NATIONAL ENERGY TECHNOLOGY LABORATORY

Water Vulnerabilities for Existing Coal-fired Power Plants

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NOTATION

The following is a list of the acronyms and abbreviations (including units of measure) used in this report.

Acronyms and Abbreviations

Argonne	Argonne National Laboratory
CBM	coal bed methane
CO_2	carbon dioxide
CPPDB	Coal Power Plant Database
CWA	Clean Water Act
DOE	U.S. Department of Energy
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
FGD	flue gas desulfurization
GIS	geographic information system
NATCARB	National Carbon Sequestration Database and Geographical Information System
NCDC	National Climatic Data Center
NERC	North American Electric Reliability Council
NETL	National Energy Technology Laboratory
NOAA	National Oceanic and Atmospheric Administration
PHDI	Palmer Hydrological Drought Index
PDSI	Palmer Drought Severity Index
R&D	research and development
SPI	Standardized Precipitation Index
USGS	U.S. Geological Survey

Units of Measure

bgd	billions of gallons per day
cfs	cubic feet per second
gal	gallon(s)

mgd	millions of gallons per day
mi^2	square miles
MWh	megawatt-hour

Summary

This report was funded by the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) Existing Plants Research Program, which has an energy-water research effort that focuses on water use at power plants. This study complements the Existing Plants Research Program's overall research effort by evaluating water issues that could impact power plants.

Water consumption by all users in the United States over the 2005–2030 time period is projected to increase by about 7% (from about 108 billion gallons per day [bgd] to about 115 bgd) (Elcock 2010). By contrast, water consumption by coal-fired power plants over this period is projected to increase by about 21% (from about 2.4 to about 2.9 bgd) (NETL 2009b). The high projected demand for water by power plants, which is expected to increase even further as carbon-capture equipment is installed, combined with decreasing freshwater supplies in many areas, suggests that certain coal-fired plants may be particularly vulnerable to potential water demand-supply conflicts. If not addressed, these conflicts could limit power generation and lead to power disruptions or increased consumer costs. The identification of existing coal-fired plants that are vulnerable to water demand and supply concerns, along with an analysis of information about their cooling systems and related characteristics, provides information to help focus future research and development (R&D) efforts to help ensure that coal-fired generation demands are met in a cost-effective manner that supports sustainable water use.

This study identified coal-fired power plants that are considered vulnerable to water demand and supply issues by using a geographical information system (GIS) that facilitated the analysis of plant-specific data for more than 500 plants in the NETL's Coal Power Plant Database (CPPDB) (NETL 2007a) simultaneously with 18 indicators of water demand and supply. Two types of demand indicators were evaluated. The first type consisted of geographical areas where specific conditions can generate demand vulnerabilities. These conditions include high projected future water consumption by thermoelectric power plants, high projected future water consumption by all users, high rates of water withdrawal per square mile (mi^2), high projected population increases, and areas projected to be in a water crisis or conflict by 2025. The second type of demand indicator was plant specific. These indicators were developed for each plant and include annual water consumption and withdrawal rates and intensities, net annual power generation, and carbon dioxide (CO_2) emissions. The supply indictors, which are also area based, include areas with low precipitation, high temperatures, low streamflow, and drought.

The indicator data, which were in various formats (e.g., maps, tables, raw numbers) were converted to a GIS format and stored, along with the individual plant data from the CPPDB, in a single GIS database. The GIS database allowed the indicator data and plant data to be analyzed and visualized in any combination.

To determine the extent to which a plant would be considered "vulnerable" to a given demand or supply concern (i.e., that the plant's operations could be affected by water shortages represented by a potential demand or supply indicator), criteria were developed to categorize vulnerability according to one of three types: major, moderate, or not vulnerable. Plants with at least two major demand indicator values and/or at least four moderate demand indicator values were considered vulnerable to demand concerns. By using this approach, 144 plants were identified as

being subject to demand concerns only. Plants with at least one major supply indicator value and/or at least two moderate supply indicator values were considered vulnerable to supply concerns. By using this approach, 64 plants were identified as being subject to supply concerns only. In addition, 139 plants were identified as subject to both demand and supply concerns. Therefore, a total of 347 plants were considered subject to demand concerns, supply concerns, or both demand and supply concerns.

Characteristics of the potentially vulnerable plants were reviewed and evaluated to identify commonalities that could be further explored through R&D to help mitigate potential water constraints on operations. The characteristics evaluated included location, type of cooling system, age of cooling system, source of cooling water (e.g., surface water), and plant capacity.

The analysis of vulnerable plants found that:

- Forty-three states contain at least one vulnerable plant, and about one-third of the vulnerable plants are located in the southeast.
- Roughly half of the vulnerable plants (53%) use once-through cooling systems, and half (47%) use recirculating systems.
- Water consumption rates (in million gallons per day [mgd]) and intensities (in gallons per megawatt hour [gal/MWh]) vary considerably among the different types of recirculating systems.
- Most of the once-through systems are between 39 and 58 years old, and most of the recirculating systems are between 22 and 43 years old, suggesting that further investigation of plants in these age ranges could yield information on design or operating characteristics that could influence water efficiency.
- Of the vulnerable plants that use once-through systems, about 80% use freshwater, 10% use cooling ponds or canals, and about 10% use saline water. (About 30% of all surface water withdrawn by thermoelectric plants is saline [Kenny et al. 2009].)
- Of the vulnerable plants that use recirculating systems, about 70% use surface water, 16% use groundwater, and 13% use municipal or recycled water. Some of the plants that use groundwater are in areas where portions of the underlying aquifers have experienced declining water levels.
- The median capacity of the vulnerable plants is about 650 MW.

One area in which R&D is already underway at NETL is the use of nontraditional waters to substitute for some portion of freshwater in existing power plants. The GIS was used to provide an overview of the general proximity of vulnerable plants to locations of nontraditional water sources. The overview showed that more than 120 vulnerable plants are located over deep saline aquifers, 64 plants are located over shale gas plays, and nearly 50 are located near coal mines. Fewer than 15 vulnerable plants are located near coal bed methane fields, and five are located near major oil and gas fields.

By analyzing characteristics of the vulnerable plants and considering the proximity of these plants to various nontraditional water sources, several possible R&D recommendations were derived. These are summarized below.

- Pursue R&D for both once-through and recirculating systems and the individual types of cooling approaches (e.g., natural draft cooling towers) within these two main groups.
- If location were a factor in directing resources for other R&D efforts that included water use, consider focusing on the southeast (because of the high concentration of vulnerable plants in this area).
- Investigate the characteristics of once-through systems installed between 1952 and 1971 and recirculating systems installed between 1967 and 1988 that could affect water use.
- Identify ways to increase the use of (or at least maintain the current ability to use) saline water for power plant cooling.
- Consider investigating the use of water generated during the production of gas shale to contribute a portion of plant cooling water.
- Begin to focus R&D on promising nontraditional sources for cooling water by using criteria that consider proximity to power plants.
- Consider conservation efforts directed at power plants that use groundwater.
- All else being equal, direct R&D efforts toward plants with capacities in the 650 MW and below range (since most of the vulnerable plants are in this range).
- Consider R&D efforts directed toward plant-specific water consumption and withdrawal issues.

With all of these R&D efforts, it will be important to identify and consider other impacts that can result from the application of R&D aimed at reducing freshwater consumption and withdrawal. The consideration of these net (or life-cycle) environmental impacts will help ensure that any negative or unintended consequences associated with the application of water-focused R&D efforts are recognized prior to their actual implementation.

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Chapter 1 Introduction

This report was funded by the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) Existing Plants Research Program, which has an energy-water research effort that focuses on water use at power plants. This study complements the overall research effort of the Existing Plants Research Program by evaluating water issues that could impact power plants.

In 2008, Argonne conducted a study for the NETL that estimated the amount of water that would be consumed by energy (e.g., coal mining) and nonenergy (e.g., industrial and commercial) uses in the United States between 2005 and 2030 at the national and regional levels. The study, which was updated and summarized in a 2010 report (Elcock 2010), projected that water consumption by all users over the 2005–2030 time period would increase by about 7%. By contrast, water consumption by coal-fired power plants over this period is projected to increase by about 21% (from about 2.4 billion gallons per day [bgd] to about 2.9 bgd) — under the assumption that new capacity additions use wet recirculating cooling systems and that retirements reflect the current mix of cooling systems (NETL 2009b).

These findings, combined with (1) the concern that water supplies in many areas are expected to be challenged by drought, increasing population, or both; (2) the knowledge that competition for water — both consumption and withdrawal — can constrain operations of existing and construction of new coal-fired power plants; and (3) the impending reality that existing coal plants may need to install carbon-capture equipment, which can increase water consumption by 30–40%, suggest that specific coal-fired power plants may be particularly vulnerable to potential water demand-supply conflicts. If not addressed, these conflicts could limit power generation and lead to power disruptions or increased costs to consumers. The identification of existing vulnerable coal-fired plants and their locations, as well as information about their cooling systems and related characteristics, can provide information to help guide research and development (R&D) to ensure that coal-fired generation demands are met in a cost-effective and environmentally protective manner.

Recognizing that the earlier Argonne National Laboratory (Argonne) study could provide a foundation for exploring these concerns, NETL asked Argonne to build on the findings of that Phase I study to identify existing coal-fired power plants that may be subject to water demand and supply constraints. This Phase II report identifies factors that can lead to water demand and supply conflicts and analyzes how these factors apply to specific coal-fired power plants. These factors include indications of increased demand concerns (e.g., growing population, projected demand for water consumption by all users) and of potential supply concerns (e.g., increasing drought conditions, low precipitation).

As with the Phase I study, this Phase II study uses a Geographical Information System (GIS) to facilitate analysis by allowing data of different types to be viewed simultaneously on individual maps. In this Phase II study, data on demand and supply from a variety of sources are combined with plant-specific data from NETL's 2007 Coal Power Plant Database (CPPDB) (NETL 2007a) to identify potentially vulnerable plants. For these potentially vulnerable plants, plant-specific data were analyzed to identify common characteristics, which could be used to help target R&D

efforts that would complement NETL's existing plants research program to reduce water use. Finally, recognizing the potential benefits of recycling and reusing water, the GIS was also used to provide a first-cut identification of existing power plant locations near areas with alternative water sources, which, if used by power plants, could reduce demand for freshwater. Such sources include produced water from oil and gas and coal bed methane (CBM) production, accumulated water in underground mines, and water generated during carbon dioxide (CO_2) injection into saline aquifers.

The remainder of this report contains three chapters. Chapter 2 describes the methodology, Chapter 3 presents the findings, and Chapter 4 offers conclusions and recommendations.

Chapter 2 Methodology

The approach used to identify existing plants with potential water demand and supply vulnerabilities consisted of the following steps:

1. Identifying and collecting data on indicators of demand and supply conditions that could make plants vulnerable to specific water concerns.
2. Developing the GIS database.
3. Creating and interactively analyzing GIS database content to locate plants within specific demand and supply constraint areas.
4. Developing criteria for identifying plants subject to water demand and supply vulnerabilities.
5. Using the criteria to identify potentially vulnerable plants.
6. Characterizing the potentially vulnerable plants to identify commonalities.
7. Assessing the proximity of vulnerable plants to nontraditional water sources.

These steps are described further in the following paragraphs.

2.1 Identifying and Collecting Data on Demand and Supply Conditions

2.1.1 Demand Indicators

The demand indicators identified in this study are of two types. The first are “area demand indicators.” or geographical areas where specific conditions can cause plants to be vulnerable to demand concerns. These conditions include projected future water consumption by thermoelectric power plants, projected future water consumption by all users, the intensity of water withdrawals by all users, projected population demand, and areas projected to be in a water crisis or conflict by 2025. The second, “plant-specific demand indicators,” are developed for each plant and include annual water consumption and withdrawal, net annual power generation, and CO_2 emissions. It is important to note that the significance between water consumption and water withdrawal in the context of this analysis is that although consumed water (that portion of the withdrawn water that is generally evaporated, transpired, incorporated into products or crops, or consumed by humans or livestock) returns via the water cycle to surface or groundwater, it is generally not returned to its original source, and hence is not available for other potential users. The area- and plant-specific demand indicators, their corresponding measures, and data sources are summarized in Table 2-1, and the following paragraphs note their value as indicators.

TABLE 2-1 Demand Indicators, Measures, and Data Sources

Demand Indicator	**Measure**	**Data Source**
Area Demand Indicators		
Projected future water consumption — thermoelectric plants	Areas with projected increased consumption by 2030 (% change in water consumption by thermoelectric plants between 2005 and 2030)	Phase I study, NETL, 2007b
Projected future water consumption — all users	• Projected high consumption in 2030 • Projected increased consumption by 2030 (% change in water consumption by all users between 2005 and 2030)	Phase I study Phase I study
Water withdrawal — all users	Intensity of water withdrawals (gallons per day/mi^2) (by state)	Kenny et al., 2009
Population	Change in population per square mile (2000 to 2030 by state)	U.S. Census Bureau, 2005
Potential water supply crisis areas by 2025	Areas where existing supplies are not adequate to meet water demands for people, farms, and the environment	U.S. Bureau of Reclamation, 2005
Plant-Specific Demand Indicators		
• Power generation • Cooling water consumption • Cooling water consumption intensity • Cooling water withdrawal • Cooling water withdrawal intensity • CO_2 emissions	• Net annual electrical generation (megawatt-hour [MWh]) • Annual Average Consumption (million gallons per day [mgd]) • Cooling water consumption intensity (gallons [gal]/MWh) • Cooling Water Annual Average Withdrawal (mgd) • Cooling Water Withdrawal intensity (gal/MWh) • Tons	NETL, 2007a NETL, 2007a Calculated by using data in NETL, 2007a NETL, 2007a Calculated by using data in NETL, 2007a NETL, 2007a

Area Demand Indicators

Aggregate water consumption by power plants. Most of the water consumed in power plants is evaporated in the cooling systems. Once-through cooling systems are generally considered more efficient and less costly than recirculating systems. However, regulations promulgated in 2001[1] under the Clean Water Act (CWA) §316(b), favor the use of recirculating systems at new facilities. Section 316(b) requires that "the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts." Although recirculating systems withdraw a fraction of the amount of water that is withdrawn by once-through cooling systems, they consume a major portion of the water they do withdraw (80% on a gallon-per-MWh basis compared with about 4% for once-through cooling systems; see Table 2-2). Because recirculating systems are expected to constitute an increasing share of the cooling system population over time, the amount of water consumed by power plants is expected to grow even faster than it would in the absence of the §316(b) regulations. NETL's latest projections (NETL 2009b) are that by 2030, the amount of freshwater consumed by thermoelectric power plants will increase nationwide by about 14–30% — from 3.6 bgd in 2005 to 4.2-4.7 bgd in 2030 — depending on assumptions regarding the mix of cooling systems in power plant additions and retirements. Under the assumptions that all additions use freshwater and wet recirculating cooling and that retirements are proportional to current water sources and cooling systems (NETL's "Case 2," which "represents a plausible future cooling system scenario"), water consumption nationwide for all thermoelectric power generation would increase by about 20% (from 3.6 bgd in 2005 to 4.4 bgd in 2030), with regional increases significantly higher in some areas, such as New York and Florida (NETL 2009b). For conventional coal-fired thermoelectric power generation in NETL's Case 2, water consumption nationwide is projected to increase from 2.4 bgd in 2005 to 2.9 bgd in 2030. Regions with particularly high increases in projected water consumption by coal-fired power plants include New England, New York, and Texas (NETL 2009b).

TABLE 2-2 Average Withdrawal and Consumption Rates for Once-Through and Recirculating Cooling Systems

Cooling System	Withdrawal (gal/KWh)	Consumption (gal/KWh)	Consumption as a % of withdrawal
Once through	26	0.10	4%
Recirculating	0.54	0.45	83%

Source: Based on data in NETL (2009b).

Additional increases in water consumption by coal-fired power plants can be expected with the installation of carbon-capture equipment. NETL (2009b) estimates that water consumption in 2030 (again for Case 2) will increase from 4.4 bgd assuming no carbon capture to between 5.6 and 7.0 bgd — or by about 30–60% — depending on assumptions regarding the additional

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[1] 66 *Federal Register* 65255, December 18, 2001, National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities.

capacity needed to make up for the power lost as a result of carbon capture operations. These increases can exacerbate competition for water.

Aggregate water consumption by all users. To place water consumption by thermoelectric power plants in the context of water consumption by other energy and nonenergy uses, Phase I of this study estimated water consumption for energy and nonenergy users at the regional and national levels for a 2005 base year and in five-year increments to 2030. Figure 2-1 shows estimated consumption by all users in 2005 and 2030. Areas with high projected consumption by all users indicate areas of high demand and potential competition. (See Elcock [2010] for assumptions regarding aggregate water consumption estimates and projections.)

Areas with significant increases in projected water consumption by all users over the next 25 years. Plants in areas with significant increases in water consumption by all users over the 2005-2030 time period can be expected to compete with other users for water. These areas with significant projected increases are not necessarily the same as those areas where water consumption is high in 2030 (relative to other areas), because some areas may have high consumption in both the base year and in 2030 (see Figure 2-1).

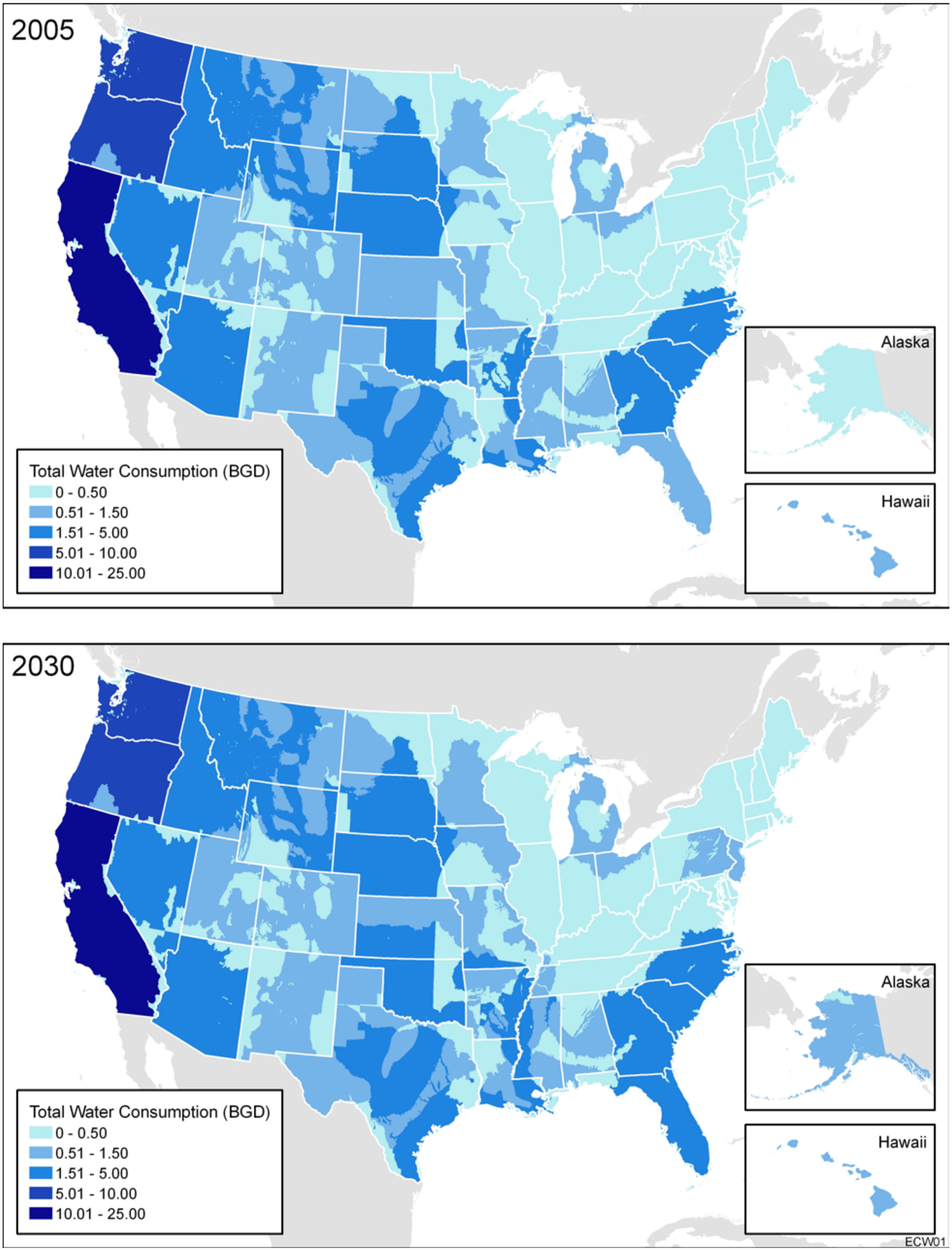

FIGURE 2-1 Estimated Water Consumption by All Users, 2005 and 2030

Water withdrawal. Water withdrawal refers to the total volume of water removed from a water source such as a river, stream, lake, estuary, or aquifer. Unlike water consumed in cooling operations, some portion of the withdrawn water is often returned to the source after serving its purpose at the power plant, thus becoming available for reuse. The U.S. Geological Survey (USGS), which collects and reports data on water withdrawal by type of use at the state level, estimates that in 2005, water withdrawn for thermoelectric power generation (201 bgd) accounted for nearly half (49%) of the total amount of water withdrawn for all uses (410 bgd), and that the 143 bgd of freshwater withdrawn for thermoelectric power generation accounted for about 41% of the 349 bgd of freshwater withdrawn for all uses (Kenny et al. 2009). Increases in water withdrawal rates by power plants of about 4% can be expected by 2030 as carbon-capture equipment is installed at many facilities (NETL 2009b). (The increases in water withdrawal rates due to carbon capture are lower than the increases in water consumption due to carbon capture, because the capacity additions generally will use recirculating cooling systems, which consume more but withdraw less water than once-through systems.)

In 1995 (the last year for which the USGS reported water consumption data), the amount of freshwater consumed by thermoelectric generation was 3.3 bgd, or about 2.5% of the 132 bgd withdrawn by thermoelectric power plants (Solley et al. 1998). The high ratio of withdrawal to consumption is because a large share of generating capacity (roughly half) uses once-through cooling systems. Data in NETL (2009b) indicate that once-through cooling systems withdraw, on a gallon per megawatt hour (gal/MWh) basis, almost 50 times the amount of water as recirculating systems; recirculating systems, however, consume almost five times as much water as once-through systems (see Table 2-2).

In addition to the water withdrawal uses for which USGS collects and reports data (e.g., irrigation, livestock watering, domestic and public, industrial and commercial), surface water withdrawals can also affect recreational, hydropower, navigation, and ecological needs. Groundwater withdrawals can lower water tables, reduce surface water flow, and dewater wells. This analysis uses USGS data on intensity of freshwater withdrawals — measured in gallons per day per square mile (gpd/mi^2) at the state level — as the indicator for water withdrawal. This metric adjusts for the land area of the state and indicates areas where withdrawal rates are high and hence where demand is great. (While some large states withdraw vast amounts of water [more than 20 bgd] and some smaller states withdraw a fraction of that, the intensity levels of freshwater withdrawals in many of these smaller states is much greater than in the larger states. For example, in North Carolina, New Jersey, and Tennessee, the intensity of freshwater withdrawals is about 250,000 gpd/mi^2 compared to about 90,000 gpd/mi^2 in Texas) (Kenny et al. 2009).

Population. Population growth generates increased demand for water in all sectors. Although some of the demand (e.g., for irrigation) may be far from the area of population growth, thermoelectric water demand will generally occur in the same region as the growing population. The indicator of population growth used in this analysis is the forecasted change in population per square mile between 2000 and 2030 by the U.S. Census Bureau (2005).

Potential water supply crisis/conflict areas by 2025. In 2005, the U.S. Bureau of Reclamation published a report, “Water 2025, Preventing Crises and Conflict in the West,” which identified potential water supply crises areas in 2025. These are areas in the western United States in which such factors as hydrologic conditions, weather patterns, locations of endangered species, and population growth trends are converging such that existing supplies will not be adequate to meet water demands for people, farms, and the environment. The U.S. Bureau of Reclamation characterized these areas according to whether conflict potential was moderate, substantial, or highly likely. Figure 2-2 (copied from that report) shows these areas. Plants located in these areas can be considered vulnerable to water demand concerns.

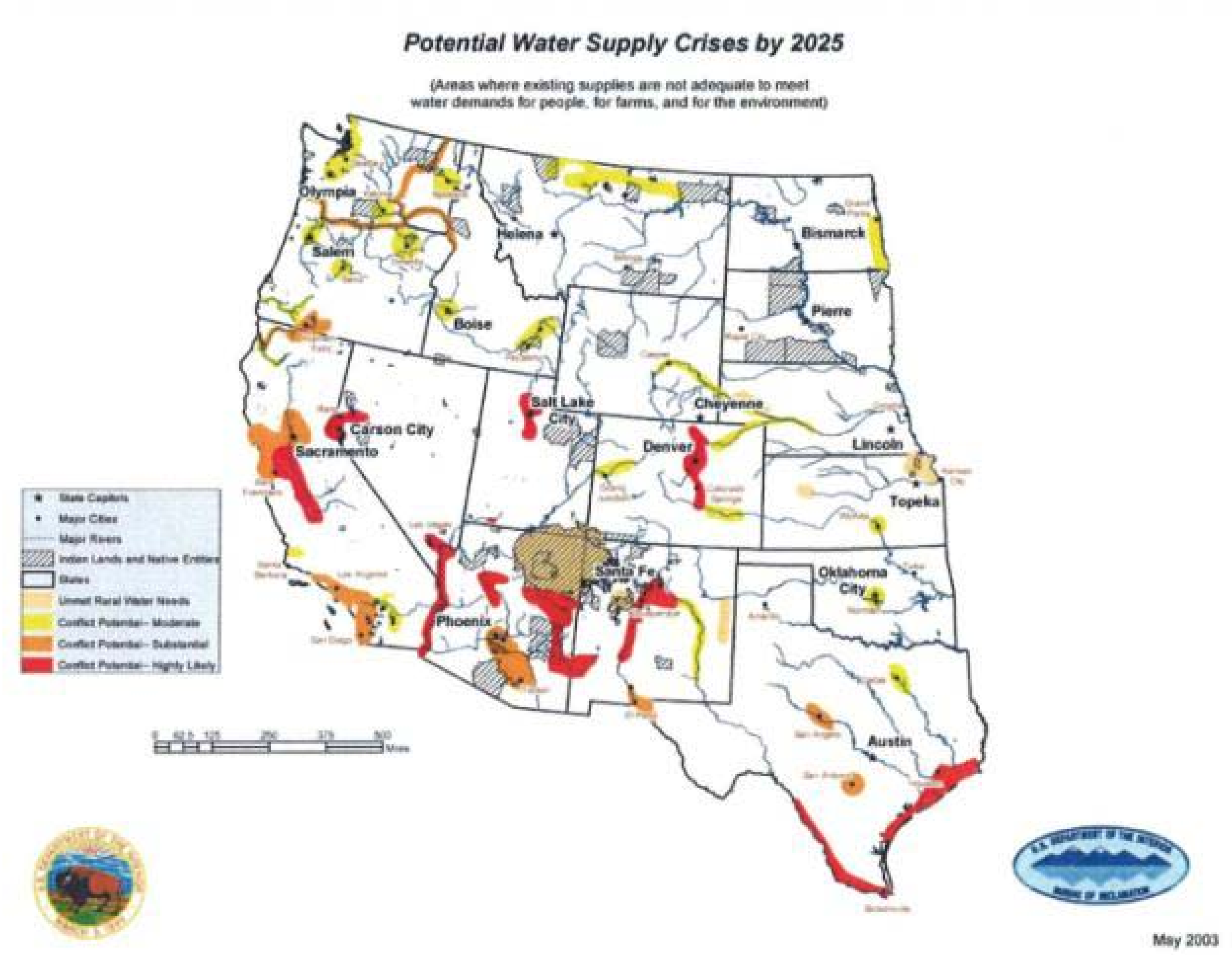

FIGURE 2-2 Potential Water Supply Crisis/Conflict Areas (Source: U.S. Bureau of Reclamation 2005)

Plant-specific Demand Indicators

Plant-specific water consumption and withdrawal data. The regional consumption and withdrawal indicators described above are used to identify areas where water demands are high or are expected to become high in the next several years. Because the average water consumption (and withdrawal) in a given region is assumed to be constant throughout the region, plant-specific water data complement the regional data by allowing for plants that may be high users and thus subject to potential demand concerns — even though they may not necessarily be located in regions identified as having high demands — to be identified. This analysis uses plant-specific average annual consumption and withdrawal rates (in mgd) to indicate actual consumption and withdrawal. It also uses plant-specific average consumption and withdrawal intensity (in mgd/KWh) as an indicator of water use efficiency in the plant.

