salt Ck NE	Salt Ck NW	Salt Ck SE	Salt Ck SW	N Fork Head Water	N Fork Local	Clinton Lake
Watershed Parameters									
A	$Mile^2$	126.8	5	16.3	6.2	8.2	111	15	8
$t = 1.05A^{0.6}$	hr	19.2	2.8	5.6	3.1	3.7	17.7	5.3	3.7
$T_L = (t/2.8)^{1/0.81}$	hr	10.8	1.0	2.4	1.2	1.4	9.8	2.2	1.4
Max D = tp/3	hr	4.1	0.4	0.9	0.5	0.6	3.8	0.8	0.5
Min D = tp/5	hr	2.5	0.2	0.5	0.3	0.3	2.3	0.5	0.3
D (selected)	hr	3	0.25	0.5	0.5	0.5	3	0.5	0.5
Peak flow (qp) (Clinton 2002)	cfs	4490	1155	1880	1275	1410	4250	1890	2500
Peak flow (qp)	cfs	5004	2187	3028	2142	2382	4774	2946	2361
Unit Hydrograph Vol. Check	in	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SCS Hydrograph Parameters									
SCS lag time	hr	12.3	1.1	2.6	1.4	1.7	11.3	2.5	1.6
Initial Loss	in	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0

TABLE 2.4-12
Hydrologic Parameters for the “Seven–Basin + Lake Model”

Parameter	Units	Salt Ck Head Water	Salt Ck NE	Salt Ck NW	Salt Ck SE	Salt Ck SW	N Fork Head Water	N Fork Local	Clinton Lake
Watershed Parameters									
A	$Mile^2$	126.8	5	16.3	6.2	8.2	111	15	8
$t = 1.05A^{0.6}$	hr	19.2	2.8	5.6	3.1	3.7	17.7	5.3	3.7
$T_L = (t/2.8)^{1/0.81}$	hr	10.8	1.0	2.4	1.2	1.4	9.8	2.2	1.4
Constant Infiltration Rate	in/hr	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0
Snyder Hydrograph Parameters									
Snyder’s peaking factor	-	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Snyder’s lag time	hr	9.7	0.9	2.1	1.1	1.3	8.9	2.0	1.3
Initial Loss	in	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0
Constant Infiltration Rate	in/hr	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0

Note:
Lag Time: time interval in hours from the center of mass of excess rainfall to the peak of the resulting hydrograph
Time to Peak: time interval in hours from the start of excess rainfall to the peak of the resulting hydrograph

Table 2.4-13

Hydraulic Routing Parameters for the “Seven-Basin + Lake” Model

Element	Method	Length (ft)	Slope (ft/ft)	Manning's n	Width (ft)	Shape
North Fork Reach	Kinematic Wave	35000	0.002	0.03	1400	Deep
Salt Creek Reach-2	Kinematic Wave	35000	0.002	0.03	3000	Deep
Salt Creek Reach-1	Kinematic Wave	30000	0.002	0.03	2500	Deep

Table 2.4-14

HEC-HMS Results for the “Seven-Basin + Lake” Model

Method	Max Clinton Lake Water Level (ft)	Peaking Factor
SCS Hydrograph	709.8	-
Snyder’s Hydrograph	709.2	0.6
	709.7	0.8
	709.0	0.4

Table 2.4-15

Probable Maximum Flood Flow

Method	Max Inflow (cfs)	Max Storage (acre-ft)	Max WS Elevation (ft)	Max Outflow (cfs)
Two Watershed				
Snyder with peaking factor of 0.4	192,170	201,787	708.3	125,840
Snyder with peaking factor of 0.6	189,694	205,847	708.7	134,479
Snyder with peaking factor of 0.8	197,938	214,227	709.6	152,383
SCS	210,814	215,487	709.7	155,081
Seven Watershed				
Snyder with peaking factor of 0.4	214,175	208,660	709.0	140,466
Snyder with peaking factor of 0.6	189,974	210,509	709.2	144,442
Snyder with peaking factor of 0.8	189,753	215,474	709.7	155,053
SCS	200,372	216,700	709.8	157,677
Max	214,175	216,700	709.8	157,677

TABLE 2.4-16
Water Usage

Service	Normal usage, GPM	Maximum usage, GPM
Cooling Tower Make-up Water for evaporative losses	31,500	31,500
Cooling Tower Makeup water, for evaporative losses, with wet/dry tower	9,450	9,450
Potable/Sanitary Water	90	198
Demineralized Water	550	720
Filtered Water	140	180
Fire Protection	10	2500

TABLE 2.4-17
Stratigraphic Units and Their Hydrogeologic Characteristics

Geologic System	Stratigraphic Unit	Description	Hydrogeologic System	Hydrogeologic Characteristics
Quaternary	Henry Formation	Clayey silt overlying stratified silt, sand, or gravel	Alluvium	Groundwater occurs in permeable sand and gravel deposits underlying the fine-grained floodplain deposits. Yields are generally suitable for domestic or farm use. Sufficient quantities for municipal use may be available in those areas along the larger streams where thick sand and gravel deposits are present.
	Richland Loess	Clayey silt, trace fine sand	Wisconsinan deposits	Groundwater may be obtained from sand and gravel lenses in the Wisconsinan tills. Groundwater occurs under water table conditions in the Wisconsinan deposits.
	Wedron Formation	Clayey sandy silt till with interbedded discontinuous lenses of stratified silt, sand, or gravel		
	Robien Silt	Silt, some organics, trace clay, and fine sand	Interglacial Zone	
	Glasford Formation	Sandy silt till, with interbedded discontinuous lenses of stratified silt, sand, or sandy silt; upper 10 ft is highly weathered (altered)	Illinoian deposits	Groundwater may be obtained from sand and gravel lenses in the Illinoian tills. Groundwater occurs under artesian conditions in the Illinoian deposits. Yields from wells that intercept good water-yielding sand and gravel deposits are suitable for domestic and farm purposes. Higher yields for small industrial or municipal supply are locally available. Where sand and gravel deposits are thin or absent, small amounts of groundwater may be obtained using large-diameter wells.
	Banner Formation	Complex sequence of stratified silt, sandy clay till, and sand and gravel outwash	Kansan deposits	Groundwater may be obtained from Kansan outwash deposits (Banner Formation) in the buried Mahomet Bedrock Valley. Groundwater occurs under artesian conditions in the Kansan deposits. Kansan sand and gravel deposits in the buried Mahomet Bedrock Valley comprise the major aquifer in the area. Yields of up to 2,000 gpm may be obtained from a suitably constructed well located in the main channel of the valley
Pennsylvanian	Bond Formation Modesto Formation Carbondale Formation Spoon Formation Abbott Formation	Shale with thin beds of limestone, sandstone, siltstone underclay, and coal	Pennsylvanian bedrock	Groundwater occurs in thin sandstone and fractured limestone beds under artesian conditions. Small quantities of groundwater, suitable only for domestic or farm supply, may be obtained from the upper 50 to 100 ft of the Pennsylvanian formations.
Mississippian, Silurian, Devonian	Various Formations	Sandstone, limestone, and dolomite units	Mississippian, Silurian, Devonian bedrock	The best groundwater yields are from wells that intersect bedding planes, fractures, and solution channels.

Source: CPS, 2002; USGS, 1995a

Note: Excavations for the CPS did not extend below the Glasford Formation. CPS borings did not fully penetrate rocks of the Carbondale Formation. The ESP borings did not fully penetrate the Modesto Formation.

TABLE 2.4-18
Water Withdrawals by County

County	Number of Producing Wells	Population/Usage (thousands) Pop. Served by Public Supply Groundwater	Pop. Served by Public Supply Surface Water	Total Pop. Served by Public Supply	Pop. Served by Domestic Supply	Public Supply Withdrawals (MGD) Ground-water	Surface Water	Total	Domestic Supply Withdrawals (MGD) Ground-water	Surface Water	Total
Champaign	3,755	166.88	0	166.88	2.22	22.59	0	22.59	0.2	0	0.2
Christian	1,523	13.96	5.08	19.04	15.88	2.13	0.77	2.9	1.43	0	1.43
DeWitt	997	12.38	0	12.38	4.44	1.48	0	1.48	0.4	0	0.4
Douglas	1,114	13.06	0	13.06	6.74	1.26	0	1.26	0.61	0	0.61
Ford	876	9.23	0	9.23	4.9	1.73	0	1.73	0.44	0	0.44
Livingston	1,535	11.02	17.43	28.45	11.95	1.88	2.97	4.85	1.08	0	1.08
Logan	1,360	25.97	0	25.97	5.3	3.2	0	3.2	0.48	0	0.48
Macon	1,575	4.96	95.34	100.3	16.11	1.96	37.74	39.7	1.45	0	1.45
Mason	1,636	8.96	0	8.96	7.73	1.16	0	1.16	0.7	0	0.7
McLean	2,241	42.38	36.79	79.17	60.1	5.64	4.9	10.54	5.41	0	5.41
Menard	780	8.73	0	8.73	3.55	0.76	0	0.76	0.32	0	0.32
Moultrie	714	9.75	0	9.75	4.42	1.16	0	1.16	0.4	0	0.4
Piatt	958	6.58	0	6.58	9.58	1.35	0	1.35	0.86	0	0.86
Sangamon	2,284	13.67	129.45	143.12	41.61	2.27	21.52	23.79	3.74	0	3.74
Shelby	2,003	7.09	6.9	13.99	8.57	1.21	1.18	2.39	0.77	0	0.77
Tazewell	3,051	112.64	0.82	113.46	14.14	14.66	0.11	14.77	1.27	0	1.27
Woodford	1,890	5.28	16.22	21.5	13.08	2.13	6.54	8.67	1.18	0	1.18