Net electrical generation. Coal-fired plants with high electrical generation rates are presumably important for baseload or other generation requirements for which substitution would be difficult should the plant need to curtail or reduce operations because of water shortages.

CO_2 emissions. Annual CO_2 emissions can indicate a potential demand for increased water to operate carbon-capture equipment. NETL (2009a) has estimated that retrofitting an existing subcritical pulverized coal plant with carbon-capture equipment would increase water consumption by about 30%. Assuming that plants with high CO_2 emissions would be among the first to reduce their CO_2 emissions via the use of carbon-capture equipment, those high-CO_2-emitting plants will likely experience significant increases in water consumption. (Plants with lower CO_2 emissions may not meet the thresholds for installing carbon-capture equipment in the early years of carbon regulation, or they may find that meeting the CO_2 reduction requirements through other means such as carbon trading may be more cost effective.)

2.1.2 Supply Indicators

The identified supply indicators include precipitation, temperature, streamflow, and drought. These indicators, and their corresponding measures and data sources, are summarized in Table 2-3, and the following paragraphs highlight their value as indicators.

TABLE 2-3 Supply Indicators, Measures, and Data Sources

Supply Indicator	Measure	Data Source
Precipitation	Mean annual precipitation	Anderson et al., 2005
Temperature	Mean annual temperature	Anderson et al., 2005
Streamflow	2008 Statewide Streamflow (by state)	USGS, 2009
Drought	Standardized Precipitation Index	NOAA, 2010a
Drought	Palmer Drought Index	NOAA, 2010b
Drought	Observed Drought Trends 1958–2007	Karl et al., 2009

Precipitation. Because precipitation helps replenish both surface and groundwater sources, it is an important indicator of water supply. The National Climatic Data Center (NCDC) within the National Oceanic and Atmospheric Administration (NOAA) provides data and maps that show mean annual precipitation rates. Data on mean annual precipitation rates in the contiguous United States over the past 100 years were used to indicate areas with low precipitation.

Temperature. Higher temperatures are generally associated with reductions in water supply resulting from increased evaporation and uptake by heat-stressed vegetation and to sublimation from glaciers (which can reduce the water flow that would otherwise come from snowmelt).

Data on mean annual temperatures throughout the contiguous United States over the past 100 years from the NCDC were used to indicate areas with high temperatures.

Streamflow. Streamflow refers to the amount of water flowing in a river, stream, or other channel. Streamflow, which constantly changes, is affected primarily by precipitation runoff in the watershed but also by other factors such as evaporation, groundwater discharge from aquifers and recharge from surface-water bodies, sedimentation, glacial formation and melt, and human activities that include surface-water withdrawals and transbasin diversions, riverflow regulation for hydropower and navigation, and drainage or restoration of wetlands. The USGS provides streamflow information collected from numerous stream gauges throughout the United States. This analysis uses streamflow conditions in seven categories ranging from wet to dry to identify states where recent streamflow conditions are low relative to historical levels (since 1930).

Drought. NOAA defines drought as a prolonged deficiency in precipitation and runoff, usually over a season, several years, or longer, that leads to water shortages having adverse impacts on vegetation, animals, energy production, commerce, and people (NOAA 2008). Because of the variety of disciplines affected by drought, several indices have been developed to measure it. This analysis uses the following three hydrological and meteorological measures that are relevant to water supply:

1. *Standardized Precipitation Index (SPI)*. The SPI measures meteorological drought, which is defined by the magnitude of precipitation differences from long-term average values. It is based on the probability of recording a given amount of precipitation; the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive (Table 2-4). This analysis uses the SPI computed by NOAA for the one-year period ending in February 2010.

TABLE 2-4 Standardized Precipitation Index Values

SPI	**Value**
Exceptionally Dry	-2.00 and below
Extremely Dry	-1.99 to -1.60
Severely Dry	-1.59 to -1.30
Moderately Dry	-1.29 to 0.80
Abnormally Dry	-0.79 to -0.51
Near Normal	-0.50 to +0.50
Abnormally Moist	+0.51 to +0.79
Moderately Moist	+0.80 to +1.29
Very Moist	+1.30 to +1.59
Extremely Moist	+1.60 to +1.99
Exceptionally Moist	+2.00 and above

Source: NOAA (2010a).

2. *Palmer Hydrological Drought Index (PHDI).* The PHDI was developed to quantify the hydrological impacts of drought (e.g., reservoir levels, groundwater levels). While the SPI considers only precipitation, the PHDI considers inflow (precipitation), outflow (evapotranspiration and runoff), and storage. PHDI values are shown in Table 2-5. Severe drought is characterized by serious crop and pasture losses, water shortages, and water use restrictions; moderate drought is associated with some crop damage and scattered water shortages.

TABLE 2-5 Palmer Hydrological Drought Index Values

PHDI	Value
Severe drought	-3.91 to -3.00
Moderate drought	-2.99 to -2.00
Midrange	-1.99 to +1.99
Moderately Moist	+2.00 to +2.99
Very Moist	+3.00 to +3.99

Source: NOAA (2010b).

3. *Drought trends*. Drought trends (end-of-summer drought as measured by the Palmer Drought Severity Index [PDSI]) over the period 1958–2007) identify areas within the United States as experiencing increasing drought, significantly increasing drought, decreasing drought, and significantly decreasing drought. Developed to measure lack of moisture over a relatively long period of time, the PDSI compares the actual amount of precipitation received in an area during a specified period with the average amount expected during that same period, and it considers evaporation, soil recharge, runoff, temperature, and precipitation data.

2.2 Preparing the GIS Database

To identify plants that may be vulnerable to specific demand and supply indicators, the indicator data and the power plant data needed to be superimposed on a common map so their associations could be clearly discerned and analyzed. GIS software combines database technologies, computer graphics, and visualization and analysis tools into one system. Typically, each “theme” (e.g., states, roads, streams, power plants) is stored separately in a GIS database. In the map view, the display of each theme can be turned on or off separately to display and superimpose “layers” of interest. In this study, ESRI ArcGIS 9.3.1 software (ESRI 2010) was used for all stages of the work. Personal GeoDatabase format was selected as the database type. This format uses a standard Microsoft Access 2007 (Microsoft 2010) database file, augmented by a set of proprietary tables added and managed by the GIS software. Personal GeoDatabases store both computer graphics and traditional database information in one file, and are also compatible with

Microsoft Access and other Microsoft Office tools. GIS is well suited to the necessary analysis for this study; however, each data source had to be imported to the GIS database with correct locational reference information. Depending on the form of the source data, various steps were taken to prepare and import the data to the database. These steps are described in the following section.

2.2.1 Preparation of the Indicator Data

Many of the indicator data sources were already in GIS data formats that could easily be imported to the project database. Other data (e.g., plant-specific water consumption data) needed to be converted to the GIS format. The quality of the spatial information varied substantially in some sources. For example, some maps were only available as low-resolution figures from a document despite the fact that the map content and associated analysis were of high quality. Different strategies were used to prepare and add information to the GIS database, taking into account spatial data quality and the type of available information. Table 2-6 provides examples of data sources and the methods used for adding the information to the GIS database.

2.2.2 Collection and Formatting of Data for Existing Coal-Fired Power Plants

Data on existing coal-fired power plants for this study come from NETL's 2007 Coal Power Plant Database (NETL 2007a). The CPPDB contains data on the locations, generation levels, emissions, control technologies, water use levels, and other items (nearly 200 different fields in total) for more than 1,700 coal-fired boilers and associated units in the United States. Much of the data in the CPPDB comes from EIA Form 767 (Annual Steam-electric Plant Operation and Design Data Form), which DOE's Energy Information Administration (EIA) has used to collect annual boiler-specific steam-electric plant data from electric power facilities. Data in the 2007 CPPDB are current as of 2005. EIA Form 767 instructions require the reporting of water data (e.g., withdrawal and consumption rates, type of cooling system, cooling water source, cooling system operation status, cooling system installation date) for plants with a generation capacity of 100 MW or greater. Because reporting water data is optional for plants less than 100 MW in size, many plants in the CPPDB have no water data. In this analysis, several of the identified vulnerable plants have a generating capacity of less than 100 MW, but because only a few of these plants have water data, many of the statistical analyses developed in Chapter 3 include only those plants with capacities greater than or equal to 100 MW.

The CPPDB is distributed in Microsoft Office Access (database) and Excel (spreadsheet) formats. The database version was used because (1) the structured database tables were more easily accessed and manipulated in the GIS, and (2) data in the database version was separated into plant, boiler, generation, and cooling tables, which better represented the different combinations of these systems at each location. The following data were extracted from the Plant table in the CPPDB for each plant:

- Plant Code,
- Name,
- Latitude/Longitude, and
- State

The following data were extracted from the Boiler table in the CPPDB:

- Plant Code,
- Boiler Status (e.g., operating),
- Primary Fuel Type, and
- Annual CO_2 Emissions (tons).

TABLE 2-6 Methods and Examples for Converting Data Sources to the GIS Format for Analysis

Data Source	Method
• NETL Coal Power Plant Database	Latitude and longitude coordinate values were used to create point locations in the GIS databases. Additional tabular data were linked to the points by using database functions.
• U.S. Census Demographic Data • Mean Annual Precipitation and Temperature	Available GIS data were directly imported.
• USGS Water Withdrawals • Statewide Streamflow	Tabular statistics from the data sources were added to existing GIS layers, such as U.S. states.
• Coal Mines • Top 100 U.S. Oil and Gas Fields by 2008 Proved Reserves	Map figures in electronic documents were converted to image files, then superimposed with GIS maps based on a set of common landmarks. For example, state boundary intersections present in a figure were matched to state boundary intersections in the GIS.
• Deep Saline Formations • Seasonal Drought Outlook • Palmer Hydrological Drought Index • Potential Water Supply Conflicts	The same method described above (e.g., map figures in electronic documents were converted to image files, then superimposed with GIS maps based on a set of common landmarks) was used. Then, once the map graphic was superimposed in the GIS, a new GIS layer was created and information was added by sketching features as accurately as possible. Tabular fields were then added and populated, and map symbols were displayed on the basis of the tabular information entered in the fields of the new GIS layer.

The data listed below were extracted from the Cooling table in the CPPDB. To compare water withdrawal and consumption by coal-fired power plants with withdrawal and consumption by other uses, which are reported in mgd, the water consumption and withdrawal data reported in cubic feet per second (cfs) in the CPPDB were converted to mgd in the GIS database.

- Plant Code,
- Primary Cooling System type (e.g., once through, freshwater),
- Cooling System Status (e.g., operating),
- Cooling Water Source (e.g., Platte River),
- Cooling Water Annual Average Withdrawal and Consumption (cfs),
- Cooling Water Source Type, and
- Cooling System Status Type.

The following data were extracted from the Generator table in the CPPDB:

- Plant Code,
- Generator Nameplate Rating (MW), and
- Net Annual Electrical Generation (MWh).

Latitude and longitude values were missing from some of the plants in the CPPDB. In these cases, the location of the plant was determined through Internet searches (Google 2009a) — by finding reliable locational information such as a street address in a power company's Web site, and then verifying it by using aerial photography available from Google (2009b), which has high-resolution imagery throughout the area studied. The latitude and longitude values for these locations were added to a working copy of the CPPDB data and imported into the GIS as point locations.

Boiler, cooling, and generation data are stored in the CPPDB in separate tables as described above, and this information was linked to the plant locations in the GIS layers as needed. However, many power plants have multiple boiler, cooling, and/or generation systems. This relationship is mirrored in the CPPDB with multiple boiler, cooling, and/or generation table records for the same plant. To distill the information down to one record per plant, multiple boiler, cooling, or generation records belonging to a plant were combined, and the combined data were added to the plant record. For numeric fields such as Net Annual Electrical Generation, the sum of the values was used. Text fields such as Primary Cooling System Type had the same values for a plant in most cases; however, when more than one characteristic was present at a plant, the data were examined manually to determine which values to use. For example, when more than one Primary Cooling System Type existed, the type associated with the largest consumption and withdrawal volumes was used. This process allowed the information needed for this study to be summarized on a per-plant basis without sacrificing any significant detail existing in the boiler, cooling, and generation tables.

These steps resulted in a single database table consisting of 594 plants with aggregated boiler, cooling, and generation data. Plants listed as deactivated (seven plants) and out-of-service (three plants) were removed. Also removed were one plant with negative net annual electrical generation and three plants with zero generation and no cooling data. (These plants had very small generation capacities – between 18 and 85 MW.) Three plants listed as new construction were verified as now built or substantially complete. After these removals and verifications, 580 plants remained. These plants were assessed for water demand and supply vulnerabilities, and they are collectively referred to in the remainder of this report as the "analysis set."

2.3 Creating and Interactively Analyzing GIS Database Content to Locate Plants within Specific Demand and Supply Constraint Areas

All of the indicator data for the plants in the analysis set were compiled in the GIS database so they could be analyzed and visualized in any combination. Several ways of visualizing the power plant points were prepared, including display by primary cooling system type, consumption and withdrawal levels, and net annual electrical generation. These displays could be superimposed in the GIS with data from any of the sources identified in Tables 2-1 and 2-2 to identify plants in high-demand or supply-constrained areas or with plant-specific data that indicated demand concerns. For example, the map layer designating areas of the country according to observed drought trends (increasing drought, significantly increasing drought, decreasing drought, or significantly decreasing drought), combined with the map layer showing power plants in the analysis set, was used to identify plants located in areas with increasing or significantly increasing drought trends. Results from this analysis of the 18 indicator fields were compiled in a spreadsheet containing the 580 plant records in the analysis set and are provided in Appendix A.

2.4 Developing Criteria for Identifying Plants Subject to Water Demand and Supply Vulnerabilities

To determine the extent to which a plant would be considered “vulnerable” to a given demand or supply concern (i.e., that the plant’s operations could be affected by water shortages represented by a potential supply or demand indicator), criteria were developed to categorize vulnerability according to one of three types: major, moderate, or not vulnerable. Table 2-7 shows the criteria developed for the demand indicators, and Table 2-8 shows those developed for the supply indicators.

TABLE 2-7 Criteria for Assessing Demand Vulnerabilities

Demand Indicator	**Measure**	**Criteria**		
		Major	**Moderate**	**Not Applicable**
Area Demand Indicators				
Increasing water consumption by thermoelectric power	Change in water consumption by thermoelectric power plants between 2005 and 2030 (percent)	>100%	51–100%	≤50%
High levels of future water consumption — all users	Projected average 2030 water consumption by all users in area (in bgd)	≥2 bgd	0.5–2 bgd	<0.5 bgd
Increasing water consumption over time — all users	Change in water consumption by all users in area between 2005 and 2030 (percent)	≥50%	0–50%	Decrease in consump-tion
Water withdrawals by all users	Gallons of water withdrawn per square mile by all users (by state)	220,000–330,000	150,000–220,000	<150,000
Population	Projected change in population per square mile between 2005 and 2030 (by state)	101–228	51–100	≤50
Potential conflicts	Potential crisis/conflict areas	Conflict potential — highly likely	Conflict potential — substantial	Conflict potential — moderate
Plant-Specific Demand Indicators				
Power generation	Net annual generation (in MWh)	>10,000,000	5,000,000–10,000,000	<5,000,000
Cooling water consumption	Average annual cooling water consumption rate (in mgd)	>10 mgd	5–10 mgd	<5 mgd
Consumption intensity	Average annual intensity of cooling water consumption (in gal/MWh)	>5,000	1,000–5,000	<1,000
Cooling water withdrawal	Average annual cooling water withdrawal rate (in mgd)	>400 mgd	150–400 mgd	<150 mgd
Withdrawal intensity	Average annual intensity of cooling water withdrawal (in gal/MWh)	>100,000	50,000–100,000	<50,000
CO_2 emissions	Annual CO_2 emissions (in tons)	>10 million	5–10 million	<5 million

TABLE 2-8 Criteria for Assessing Supply Vulnerabilities

Supply Indicator	Measure	Criteria		
		Major	**Moderate**	**Not Applicable**
Precipitation	Mean annual precipitation (in inches)	<5	5–12	≥12
Temperature	Mean annual temperature (degrees F)	>70	65–70	<65
Stream Flow	2008 statewide streamflow	Moderately dry	Drier than normal	Normal or wetter than normal
Drought	Standardized Precipitation Index	Exceptionally, extremely, or severely dry (-1.30 and below; no areas in these categories)	Moderately dry (-1.29 to -0.80)	>-0.79
Drought	Palmer Hydrological Drought Index	Severe (-3.91 to -3.00)	Moderate (-2.99 to -2.00)	>-2.00
Drought	Observed drought trends 1958–2007	Significantly increasing	Increasing	Decreasing or significantly decreasing

2.5 Using the Criteria to Identify Potentially Vulnerable Plants

By using the criteria shown in Tables 2-7 and 2-8, each plant-specific demand and supply indicator value in the analysis set was color-coded as major (dark orange), moderate (light orange), or not vulnerable (white). Plants with at least two major demand indicator values and/or at least four moderate demand indicator values were considered vulnerable to demand concerns. By using this approach, 144 plants were identified as being subject to demand concerns only. Plants with at least one major supply indicator value and/or at least two moderate supply indicator values were considered vulnerable to supply concerns. By using this approach, 64 plants were identified as being subject to supply concerns only. In addition, 139 plants were identified as subject to both demand and supply concerns. Therefore, a total of 347 plants were considered subject to demand concerns, supply concerns, or both demand and supply concerns. These are the vulnerable plants, and their scoring results are shown in Appendix B.

2.6 Characterizing the Potentially Vulnerable Plants to Identify Commonalities

Characteristics of the potentially vulnerable plants were reviewed and evaluated to identify any commonalities that could be further explored through R&D to help mitigate potential water constraints on operations. The characteristics evaluated included location, type of cooling system, age of cooling system, cooling water source (e.g., surface water), and capacity.

In reviewing the data for the 347 plants identified as vulnerable, five plants were identified with extraordinarily high and unexplained water consumption rates — on the order of 100 mgd to 500 mgd, in contrast to the next-highest rate for the remaining plants, which was about 55 mgd. Because the data for these five plants is so far out of the range of the other 342 plants, the calculations made to characterize consumption and withdrawal data in Chapter 3 do not include these five plants. The plants remain in the set of vulnerable plants for assessing qualitative factors such as type of cooling system, cooling water source, and location.

2.7 Assessing the Proximity of Vulnerable Plants to Nontraditional Water Sources

The previous steps culminate in the identification of potentially vulnerable plants and shared characteristics, which can be used to identify R&D efforts to help reduce freshwater demand at these plants. By taking advantage of the GIS database developed to identify these plants, this final step provides a rough indication of the relative proximity of the vulnerable plants to alternative water sources, the use of which could help reduce freshwater demand. Here, the vulnerable plants are viewed in the context of potential water sources associated with oil and gas production, coal bed methane production, mine pool water, and saline aquifers (which may be exploited as part of a future CO_2 injection and sequestration process) to provide a first-cut view of the proximity of these source to vulnerable plants.

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Chapter 3 Findings

This chapter discusses the results of the methodology described above. The results pertain specifically to existing coal-fired power plants.

3.1 Characteristics of Vulnerable Plants

On the basis of the methodology described in Chapter 2, 144 plants were identified as being vulnerable to water demand concerns only, 64 plants were identified as being vulnerable to water supply concerns only, and 139 plants were identified as being vulnerable to both water demand and supply concerns. Therefore, a total of 347 plants were considered vulnerable to demand concerns, supply concerns, or both demand and supply concerns. The following paragraphs discuss these 347 vulnerable plants in terms of location, type and age of cooling system, source of cooling water, and plant capacity.

3.1.1 Location

Figure 3-1 shows that 43 states have at least one of the 347 vulnerable plants; and that more than half of the states have five or more. States with the most vulnerable plants are North Carolina, Virginia, South Carolina, Indiana, and Georgia — each with 18 or more. Only five states have no vulnerable plants. These are Alaska (which has only five plants in the state, the largest of which is 28 MW), Hawaii (which has 2 plants total), Idaho (which has only one [10-MW] plant), New Hampshire (two plants total), South Dakota (two plants total), Rhode Island (no coal-fired plants), and Vermont (no coal-fired plants). Figure 3-2 shows the distribution of vulnerable plants by state.

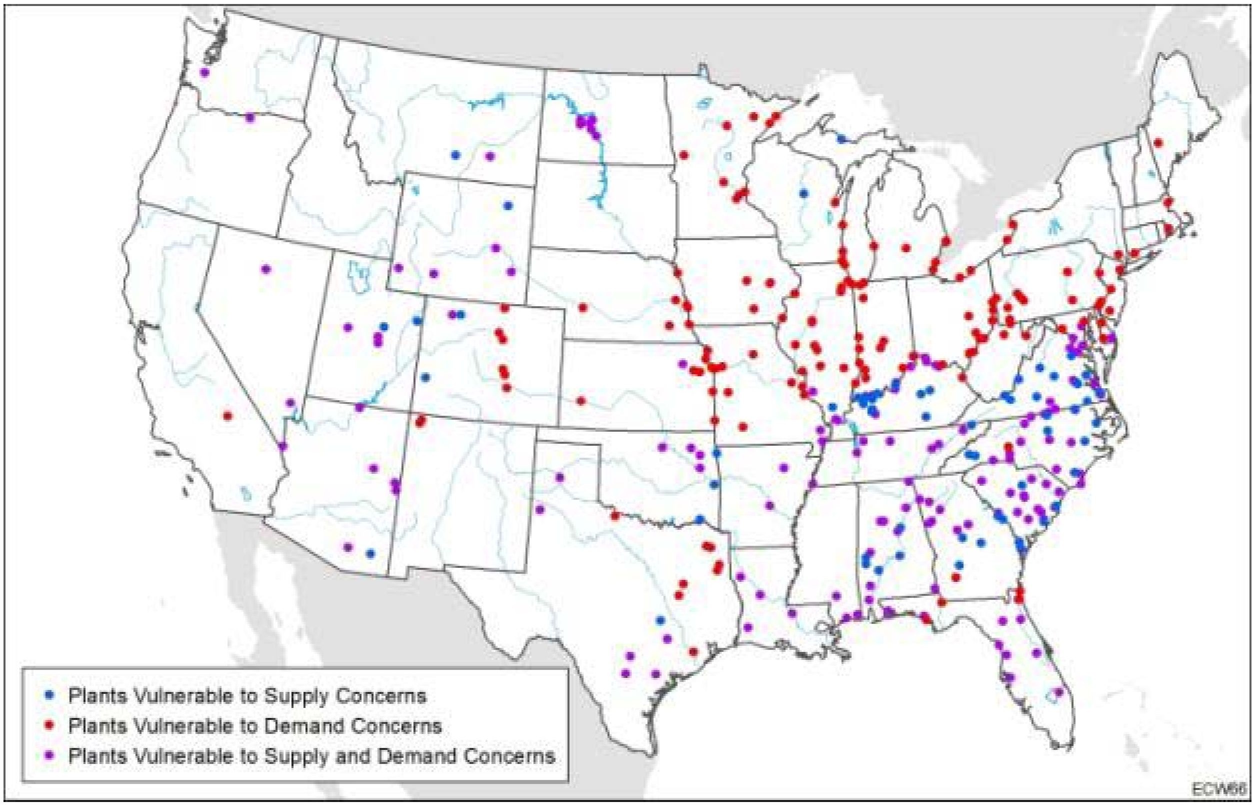

FIGURE 3-1 Plants with Demand Concerns, Supply Concerns, or Both Demand and Supply Concerns

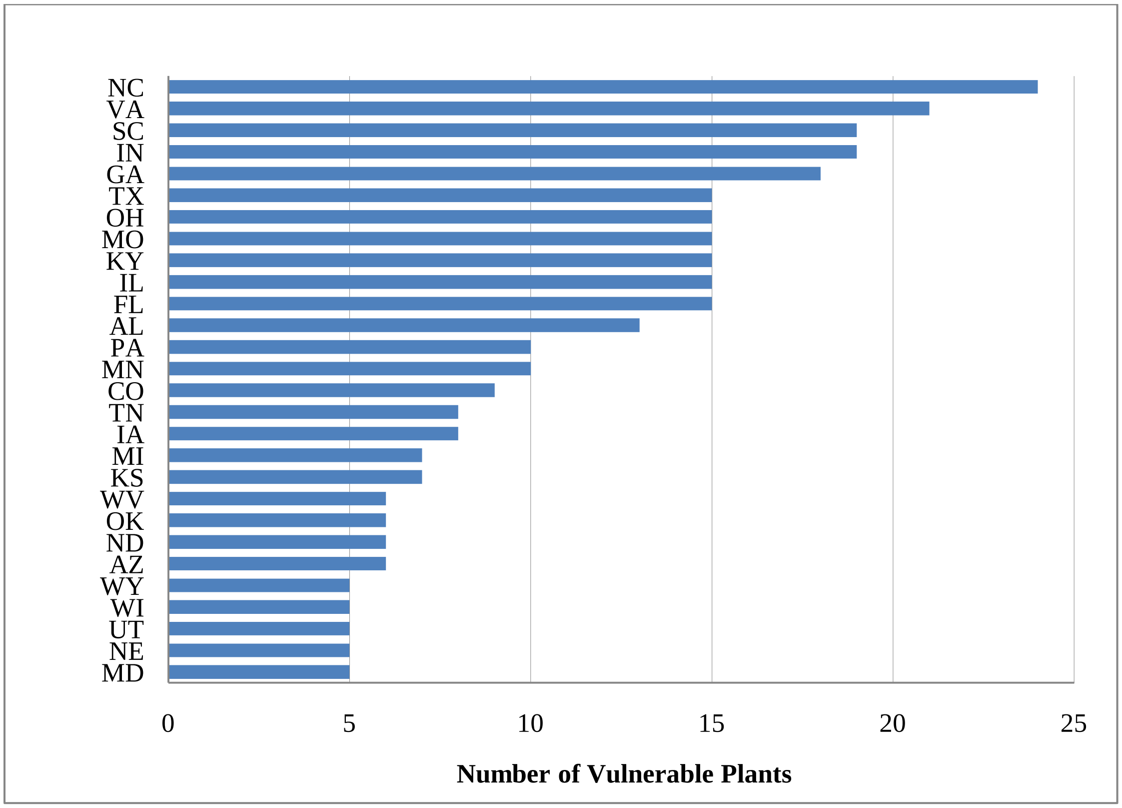

FIGURE 3-2 Distribution of Vulnerable Plants by State

Figure 3-3 shows that many of the plants that are vulnerable to demand concerns are concentrated in the Middle Atlantic states and in the Midwest, with others in Minnesota, Colorado, Texas, and the Southeast.