Source: USGS, 1995a

TABLE 2.4-18
Water Withdrawals by County

County	Number of Producing Wells	Commercial Withdrawals (MGD)			Industrial Withdrawals (MGD)			Irrigation Withdrawals (MGD)			Total Agricultural Withdrawals[a] (MGD)
		Ground-water	Surface Water	Total	Ground-water	Surface Water	Total	Ground-water	Surface Water	Total	
Champaign	3,755	0.1	0.03	0.13	2.27	0	2.27	5.32	0	5.32	5.57
Christian	1,523	0.01	0	0.01	0	0	0	0.16	0	0.16	0.43
DeWitt	997	0.04	0	0.04	0	0	0	0.38	0	0.38	0.68
Douglas	1,114	0.03	0	0.03	0	3.32	3.32	0.02	0	0.02	0.28
Ford	876	0.09	0	0.09	0.1	0	0.1	0.62	0	0.62	0.88
Livingston	1,535	0	0.21	0.21	0.08	0	0.08	0.29	0	0.29	0.96
Logan	1,360	0	0	0	0	0	0	0.64	0	0.64	1.09
Macon	1,575	0.01	0	0.01	0.6	4.36	4.96	0.26	0	0.26	0.43
Mason	1,636	4.35	9.17	13.52	0	0	0	35.57	0	35.57	42.4
McLean	2,241	0.12	0	0.12	0	0	0	0.26	0	0.26	0.89
Menard	780	0	0	0	0	0	0	0.52	0	0.52	0.85
Moultrie	714	0	0.8	0.8	0	0	0	0.02	0	0.02	0.2
Piatt	958	0.02	0	0.02	0.79	0	0.79	0.15	0	0.15	0.27
Sangamon	2,284	0	0	0	0	0	0	0.49	0	0.49	1.03
Shelby	2,003	0.29	0	0.29	0	0	0	0.25	0	0.25	0.92
Tazewell	3,051	0.02	0	0.02	12.99	22.84	35.83	11.61	0	11.61	12.24
Woodford	1,890	0.01	0	0.01	0.01	0	0.01	0.26	0	0.26	0.88

Source: USGS, 1995a
[a] Total Agricultural Withdrawals is the total of irrigation withdrawals and livestock withdrawals.

TABLE 2.4-19
Historical and Recent Piezometer Data [a]

Historical Data	Piezometer Number	Date of Installation	Surface Elevation (ft, msl)	Tested Interval [c]		Stratigraphic Units Open to Piezometer
				Depth (ft)	Elevation (ft, msl)	
X	D-23B[d]	7-14-72	655.8	11.5–16.0	639.8–644.3	Alluvium
X	D-30B[d]	7-26-72	669.9	3.5–12.0	657.9–666.4	Alluvium
X	D-3B[d]	7-13-72	660.0	10.5–20.5	639.5–649.5	Alluvium
X	D-8B[d]	7-19-72	655.7	1.5–16.0	639.7–654.2	Alluvium
X	P-1B[d]	6-26-72	675.9	10.0?–?	?–665.9?	Alluvium
X	OW-18	7-16-79	656.5	7.0–15.0	641.5–649.5	Alluvium and Fill
X	D-19B[d]	7-13-72	658.9	23.0–30.0	628.9–635.9	Alluvium and Illinoian
X	OW-12	8-2-77	659.2	17.0–25.0	634.2–642.2	Alluvium and Illinoian
X	OW-19	7-16-79	654.5	6.0–18.5	636.0–648.5	Alluvium and Illinoian
	B-1	8-2002	738.6	80-90	658.6-648.6	Illinoian
X	D-19A[d]	7-13-72	658.9	33.0–38.0	620.9–625.9	Illinoian
X	D-23A[d]	7-14-72	655.8	25.0–31.5	624.3–630.8	Illinoian
X	D-30C[d]	7-27-72	669.9	45.0–50.0	619.9–624.9	Illinoian
X	D-3A[d]	7-13-72	660.0	30.0–40.0	620.0–630.0	Illinoian
X	E-2B[d]	7-12-72	746	60–68	678–686	Illinoian
X	E-3B	7-12-72	730	68–75	655–662	Illinoian
X	E-4B	7-6-72	740	80–96	644–654	Illinoian
X	E-5B	7-19-72	750	70–76	674–680	Illinoian
X	OW-1	5-12-76	716.7	60–70	646.7–656.7	Illinoian
X	OW-10	8-2-77	656.0	27.0–35.0	621.0–629.0	Illinoian
X	OW-11	8-2-77	654.5	19.0–27.0	627.5–635.5	Illinoian
X	OW-13	8-2-77	662.1	32.0–40.0	622.1–630.1	Illinoian
X	OW-14	8-2-77	657.1	23.0–31.0	626.1–634.1	Illinoian
X	OW-15	8-3-77	664.5	47.0–55.0	609.5–617.5	Illinoian
X	OW-16	8-3-77	657.9	22.0–30.0	627.9–635.9	Illinoian
X	OW-17	8-3-77	659.5	32.0–40.0	619.5–627.5	Illinoian
X	OW-22A	10-9-79	665.9	23.0–44.5	621.4–642.9	Illinoian
X	OW-9	8-1-77	654.3	16.5–24.5	629.8–637.8	Illinoian

TABLE 2.4-19
Historical and Recent Piezometer Data [a]

Historical Data	Piezometer Number	Date of Installation	Surface Elevation (ft, msl)	Tested Interval [c]		Stratigraphic Units Open to Piezometer
				Depth (ft)	Elevation (ft, msl)	
X	P-1A[d]	6-26-72	675.9	66.0[b]–79.5	596.4–609.9[b]	Illinoian
X	P-22B[d]	6-28-72	734.0	55.0–64.0	670.0–679.0	Illinoian
X	P-27[d]	6-6-72	742.9	57.5	85.4	Illinoian
X	P-31[d]	9-11-73	736.8	50.0–159.0	577.8–686.8	Illinoian
X	P-39[d]	8-28-73	740.8	62.0–150.0	590.8–678.8	Illinoian
X	P-7B[d]	7-5-72	737.5	70.0–78.0	659.5–667.5	Illinoian
X	OW-20	7-17-79	658.4	10.0–34.4	624.0–648.4	Illinoian and Fill
X	OW-21	10-8-79	670.0	5.0–55.0	615.0–665.0	Illinoian and Fill
X	OW-23	10-10-79	654.5	5.0–34.5	620.0–649.5	Illinoian and Fill
X	OW-24	10-11-79	654.9	5.0–34.0	620.9–649.9	Illinoian and Fill
X	P-17[d]	7-10-72	738.3	149.9–240.0	498.3–589.3	Illinoian and Kansan
X	P-20[d]	6-28-72	738.3	170.0–305.5	432.8–568.3	Illinoian, Kansan, and Bedrock
X	D-31[d]	6-16-72	667.7	158.0–356.5	311.2–509.7	Illinoian, Mahomet Sand, and Bedrock
X	P-36[d]	11-6-73	738.2	178.0–223.0	515.2–560.2	Kansan
X	E-3A	7-5-72	730	214–238	492–516	Kansan and Mahomet Sand
X	D-11[d]	6-21-72	653.8	140.0–343.5	310.3–513.8	Kansan, Mahomet Sand, and Bedrock
	B-2	8-2002	737.2	8-28	729.2-709.2	Wisconsinan
	B-3	8-2002	734.1	16-26	718.1-708.1	Wisconsinan
X	D-50	4-30-73	718.0	2.0–37.0	681.0–716.0	Wisconsinan
X	E-1B[d]	7-13-72	733	30–40	693–703	Wisconsinan
X	OW-22B	10-9-79	665.9	5.5–20.0	645.9–660.4	Wisconsinan
X	OW-3d	5-10-76	735.9	10–40	695.9–725.9	Wisconsinan
X	OW-3s	5-10-76	735.9	5–10	725.9–730.9	Wisconsinan
X	OW-4d	5-7-76	721.0	10–23.5	697.5–711.0	Wisconsinan
X	OW-4s	5-7-76	720.9	2.5–6.5	714.1–718.1	Wisconsinan
X	OW-5d	5-7-76	712.6	10–18.2	694.4–702.6	Wisconsinan
X	OW-5s	5-7-76	712.8	4–8	704.8–708.8	Wisconsinan

TABLE 2.4-19
Historical and Recent Piezometer Data [a]

Historical Data	Piezometer Number	Date of Installation	Surface Elevation (ft, msl)	Tested Interval [c] Depth (ft)	Tested Interval [c] Elevation (ft, msl)	Stratigraphic Units Open to Piezometer
X	OW-6d	5-10-76	743.2	10–52	691.2–733.2	Wisconsinan
X	OW-6s	5-10-76	743.3	2.5–7.5	735.8–740.8	Wisconsinan
X	OW-7d	5-13-76	718.6	10–25	693.6–708.6	Wisconsinan
X	OW-7s	5-13-76	718.6	2–6	712.6–716.6	Wisconsinan
X	P-37[d]	8-27-73	739.1	16.0–40.0	699.1–723.1	Wisconsinan
X	P-40[d]	10-19-73	742.1	10.0–38.0	704.1–732.1	Wisconsinan
X	D-46	4-24-73	710.3	2.0–27.0	683.3–708.3	Wisconsinan and Illinoian
X	D-47[d]	4-24-73	714.8	2.0–38.0	676.8–712.8	Wisconsinan and Illinoian
X	D-48	4-24-73	715.3	2.0–39.0	676.3–713.3	Wisconsinan and Illinoian
X	OW-2[d]	5-12-76	--	5–20	--	Wisconsinan and Illinoian
X	OW-8	5-12-76	719.2	18–42	677.2–701.2	Wisconsinan and Illinoian
X	E-6B	7-25-72	736	0–151	585–736	Wisconsinan, Illinoian, and Kansan
X	E-7[d]	7-20-72	712	0–151	560.5–712	Wisconsinan, Illinoian, and Kansan

[a] CPS Historical data as reported in CPS, 2002.
[b] Indicates that the exact depth is unknown
[c] “Tested Interval” refers to portion of piezometer backfilled with pea gravel and open to stratigraphic unit.
[d] Piezometer has been destroyed by construction activities.

TABLE 2.4-20
Laboratory Permeability Test Data

Boring Number	Elevation (ft,msl)	Soil Type [a]	Geologic Unit	Type of Test	Field Moisture Content	Field Dry Density (lb/ft^3)	Average Coefficient of Permeability at 20°C (cm/sec)	Estimated Porosity
Dam Site Borings								
D-3	626.2	ML	Illinoian Glacial Till	Falling head	7.5%	144	3.9×10^{-9}	16.8%
D-10	627.0	ML	Illinoian Glacial Till	Falling head	7.2%	131	1.0×10^{-8}	16.3%
D-13	676.4	SP	Interglacial Zone	Constant head	24.8%	94	1.8×10^{-4}	40.0%
D-13	661.4	SP, SW	Interglacial Zone	Constant head	6.4%	105	4.7×10^{-3}	14.8%
D-13	632.0	ML	Illinoian Glacial Till	Falling head	7.3%	142	3.8×10^{-9}	16.4%
D-24	631.0	ML	Salt Creek Alluvium	Falling head	7.4%	123	1.8×10^{-8}	16.5%
D-34	664.8	SP, GP	Interglacial Zone	Constant head	6.2%	112	2.3×10^{-3}	14.3%
D-34	649.8	SP, GP	Interglacial Zone	Constant head	17.5%	118	2.0×10^{-4}	32.0%
D-34	629.8	ML	Illinoian Glacial Till	Falling head	7.8%	138	6.5×10^{-9}	17.4%
D-37	663.7	SP, SW	Interglacial Zone	Constant head	12.2%	116	3.0×10^{-3}	24.7%
D-37	643.7	ML, CL	Illinoian Glacial Till	Falling head	11.7%	134	1.3×10^{-8}	24.0%
Station Site Borings								
P-14	654.8	ML	Illinoian Glacial Till	Falling head	9.5%	129	2.5×10^{-8}	--[b]
P-14	579.8	ML	Illinoian Glacial Till	Falling head	8.1%	139	9.5×10^{-9}	--[b]
P-18	683.7	ML, SM	Illinoian Glacial Till	Falling head	10.3%	131	2.3×10^{-7}	--[b]

Source: CPS, 2002
[a] Soil Types:
GP = Poorly graded gravels, gravel-sand mixtures, little or no fines.
SW = Well-graded sands, gravelly sands, little or no fines.
SP = Poorly graded sands, gravelly sands, little or no fines.
SM = Silty sands, silt-sand mixtures.
ML = Inorganic silts with very fine sands, rock flour, silty or clayey fine sands or clayey silts, with slight plasticity.
CL = Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.

--[b] Data not available

TABLE 2.4-21
Field Permeability Tests

Boring Number	Ground Surface Elevation (ft, msl)	Zone of Percolation Elevation (ft, msl)	Geologic Unit	Average Coefficient of Permeability (cm/sec)	Estimated Porosity
D-19	658.9	625.0–620.9	Illinoian Till	1.4×10^{-5}	26.7%
D-23	655.8	630.8–624.3	Illinoian Till	6.1×10^{-6}	24.5%
E-1B	733.0	703.0–693.0	Wisconsinan Till	1.5×10^{-6}	--[a]
P-37	741.5	726.1–701.1	Wisconsinan Till	2.6×10^{-6}	25.7%

--[a] Data not available

Source: CPS, 2002

TABLE 2.4-22
Laboratory Permeability for Site Soils

Boring Number	Elevation (ft, msl)	Soil Type	Geologic Unit	Test Type	Remolded Sample		Average Coefficient of Permeability at 20°C (cm/sec)
					Moisture Content	Dry Density (lb/ft^3)	
S-10	702.6–697.6	Clay	Wisconsinan Glacial Till	Falling head	13.6%	126	3.2×10^{-9}
S-10	702.6–697.6	Clay	Wisconsinan Glacial Till	Falling head	12.4%	125	2.0×10^{-8}
S-14	727.2–720.2	Clay	Wisconsinan Glacial Till	Falling head	16.8%	109	1.6×10^{-8}
S-14	727.2–720.2	Clay	Wisconsinan Glacial Till	Falling head	11.0%	125	1.0×10^{-8}

Source: CPS, 2002

TABLE 2.4-23
Relative Density Data for Site Soils

Boring Numb er	Elevation (ft, msl)	Soil Type	Geologic Unit	Minimum Dry Density (lb/ft^3)	Maximum Dry Density (lb/ft^3) (wet method)
D-11	473.8	Sand and gravel	Mahomet Bedrock Valley Outwash	92	113
D-11	424.8	Sand and gravel	Mahomet Bedrock Valley Outwash	91	118

Source: CPS, 2002

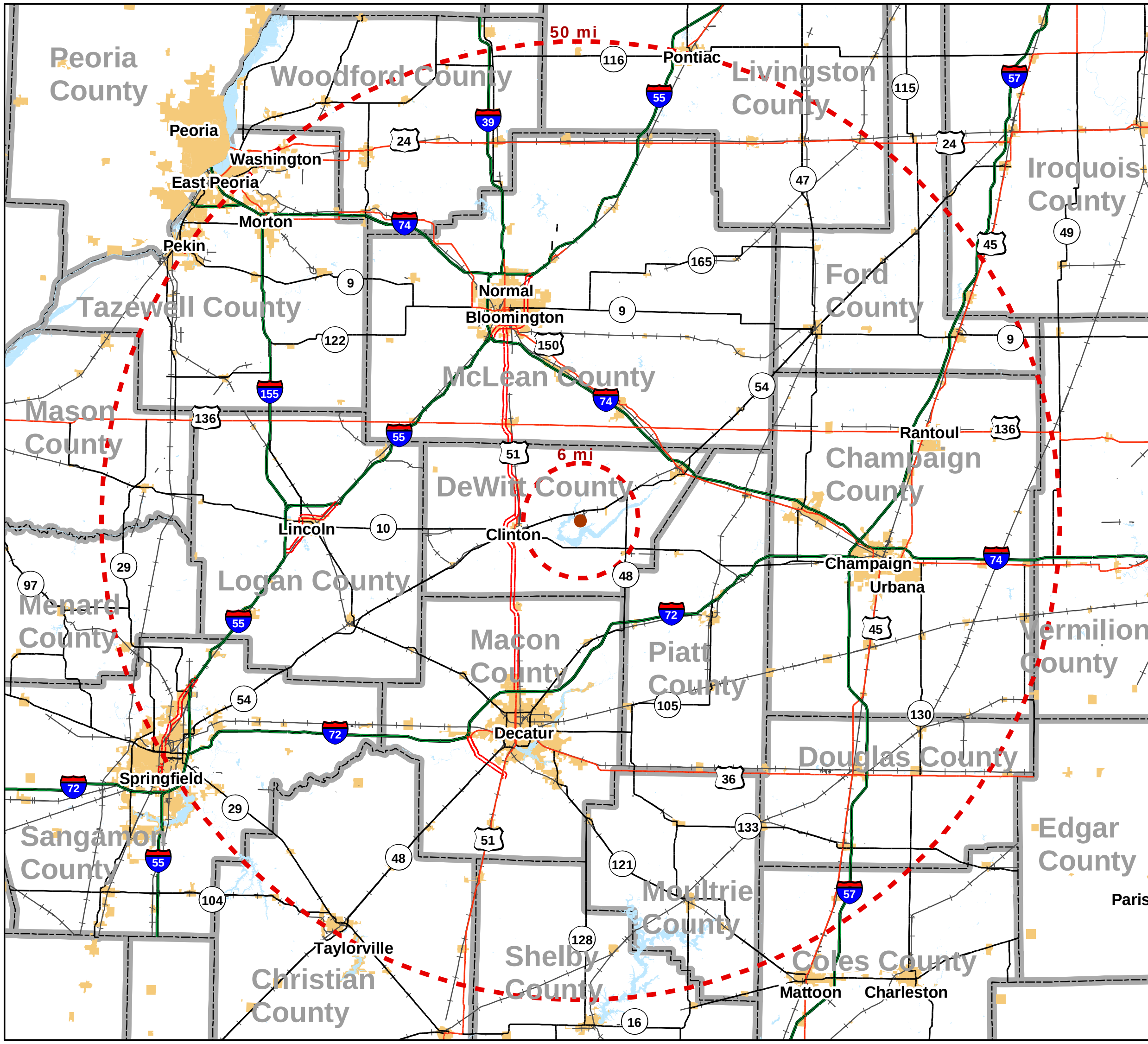
TABLE 2.5-1
Summary of Soil Properties at the EGC ESP and CPS Sites