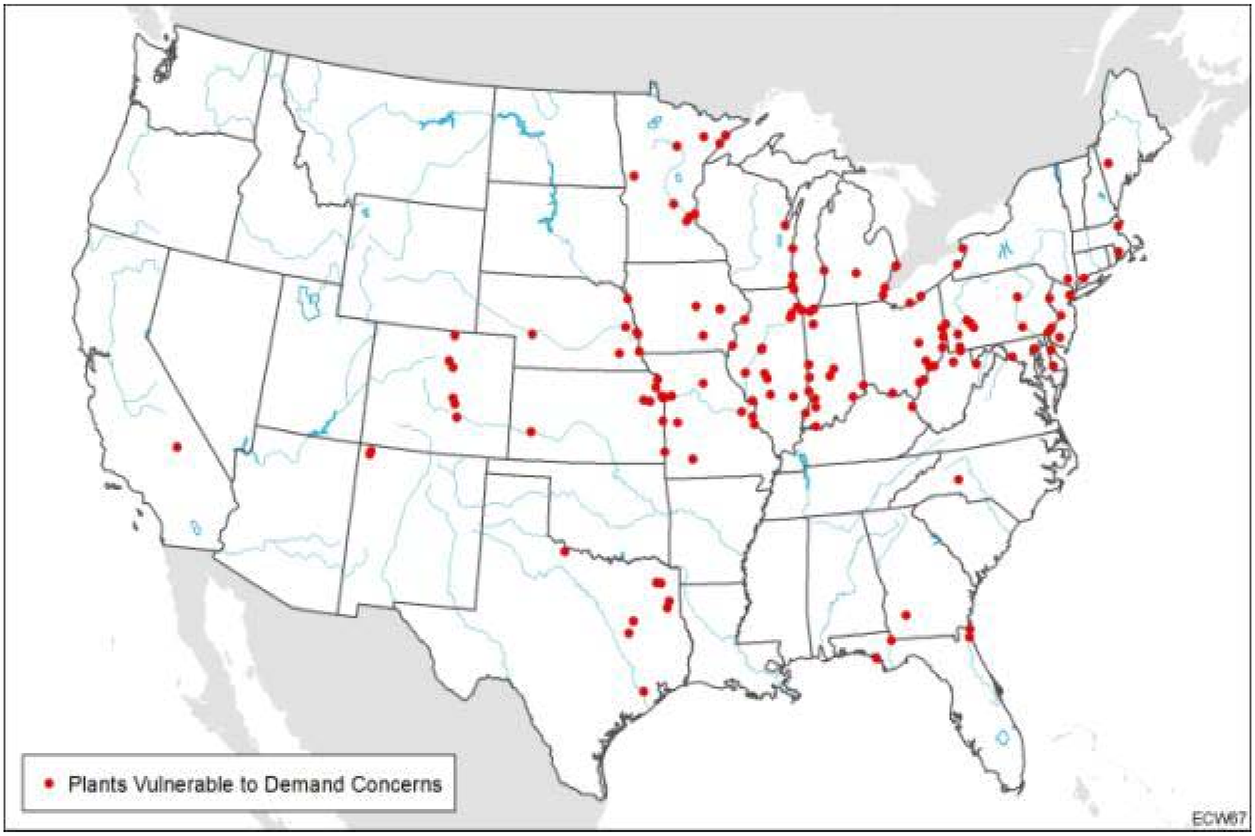

FIGURE 3-3 Plants with Demand Concerns

Figure 3-4 shows that most of the plants with supply concerns are in the East and Southeast, with a few scattered in the Rocky Mountain states, the upper Midwest, and along the Arkansas-Oklahoma border.

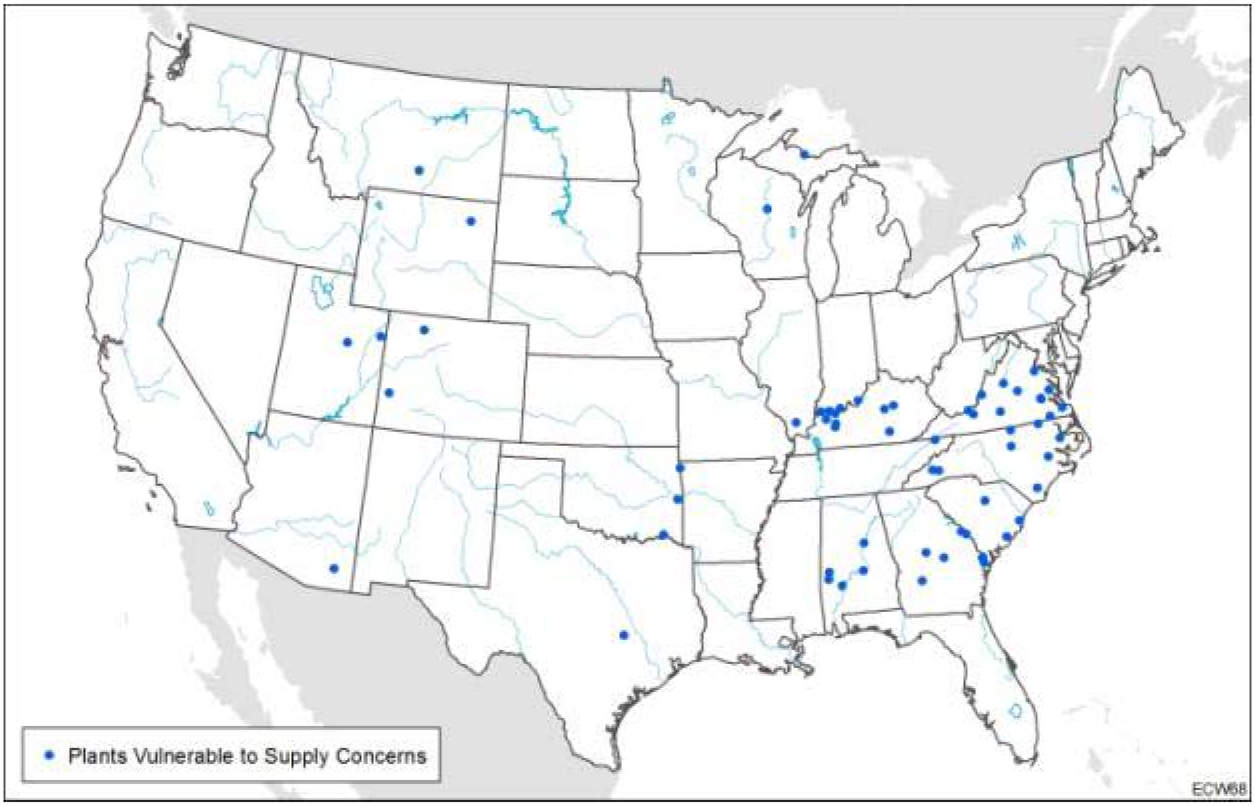

FIGURE 3-4 Plants with Supply Concerns

Plants subject to both demand and supply concerns follow the same pattern, with the highest concentrations in the South and East but with a broader distribution that includes more western plants (Figure 3-5).

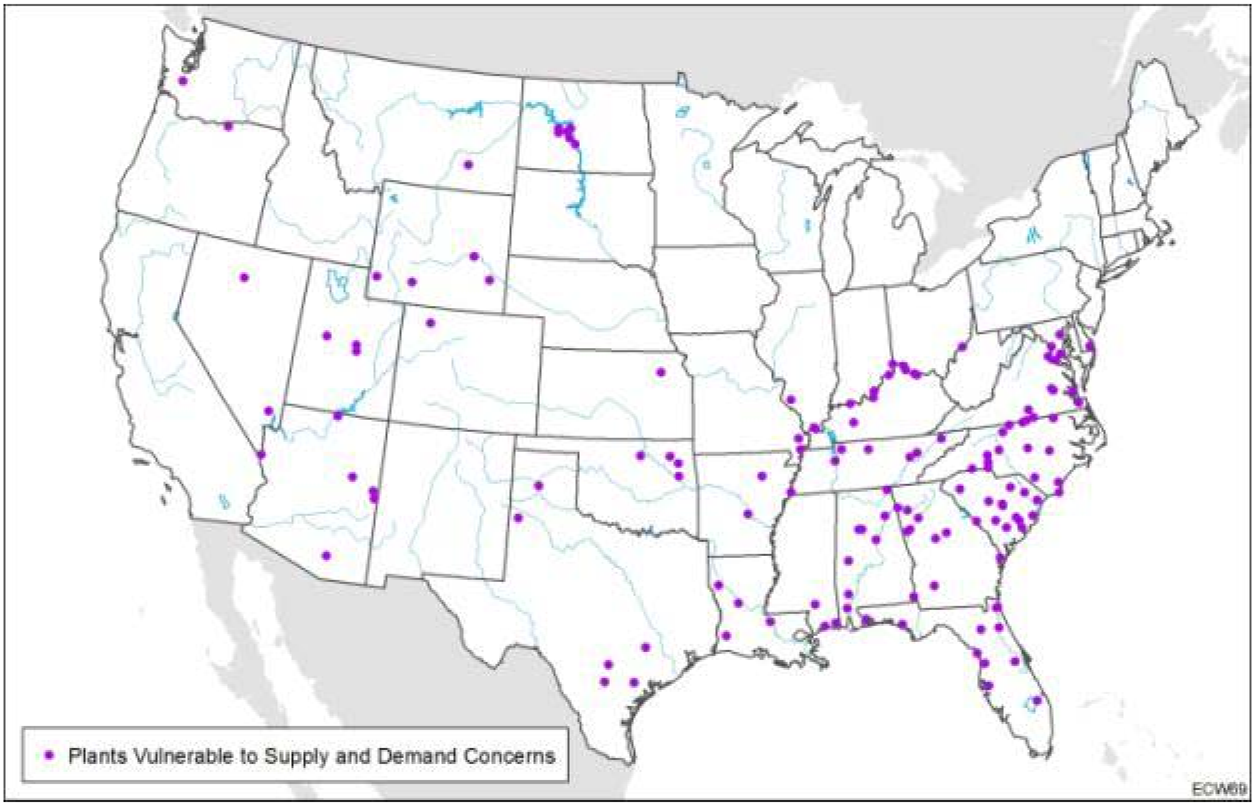

FIGURE 3-5 Plants with Both Demand and Supply Concerns

3.1.2 Type of Cooling System

As mentioned earlier, only plants with capacities of 100 MW or greater are required to report data on cooling systems. Hence, cooling system data were obtained for only 307 of the 347 plants identified as vulnerable.[2] While it is expected that most new cooling systems will be the recirculating rather than once-through type, slightly more than half (53%) of the vulnerable plants with water data use once-through cooling, and slightly fewer than half (47%) use recirculating cooling systems (Table 3-1). Because the difference between the number of existing vulnerable plants using once-through systems and the number using recirculating systems is not significant, and because existing plants can be expected to continue operating for many years into the future,[3] research efforts to reduce freshwater use should address both once-through and recirculating systems.

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[2] Two additional vulnerable plants reported cooling system type as "other." These plants were not included in this portion of the analysis.

[3] Obtaining permits for new coal-fired power plants is becoming increasingly difficult, and renewable energy sources are not expected to produce sufficient power to displace a significant portion of the demand supplied by coal.

TABLE 3-1 Distribution of Plants by Cooling System for Vulnerable Plants Providing Water Data

Primary Cooling System **Category**	**Vulnerable Plants**		
	Number	**Category (by percent)**	**Total (by percent)**
Once Through			
Cooling pond(s) or canal(s)	17	10	
Freshwater	130	79	
Saline water	17	10	
Total in once-through category	164	100	53
Recirculating			
Cooling pond(s) or canal(s)	25	17	
Forced draft cooling tower(s)	49	34	
Induced draft cooling tower(s)	45	31	
Natural draft cooling tower(s)	24	17	
Total in recirculating category	143	100	47
Plants providing Water Data	307		100

3.1.3 Cooling System Age

Knowing the ages of cooling systems at vulnerable plants can help target research efforts. For example, if vulnerable plants tend to have cooling systems built during a certain time period, those particular systems could be identified and evaluated to determine whether there are specific design or operating issues that could be improved to reduce water consumption or withdrawal. Chapter 2 explained that the cooling system data in the CPPDB is generally reported at the cooling system (rather than plant) level, and that for this analysis most of these data (e.g., water consumption) were aggregated from the system level to the plant level. Because system-level age data (in contrast to system-level generation or water consumption data) are not cumulative for a given plant, the analyses for cooling system age were made at the system level. The 347 vulnerable plants consist of 1,077 cooling systems, 694 of which have associated age data. For these 694 cooling systems, the ages range from 1 to 87 years, with a mean (and median) of 42 years and a standard deviation of about 13. Of the 694 systems, 376 were identified as once-through, 315 as recirculating, and 3 as other.

When considering age data for once-through systems and recirculating systems separately, the data show, as would be expected, that once-through systems are generally older (with an average age of 48 years and a median age of 50 years) than the average and median ages of recirculating systems (with an average age of 33 years and a median age of 32 years). Figure 3-6 shows the age distribution of once-through systems for the vulnerable plants. While these systems range in age from 17 to 85 years, most are between 39 and 58 years old. Figure 3-7 shows that while recirculating systems range in age from 1 to 86 years, most are between 22 and 43 years old.

Thus, further investigation into the characteristics of once-through systems installed between 1952 and 1971 and recirculating systems installed between 1967 and 1988 may be warranted to determine whether there are particular design characteristics or operating conditions associated with these plants that could be modified to reduce water demand (particularly for the once-through systems) and water consumption (particularly for the recirculating systems).

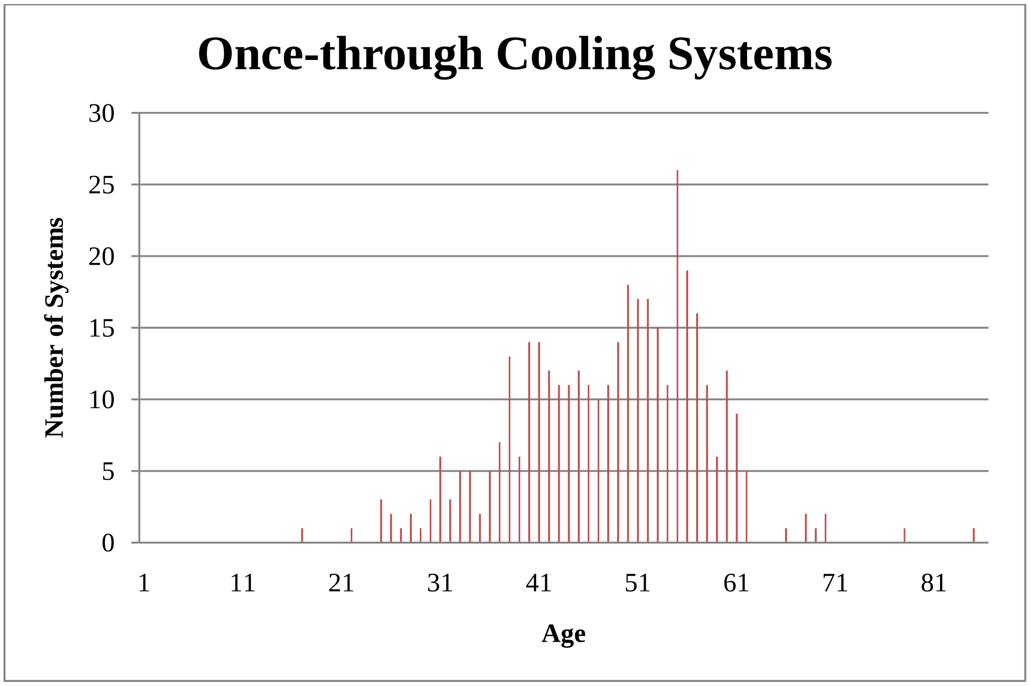

FIGURE 3-6 Age Distribution for the Once-Through Cooling Systems of Vulnerable Plants

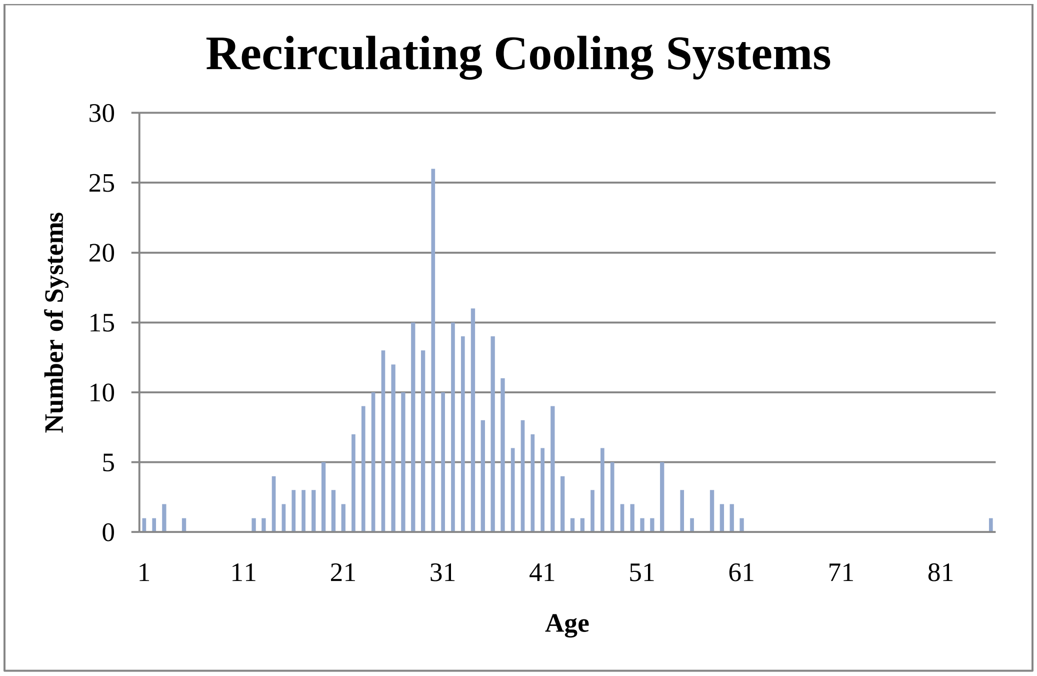

FIGURE 3-7 Age Distribution for the Recirculating Cooling Systems of Vulnerable Plants

3.1.4 Source of Cooling Water

Thermoelectric plant cooling systems can use surface water or groundwater, saline or fresh. Figure 3-8 shows USGS water withdrawal data for all uses and for thermoelectric generation in 2005. Virtually all of the water used for thermoelectric cooling (99%) was obtained from surface sources, and of this amount, about 71% was obtained from freshwater sources and 28% from saline. Of the 1% amount of groundwater used, about two-thirds came from saline sources. For all uses, 80% of the water used was obtained from surface sources, of which about 66% was freshwater and 14% was saline. On a percentage basis, thermoelectric plants use more saline water than do other users; thermoelectric plants use 98% of the saline surface water withdrawn by all users and 48% of the saline groundwater withdrawn by all users. Because the use of saline water is an established practice at many power plants (see Figure 3-9), and because saline water provides an effective means of reducing freshwater consumption and withdrawal, additional R&D into ways to increase the use of saline water at existing power plants may be warranted. At least three areas could be explored:

1. *Intake systems that would meet the requirements of CWA §316(b)*. Saline water is typically used by once-through systems in coastal or other areas with ready access to saline surface water (Figure 3-9). While the existing §316(b) regulations apply to new plants, §316(b) regulations that would apply to existing plants are pending. R&D could be directed toward technologies or procedures that would allow additions to plant capacity to also use once-though systems. Also, depending on the outcome of the U.S. Environmental Protection Agency's (EPA's) rulemaking for existing plants, R&D

directed toward technologies and procedures that would allow existing systems to continue operating while still meeting the objectives of CWA §316(b) may be warranted. If freshwater for cooling in some areas becomes scarce, such as in the Southeast where many vulnerable plants are located, the option to use saline water in once-through systems may be an attractive alternative to converting to recirculating systems.

2. *Other sources of saline water (or alternatives with similar characteristics).* NETL's existing plants program is investigating several alternative sources of water for power plant cooling, such as deep saline aquifers and produced water from oil and gas and CBM production (see, for example, NETL 2009c). An additional nontraditional water source that may be worth investigating for its potential to contribute to power plant cooling needs is the flowback and produced water that accompanies shale gas production. Producing commercial quantities of natural gas from shale requires water in order to drill and hydraulically fracture the rock. While water supply is a concern in implementing this technology, once the water is used, it must be recovered from the well and managed before the gas can flow. Today, using this source for water would not be practical due to the small volumes of water generated during shale gas production relative to the amount needed for power plant cooling. However, as competition for existing water resources increases, and as shale gas production increases in areas where water disposal options are limited (e.g., the Marcellus shale play), NETL may want to consider exploring the use of flowback and produced water associated with gas shale production as another option for contributing a portion of power plant cooling needs in the future.

3. *Identification and focus of research toward the most promising nontraditional sources*. Research into nontraditional sources has benefitted from Congressional funding in the recent past. Whether such funding will continue is not known. As a consequence, and to ensure that funds are spent in ways that are most likely to accomplish the goals of reducing freshwater consumption in a cost-effective and environmentally protective manner, it may be appropriate to begin focusing these R&D efforts toward the most promising alternatives. With this objective in mind, NETL may want to develop a process that would use a set of criteria to compare and evaluate the various nontraditional source alternatives in a consistent manner to select those few on which to target its dollars. Factors to consider in evaluating each of the various nontraditional source alternatives could include (but would not be limited to) the following:
    a. Net environmental impact (While the primary goal is to reduce freshwater consumption, it is important to identify and weigh other potential environmental impacts that can result from the development and use of a nontraditional source. A life-cycle approach could be used to consider impacts associated with the treatment chemicals, transportation of the water from the source to the plant, air emissions from equipment, noise, etc.)
    b. Time to deployment
    c. Costs
    d. Treatment requirements
    e. Proximity to power plants
    f. Volume and reliability of source
    g. Potential competition from other users

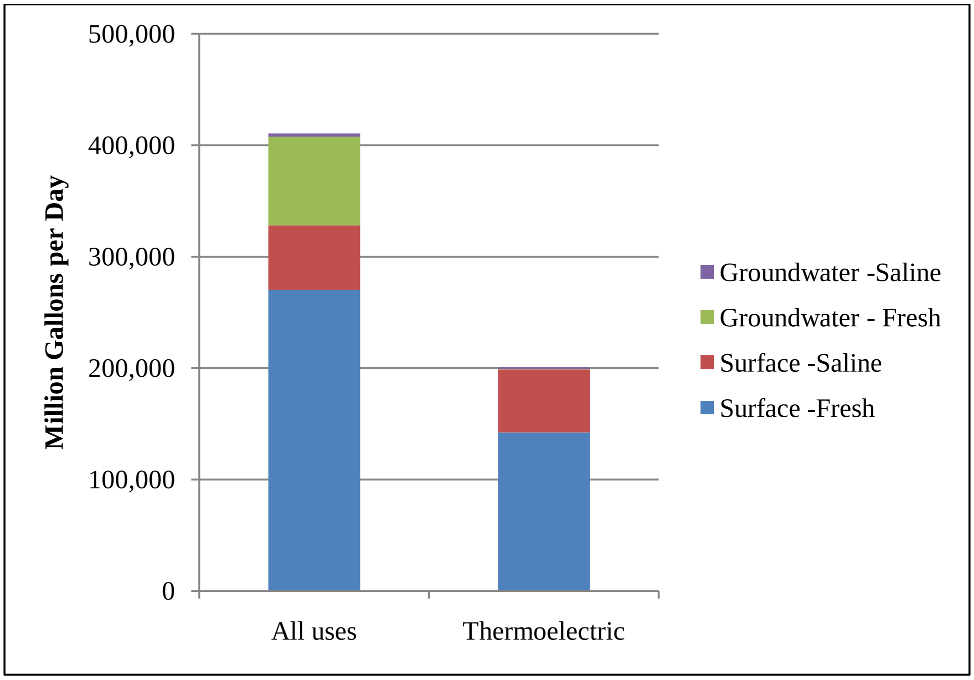

FIGURE 3-8 Water Withdrawals by Source for All Users and for Thermoelectric Power Generation, 2005 (Source: Kenny et al. 2009)

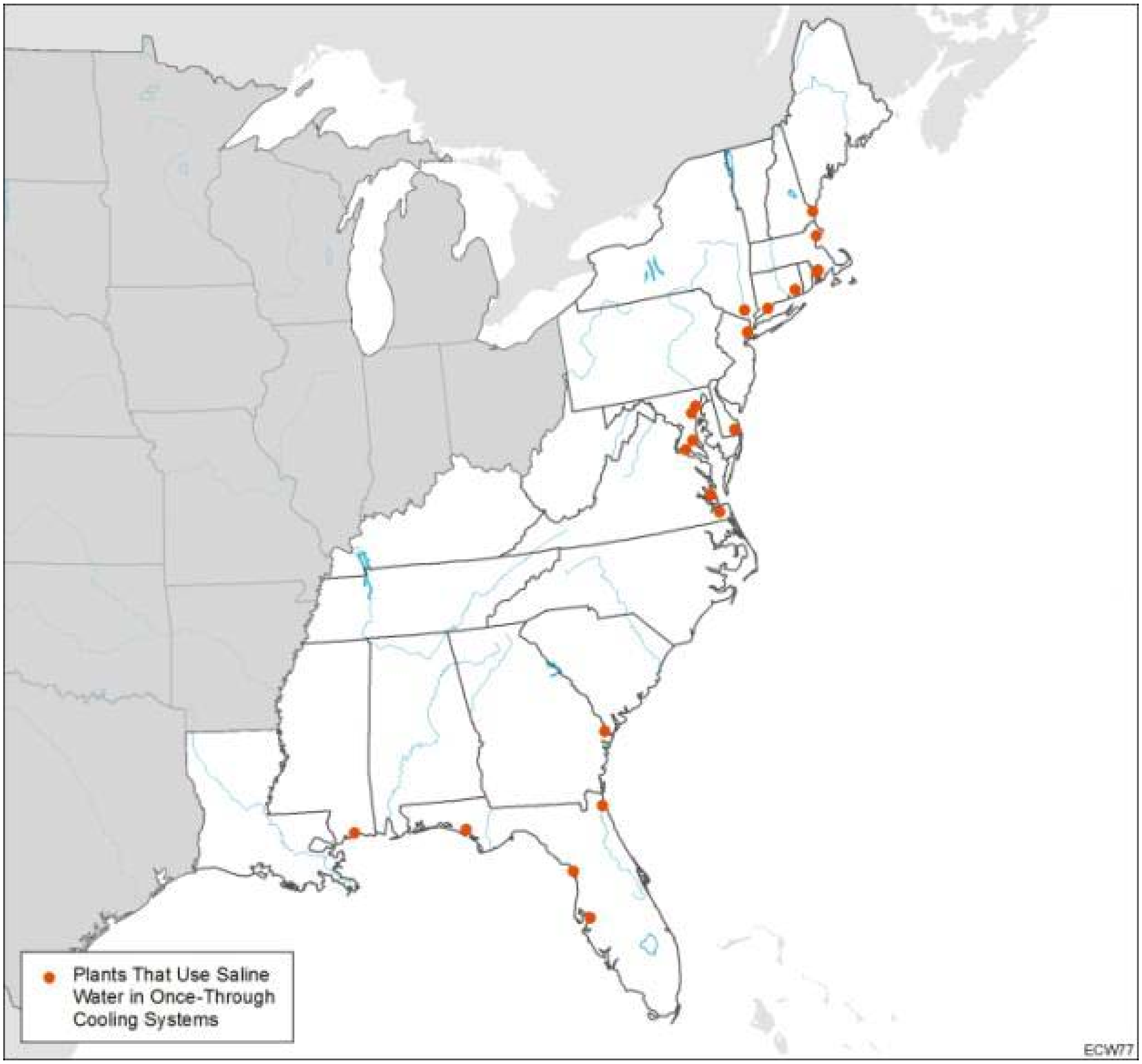

FIGURE 3-9 Plants in the East That Use Saline Water

For the vulnerable plants for which cooling data were obtained, about 84% use surface water, and of these, only about 4% use saline water. This relatively low percentage of saline users (compared with all thermoelectric plants) may occur because most of the plants that already use saline water are not considered vulnerable relative to the others. It may also mean that more plants that currently use freshwater could use saline water as a means to help reduce freshwater withdrawal and use.

About 95% of the vulnerable plants that use once-through systems use surface water. About 70% of the vulnerable plants that use recirculating cooling systems also use surface water, and about 16% report using groundwater (Table 3-2). Figure 3-9 shows the locations of vulnerable plants with recirculating systems that use groundwater. Some of these plants are in areas where portions of the underlying aquifers (e.g., the Ogallala) have experienced declining water levels. The use of groundwater in areas where aquifer levels are decreasing, such as in the Gulf Coastal Plain and the desert southwest, underscores the need to conserve water via improved technologies and equipment or through the use of recycled or reclaimed water.

TABLE 3-2 Distribution of Vulnerable Plants by Type of Cooling Water Source

Cooling System	Cooling Water Source Type	Number of Plants	Percent of Plants (%)
Once-Through	Groundwater	3	2
	Municipal/recycled	5	3
	Surface water	156	95
Total Once-Through		164	100
Recirculating	Wells/groundwater	23	16
	Municipal/recycled	18	13
	Surface water	102	71
Total Recirculating		143	100
Total		307	

FIGURE 3-10 Vulnerable Plants with Recirculating Systems That Use Groundwater

Some vulnerable plants already use municipal/recycled water to provide at least some of their cooling water needs. These include the 257-MW Martin Drake Power plant in Colorado Springs, Colorado, which uses wastewater from a local treatment facility; the 930-MW Stanton Energy Center in Orlando, Florida, which uses effluent from a sewage plant; the 292-MW Cedar Bay Generating Plant in Duvall County, Florida, which uses industrial waste water; the 295-MW Rawhide Plant, Larimer County, Colorado, which uses municipal treated sewage; and the 1,080-MW Harrington Plant in Potter County, Texas, which uses treated recycled municipal effluent.

3.1.5 Plant Capacity

Information on the generating capacities of the vulnerable plants can help target research efforts. For example, if the vulnerable plants tend to cluster around a certain nameplate capacity, plants with these capacities can be further investigated to identify common characteristics that could be evaluated for water consumption reduction ideas. The 347 vulnerable plants range in capacity from 12 MW to 3,564 MW, which is essentially the same range as that for all plants in the analysis set (although there are six plants in the analysis set whose capacities are lower than 12 MW). The median and mean capacities for the vulnerable plants, however, are much higher for the vulnerable plants (Table 3-3). The higher capacities for the vulnerable plants may be due in part to the selection criteria used for determining vulnerability. That is, one of the demand criteria, net annual electrical generation, was used to address the enhanced vulnerability of large plants because they need to supply more power than the smaller ones and they would cause greater disruptions if their generation were reduced (for example, due to water shortages). It is reasonable to assume that, in general, plants with higher generation rates will also have higher capacities. Nonetheless, the distribution of vulnerable plants by capacity (Figure 3-11) shows that the capacities tend to concentrate at around 650 MW and below. The capacities of the remaining vulnerable plants span a much broader range. All else being equal, research efforts may be more productive if targeted toward plants with these mid-range capacities. Such research could be further targeted toward identifying specific plants and characteristics. For example, a subset of the plants in the 650-MW range and below that have the highest consumption and/or withdrawal intensities could be further examined for specific plant characteristics to see whether there are commonalities in plant operations, equipment, or other factors that could contribute to the high water consumption (or withdrawal) intensities. These common characteristics could then be targeted to identify water-reducing options.

TABLE 3-3 Nameplate Capacities of Vulnerable Plants Compared with All Plants in the Analysis Set

	Vulnerable Plants	Plants in Analysis Set
Number of plants	347	580
Range in size (MW)	12–3,564	9–3,564
Average size (MW)	864	576
Median size (MW)	646	294

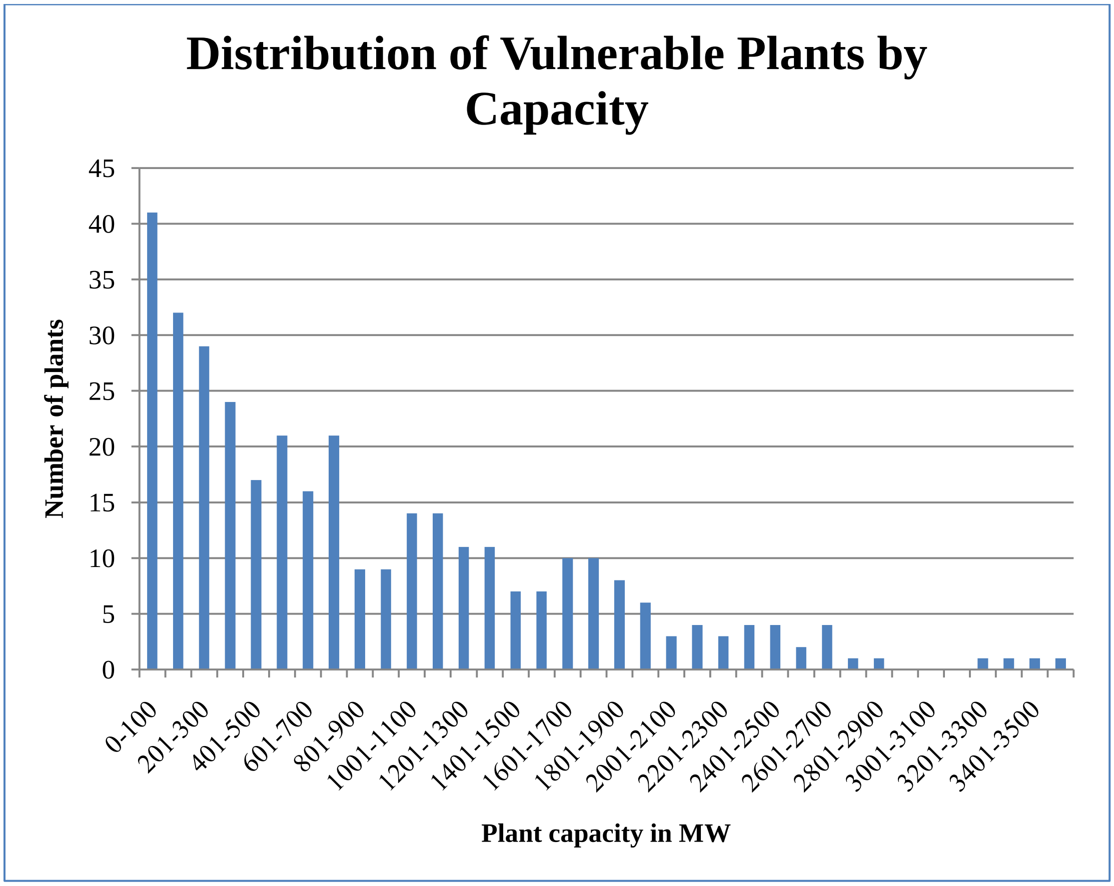

FIGURE 3-11 Distribution of Vulnerable Plants by Capacity

3.2 Area Demand Indicators

3.2.1 Areas with Projected Increases in Water Consumption by Thermoelectric Power

Aggregate water consumption data (from NETL 2007b, Case 2) by power plants for each North American Electric Reliability Council (NERC) region in 2005 were compared with projected water consumption data for 2030. Power plants in NERC regions with a projected change in consumption of more than 100% were considered to have a major vulnerability, and plants in NERC regions where the projected change in consumption was between 50% and 100% were considered to have a moderate vulnerability for this indicator. Twenty plants in Florida, California, and New York are in areas where projected increases in water consumption by thermoelectric power plants are greater than 100%, and 58 plants in the Northeast (New Hampshire, Connecticut, Maine, Massachusetts), the mid Atlantic (Maryland, New Jersey, Delaware) and the West (Arizona, Colorado, New Mexico, Nevada, Oregon, Montana) are in areas with projected increases in water consumption for thermoelectric power generation of 50-100%. Appendix B shows which plants are in areas with high projected increases.

3.2.2 Areas with High Levels of Projected Water Consumption by All Users

Figure 3-12 shows the locations of existing coal-fired power plants with respect to projected total water consumption rates in 2030, including thermoelectric power. Areas with high projected consumption may experience competition among various users, making high water consumers such as power plants vulnerable to demand constraints. Plants in areas with total projected consumption rates by all users of greater than 2 bgd are assumed to have a major vulnerability for this indicator, and plants in areas with total projected consumption rates of between 0.5 and 2 bgd are considered to have a moderate vulnerability. Seventy-one plants are in areas with consumption rates by all users of 2 bgd or higher, and 84 are in areas with consumption rates by all users of between 0.5 and 2 bgd. Appendix B identifies these plants and the consumption rates of the areas in which they are located.

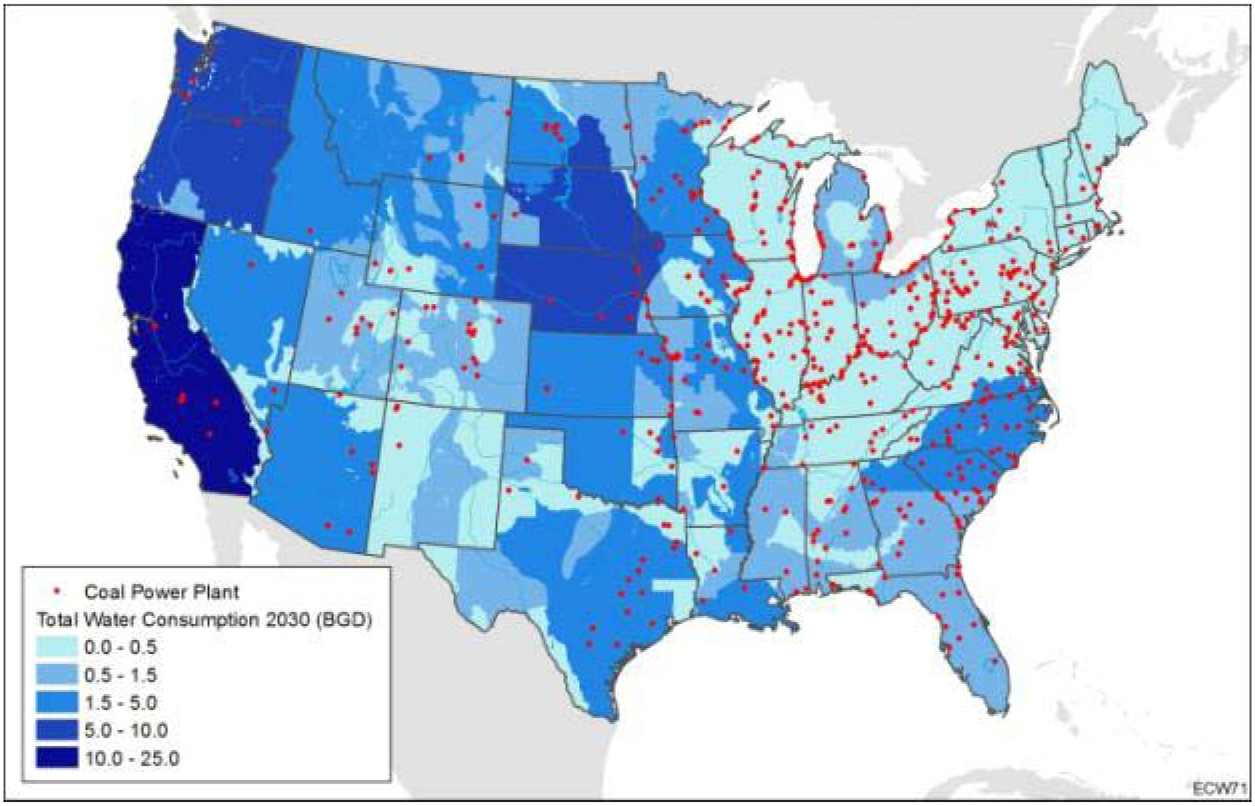

FIGURE 3-12 Power Plant Locations and Projected Water Consumption by All Users, 2030

3.2.3 Areas with Significant Projected Increases in Consumption by All Users

Because total consumption is assumed to be constant throughout a given (and typically large) area, the area consumption indicators can mask local areas where consumption may be particularly high (or low) relative to the average value over the larger area. Also, some areas where projected consumption rates are not necessarily high in 2030 may nonetheless experience a significant increase in consumption between 2005 and 2030. Plants in these high-growth areas can be subject to increased competition over the next several years. To identify these high-growth areas, the approach used earlier to identify areas with high increases in water consumption by thermoelectric plants was used to identify areas with high consumption increases by all users. In this case, plants in areas where the percent change in water consumption by all users was 50% or more were considered to have a major vulnerability, and plants in areas where the percent change was up to 50% were considered to have a moderate vulnerability. That the percentage cutoffs differ between thermoelectric (major vulnerability if increase is more than 100%) and total water consumption (major vulnerability if increase is 50% or more) underlines the fact that water consumption for thermoelectric is predicted in general to increase at a faster rate than water consumption by all users between 2005 and 2030. By using data from the Phase I study and NETL (2007b), aggregate water consumption for all uses in 2005 (including thermoelectric, e.g., NETL Case 2) was compared with that projected in 2030. Forty plants (mostly in the Midwest) are in areas where projected increases in water consumption are 50% or more (largely due to projected increases in irrigation for biofuels over the next several years). About 30 plants are in areas where projected water consumption by all users is up to 50%; these plants are primarily in the growing areas of the Southeast. Appendix B identifies plants in areas with projected increases in total water consumption by 2030.

3.2.4 Areas with High Water Withdrawals

Even though a substantial portion of withdrawn water is often returned to its source, during periods of low flow or in areas of increasing competition, the water available may be insufficient to meet the needs of all users. The intensity of freshwater withdrawal (in gpd/mi^2) is used to indicate water withdrawal. Power plants in states where freshwater withdrawal intensity is between 220,000 and 330,000 gpd/mi^2 are considered to have a major vulnerability with respect to water withdrawal, and plants in states where withdrawal intensity is between 150,000 and 220,000 are considered to have a moderate vulnerability. Figure 3-13 shows that 113 plants are in states with a water withdrawal intensity rate of between 220,000 and 330,000 gpd/mi^2, and 16 plants are in states with an intensity rate of between 150,000 and 220,000 gpd/mi^2. Appendix B identifies specific plants with major or moderate vulnerabilities to freshwater withdrawal intensity.

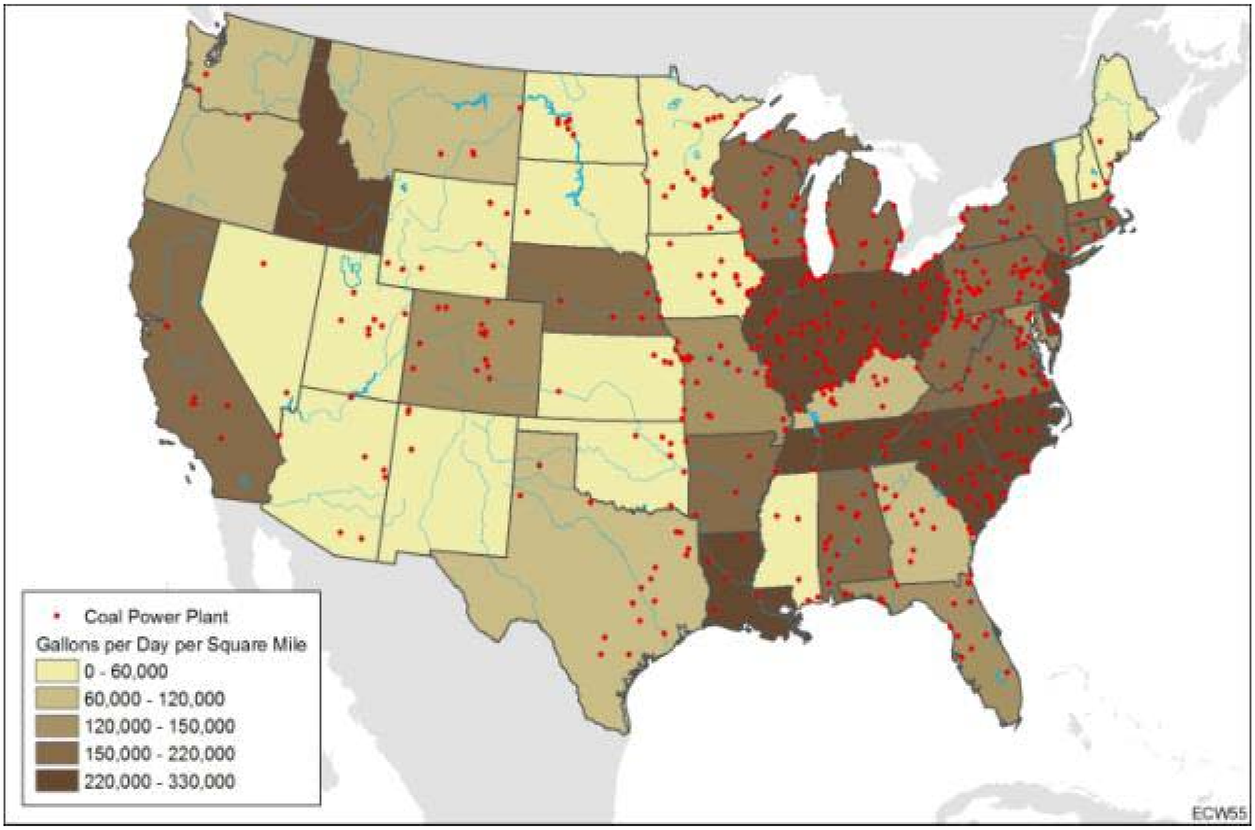

FIGURE 3-13 Power Plant Locations According to Intensity of Freshwater Withdrawals (Sources: based on NETL 2007a and Kenny et al. 2009)

3.2.5 Population

Increasing population density leads to increasing water demand. Plants in areas where the projected increase in population per square mile between 2000 and 2030 is greater than 100 are considered to have a major vulnerability, and plants in areas where the projected increase is between 51 and 100 per square mile are considered to have a moderate vulnerability. Figure 3-14 shows the projected population increases per square mile between 2000 and 2030 for the contiguous U.S. states and also the locations of existing plants. There are 21 plants in states with projected population density increases of more than 100 per square mile and 53 in states with projected increases of between 51 and 100. Appendix B identifies plants with major and moderate vulnerabilities for population growth.

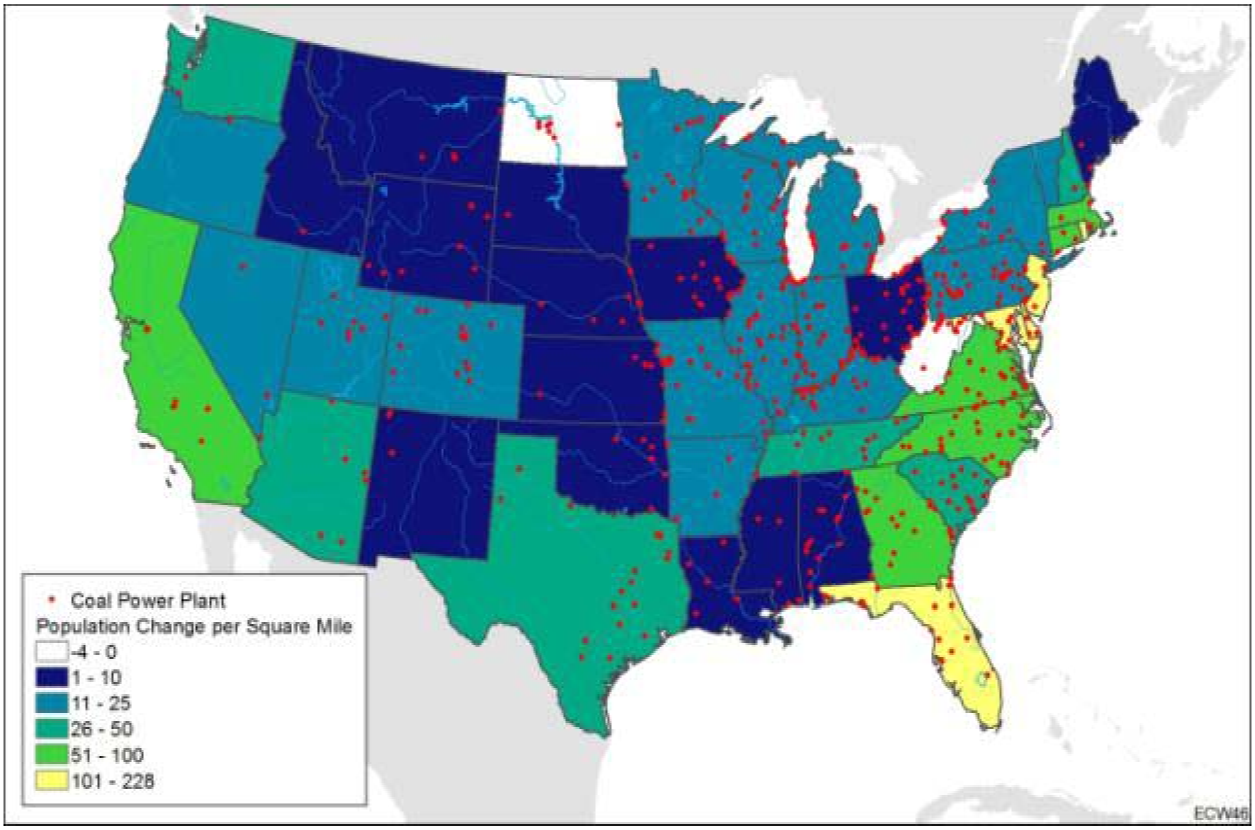

FIGURE 3-14 Power Plant Locations According to Change in Population per Square Mile 2000–2030 (Sources: Based on NETL 2007a and US Census Bureau 2005)

3.2.6 Potential Crisis/Conflict Areas

In 2003, the U.S. Bureau of Reclamation identified and mapped potential crisis/conflict areas in the western United States on the basis of data on hydrologic conditions, weather patterns, endangered species locations, and population growth (U.S. Bureau of Reclamation 2005). Figure 3-15 shows the locations of plants relative to these areas. There are 11 plants in areas identified as highly likely to have potential water conflicts by 2025, and 4 plants in areas identified as having a substantial likelihood of potential conflict by 2025. Salient characteristics of these 15 plants are shown in Table 3-4. When assessed in conjunction with other demand and supply indicators, 11 of these plants will be among the 100 most vulnerable in the country (see Section 3.5).

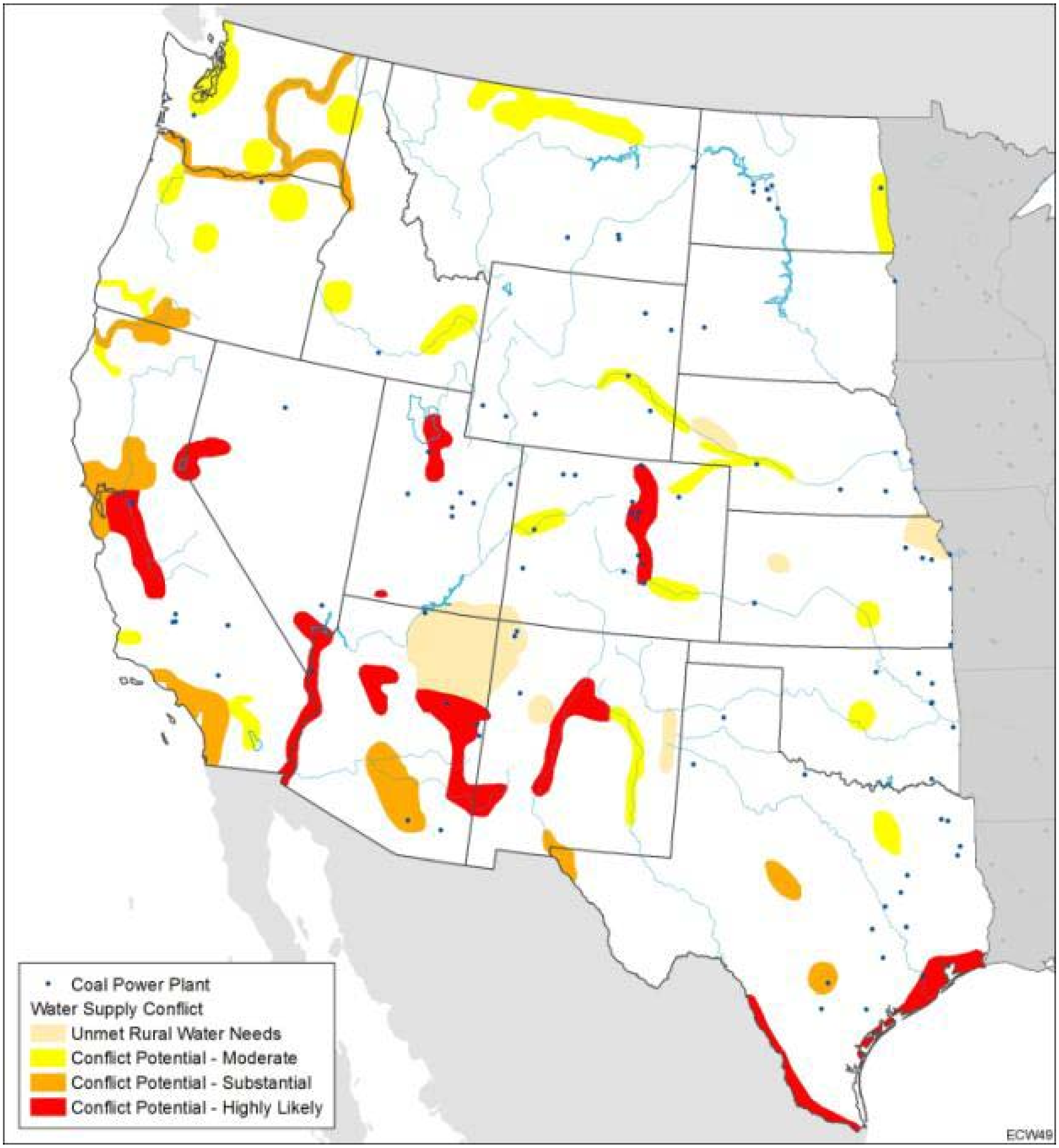

FIGURE 3-15 Plants and Projected Western Water Supply Crisis Areas, 2025 (Sources: Based on NETL 2007b and U.S. Bureau of Reclamation 2005)

TABLE 3-4 Selected Demand and Supply Indicators for Plants Projected to Have a High or Substantial Likelihood of Water Conflict in 2025 (by Plant Name)

Plant Name	State	Primary Cooling System	Cooling Water Source	Potential Crisis Areas – 2025	2030 Water Consumption - All Users (mgd)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Drought Trends	Generator Nameplate Rating (MW)
Boardman	OR	Recirculating with cooling pond(s) or canal(s)	Carty Reservoir	Substantial	5,600	60	11.6	1,184	Increasing drought	601
Cherokee	CO	Recirculating with forced draft cooling tower(s)	Platte River	Highly likely	190	55	7.0	509		802
Cholla	AZ	Recirculating with induced draft cooling tower(s)	Wells	Highly likely	3,740	55	0.0	–		1,129
Comanche	CO	Recirculating with forced draft cooling tower(s)	Arkansas River	Highly likely	770	55	6.0	511		1,599
Coronado	AZ	Recirculating with forced draft cooling tower(s)	Wells	Highly likely	3,740	55	8.0	482		822
H. Wilson Sundt Generating Station	AZ	Recirculating with forced draft cooling tower(s)	Wells	Substantial	3,740	55	1.3	602	Increasing drought	173
Hawthorn	MO	Once-through, freshwater	Missouri River	Substantial	990	45	0.0	–	Increasing drought	737

TABLE 3-4 (Cont.)