		General Soil Properties - EGC ESP Site (and CPS Site)[a]					Shear Wave Velocity (fps) at the EGC ESP Site[b]	
Unit	**Depth Range at EGC ESP Site Boring B-2 (ft bgs[c])**	**Moist Unit Weight (pcf[d])**	**Moisture Content (%)**	**LL[e]**	**PL[f]**	**PI[g]**	**Range**	**Average**
Loess & Wisconsinan Till	0 - 42	131	16	35	14	14	820 to 1340	975
		(131)	*(16)*	*(25)*	*(14)*	*(11)*		
Interglacial	42 - 59	116	39	40	26	14	860 to 1970	1343
		(132)	*(17)*	*(26)*	*(13)*	*(13)*		
Illinoian Till	59 - 163	148	8	18	9	9	1100 to 3250	2188
		(147)	*(9)*	*(18)*	*(11)*	*(7)*		
Lacustrine	163 - 190	133	13	28	11	17	1390 to 2670	1829
		(140)	*(11)*	*(19)*	*(12)*	*(7)*		
Pre-Illinoian Till	190 - 269	138	14	29	14	15	1560 to 2800	2068
		(137)	*(14)*	*(27)*	*(14)*	*(13)*		
Pre-Illinoian Alluvial/ Lacustrine	269 - 292	NA[h]	23	48	17	29	1190 to 3310	2045
		(NA)	*(NA)*	*(NA)*	*(NA)*	*(NA)*		
Bedrock	292 - 322	NA	NA	NA	NA	NA	3250 to 3880	3420
		(NA)	*(NA)*	*(NA)*	*(NA)*	*(NA)*		

[a.] The first value listed in each cell is the arithmetic mean for all available soil samples from that unit from the EGC ESP Site investigation. *(Italic)* = Numbers in parenthesis and italics below the EGC ESP Site results are the average of applicable data from CPS Site P-Series Soil Samples.
[b] Shear wave velocity data are from the downhole suspension logging test performed at EGC ESP Site Boring B-2.
[c] below ground surface
[d] PCF definition
[e] LL definition
[f] PL definition
[g] LL definition
[h] NA = Results not available

Site Safety Analysis Report for
the EGC Early Site Permit

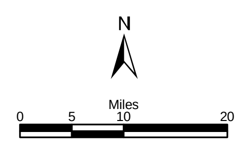
Figure 2.1-1
Site/Region Location Map



Legend

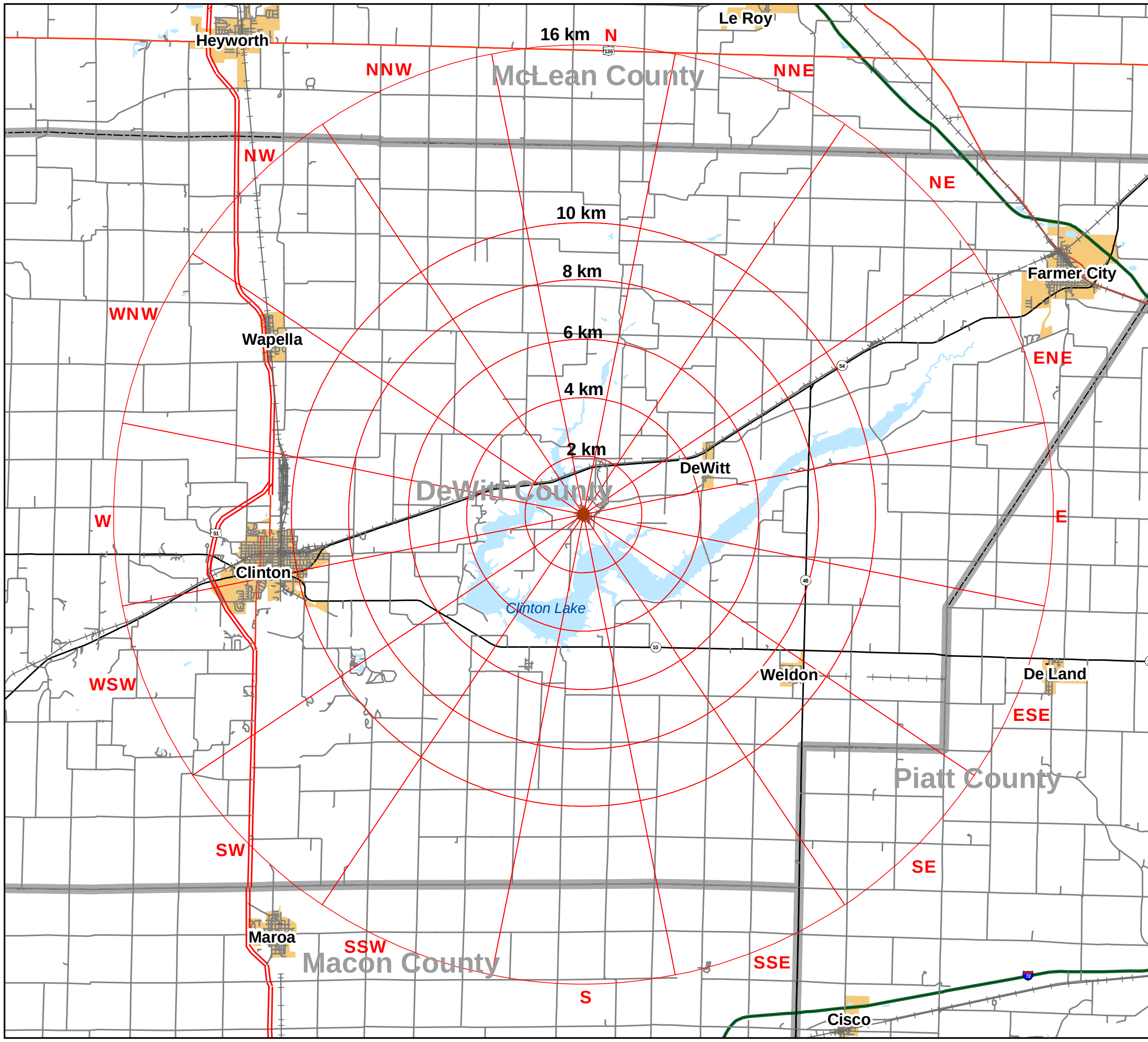
- EGC ESP Site
- Vicinity: 6-mi radius around site
- Region: 50-mi radius around site
- Interstate, Fully access controlled
- U.S. Highway, Multilane divided
- U.S. Highway
- State Route
- Railroads
- Water: Lakes and Rivers
- Incorporated/Designated Places
- County Boundary

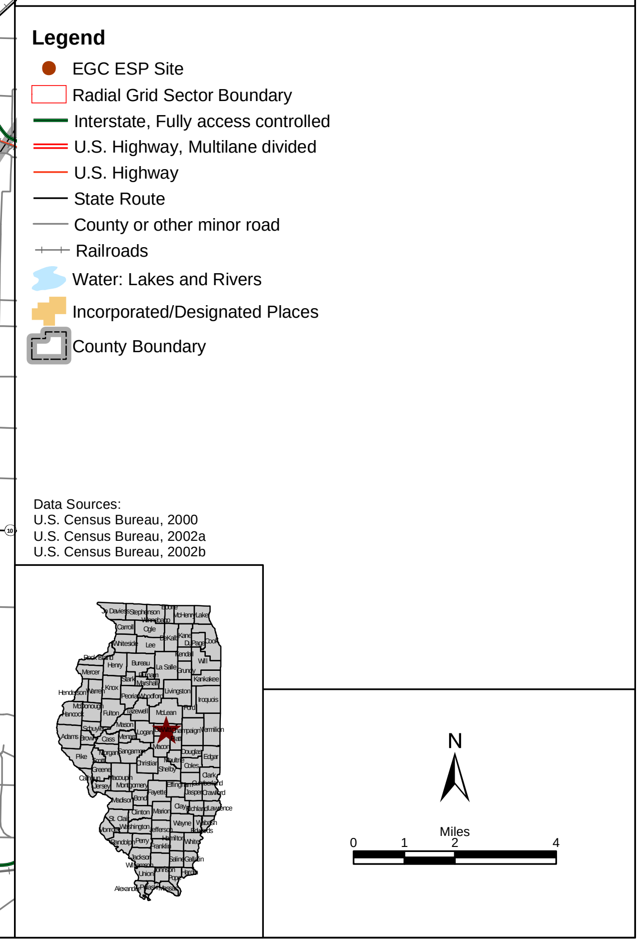
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002a
U.S. Census Bureau, 2002b