Plant Name	State	Primary Cooling System	Cooling Water Source	Potential Crisis Areas – 2025	2030 Water Consumption - All Users (mgd)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Drought Trends	Generator Nameplate Rating (MW)
J. T. Deely	TX	Recirculating with cooling pond(s) or canal(s)	Calaveras Lake Make-up FR	Substantial	3,450	9	12.1	746	Increasing drought	932
Martin Drake	CO	Recirculating with induced draft cooling tower(s)	Municipal	Highly likely	770	55	3.1	553		257
Mohave	NV	Recirculating with forced draft cooling tower(s)	Colorado River	Highly likely	3,740	55	16.2	560	Significantly increasing drought	1,636
Rawhide	CO	Recirculating with cooling pond(s) or canal(s)	Municipal treated sewage	Highly likely	3,230	55	4.5	859		294
Ray D. Nixon	CO	Recirculating with induced draft cooling tower(s)	Wells	Highly likely	770	55	2.5	602		207
Springerville	AZ	Recirculating with induced draft cooling tower(s)	Wells	Highly likely	3,740	55	7.6	457		850
Valmont	CO	Recirculating with cooling pond(s) or canal(s)	South Boulder Creek	Highly likely	650	55	3.3	802		192
W. A. Parish	TX	Recirculating with cooling pond(s) or canal(s)	Brazos River	Highly likely	3,450	9	12.6	248		2,698

3.3 Plant-Specific Demand Indicators

3.3.1 Net Annual Electrical Generation

Under the assumption that plants with higher electrical generation rates will be more vulnerable to water shortages than those with lower generation rates (because finding substitute power in the event of a shutdown or reduction in output due to water supply issues would be more difficult for larger plants), net annual electrical generation was used as a plant-specific demand indicator. Plants with net annual electrical generation rates of 10,000,000 MWh or more were assumed to have a major vulnerability for generation, and plants with generation rates of 5,000,000–10,000,000 MWh were assumed to have a moderate vulnerability. The range of net annual electrical generation for all 580 plants in the analysis set is about 300 to 24,000,000 MWh, while the mean is about 3,500,000, and the median is about 1,500,000. Figure 3-16 shows plants in the analysis set according to net annual generation and location. Of the 580 plants in the analysis set, 55 generated 10,000,000 MWh or more per year, and 84 generated between 5,000,000 and 10,000,000 MWh per year. The range in net annual generation for the 347 vulnerable plants is about 700 to 24,000,000 MWh, the average is about 5,200,000 MWh, and the median is about 3,600,000. The higher generations for the 347 vulnerable plants relative to the 580 in the analysis set may be the result, at least in part, of the fact that the criteria used for identifying vulnerable plants include net annual generation.

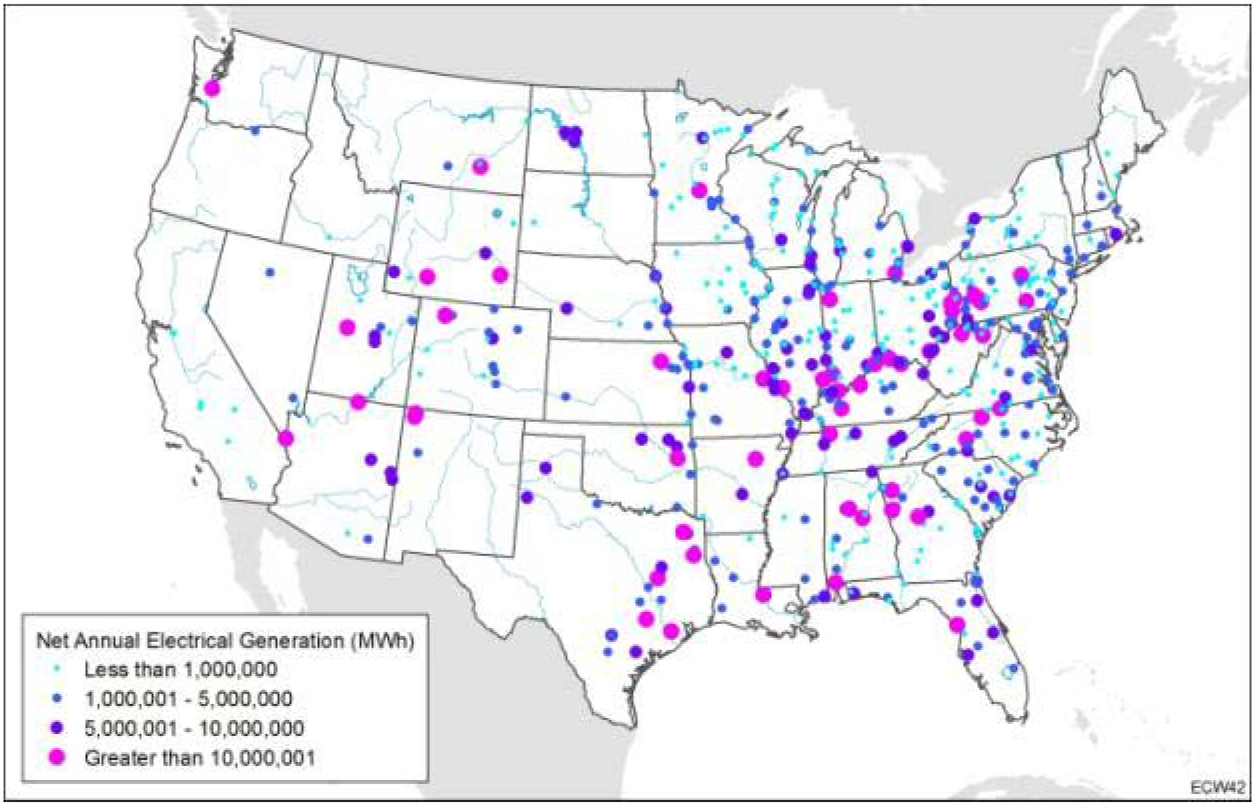

FIGURE 3-16 Power Plants According to Net Annual Electrical Generation (Source: Based on NETL 2007a)

3.3.2 Plant-Specific Water Consumption

Water consumption by power plants can be considered in absolute terms (i.e., consumption rate [mgd]) and in relative terms (i.e., intensity [gal/MWh]). The consumption rate metric enables comparisons of water consumption among competing users, including other power plants, and the intensity metric can indicate plant-level water use efficiency (or inefficiency). Of the 347 vulnerable plants, 296 have water consumption and withdrawal data, and of the 580 plants in the analysis set, 368 have water consumption and withdrawal data. The discussion in this section pertains to those plants that have consumption data.

Consumption rates. Water consumption for plants in the analysis set (with water data) range from zero to 55 mgd, although relatively few plants reported consumption rates greater than 20 mgd. Plants with average annual cooling water consumption rates of more than 10 mgd were considered to have a major vulnerability for consumption, and plants with consumption rates of between 5 and 10 mgd were considered to have a moderate vulnerability. Seventy plants had consumption rates of more than 10 mgd, and 38 had consumption rates of 5–10 mgd. Figure 3-17 shows plants with once-through and recirculating systems according to their consumption rates, and Table 3-5 compares water consumption rates (median, mean, and range) for the vulnerable plants with those for all plants in the analysis set. Because of the considerable range in water consumption rates across power plants, and the likelihood that some plants with anomalous data may remain despite efforts to remove them,[4] median estimates may be more representative than average estimates. Appendix B shows the consumption rates for all of the vulnerable plants.

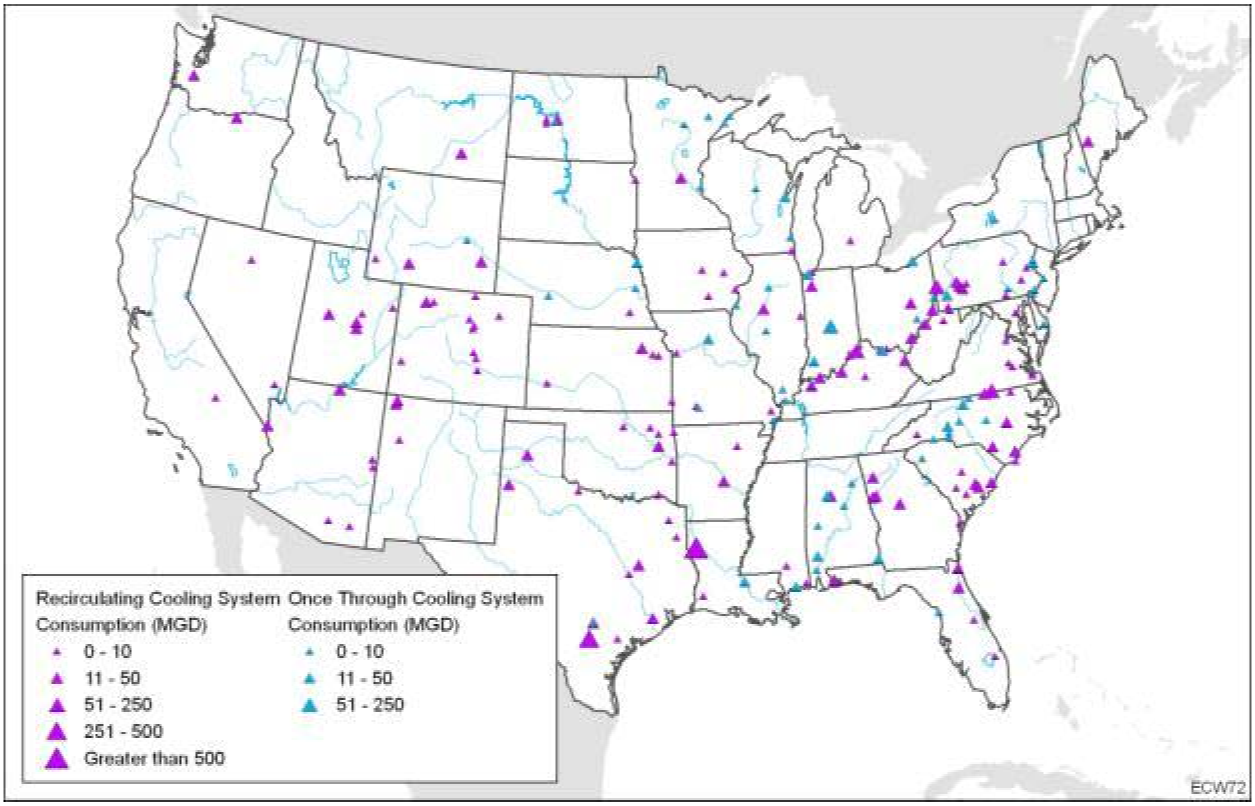

FIGURE 3-17 Water Consumption — Plants with Once-Through and Recirculating Systems (Source: Based on NETL 2007a)

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[4] As noted in Chapter 2, obvious outliers (plants with data far outside of the general ranges for water consumption and withdrawal and net electrical generation) were removed from the analysis set. However, it is likely that several data errors, discrepancies, and misrepresentations remain.

TABLE 3-5 Average Annual Water Consumption for Vulnerable Plants, Compared with All Plants in Analysis Set

Cooling System	Vulnerable Plants				All Plants in Data Set			
	Average Annual Consumption (mgd)			No. of plants	Average Annual Consumption (mgd)			No. of plants
	Median	Mean	Range		Median	Mean	Range	
Once-Through	0	3	0–48	162	0	2	0–48	211
Cooling Ponds	0	2	0–11	17	0	2	0–11	20
Freshwater	0	3	0–48	128	0	2	0–48	172
Saline Water	0	1	0–10	17	0	1	0–10	19
All Recirculating	7	11	0–55	134	5	9	0–55	157
Cooling Ponds	4	8	0–49	24	3	7	0–49	28
Forced Draft	7	11	0–55	46	4	9	0–55	60
Induced Draft	5	9	0–32	40	4	8	0–32	44
Natural Draft	12	17	0–55	24	12	16	0–55	25
All Once-Through and Recirculating	2	6	0–55	296	1	5	0–55	368

Source: Based on NETL (2007a).

Overall, the median water consumption rate for the vulnerable power plants is about twice that of all plants in the analysis set (2 mgd vs. 1 mgd). However, as expected, there is a considerable range in consumption levels depending on the type of cooling system. The median daily consumption for power plants using once-through cooling is zero, whereas for plants using recirculating systems, the median is about 7 million gallons, with the amount also varying significantly by type of recirculating system. The median consumption rate for vulnerable plants using natural draft cooling towers is about 12 mgd. This amount is almost twice that of the next-highest median recirculating system’s consumption rate of 7 mgd for forced draft cooling systems. The median consumption rates for induced draft and cooling pond recirculating systems are about 5 mgd and 4 mgd, respectively. These same relative variations occur for the plants in the analysis set (with data) as a whole, but, as expected, the rates are slightly lower for all cooling types (Table 3-5).

All told, the amount of water consumed on a daily basis for the 134 vulnerable plants (with consumption data) that use recirculating systems is about 1.4 bgd. This amount is about 40% of the 3.6 bgd consumed by all thermoelectric plants and about 60% of the 2.4 bgd consumed by all coal-fired power plants (in 2005, the base year). It is worth noting that that if these plants were to install carbon-capture equipment and their consumption rates increased by the projected 30% (see section 2.1), the water consumption for the vulnerable pants with recirculating systems would be about one-half of that consumed by all thermoelectric plants and about three-fourths of that consumed by all coal-fired power plants. These shares are likely to be higher, because the 1.4 bgd value applies only to those plants with water consumption data and does not include the water consumed by the 51 vulnerable plants that did not report water data.

Consumption intensity. Water consumption intensity was estimated for each plant by multiplying the plant-specific average annual rate of cooling water consumed (converted to mgd) by 365 days and dividing that product by the plant-specific net annual electrical generation (in MWh). Plants with water consumption intensities greater than 5,000 gal/MWh were considered to have a major vulnerability, and eight such plants were identified. Plants with intensities between 1,000 and 5,000 gal/MWh were considered to have a moderate vulnerability, and 22 such plants were identified. Appendix B provides the consumption intensities for each of the vulnerable plants.

Table 3-6 shows that the median cooling water intensity for vulnerable plants that use recirculating cooling systems is 512 gal/MWh and that the median for all plants in the analysis set that use recirculating systems is lower (as would be expected) at 497 gal/MWh. As with consumption rates, consumption intensities vary with type of cooling system. However, with the exception of recirculating systems that use cooling ponds (which have both the lowest consumption rates and the lowest consumption intensities among all of the recirculating systems), there is little consistency among the different cooling systems with respect to the two measures. For example, while the natural draft systems had the highest consumption rates (median of 12 mgd/day), they have the lowest consumption intensity (423 gal/MWh) of the three types of noncooling-pond recirculating systems. This result could occur because the natural draft towers are often used at plants that have higher capacities and higher net annual generation levels than the other types of recirculating cooling systems, so that on a gal/MWh basis, they are actually more efficient.

The median consumption intensities for recirculating systems in the vulnerable plants are also higher than those reported in other studies. For example, by using data in NETL (2009b), a weighted average consumption intensity factor of 447 gal/MWh was calculated for existing plants with recirculating systems.[5] This value is lower than both the 512 gal/MWh median value for vulnerable plants (as would be expected) and the 497 gal/MWh value for all plants in the analysis set. That the calculated NETL factor is lower than the median consumption factor in the analysis set can be explained, at least in part, by two factors. First, the assumptions that were made in calculating a weighted average NETL consumption intensity may be incorrect. (For example, it was assumed that each of the three flue gas desulfurization (FGD) treatment scenarios would have equal weight, but they may not have equal weights.) Second, to reflect operating practices in which cooling water flows through the condenser are maintained at full design rates, NETL calculated consumption factors on the basis of plant capacity rather than on net electrical generation. Because the current analysis calculates intensity on the basis of reported generation (which is less than full capacity), the calculated plant-specific intensities in this study are higher than those calculated by NETL.

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[5] A weighted average consumption intensity factor was calculated by using the following procedure: For each type of cooling system (once-through and recirculating), NETL (2009b) provides separate factors for two types of plants (subcritical and supercritical) and for three types of FGD treatment (wet FGD, dry FGD, and no FGD), yielding a total of six factors for each type of cooling system. To calculate an average factor, this analysis assumes that the weights for each type of FGD system are the same (1/3 wet, 1/3 dry, and 1/3 no FGD), and the weights for the two types of power plant are 73% subcritical and 27% supercritical.

NETL has developed another benchmark intensity factor for new recirculating plants. This factor, 481 gal/MWh, is also lower than both the value for the vulnerable plants (i.e., 512 gal/MWh, again as expected) and for all the plants in the analysis set (i.e., 497 gal/MWh). In this case, the lower factor may reflect newer technologies that are more efficient than those in use at the existing plants, many of which are more than 50 years old. Finally, the Electric Power Research Institute (EPRI) reported a consumption intensity of 480 gal/MWh for recirculating plants (EPRI 2002) — virtually the same as that for the new recirculating plants. However, this factor is for all fossil plants, including oil and natural gas, which may bring down the average. The bottom line is that, as expected, the consumption intensity for the vulnerable plants is higher than those of the other benchmarks.

Consumption intensity is less of an issue for plants that use once-through systems than for those that use recirculating systems, because so little water is consumed. It is also more difficult to assess, because the median consumption intensity for plants — both the vulnerable plants and the plants in the analysis set — is zero regardless of the type of once-through system (although the means are 514 and 401 gal/MWh, respectively). The actual consumption intensities are likely somewhere between the median and the mean, and most likely toward the lower end of that range. Other benchmarks for once-through consumption intensity include a factor of 104 gal/MWh, which was based on data in NETL (2009b) and calculated in the same manner as the consumption intensity factor for recirculating systems described above, and 300 gal/MWh from EPRI (2002). With respect to the 300 gal/MWh intensity factor, EPRI stated that for once-through cooling systems, “only a small quantity (about 1%) is consumed via increased evaporation to the atmosphere from the warm discharge water plume.” EPRI also reported that once-through steam plant cooling with fossil fuels withdraws about 20,000–50,000 gal/MWh — and 300 gal/MWh would be about 1% of the withdrawal rate.

TABLE 3-6 Average Annual Water Consumption Intensity for Vulnerable Plants, Compared with All Plants in Analysis Set (mgd)

Cooling System	Vulnerable Plants				All Plants in Data Set			
	Consumption Intensity (gal/MWh)			No. of plants	Consumption Intensity (gal/MWh)			No. of plants
	Median	Mean	Range		Median	Mean	Range	
Once-Through	0	514	0–24,400	162	0	401	0–24,400	211
Cooling Ponds	0	568	0–6,700	17	0	520	0–6,700	20
Freshwater	0	562	0–24,400	128	0	421	0–24,400	172
Saline Water	0	97	0–980	17	0	87	0–980	19
All Recirculating	512	965	0–22,500	134	497	832	0–22,500	157
Cooling Ponds	233	1,335	0–22,500	24	233	1,177	0–22,500	28
Forced Draft	506	604	0–2,910	46	493	627	0–4,300	60
Induced Draft	594	1,141	0–15,650	40	565	1,073	0–15,650	44
Natural Draft	423	494	0–1,205	24	431	510	0–1,205	25
All Once-Through and Recirculating	247	718	0–22,500	296	110	585	0–24,400	368

Source: NETL (2007a).

3.3.3 Plant-Specific Water Withdrawal

As with water consumption, water withdrawal can be considered in terms of rate (mgd) and intensity (gal/MWh). Also, as with water consumption, not all plants in the analysis set have withdrawal data; the discussion in this section pertains to the plants that have withdrawal data.

Withdrawal rates. Water withdrawal rates for plants in the analysis set range from zero to more than 2,000 mgd, although relatively few plants reported withdrawal rates greater than 1,000 mgd. Most plants with recirculating cooling systems reported rates of less than 20 mgd, and most with once-through systems reported rates of less than 400 mgd. Plants with average annual cooling water withdrawal rates of more than 400 mgd were considered to have a major vulnerability for withdrawal, and plants with withdrawal rates of between 150 and 400 mgd were considered to have a moderate vulnerability. The roughly 90 plants identified as having a major vulnerability and the 55 identified as having a moderate vulnerability are identified in Appendix B.

Figure 3-18 shows plants according to their withdrawal rate and type of cooling system, and Table 3-7 compares water withdrawal rates (median, mean, and range) for the vulnerable plants with those for all plants in the analysis set. The median withdrawal rate for the vulnerable plants using once-through cooling systems (423 mgd) is 35 times the median withdrawal rate for vulnerable plants using recirculating systems (12 mgd). For water consumption, the pattern is reversed: The median consumption rate for the vulnerable plants using once-through systems is zero, while that for the recirculating plants is 7 mgd. The median withdrawal rate for all plants in the analysis set using once-through systems (284 mgd) is much lower than that of the vulnerable plants using once-through systems (423 mgd).

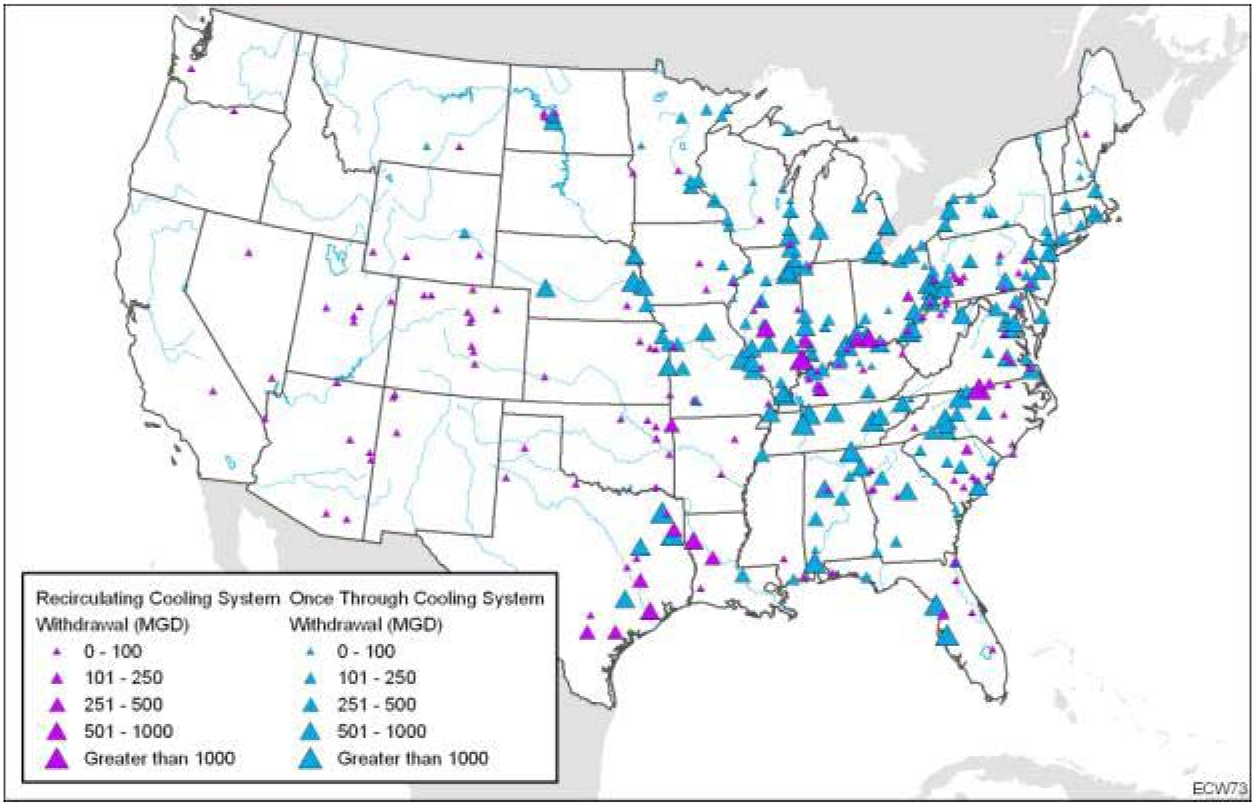

FIGURE 3-18 Water Withdrawal — Plants with Once-Through and Recirculating Systems (Source: Based on NETL 2007a)

TABLE 3-7 Average Annual Water Withdrawal for Vulnerable Plants, Compared with All Plants in the Analysis Set (mgd)

Cooling System	Vulnerable Plants				All Plants in Analysis Set			
	Average Annual withdrawal (mgd)			No. of plants	Average Annual withdrawal (mgd)			No. of plants
	Median	Mean	Range		Median	Mean	Range	
Once-Through	423	509	1–2,074	162	284	426	1–2,075	211
Cooling Ponds	505	598	70–1,942	17	413	519	8–1,943	20
Freshwater	423	499	1–2,074	128	277	413	1–2,075	172
Saline Water	351	489	49–1,188	17	299	444	12–1,188	19
All Recirculating	12	74	0–1,857	134	11	69	<1–1,858	157
Cooling Ponds	41	294	1–1,857	24	29	266	1–1,858	28
Forced Draft	9	14	0–87	46	7	18	<1–348	60
Induced Draft	6	16	1–219	40	6	15	1–219	44
Natural Draft	22	64	7–646	24	22	62	7–645	25
All Once-Through and Recirculating	150	312	<1–2,074	296	124	274	<1–2,075	368

Source: Based on NETL (2007a).

Water withdrawal intensity. Water withdrawal intensity is estimated for each plant by multiplying the plant-specific average annual rate of cooling water withdrawn (converted to mgd) by 365 days and dividing that product by the plant-specific net annual electrical generation (in MWh). Plants with water withdrawal intensities greater than 100,000 gal/MWh were considered to have a major vulnerability, and 10 such plants were identified. Plants with intensities between 50,000 and 100,000 gal/MWh were considered to have a moderate vulnerability, and 43 such plants were identified. Appendix B shows withdrawal rates for the vulnerable plants.