Site Safety Analysis Report for
the EGC Early Site Permit

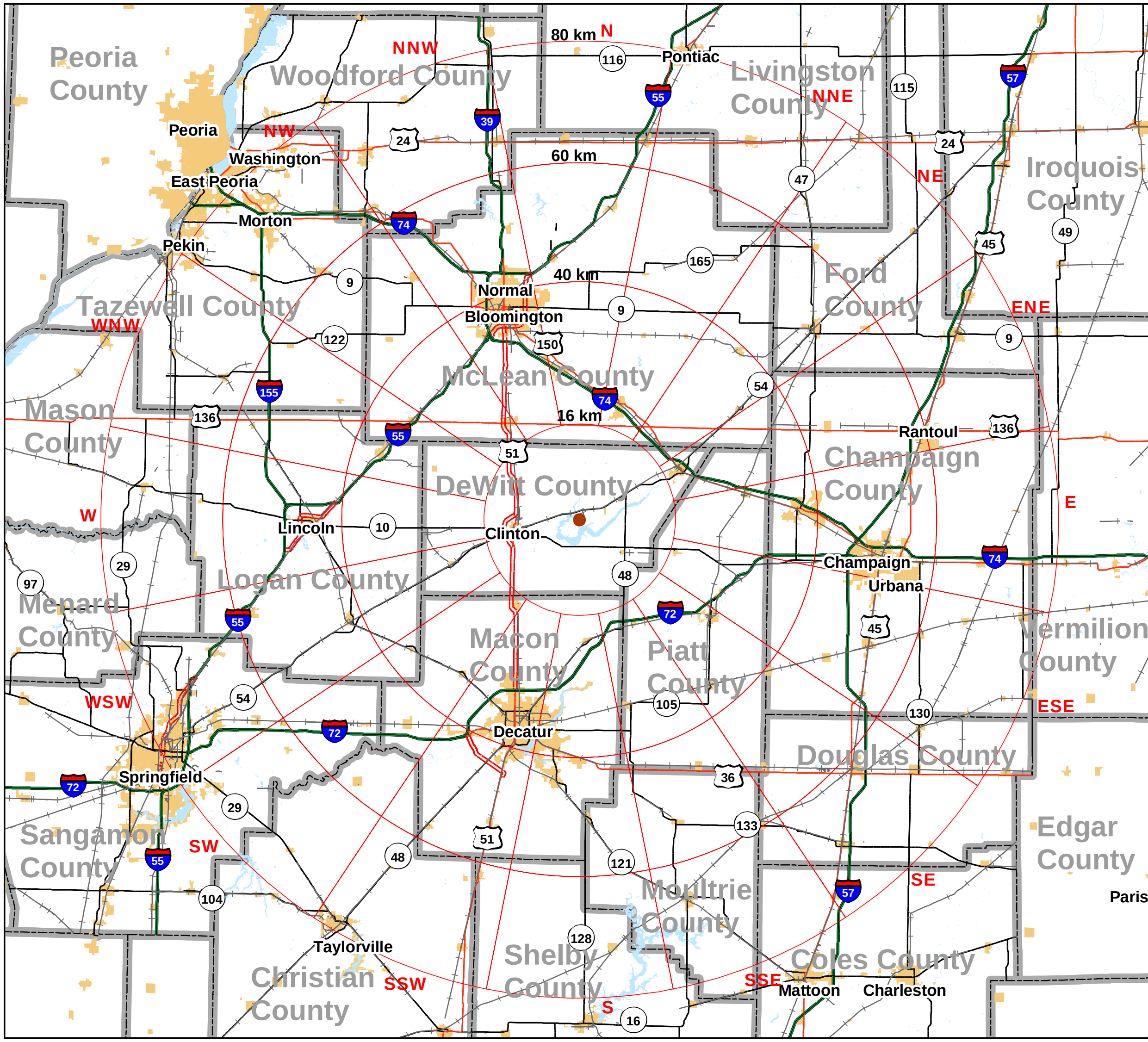
Figure 2.1-2
Vicinity Sector Chart





Site Safety Analysis Report for
the EGC Early Site Permit

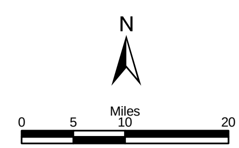
Figure 2.1-3
Regional Sector Chart



Legend

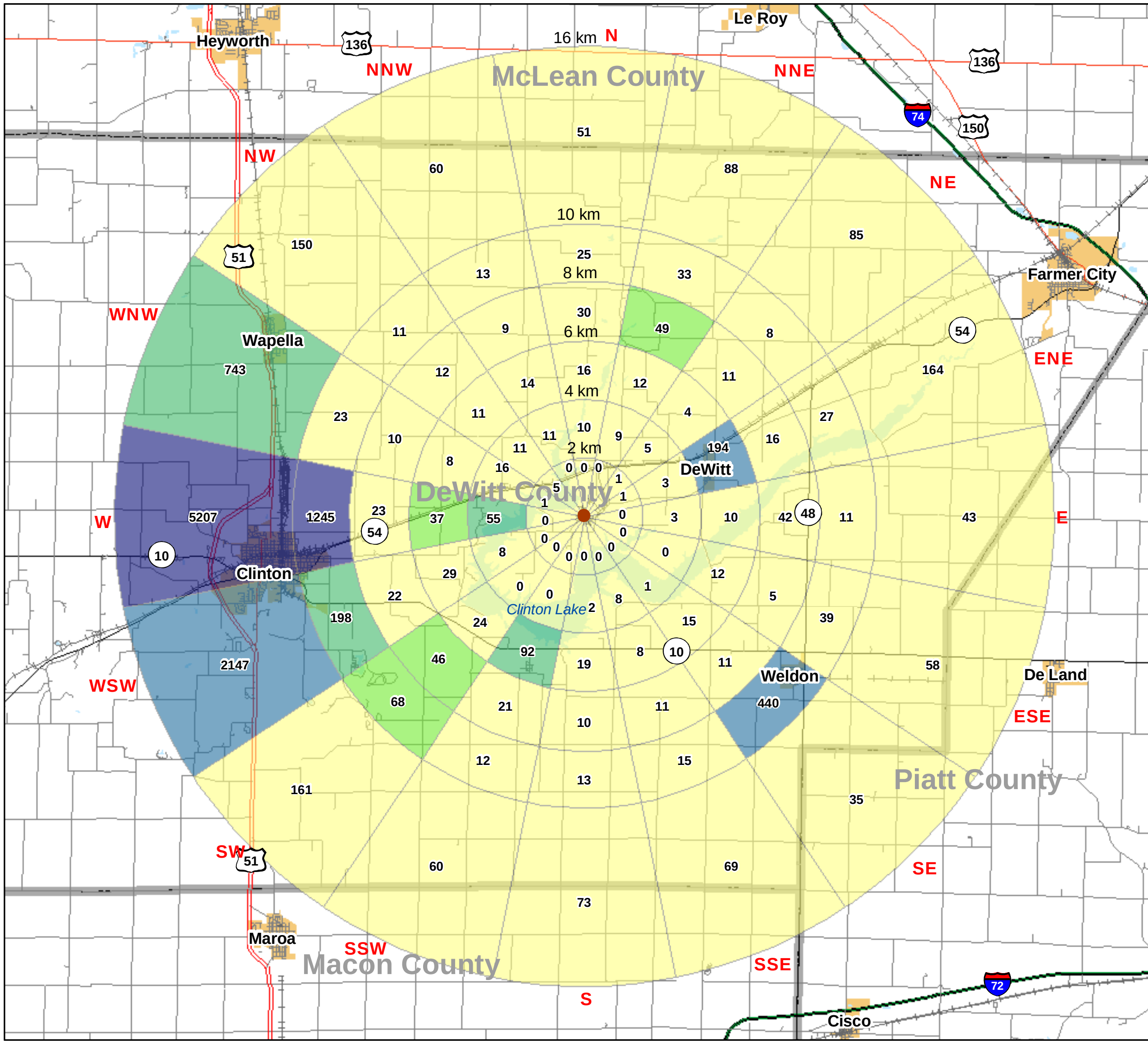
- EGC ESP Site
- Radial Grid Sector Boundary
- Interstate, Fully access controlled
- U.S. Highway, Multilane divided
- U.S. Highway
- State Route
- Railroad
- Water: Lakes and Rivers
- County Boundary
- Incorporated/Designated Places

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



Site Safety Analysis Report for
the EGC Early Site Permit

Figure 2.1-4
Vicinity Population And Population Density - Year 2000



Legend

- EGC ESP Site
- Interstate, Fully access controlled
- 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

Persons per Sq Mi

- 0 - 20
- 21 - 50
- 51 - 100
- 101 - 200
- > 200

Census 2000 Population shown for each radial grid sector

Note: Census 2000 Population shown for each Radial Grid Sector. Statistics were calculated from BLOCK level census data. If a BLOCK was bisected by a radial grid line, and parts of the same BLOCK fell in 2 or more sectors, population data were proportioned by percent BLOCK area. This implicitly assumes population is fairly uniform in the BLOCK. Since BLOCK is the smallest Census unit, this assumption was used. This assumption was made in lieu of assigning the entire BLOCK population to a particular grid cell and potentially double-counting some BLOCK level population.

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

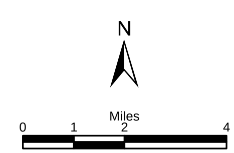


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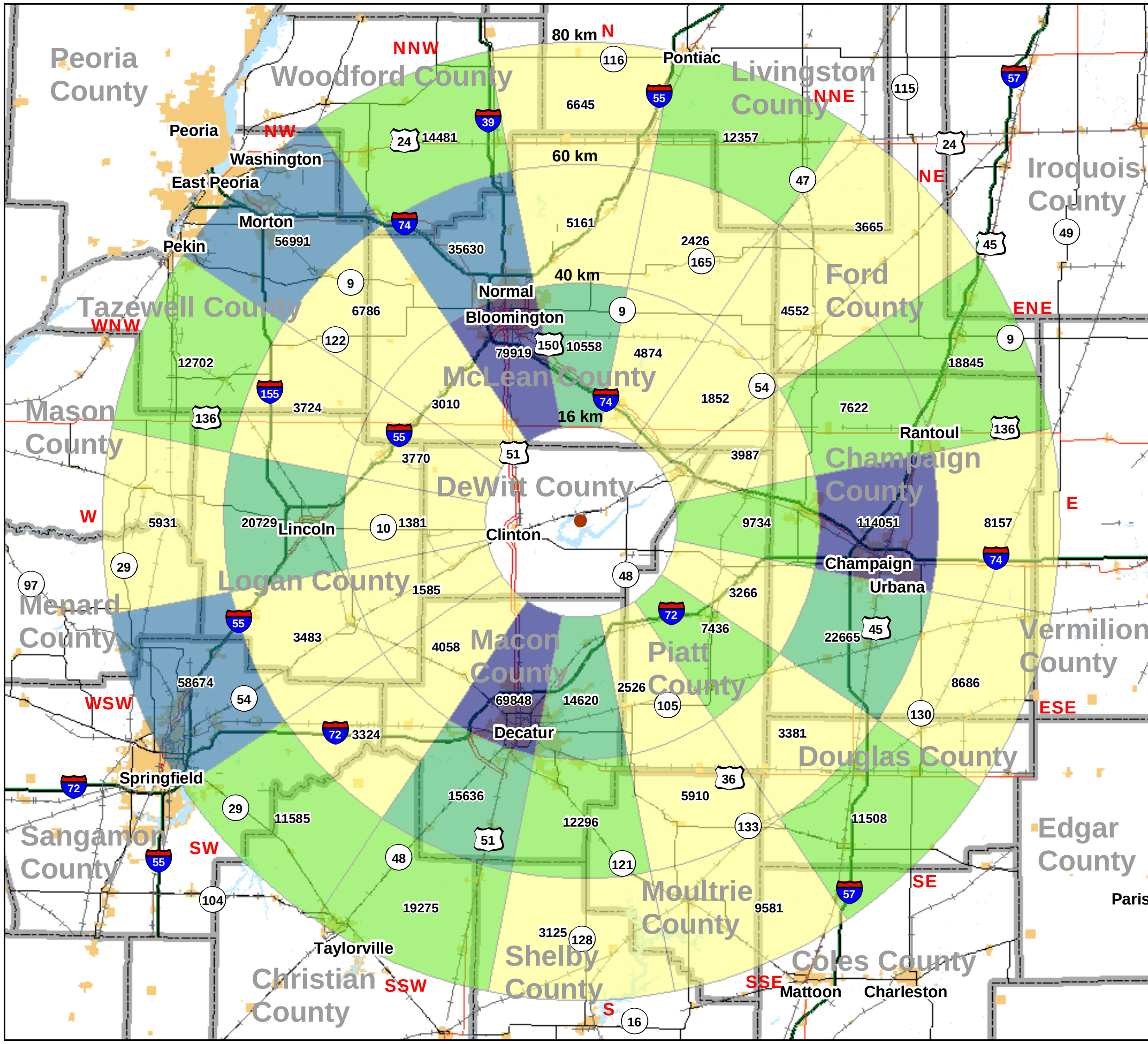
Figure 2.1-5
Regional Population And Population Density - Year 2000