Table 3-8 shows that the median cooling water withdrawal intensity for vulnerable plants that use once-through systems is about 39,000 gal/MWh, or about 60 times the withdrawal intensity of plants that use recirculating cooling systems (632 gal/MWh). These rates are generally consistent with other benchmarks for water withdrawal intensity (Table 3-9). As with consumption rates, withdrawal rates will likely increase significantly as carbon-capture equipment is added to the existing plants.

TABLE 3-8 Average Annual Water Withdrawal Intensity for Vulnerable Plants, Compared with All Plants in Analysis Set (mgd)

Cooling System	Vulnerable Plants				All Plants in Data Set			
	Withdrawal Intensity (gal/MWh)			No. of plants	Withdrawal Intensity (gal/MWh)			No. of plants
	Median	Mean	Range		Median	Mean	Range	
Once-Through	38,486	53,019	287–722,000	162	38,796	49,860	287–722,000	211
Cooling Ponds	33,894	34,553	20,972–58,869	17	33,277	32,609	737–58,869	20
Freshwater	39,444	56,901	287–722,000	128	39,932	52,999	287–722,000	172
Saline Water	42,315	42,260	15,086–67,231	17	38,439	39,601	4,454–67,231	19
All Recirculating	632	4,508	0–86,322	134	632	4,509	0–86,322	157
Cooling Ponds	9,919	17,945	110–86,322	24	3,854	16,964	56–86,322	28
Forced Draft	552	1,168	0–19,070	46	566	1,784	0–34,247	60
Induced Draft	612	1,441	351–15,647	40	612	1699	351–15,647	44
Natural Draft	657	2,583	316–22,767	24	681	2,045	316–22,767	25
All Once-Through and Recirculating	24,559	31,058	0–722,000	296	27,143	30,512	0–722,000	368

Source: Based on NETL (2007a).

TABLE 3-9 Water Withdrawal Intensities for Vulnerable Plants Compared with Benchmarks (in gal/MWh)

Cooling System	Vulnerable Plants	Average Consumption Factor for Existing Plants[a]	Average Consumption Factor for New Plants[b]	Range for Existing Plants[c]
Once Through	38,500	26,000	NA	20,000–50,000
Recirculating	632	538	644	300–600

NA = not available.

[a] Based on NETL (2009b).

[b] Based on NETL (2009a). (Assumes no carbon capture and is based on the assumption that 73% of the plants are subcritical and 27% are supercritical.)

[c] EPRI (2002).

3.3.4 High CO_2 Emissions

Plants with high levels of CO_2 emissions can be expected to be among the first to install carbon-capture equipment, and as they do, their demand for cooling water can be expected to increase significantly. Annual plant-specific CO_2 emissions range from about 10,000 tons to more than 26,000,000 tons. Plants with reported CO_2 emissions greater than 10,000,000 tons are considered to have a major vulnerability, and 67 such plants were identified; plants with CO_2 emissions between 5,000,000 and 10,000,000 tons are considered to have a moderate vulnerability, and 81 of these were identified. These plants are identified in Appendix B.

3.4 Supply Vulnerabilities

Supply vulnerabilities for precipitation, temperature, and drought were recorded for each power plant through use of the GIS. The criteria described in Chapter 2 were then applied to determine, for each indicator, whether a given power plant was vulnerable to that indicator, and if so, if the vulnerability would be considered major or moderate. The findings for each indicator are presented in the following paragraphs. Appendix B identifies specific plants that have either a major or moderate vulnerability for each supply indicator.

3.4.1 Precipitation

Figure 3-19 shows the distribution of coal-fired power plants with respect to mean annual precipitation over the 1890–2002 time period. Plants in areas where the mean annual precipitation is less than 5 inches are considered to have a major vulnerability, and plants in areas where mean annual precipitation is 5–12 inches to have a moderate vulnerability. Three plants were identified as having a major precipitation vulnerability and 14 as having a moderate precipitation vulnerability.

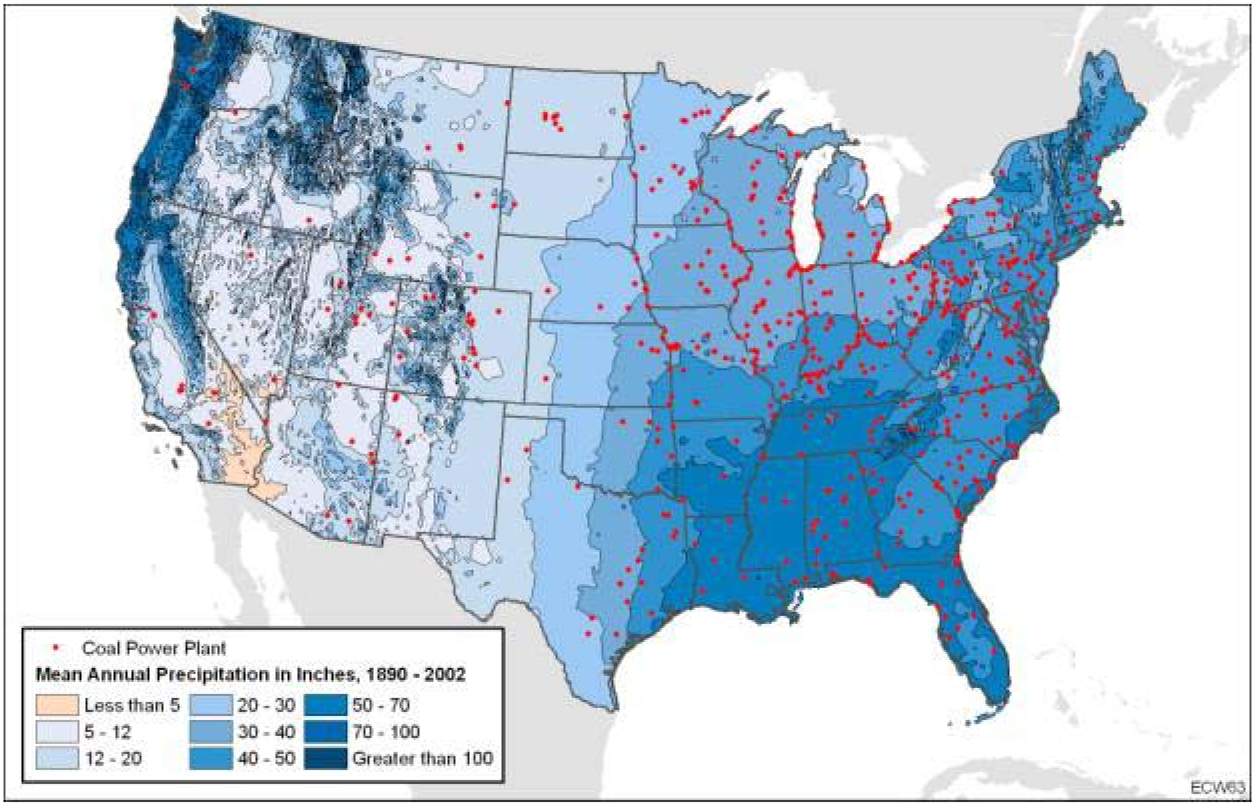

FIGURE 3-19 Power Plants and Mean Precipitation Rates, 1890–2002 (Sources: Anderson et al. 2005 and NETL 2007a)

3.4.2 Temperature

Figure 3-20 shows the distribution of coal-fired power plants with respect to mean annual temperature over the 1890–2002 time period. Plants in areas with mean annual temperatures greater than 70°F are considered to have a major vulnerability, and plants with mean annual temperatures of 65–70°F to have a moderate vulnerability. Eight plants were identified as having a major temperature vulnerability and 25 as having a moderate temperature vulnerability.

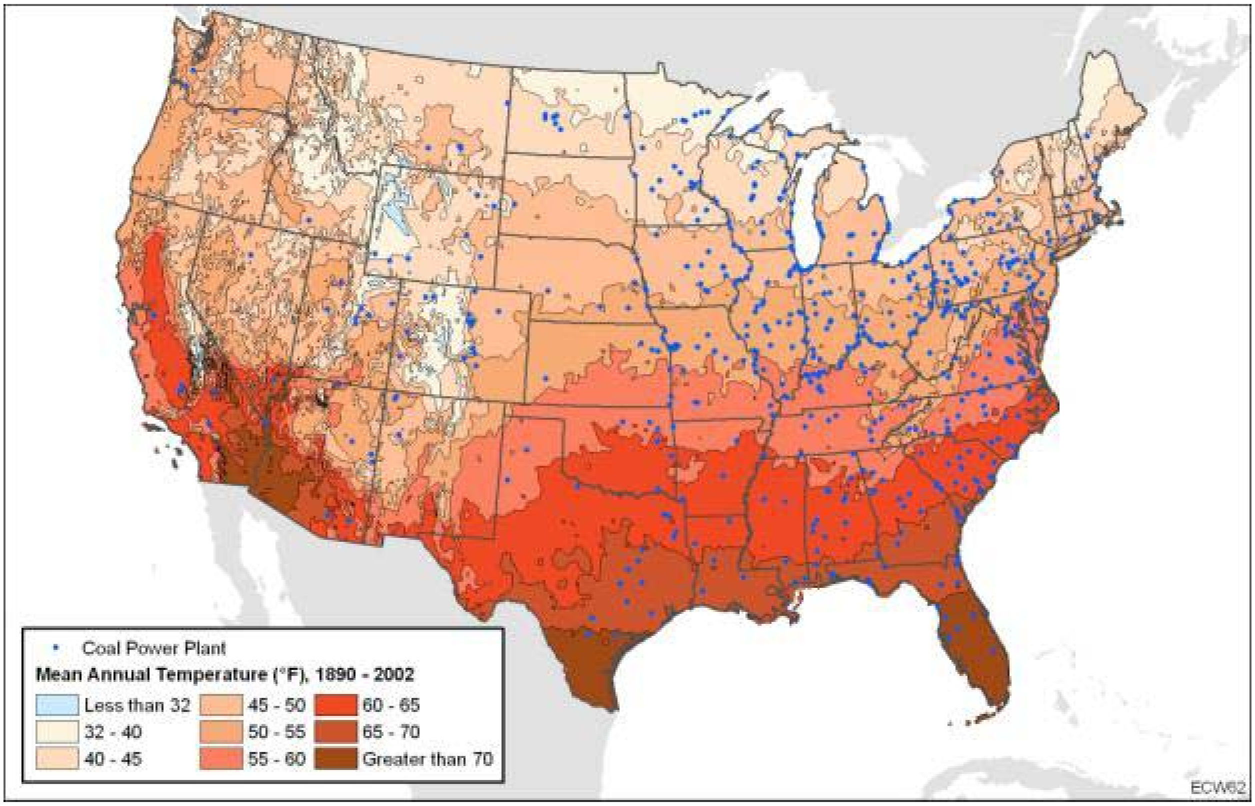

FIGURE 3-20 Power Plants and Mean Temperatures, 1890–2002
(Sources: Anderson et al. 2005 and NETL 2007a)

3.4.3 Streamflow

Figure 3-21 shows the distribution of plants according to statewide streamflow data, which compare 2008 streamflow levels to historical levels. Plants in areas with streamflow defined as dry or moderately dry were considered to have a major vulnerability for this indicator, and those defined as drier than normal were considered to have a moderate vulnerability. Although no plants were in "dry" areas, 35 were in "moderately dry" areas and hence have a major vulnerability, and 26 were in "drier than normal" areas and hence have a moderate vulnerability.

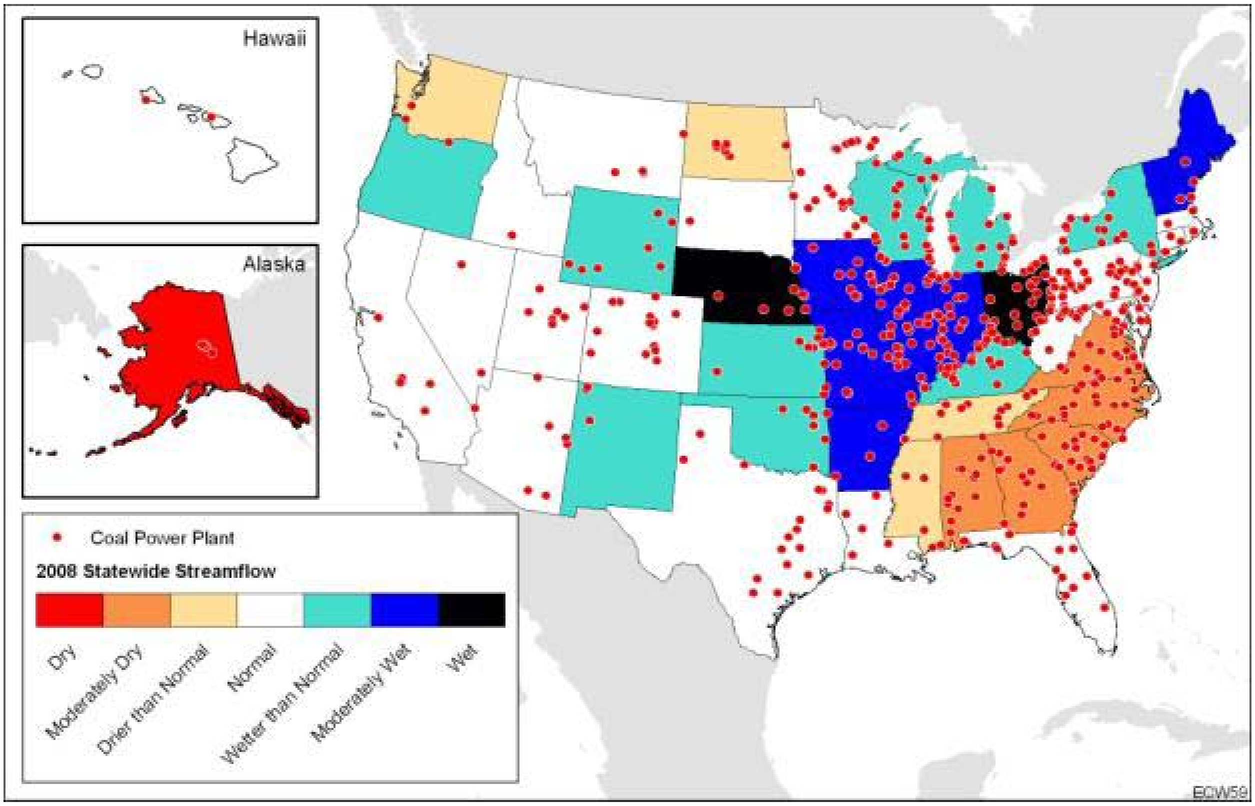

FIGURE 3-21 Power Plants and Statewide Streamflow, 2008 (Sources: USGS 2009 and NETL 2007a)

3.4.4 Drought

As explained in Chapter 2, three separate measures were used to indicate drought — the Standardized Precipitation Index (SPI), the Palmer Hydrological Drought Index (PHDI), and Observed Drought Trends 1958–2007. Figures 3-20, 3-21, and 3-22 show, respectively, the locations of power plants relative to each of these indicators, and Table 3-10 summarizes the results in terms of vulnerable plants.

TABLE 3-10 Existing Plant Vulnerabilities for Drought Indices

Indicator	Major Vulnerability		Moderate Vulnerability	
	Criteria	Number of Plants	Criteria	Number of Plants
Standardized Precipitation Index	Exceptionally, extremely, or severely dry (-1.30 and below)	0	Moderately Dry (-1.29 to -0.80)	12
Palmer Drought Index	Severe (-3.91 to -3.00)	4	Moderate (-2.99 to -2.00)	1
Observed Drought Trends 1958–2007	Significantly increasing	26	Increasing	176

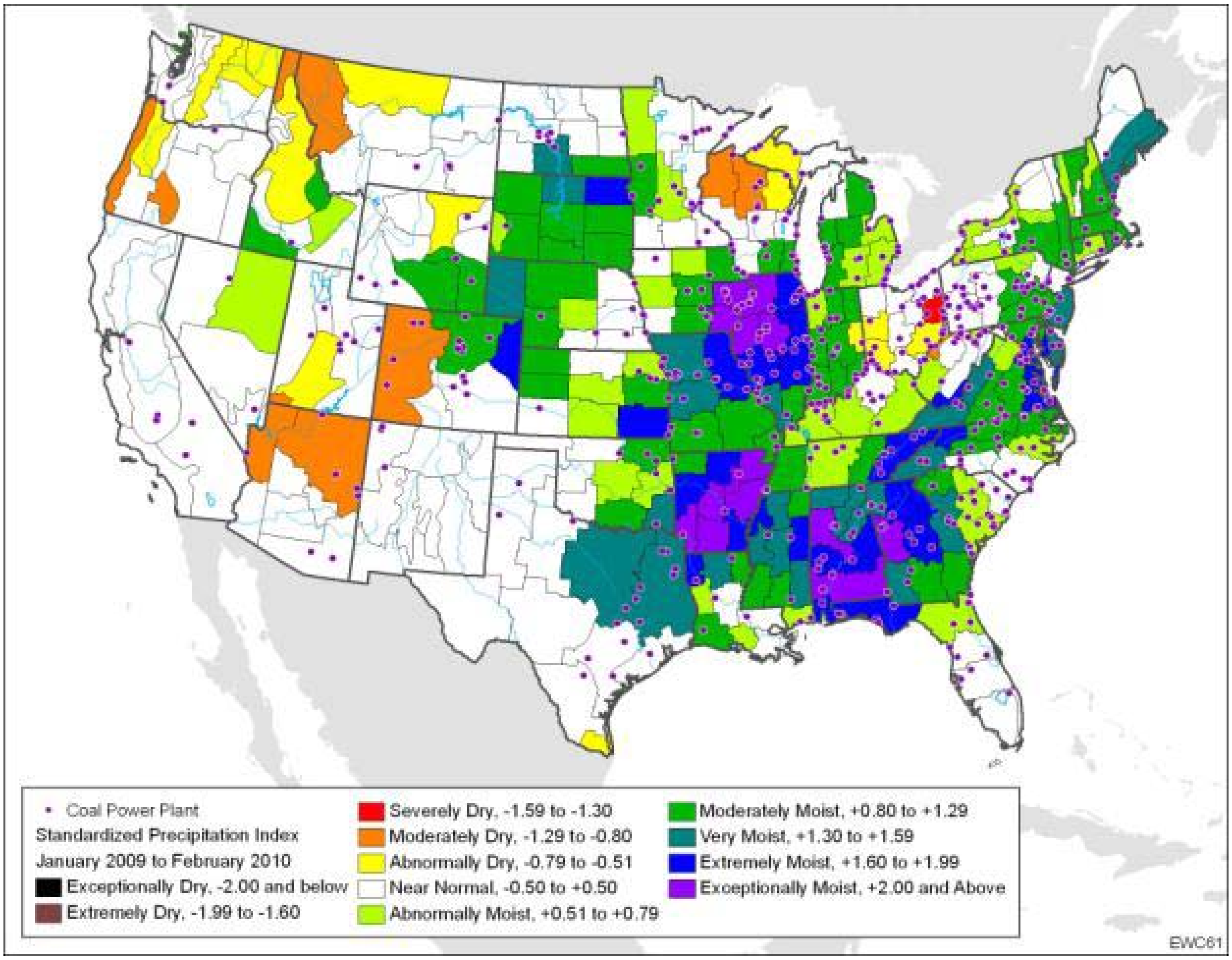

FIGURE 3-22 Power Plants and the Standardized Precipitation Index (Sources: NOAA 2010a and NETL 2007a)

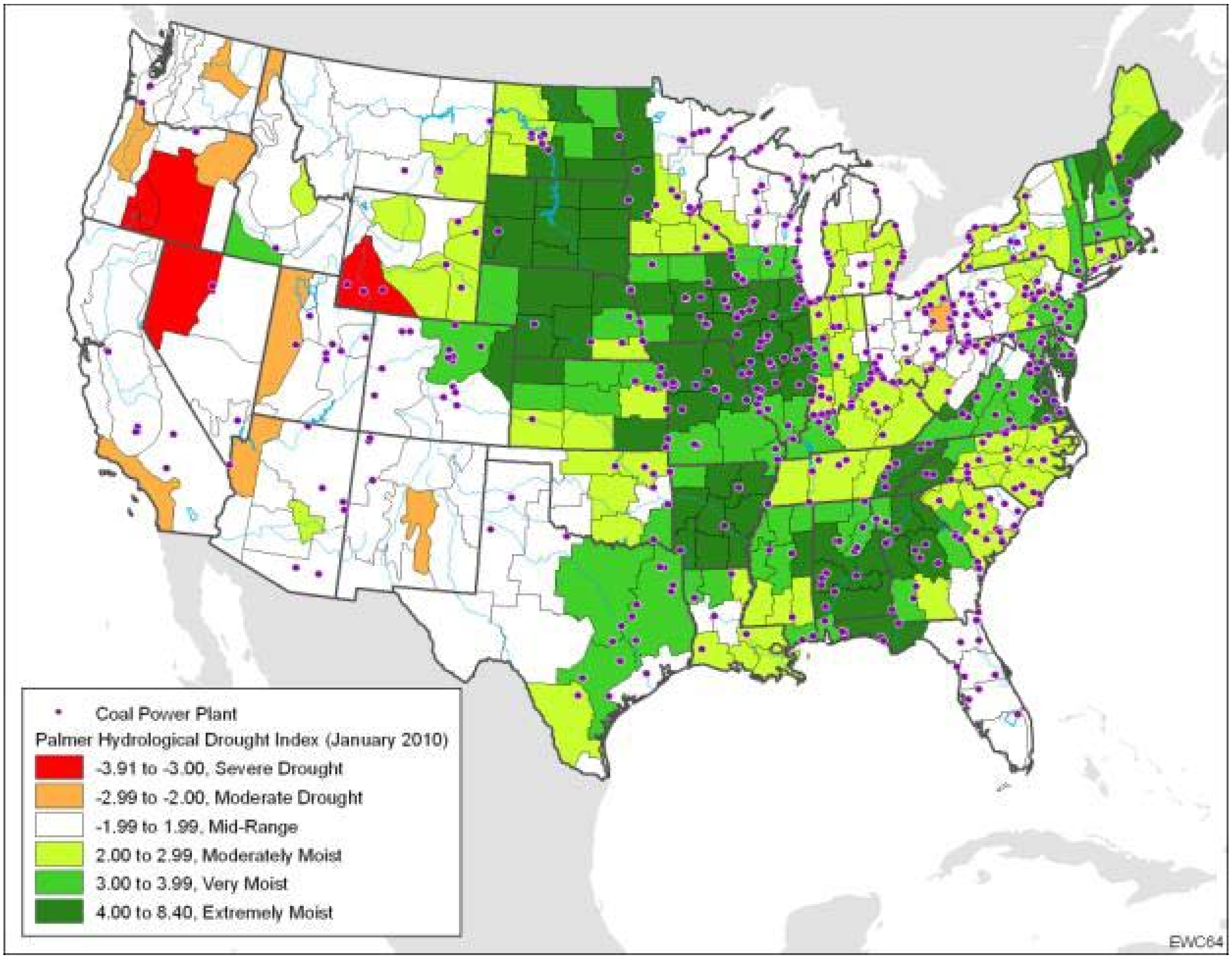

FIGURE 3-23 Power Plants and the Palmer Hydrological Drought Index (Sources: NOAA 2010b and NETL 2007a)

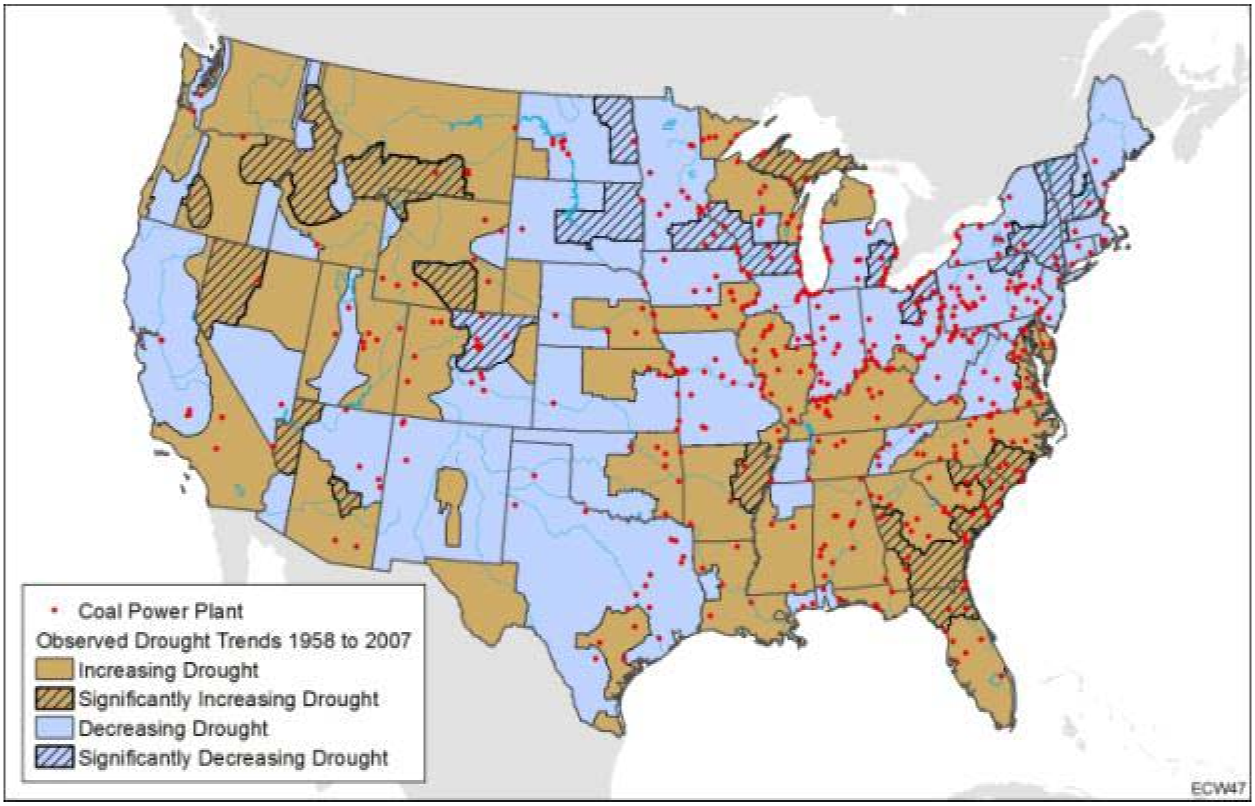

FIGURE 3-24 Power Plants and Observed Drought Trends, 1958–2007
(Sources: Karl et al. 2009 and NETL 2007a)

3.5 Site-Specific R&D efforts

The previous sections identify and characterize 18 demand and supply indicators for the 347 vulnerable plants. These sections also identify potential R&D areas associated with various characteristics and indicators that emerged during analysis of the data. This section offers an alternative, plant-specific approach for identifying R&D focus areas to help reduce freshwater consumption. This approach acknowledges that any specific water use objective will depend on site-specific conditions. That is, for some plants the objective may be to reduce total freshwater consumption. For others, it may be to reduce the intensity of freshwater consumption. For still others, the focus may be on withdrawal. Other plants may have different water-related objectives. To allow R&D to be directed toward plant-specific issues, this section provides a suggested approach. To focus this approach and provide a starting point for further analysis, it is suggested that the initial scope address only the 100 most vulnerable plants. (Other plants can be added later, and of course a subset of the 100 can be used to reduce the scope even further.) The 100 most vulnerable plants are those plants that had the highest total number of demand and supply vulnerabilities. Figure 3-25 shows the 100 most vulnerable plants; Figure 3-26 shows the locations of those plants with once-through cooling systems; Figure 3-27 shows those with recirculating systems; and in Appendix B, the 100 most vulnerable plants are at the top of the list. Indicator data (e.g., age, type of cooling system, cooling water source) for the 100 most vulnerable plants generally have the same patterns as those described in the previous sections for the 347 vulnerable plants.