Legend

- EGC ESP Site
- Interstate, Fully access controlled
- U.S. Highway, Multilane divided
- U.S. Highway
- State Route
- Railroad
- Water: Lakes and Rivers
- County Boundary
- Incorporated/Designated Places

Persons per Sq Mi

- 0 - 50
- 51 - 100
- 101 - 200
- 201 - 400
- > 400

Census 2000 Population shown for each radial grid sector

Note: Census 2000 Population shown for each Radial Grid Sector. Statistics were calculated from BLOCK level census data. If a BLOCK was bisected by a radial grid line, and parts of the same BLOCK fell in 2 or more sectors, population data were proportioned by percent BLOCK area. This implicitly assumes population is fairly uniform in the BLOCK. Since BLOCK is the smallest Census unit, this assumption was used. This assumption was made in lieu of assigning the entire BLOCK population to a particular grid cell and potentially double-counting some BLOCK level population.

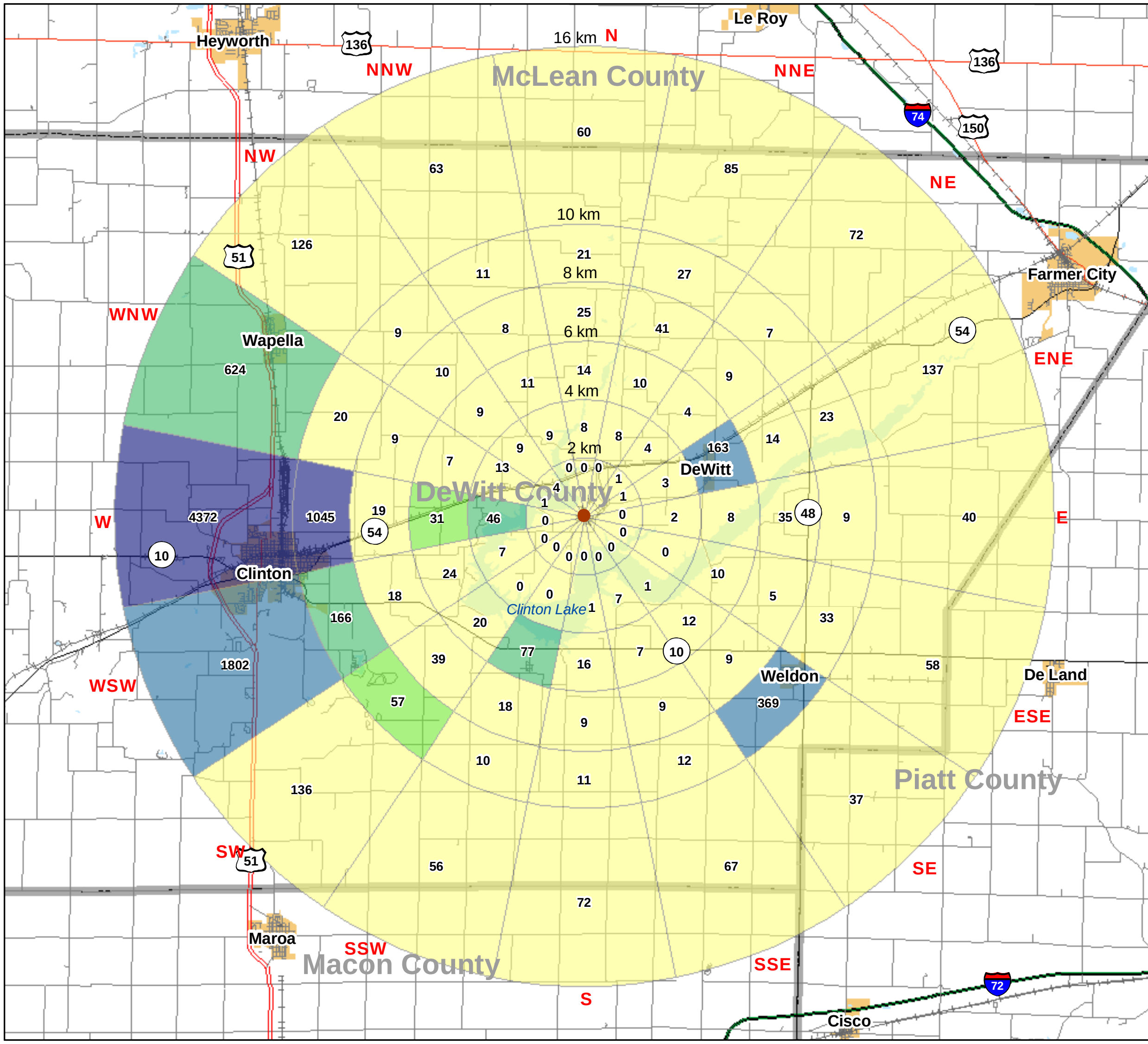
Data Sources:
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002a
U.S. Census Bureau, 2002b

N

Miles
0 5 10 20

Site Safety Analysis Report for the EGC Early Site Permit

Figure 2.1-6
Vicinity Population And Population Density - Year 2060



Legend

- EGC ESP Site
- Interstate, Fully access controlled
- 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

Persons per Sq Mi

- 0 - 20
- 21 - 50
- 51 - 100
- 101 - 200
- > 200

Forecast Year 2060 Population shown for each radial grid sector

Note: Forecast Year 2060 Population shown for each Radial Grid Sector. Statistics were calculated from BLOCK level census data. If a BLOCK was bisected by a radial grid line, and parts of the same BLOCK fell in 2 or more sectors, population data were proportioned by percent BLOCK area. This implicitly assumes population is fairly uniform in the BLOCK. Since BLOCK is the smallest Census unit, this assumption was used. This assumption was made in lieu of assigning the entire BLOCK population to a particular grid cell and potentially double-counting some BLOCK level population.

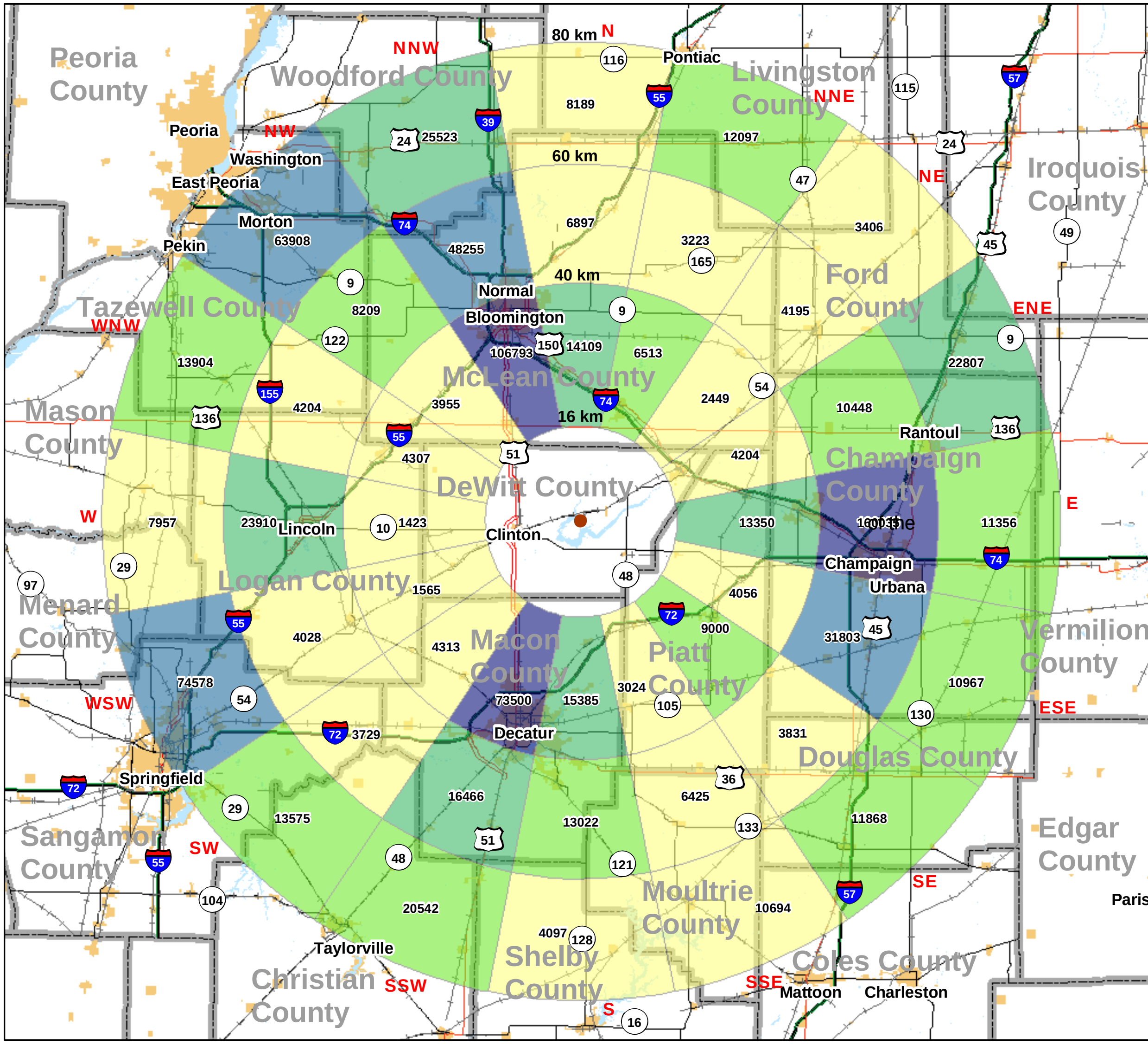
Data Sources:
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002a
U.S. Census Bureau, 2002b