FIGURE 3-25 Locations of the 100 Most Vulnerable Plants

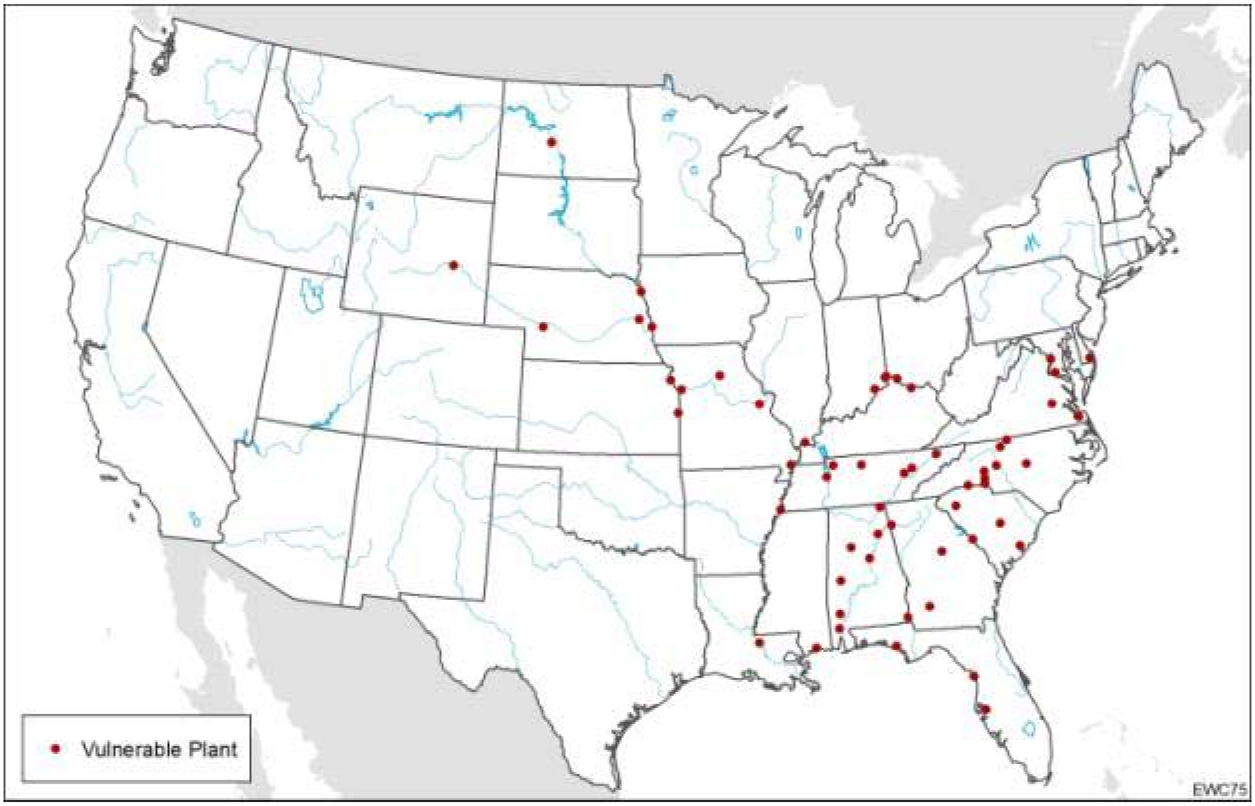

FIGURE 3-26 Locations of the 100 Most Vulnerable Plants That Have Once-Through Cooling Systems

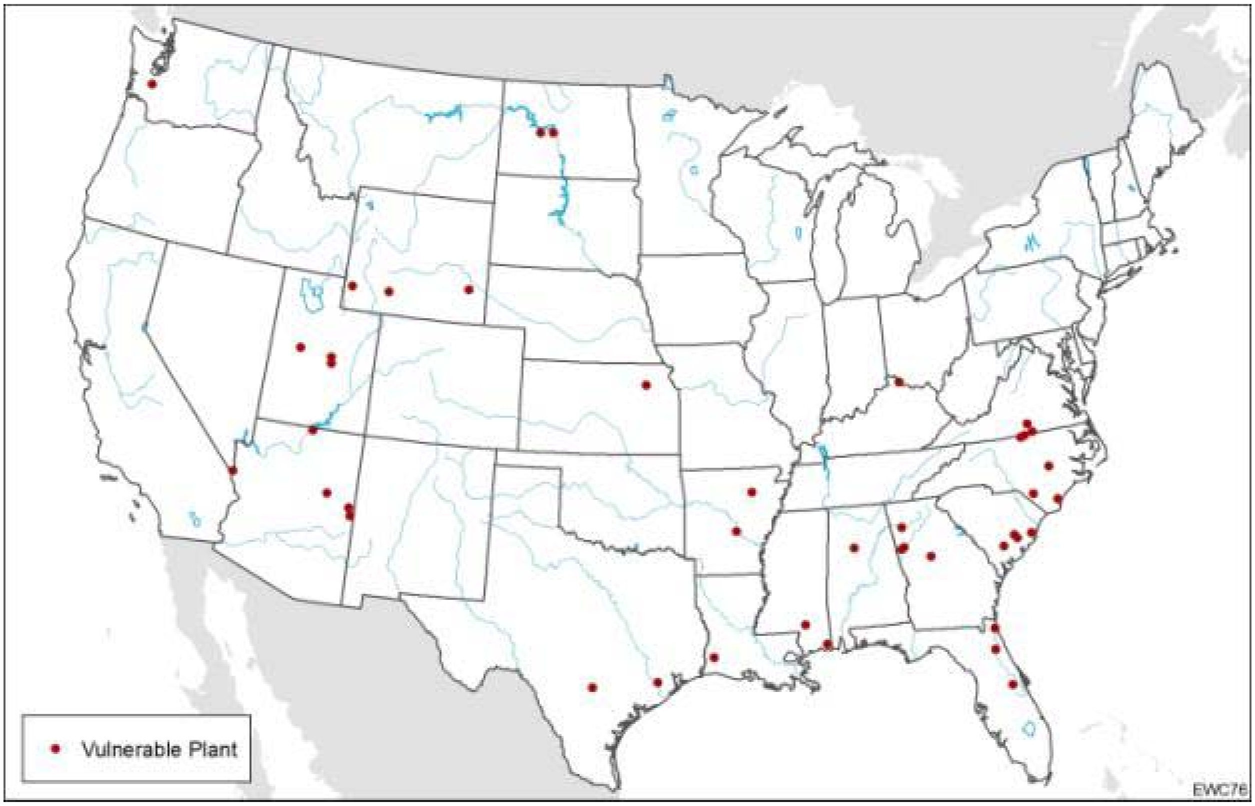

FIGURE 3-27 Locations of the 100 Most Vulnerable Plants That Have Recirculating Cooling Systems

To pursue this approach, the following steps are suggested:

1. *Verify and update data*. The power plant data in this study come from the most current NETL CPPDB, which reflects plant data as of 2005. While it is believed that most of the data will be similar to current conditions, there have been additions, retirements, and other changes since 2005 that are not reflected in the database or in this study. It is believed that the overall results of the study would not change significantly with the updated data and can be useful in directing R&D efforts toward general areas (e.g., plants of a certain age, increased use of alternative water sources). However, before examining specific plants, it will be important to ensure that the information is current and accurate. Rather than trying to update information for all 347 vulnerable plants, the 100 most vulnerable plants can provide an initial target. (Smaller subsets could, of course, be used as well). The verification effort would entail collecting information from the owners and operators via Internet searches and direct contacts.
2. *Determine the objective for the review*. For example, one objective could be to focus on a particular geographic area where there are several vulnerable plants. Another could be to focus on plants that consume relatively high amounts of water and are in areas where demand is expected to increase over the next several years. Another could be to focus on plants that have high withdrawal intensities in areas of reduced streamflow.
3. *Select plants* that would be targeted for further research by using the data in Appendix B.

4. *Work with the individual plants* directly or in partnership with a trade association or other interested party to identify specific operating, design, and other characteristics of the targeted plants that could provide clues as to how water is being used in the plant.
5. *Conduct R&D on the basis of these findings* to develop approaches (e.g., application of a different technology, practice, etc.) that could be used to mitigate the water need.

3.6 Potential Alternative Water Sources for Vulnerable Plants

The previous sections have identified vulnerable plants in 43 states that range in age from 1 to 87 years and that use both once-through and recirculating systems. Water use at these plants can be reduced by the application of technologies and equipment that are under development or that could be developed (e.g., on the basis of the findings in this and other water reports) to address specific plant characteristics associated with high water demand. Recommending specific technology applications is beyond the scope of this report (however, suggested R&D focus areas were identified earlier in this chapter and are summarized in Chapter 4).

The use of freshwater can also be reduced by substituting, where possible, nontraditional or recycled water from other activities. The GIS database was used to provide an initial overview of the potential applicability of some of these alternative water sources on the basis of their proximity to existing plants. The following sections discuss the locations of vulnerable plants relative to the following nontraditional water sources: saline aquifers, CBM fields, mine pools, oil and gas fields, and possibly — shale gas plays. The overview only considers proximity. Treatment requirements, yields, access, collection, costs, regulatory considerations, and other issues associated with the use of these waters for cooling are not considered here.[6] However, they could be explored in subsequent, more detailed analyses of specific geographic areas or alternative water sources. In addition, the use of treated municipal wastewaters is not included in this overview, because many if not most power plants are already located near municipal treatment facilities.

Almost half of the vulnerable plants (157) are located near at least one of the nontraditional water sources highlighted below, and several plants are located near more than one such source. The nontraditional sources with the most plants in close proximity are the deep saline aquifers, near which 122 plants are located. Sixty-four plants are located near shale gas plays, and 47 are located near mine pool water. Fourteen vulnerable plants are located in close proximity to coal bed methane fields, and five in close proximity to the top 100 oil and gas fields. Thirty-one of the 43 states with vulnerable plants have at least one type of nontraditional source in close proximity to at least one vulnerable plant. Appendix B indicates, for each of the 100 most vulnerable plants and for each of the nontraditional sources described below, whether the plant is located in close proximity to the source.

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[6] NETL's 2009 report, *Use of Non-Traditional Water for Power Plant Applications: An Overview of DOE/NETL R&D Efforts* (DOE/NETL-311/040609) provides a recent and comprehensive discussion of these issues for many nontraditional cooling water sources.

3.6.1 Saline Aquifers

It is possible that water from deep saline aquifers could be treated and used for cooling water. Saline aquifers that are used as carbon sequestration sites could provide large volumes of water when the CO_2 injected into these aquifers pushes the water they contain to the surface. The National Carbon Sequestration Database and Geographical Information System (NATCARB) — a joint project among five Midwestern states and the seven Regional Carbon Sequestration Partnerships — is assessing the carbon sequestration potential in the United States and is developing a national Carbon Sequestration Geographic Information System. Figure 3-28 is a map produced by NATCARB that shows deep saline formations overlain with coal-fired power plants. Of the 347 vulnerable plants, more than a third are located above a deep saline formation, indicating that on the basis of proximity alone, this source could provide water to a significant portion of the vulnerable power plants.

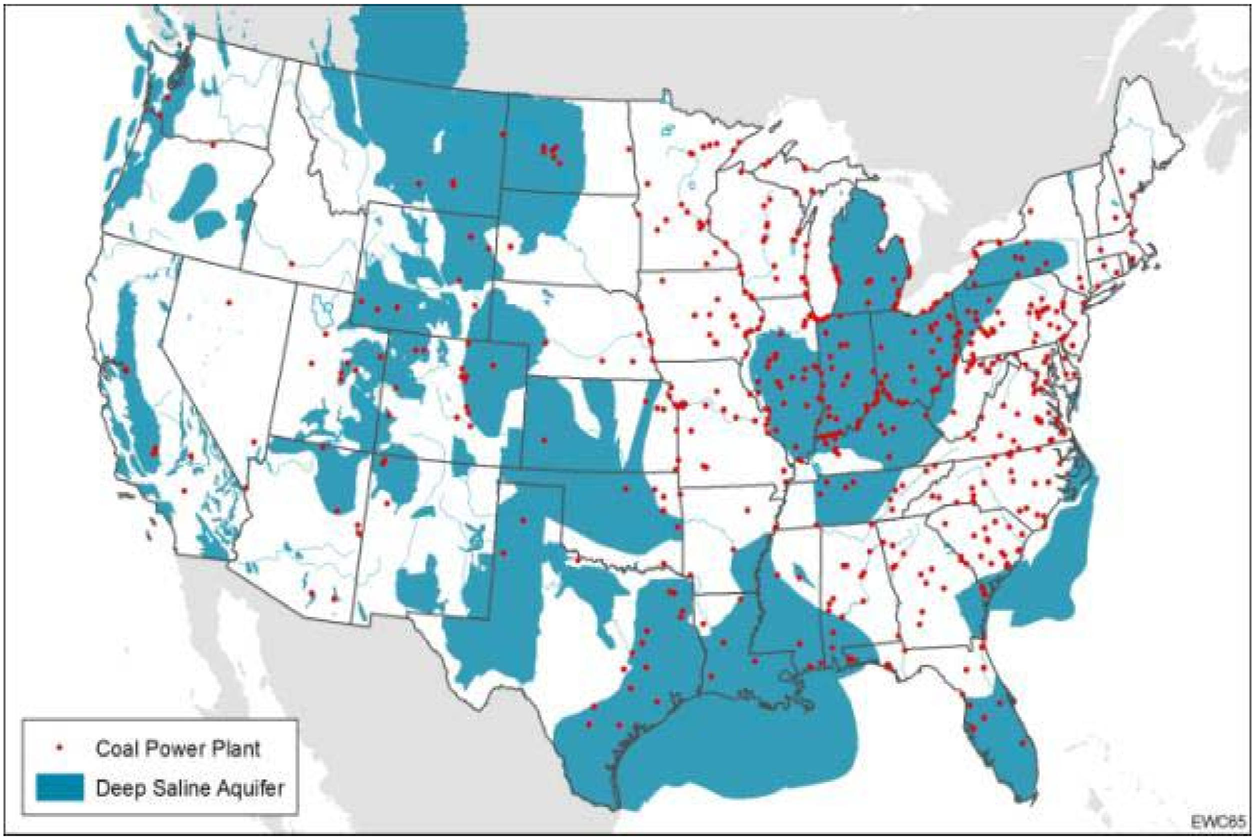

FIGURE 3-28 Power Plant Locations Relative to Deep Saline Aquifers (Sources: NATCARB 2008 and NETL 2007a)

3.6.2 Coal Bed Methane Fields

CBM accounts for about 7.5% of the total natural gas production in the United States (USGS 2000). Coal bed fractures and pores can contain and transmit large volumes of water, and the amount of water produced from CBM wells is often higher than that produced from conventional natural gas wells. This produced water could provide a source of cooling for power plants located near the CBM wells. Figure 3-29 shows that the geographic extent of CBM fields is relatively limited, however, and only about 13 vulnerable plants (about 4% of the total) are located near these fields.

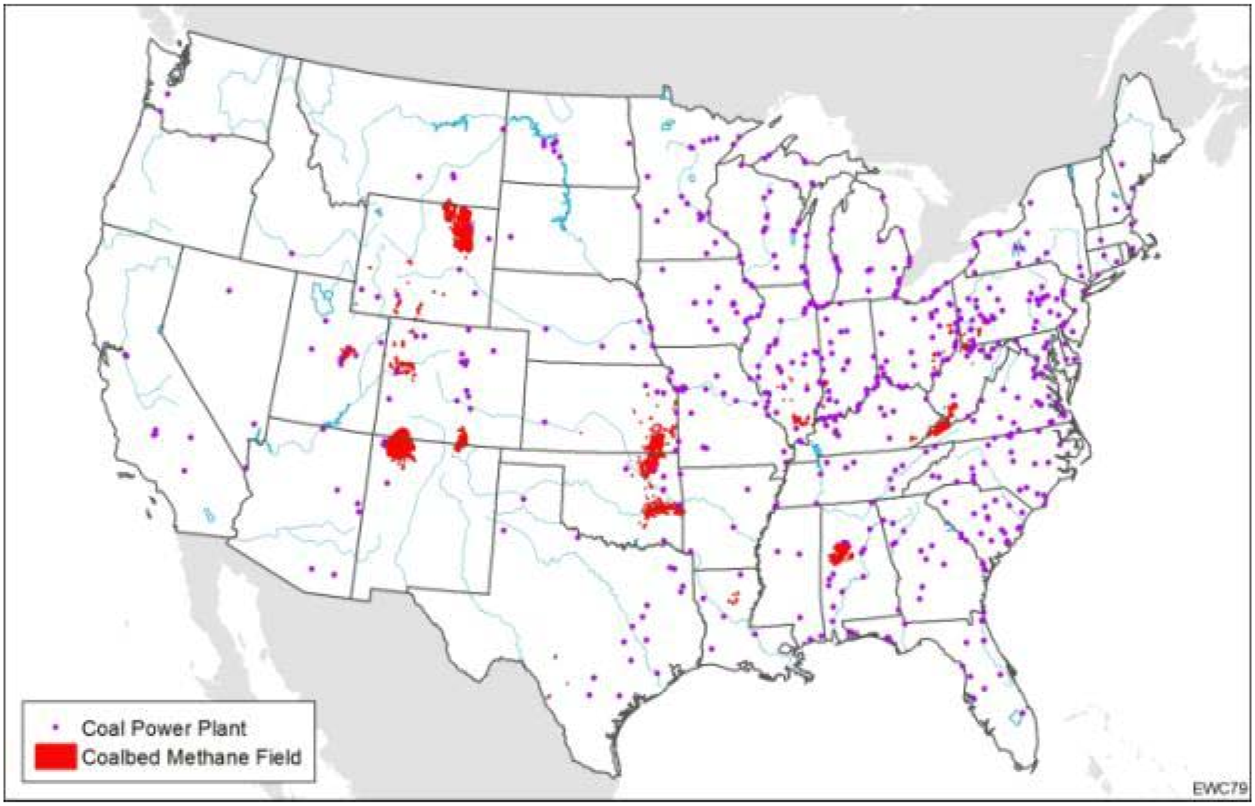

FIGURE 3-29 Power Plant Locations Relative to Coal Bed Methane Fields (Sources: EIA 2009b and NETL 2007a)

3.6.3 Oil and Gas Fields

NETL has sponsored research into the technical issues and potential benefits of using produced water from oil and gas production for power plant cooling. Figure 3-30 shows the locations of four vulnerable plants in Texas (Pirkey, Martin Lake, Big Brown, and Limestone) that are near some of the top 100 fields (in terms of proved reserves). While additional plants may be identified near other oil and gas fields, on the basis of this cursory review, it appears that when considering location alone, the proximity of power plants to oil and gas fields is less promising than for other nontraditional water sources.

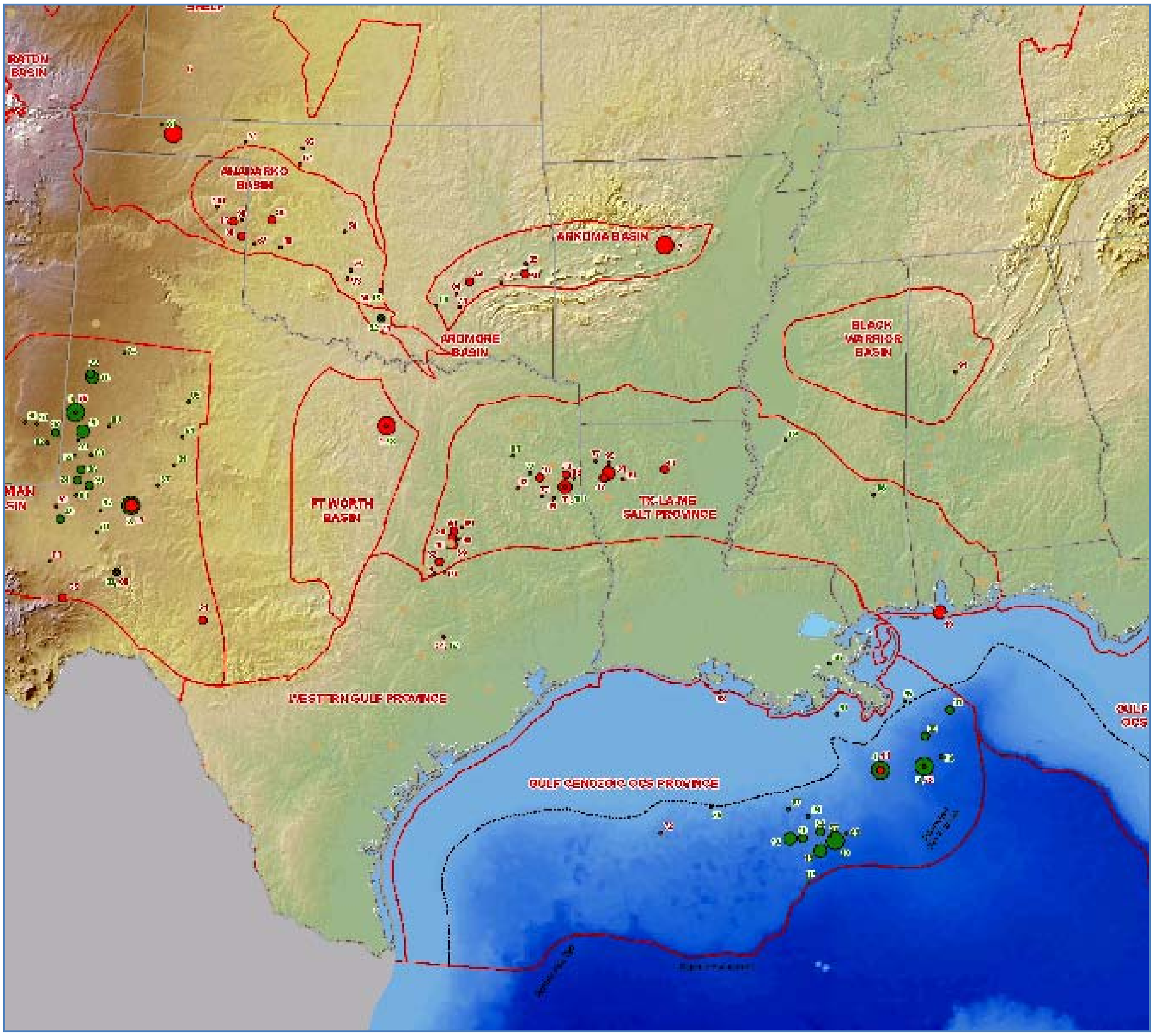

FIGURE 3-30 Locations of Plants Relative to Large Oil and Gas Fields in Texas (Sources: EIA 2009c and NETL 2007a)

3.6.4 Mine Pool Water

Mine pool water (the groundwater that has accumulated in an underground mine after operations in the mine have ceased) can provide water to power plants and other users (NETL 2009c). Figure 3-31 shows that many power plants in the eastern states are located near coal mines. Forty-seven of the 347 vulnerable plants are located near coal mines. Although the number of these mines that no longer operate is not known, it appears that if technical, regulatory, and other issues associated with using mine pool waters can be resolved, these waters could substitute for some portion of freshwater use at several plants.

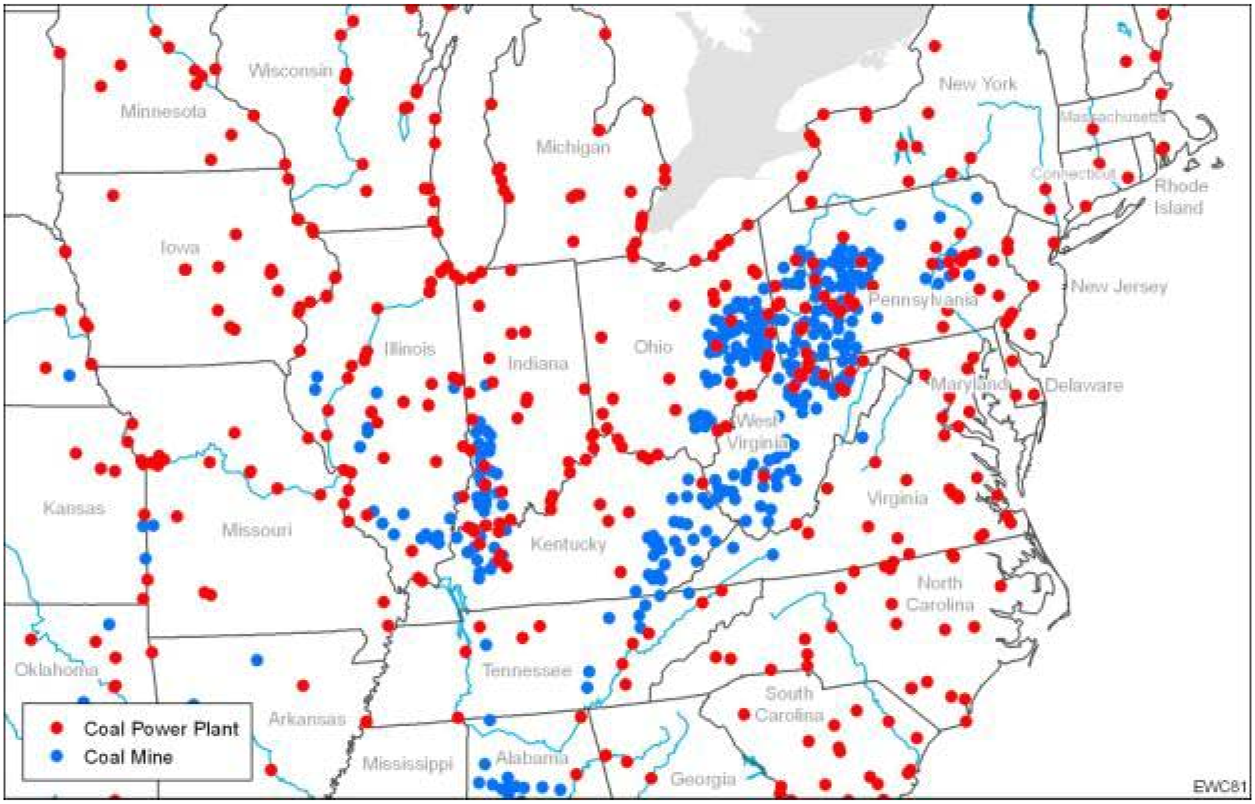

FIGURE 3-31 Locations of Power Plants Relative to Coal Mines in Several Eastern States (Sources: USGS 2010 and NETL 2007a)

3.6.5 Shale Gas Plays

Over the past decade, shale has become an increasingly important source of natural gas in the United States, and, as with CBM, the production of commercial quantities of natural gas from shale requires water in order to drill and hydraulically fracture the rock. It is possible that the water that is returned when the shale gas is released could provide a contribution to the water needed for power plant cooling. The Marcellus shale gas play, which covers parts of Pennsylvania, Ohio, New York, and West Virginia, is considered to be the second-largest natural gas field in the world and the largest unconventional natural gas reserve in the world. As such, it is targeted for significant shale gas production. In Pennsylvania alone, it has been estimated that the number of shale gas wells will increase from today's total of about 1,300 to tens of thousands in the future. Figure 3-32 shows that numerous coal-fired power plants are located above the Marcellus Shale gas play. Of the 347 vulnerable plants, 64 are located over shale gas plays, and of these, about one-third are above the Marcellus play. There is little published literature describing the use of flowback and produced water from shale gas for power plant cooling. Indeed, today, the use of such water is not practical because of (1) the relatively small volumes that are produced relative to a plant's cooling needs, (2) the quality of the flowback water, and (3) the costs required to transport the water from the source(s) to the power plant(s). However, the concentration of plants above the gas-rich Marcellus shale, the increasing demand for water, and the limited disposal capacity for flowback and produced water in this area suggest that some initial investigation into the potential for this water to contribute some portion of power plant cooling water may be warranted.