N

Miles
0 1 2 4

Site Safety Analysis Report for the EGC Early Site Permit

Figure 2.1-7
Regional Population And Population Density - Year 2060



Legend

- EGC ESP Site
- Interstate, Fully access controlled
- U.S. Highway, Multilane divided
- U.S. Highway
- State Route
- Railroad
- Water: Lakes and Rivers
- County Boundary
- Incorporated/Designated Places

Persons per Sq Mi

- 0 - 50
- 51 - 100
- 101 - 200
- 201 - 400
- > 400

Forecast Year 2060 Population shown for each radial grid sector

Note: Forecast Year 2060 Population shown for each Radial Grid Sector. Statistics were calculated from BLOCK level census data. If a BLOCK was bisected by a radial grid line, and parts of the same BLOCK fell in 2 or more sectors, population data were proportioned by percent BLOCK area. This implicitly assumes population is fairly uniform in the BLOCK. Since BLOCK is the smallest Census unit, this assumption was used. This assumption was made in lieu of assigning the entire BLOCK population to a particular grid cell and potentially double-counting some BLOCK level population.

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

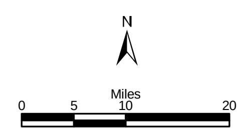


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Figure 2.1-8
ESP Exclusion Area Boundary and Low Population Zone

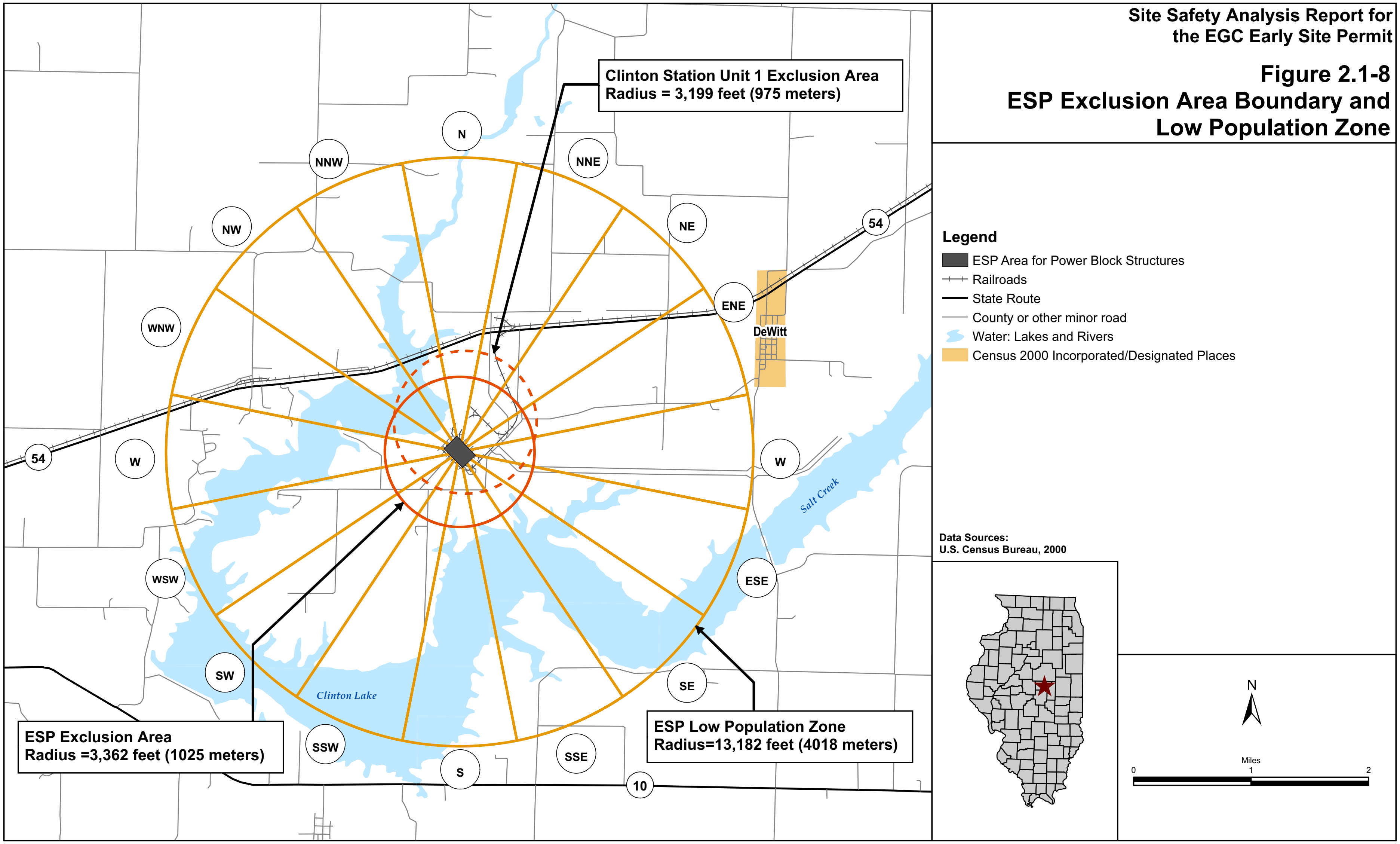
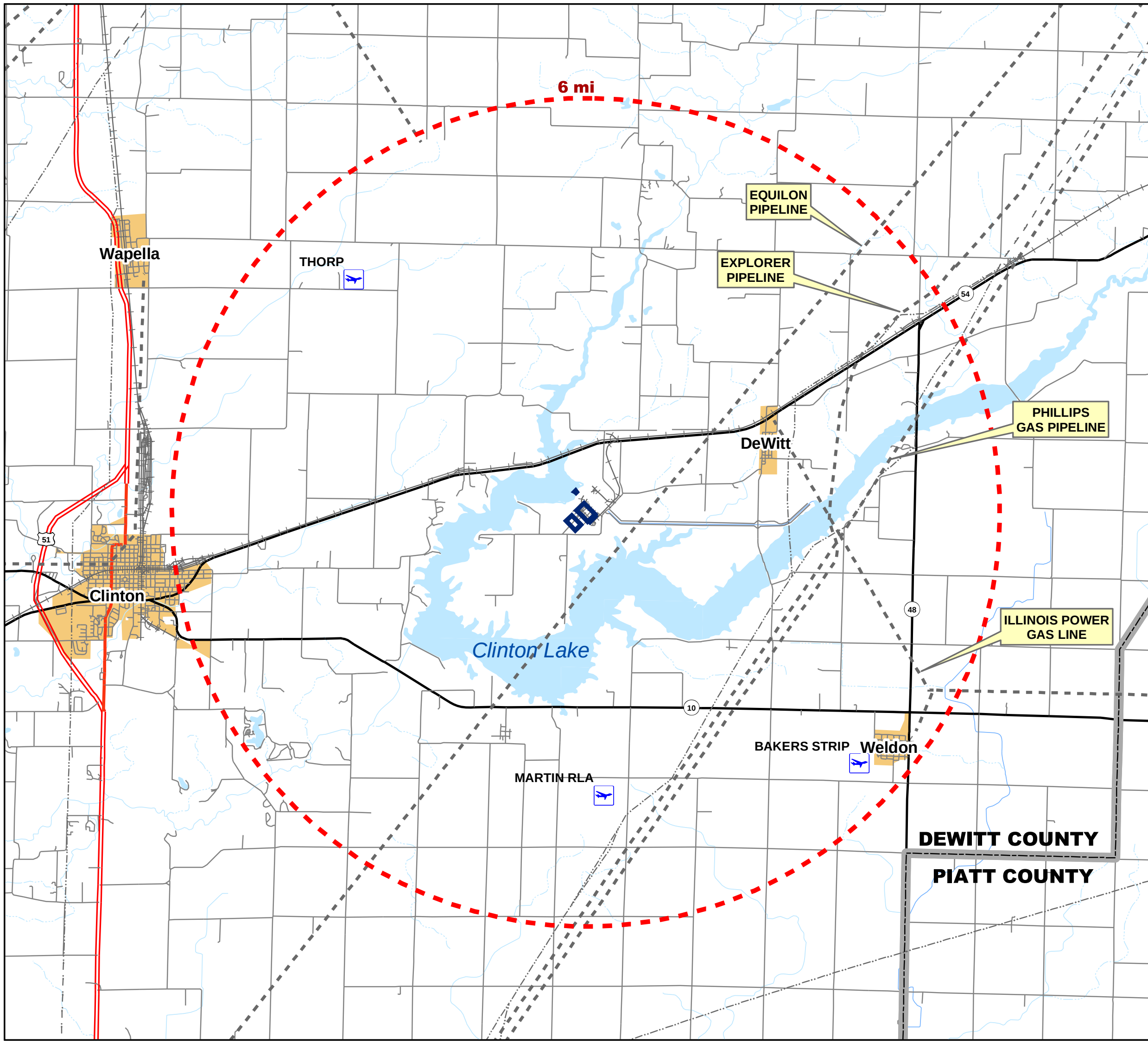


Figure 2.2-1
ESP Site Location and Transportation Network



Legend

- Proposed Areas for EGC ESP Facility Structures
- Vicinity: 6-mi radius around site
- Airports
- US Highway, Multilane divided
- US Highway
- State Route
- County or other minor road
- Railroads
- Water - Lakes and Rivers
- Census 2000 Incorporated/Designated Places
- County Boundary
- Pipelines
- Electrical Lines

Data Sources:
IDNR, 1993
IDNR, 1984
Bureau of Transportation Statistics, 2000
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002a
U.S. Census Bereau, 2002b

N

Miles
0 1 2 4

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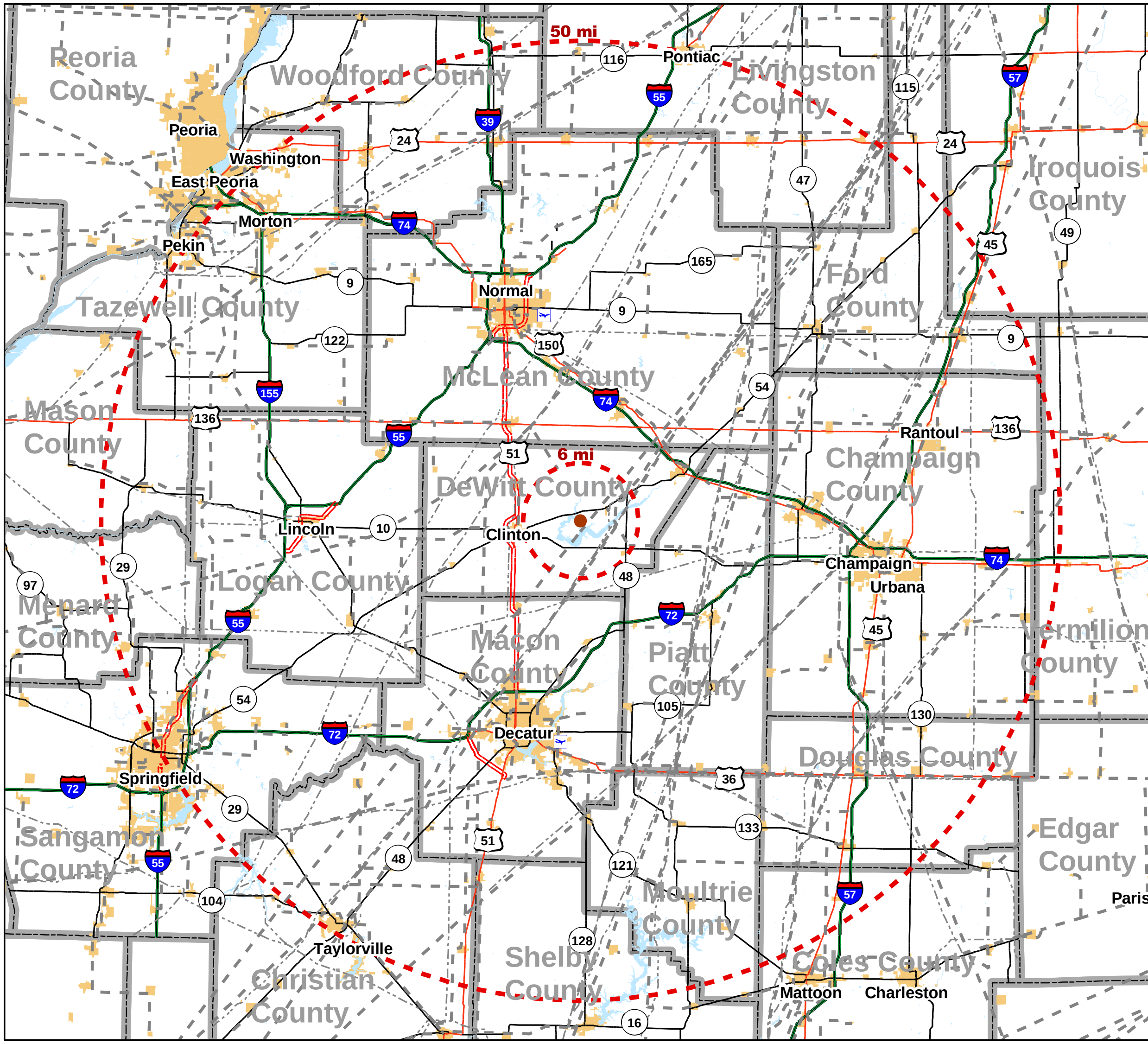
Figure 2.2-2
ESP Regional Network



Legend

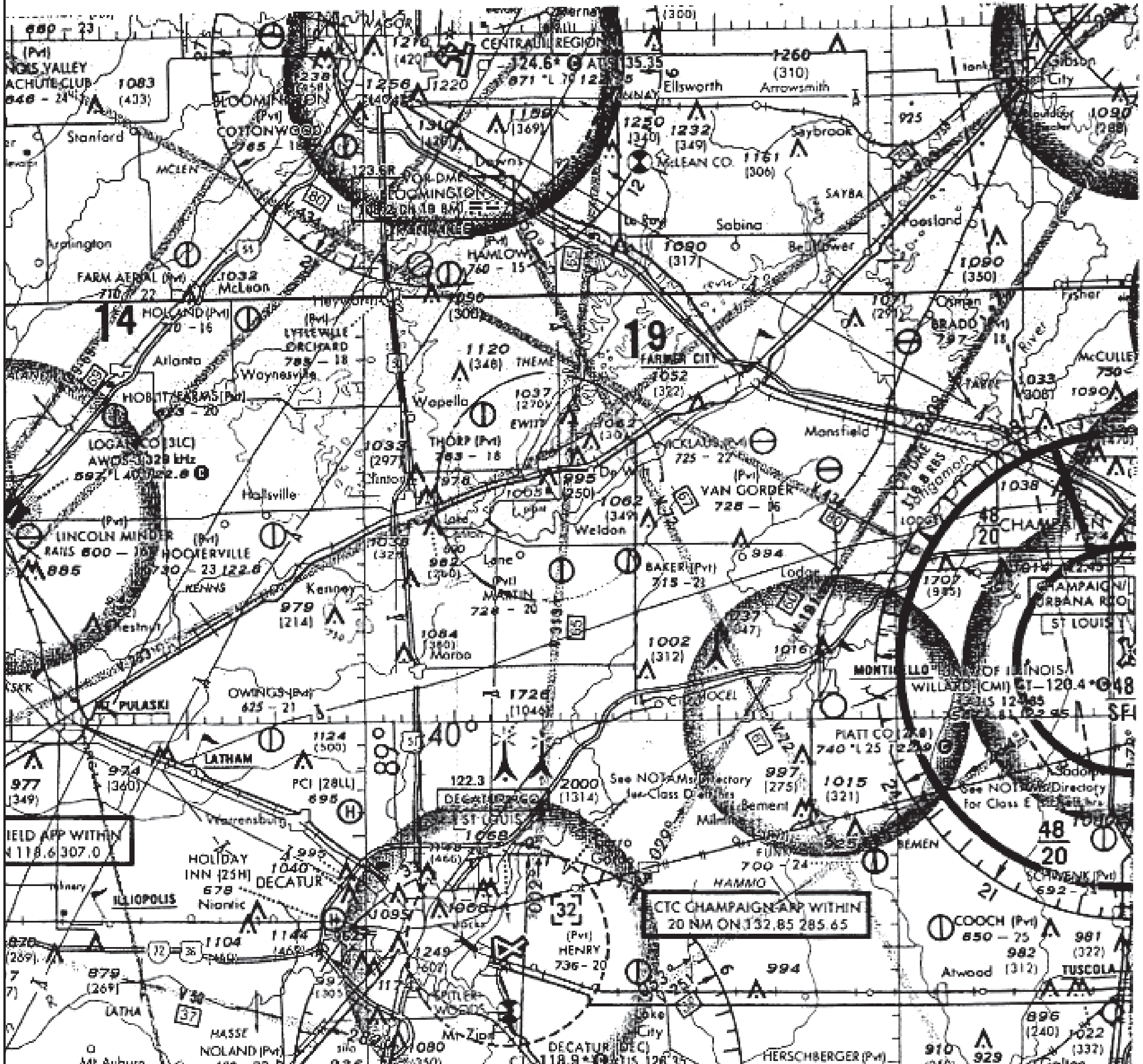
- EGC ESP Site
- Vicinity: 6-mi radius around site
- Region: 50-mi radius around site
- Pipelines
- Electrical Lines
- Airports
- Interstate, Fully access controlled
- US Highway, Multilane divided
- US Highway
- State Route
- Water - Lakes and Rivers
- Census 2000 Incorporated/Designated Places
- County Boundary

Data Sources:
IDNR, 1993
IDNR, 1984
Bureau of Transportation Statistics, 2000
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002a
U.S. Census Bereau, 2002b

N

Miles
0 5 10 20

Figure 2.2-3
Chart of Low Altitude Federal Airways



Legend

Data Source
CSAC, 2001

N

Not to Scale