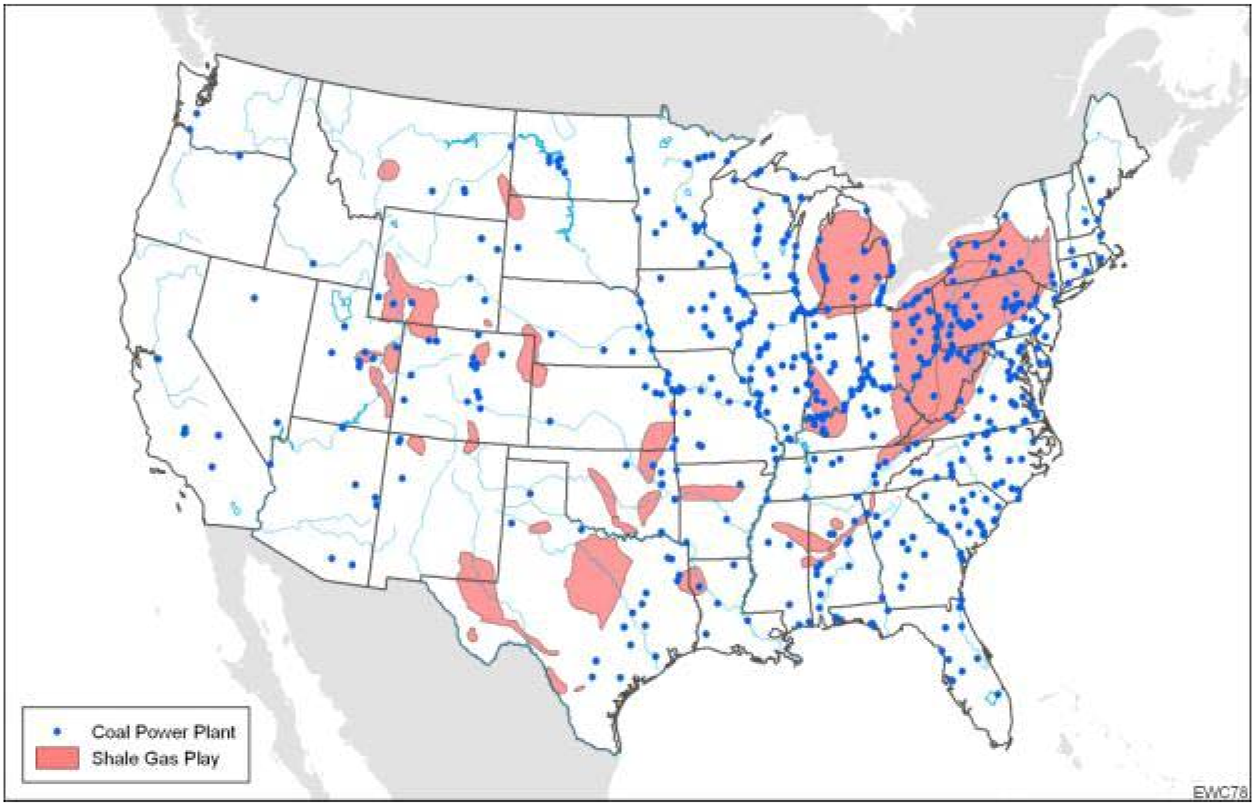

FIGURE 3-32 Power Plant Locations Relative to Shale Gas Plays (Sources: EIA 2009a and NETL 2007a)

The use of any of these nontraditional water sources will depend on numerous factors that vary with each situation. A key factor in most if not all situations relates to potential competition. Besides providing alternative water sources for power plant cooling, these nontraditional resources can, with the proper treatment, be used for other purposes. Competition for those resources may be particularly strong in areas where groundwater currently supplies a significant portion of a region's water supply, where water supplies are already constrained, and where significant population growth is expected to tax existing surface and groundwater resources. This is particularly true for deep saline aquifers where such waters could be targeted for future water supplies (particularly if their salinity levels were below that of seawater), and such use may take priority over that of sequestration (Davidson et al. 2009) or for cooling. The extent that such uses may be complementary (e.g., for sequestration, removal of the water provides space for CO_2 injection and storage) rather than competitive will depend on site-specific conditions, as well as timing, economics, and technology.

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Chapter 4 Conclusions and Recommendations

Power plants considered vulnerable to water demand and supply concerns were identified by using a GIS system that enabled the analysis of plant-specific data for more than 500 plants in NETL's CPPDB simultaneously with 18 indicators of water demand (e.g., population) and supply (e.g., drought). By applying a consistent set of evaluation criteria to review indicator data for each plant, nearly 350 coal-fired power plants were identified as vulnerable to potential supply concerns, demand concerns, or both supply and demand concerns.

Vulnerable plants consume a significant share of the total amount of water consumed by all power plants. The 134 vulnerable plants that use recirculating systems (and that reported consumption data) consumed about 1.4 bgd in 2005. This amount accounts for about 40% of the 3.6 bgd consumed by all thermoelectric plants and about 60% of the 2.4 bgd consumed by all coal-fired power plants in 2005. The median consumption rate for these plants is 7 mgd. The median consumption intensity for these plants is about 512 gal/MWh, which is higher than that of all the plants in the analysis set (497 gal/MWh) and for other benchmarks (which range from about 447 to 481 gal/MWh). The median withdrawal rate for these plants is 12 mgd, while the median withdrawal rate for the vulnerable plants using once-though cooling systems is more than 35 times that, or about 423 mgd. The median withdrawal rate for all plants in the analysis set using once-through systems is much less — 284 mgd. The median cooling water withdrawal intensity for vulnerable plants that use once-through systems is about 39,000 gal/MWh, or about 60 times that of plants that use recirculating cooling systems (632 gal/MWh). These values are generally consistent with other benchmarks for water withdrawal intensity. Both consumption and withdrawal rates (and intensities) will likely increase significantly as carbon-capture equipment is added to the existing plants.

More than 200 plants were identified as vulnerable to water supply concerns. Plants in water-scarce areas are particularly vulnerable because often existing freshwater supplies are not only limited but are expected to decline further. Many plants already depend on groundwater resources that may become more scarce as aquifers are depleted. Nearly 300 plants were identified as vulnerable to demand concerns. Many of these plants, including even those in areas where resources may be sufficient today, will not only compete for freshwater with other power plants and with other users but will also see their own requirements rise significantly as they begin to install carbon-capture equipment. In addition, EPA's forthcoming decision regarding the use of once-through cooling systems by existing power plants (CWA §316(b), phase II) could lead to an increase in freshwater consumption. This increase (along with a decrease in water withdrawal) would likely occur at existing plants that convert to recirculating systems to meet EPA's performance standards under §316(b).

That more plants are vulnerable to demand issues than to supply issues likely relates to the fact that people, who create most if not all of the demand, are generally (though not always) less likely to live in water-scarce areas, and hence power plants are generally (but not always) located in higher-demand areas. Regardless of the type of water vulnerability, it will be necessary to take steps to reduce freshwater use such as by changing operations, installing new technologies, using nontraditional water sources, or combining some mix of these and other methods.

4.1 Caveats

By analyzing characteristics of potentially vulnerable plants in the context of the various demand and supply indicators, several R&D focus areas were identified. Before discussing these areas, some data- and methodology-related caveats bear mentioning. These include the following:

1. The power plant data in the CPPDB are current as of 2005. Since then, some plants or portions of plants in the CPPDB may have been shut down either temporarily or permanently. For example, the 1,580-MW Mohave generation station in Laughlin, Nevada, ceased operations on December 31, 2005 (Southern California Edison 2010). Similarly, new plants or plant capacities may not be reflected in the CPPDB. Changes in cooling water consumption and withdrawal rates, generation rates, and other relevant data since 2005 are also not reflected in the CPPDB. However, for the purpose of this study, which is to identify possible R&D focus areas and not to present a comprehensive, current analysis of cooling water characteristics of coal-fired power plants, it is believed that the data in the CPPDB are adequate. Further, the projections of water consumption by all users and by power plant users (except where indicated otherwise) are also made on the basis of a year 2005 baseline. Thus, while not necessarily current, the data used for this analysis are consistent and are believed to be accurate to within a reasonable margin of error.

2. Many of the demand indicators are presented as averages that pertain to fairly large areas. For example, projected changes in population density and areas of relatively dry streamflow are presented at the state level. However, within these larger areas, smaller areas and locales can have much higher (and lower) water demand levels than the averages reported for the larger regions. Hence, it is possible that some plants that are vulnerable to water demand and supply concerns were not identified as such, while some that were identified as vulnerable may not belong in the vulnerable category.

3. The evaluation criteria used to assess whether a plant is considered to have a particular supply or demand vulnerability is often arbitrary. Sometimes these criteria are based on natural breaks in the data (e.g., streamflow that is lower than normal). However, where no natural breaks occur and where there are no scientific or technical bases for a particular cutoff, simple cutoffs that indicate relatively high amounts (e.g., projected consumption by all users in an area of greater than 0.5 bgd) were used. Nonetheless, the criteria are believed to be appropriate for the analysis because (1) they are applied consistently to every power plant, and (2) the number of criteria (18) is numerous enough that a given plant would generally not be mistakenly identified as vulnerable on the basis of a single indicator. In addition, for any plants with unexplained or abnormally high consumption or withdrawal rates that were not removed from the analysis set, the use of multiple indicators can reduce the impact of these outliers on the overall results.

4. Some indicators may not be independent. For example, the projected change in population per square mile is probably correlated with increasing water consumption by all users. Similarly, some of the drought indicators may be correlated with precipitation, and larger withdrawal amounts may be correlated with plant size. Nonetheless, it is believed that such correlations do not detract from the analysis but instead support the overall vulnerability assessments.

4.2 R&D Recommendations

On the basis of the analysis of the characteristics of vulnerable plants derived from plant-specific data and demand and supply indicators, the following R&D recommendations are offered:

1. *R&D efforts should address both once-through and recirculating cooling systems and the individual types of cooling approaches within these two main groups.* The analysis shows that among the 307 vulnerable plants that reported cooling system data, *t*he difference between the number of vulnerable plants using once-through systems (164, or 53%) and the number using recirculating systems (143, or 47%) is not significant. For this reason, and the expectation that existing plants will continue to operate for many years into the future, research efforts to reduce freshwater use should address both once-through and recirculating systems.

   In addition, while the rate of water consumption and the intensity of water consumption are greater for recirculating systems than these measures are for once-through systems, and while the rate of water withdrawal and the intensity of water withdrawal are each greater for once-through systems than for recirculating systems, there are significant variations in the rates and intensities among the individual types of cooling systems within each of these two main groups. However, as Table 4-1 shows, there is little if any consistency among the different types of cooling systems regarding water consumption and withdrawal rates. For example, among the recirculating systems, plants using induced draft towers have the highest water consumption intensities of any of the recirculating systems; however, plants with natural draft towers have by far the highest water consumption rates. Thus, it cannot be concluded on the basis of this analysis that one type of cooling system is necessarily more water efficient than another or that a particular type of system would benefit from R&D on the basis of rates or efficiencies. The R&D direction will depend on whether the overall target concern is consumption or withdrawal, and on whether the concern is total amount consumed or withdrawn or on efficiency, and this determination will depend to a large extent on site-specific conditions. Hence, all else being equal, R&D is warranted for all types of cooling technologies.

TABLE 4-1 Median Water Consumption and Withdrawal Rates by Type of Cooling System

Cooling System	Median for Vulnerable Plants			
	Average Annual Consumption (mgd)	Consumption Intensity (gal/MWh)	Average Annual Withdrawal (mgd)	Withdrawal Intensity (gal/MWh)
All Once-Through	0	0	423	38,486
Cooling Ponds	0	0	505	33,894
Freshwater	0	0	423	39,444
Saline Water	0	0	351	42,315
All Recirculating	7	512	12	632
Cooling Ponds	4	233	41	9,919
Forced Draft	7	506	9	552
Induced Draft	5	594	6	612
Natural Draft	12	423	22	657
All Once-Through and Recirculating	2	247	150	24,559

2. *If location were a factor in directing resources for other R&D efforts that included water use, the southeast should be considered.* Vulnerable plants are located in almost every state, and the distribution of vulnerable plants among the states is broad enough that it would be inappropriate to suggest focusing R&D efforts on the basis of location alone. However, because almost one-third of the vulnerable plants are located in the southeastern states of Florida, Georgia, South Carolina, North Carolina, Virginia, and Alabama, should NETL decide for some other reason to select a region of the country, such as for testing approaches at a variety of plants with similar geographic conditions, directing these efforts in the southeast would capture a high concentration of vulnerable plants.

3. *Additional investigation into the characteristics of cooling systems installed during certain periods may be warranted*. The analysis of the age distribution of the nearly 700 cooling systems with age data associated with the 347 vulnerable plants found that once-through systems range in age from 17 to 85 years, and recirculating systems range in age from 1 to 86 years. However, most of the once-through systems are between 39 and 58 years old, and most of the recirculating systems are between 22 and 43 years old. Thus, further investigation into the once-through systems installed between 1952 and 1971 and recirculating systems installed between 1967 and 1988 may be warranted to determine whether particular design characteristics or operating conditions associated with these systems could be modified to reduce water demand (particularly for the once-through systems) or water consumption (particularly for the recirculating systems).

4. *Identify ways to increase (or at least maintain) the ability to use saline water at power plants.* Because the use of saline water is an established practice at many power plants,

and because the use of saline water can provide an effective means of reducing freshwater consumption and withdrawal, additional R&D directed toward increasing the use of saline water at existing power plants may be appropriate. Although the CWA §316(b) regulations argue against using once-through systems, if freshwater becomes very scarce, the ability to continue using saline water in areas where it is currently used or even in some circumstances to convert to saline water, will be an important option to preserve. R&D targeted toward improving intake systems to meet the requirements of CWA §316(b), for example, by identifying or developing alternative impingement mortality and entrainment measures that would provide a level of reduction comparable to that of recirculating systems could help make this a viable option.

5. *Consider investigating the use of produced water from gas shale for cooling water.* Given such considerations as the large number of power plants in proximity to the Marcellus shale gas play (about 20 of the 347 vulnerable plants are located above the Marcellus play), the concern over water pollution related to the disposal of the water that would be generated during hydraulic fracturing and production of the gas, the limited disposal capacity for water generated by shale gas production in the Marcellus Shale area, and the R&D already underway for using produced water from CBM and oil and gas fields, it may be appropriate for NETL to consider an initial investigation into the potential for using water generated during shale gas production, and in particular, from that associated with production in the Marcellus field, to contribute some portion of the cooling water needs for power plants.

6. *Focus R&D on promising nontraditional cooling water sources*. The analysis in this study found that on the basis of proximity to nontraditional water sources (e.g., deep saline aquifers, coal mines) alone, many vulnerable power plants may be able to use these nontraditional sources to substitute for at least some portion of the freshwater used at these plants. Some nontraditional sources (e.g., deep saline aquifers, shale gas, mine pools) are co-located with or are near more vulnerable plants than others (e.g., produced water from oil and gas, CBM). NETL has supported and continues to support R&D efforts directed toward using nontraditional waters for power plant cooling. To help ensure that the dollars spent to date as well as the future dollars (which may decrease when budgets are tightened) will provide the greatest reduction in freshwater use for the effort expended, NETL may want to consider whether it has gained enough data to begin focusing its efforts on those nontraditional sources that are the most promising. If and when it decides to pursue this focusing effort, it is suggested that a process that identifies and evaluates several criteria for each of the sources in a consistent manner be used to select those few on which to target its resources. Examples of such criteria could include cost, net environmental impact, volume and reliability of water source, time to deployment, treatment costs, proximity to power plants, and competition from other uses — along with estimates of the levels of uncertainties associated with each of these criteria.

7. *Consider conservation efforts directed at power plants that used groundwater*. Of the vulnerable plants that use recirculating systems, about 70% use surface water, 16% use groundwater, and 13% use municipal or recycled water. Some of the plants that use

groundwater are in areas where portions of the underlying aquifers have experienced declining water levels. Extended R&D aimed at increasing the use of recycled municipal water for these and other plants (e.g., by identifying mitigating solutions to barriers that have previously been identified) could help reduce the vulnerability of these plants to water shortages.

8. *All else being equal, R&D efforts could focus on plants with capacities in the 650 MW and below range.* This recommendation is because the capacities of the vulnerable plants tend to cluster around this range, and hence R&D efforts directed at plants with these capacities could apply to numerous plants. Research efforts could be further targeted toward identifying specific plants and characteristics within this group. For example, a subset of the plants in the 650-MW-and-below range that have the highest consumption and/or withdrawal intensities could be further examined for specific plant characteristics to see whether there are commonalities in plant operations, equipment, or other factors that could contribute to the high water consumption (or withdrawal) intensities. These common characteristics could then be targeted to identify options to reduce water consumption or withdrawal.

9. *Consider R&D efforts directed toward plant-specific issues*. R&D efforts directed toward plant-specific concerns acknowledge the idea that site-specific conditions can help identify specific R&D needs and objectives. For example, at some plants, the priority water need may be to reduce total freshwater consumption; for others it may be to reduce the intensity of freshwater consumption. Other plants will have other water objectives. To facilitate the directing of R&D efforts toward these plant-specific issues, the following approach is suggested: (1) reduce the scope to address the 100 most vulnerable plants (to provide a manageable data set); (2) for these plants, verify and update the data in the CPPDB to ensure that the information is current and accurate; (3) determine the focus of the review (e.g., on plants that have high withdrawal rates in areas of reduced streamflow, plants that consume relatively high amounts of water and are in areas where demand is expected to increase over the next several years); (4) after determining the focus area, select plants that would be targeted for further research; and (5) for those plants, work directly with the plant operators to identify specific operating, design, and other characteristics that could explain how water is used in the plants. R&D would then be conducted, on the basis of these findings, to mitigate the water demand or supply concern.

10. *Consider net environmental or life-cycle impact*. The primary goal of the R&D is to reduce freshwater use. However, a variety of impacts — many of which may be unintended — can occur from the resulting application of the R&D results (e.g., the modification or replacement of existing systems, components, operations, or the use of nontraditional water sources). Examples of such impacts can include, but are not limited to, the following: increased air, water, and waste emissions associated with increased or changed use of chemicals in water recycling systems; energy impacts associated with the use of different cooling technologies; visual impacts; noise impacts; and impacts resulting from accessing and transporting nontraditional waters from their sources to the power plant cooling systems. Thus, with any and all of these recommendations, it will be

important to identify and consider the other impacts that can result from the application of R&D aimed at reducing freshwater use.

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APPENDIX A. COAL-FIRED POWER PLANTS IN THE ANALYSIS SET

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TABLE A-1 Coal-fired Power Plants in the Analysis Set (Cooling System Information and Area Demand Indicators)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
A. B. Brown	IN	Recirculating with forced draft cooling tower(s)	Ohio River		0.06	-90%	8%	220,000–330,000	20	
ACE Cogeneration Facility	CA	Recirculating with forced draft cooling tower(s)	Wells		22.67	-3%	200%	150,000–220,000	80	
AES Beaver Valley Partners Beaver Valley	PA	Once through, fresh water	Ohio River		0.08	-88%	8%	150,000–220,000		
AES Cayuga	NY	Once through, fresh water	Cayuga Lake		0.15	-94%	900%	150,000–220,000		
AES Greenidge LLC	NY	Once through, fresh water	Seneca Lake		0.15	-94%	900%	150,000–220,000		
AES Hawaii	HI	Recirculating with induced draft cooling tower(s)	Wells			-	-			
AES Petersburg	IN	Once through, fresh water	White River		0.09	-91%	8%	220,000–330,000	20	
AES Shady Point	OK	Recirculating with forced draft cooling tower(s)	Poteau River		0.44	-14%	6%			
AES Somerset LLC	NY	Once through, fresh water	Lake Ontario		0.15	-94%	900%	150,000–220,000		
AES Thames	CT	Once through, saline water	Thames River			-	71%	150,000–220,000	57	
AES Warrior Run Cogeneration Facility	MD	Recirculating with induced draft cooling tower(s)	Municipal		0.07	-89%	8%		177	
AES Westover	NY	Once through, fresh water	Susquehanna River			-	900%	150,000–220,000		
Albright	WV	Once through, fresh water	Cheat River		0.08	-91%	8%	150,000–220,000		
Allen S. King	MN	Once through with cooling pond(s) or canal(s)	Lake St. Croix		2.45	145%	14%			
Allen Steam Plant	TN	Once through, fresh water	Mississippi River		0.15	15%	45%	220,000–330,000	40	
Alloy Steam Station	WV					-	8%	150,000–220,000		
Alma	WI	Once through, fresh water	Mississippi River		0.35	-93%	14%	150,000–220,000		
Altavista Power Station	VA					-	8%	150,000–220,000		
Amalgamated Sugar Twin Falls	ID					-	60%	220,000–330,000		
American Eagle Paper Mills	PA					-	50%	150,000–220,000		
Ames Electric Services Power Plant	IA					-	20%			
Anheuser Busch St. Louis	MO					-	20%			

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Antelope Valley	ND	Recirculating with forced draft cooling tower(s)	Lake		2.73	45%	14%			
Apache Station	AZ	Recirculating with induced draft cooling tower(s)	Wells		3.74	-18%	55%			
Arapahoe	CO	Recirculating with forced draft cooling tower(s)	Platte River		0.19	-24%	55%			Highly likely
Archer Daniels Midland Cedar Rapids	IA	Recirculating with forced draft cooling tower(s)	Municipal		1.87	143%	20%			
Archer Daniels Midland Clinton	IA					-	20%			
Archer Daniels Midland Decatur	IL	Other	NWTP		0.19	-92%	20%	220,000–330,000		
Archer Daniels Midland Peoria	IL					-	20%	220,000–330,000		
Argus Cogen Plant	CA					-	200%	150,000–220,000	80	
Armstrong Power Station	PA	Once through, fresh water	Allegheny River		0.05	-92%	50%	150,000–220,000		
Asbury	MO	Recirculating with induced draft cooling tower(s)	Wells		0.63	66%	20%			
Ashdown	AR	Other	Boiler makeup water			-	6%	150,000–220,000		
Asheville	NC	Recirculating with cooling pond(s) or canal(s)	Lake Julian		0.09	-89%	45%	220,000–330,000	85	
Ashtabula	OH	Once through, fresh water	Lake Erie		0.5	-91%	8%	220,000–330,000		
Aurora Energy LLC Chena	AK					-				
Austin Northeast	MN					-	20%			
Avon Lake	OH	Once through, fresh water	Lake Erie			-	8%	220,000–330,000		
B. C. Cobb	MI	Once through, fresh water	Muskogon Lake		0.5	-91%	8%	150,000–220,000		
Bailly	IN	Once through, fresh water	Lake Michigan		0.5	-91%	8%	220,000–330,000	20	
Baldwin Energy Complex	IL	Recirculating with cooling pond(s) or canal(s)	Kaskaskia River		0.35	-93%	20%	220,000–330,000		
Barry	AL	Once through, fresh water	Mobile River		1.39	14%	45%	150,000–220,000		
Bay Front	WI					-	14%	150,000–220,000		
Bay Shore	OH					-	8%	220,000–330,000		
Belews Creek	NC	Once through, fresh water	Belews Lake		2.39	-79%	45%	220,000–330,000	85	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Belle River	MI	Once through, fresh water	St. Clair River			-	8%	150,000–220,000		
Ben French	SD					-	14%			
Big Bend	FL	Once through, saline water	Hillsborough Bay		1.23	7%	180%			
Big Brown	TX	Once through with cooling pond(s) or canal(s)	Fairfield Lake		1.55	-6%	9%			
Big Cajun 2	LA	Once through, fresh water	Mississippi River		2.63	18%	45%	220,000–330,000		
Big Sandy	KY	Recirculating with natural draft cooling tower(s)	Big Sandy River			-	8%			
Big Stone	SD	Recirculating with cooling pond(s) or canal(s)	Big Stone Lake		0.09	-81%	14%			
Birchwood Power	VA	Recirculating with induced draft cooling tower(s)	Rappahannock River		0.29	-89%	45%	150,000–220,000		
Biron Mill	WI					-	20%	150,000–220,000		
Black Dog	MN	Once through with cooling pond(s) or canal(s)	Minnesota River		2.45	145%	14%			
Black River Generation	NY					-	900%	150,000–220,000		
Blount Street	WI	Once through, fresh water	Lake Monona		0.35	-93%	20%	150,000–220,000		
Blue Valley	MO	Recirculating with forced draft cooling tower(s)	Wells			-	45%			
Boardman	OR	Recirculating with cooling pond(s) or canal(s)	Carty Reservoir		5.6	-15%	60%			Substantial
Bonanza	UT	Recirculating with forced draft cooling tower(s)	Green River		0.35	-19%	60%			
Bowater Newsprint Calhoun Operation	TN					-	45%	220,000–330,000	40	
Bowen	GA	Recirculating with natural draft cooling tower(s)	Etowah River		2.39	-79%	45%			
Brandon Shores	MD	Recirculating with forced draft cooling tower(s)	Patapsco River		0.11	-91%	50%		177	
Brayton Point	MA	Once through, saline water	Taunton River			-	71%	150,000–220,000		
Bremo Bluff	VA	Once through, fresh water	James River		0.29	-89%	45%	150,000–220,000		
Bridgeport Station	CT	Once through, saline water	Bridgeport Harbor		0.43	-94%	71%	150,000–220,000	57	
Bruce Mansfield	PA	Recirculating with natural draft cooling tower(s)	Ohio River		0.08	-88%	8%	150,000–220,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Buck	NC	Once through, fresh water	Yadkin River		2.39	-79%	45%	220,000–330,000	85	
Bull Run	TN	Once through, fresh water	Clinch River			-	45%	220,000–330,000	40	
Bunge Milling Cogen	IL					-	20%	220,000–330,000		
Burlington	IA	Once through, fresh water	Mississippi River		1.87	143%	20%			
C. D. McIntosh Jr.	FL					-	180%			
C. P. Crane	MD	Once through, saline water	Seneca Creek		0.11	-91%	50%		177	
C. R. Huntley Generating Station	NY	Once through, fresh water	Niagara River		0.15	-94%	900%	150,000–220,000		
Cambria Cogen	PA					-	50%	150,000–220,000		
Camden South Carolina	SC					-	45%	220,000–330,000	37	
Cameo	CO					-	55%			
Canadys Steam	SC	Recirculating with induced draft cooling tower(s)	Edisto River		1.44	-79%	45%	220,000–30,000	37	
Cane Run	KY	Once through, fresh water	Ohio River		0.46	-91%	8%			
Canton North Carolina	NC					-	45%	220,000–330,000	85	
Cape Fear	NC	Once through, fresh water	Cape Fear River		2.39	-79%	45%	220,000–330,000	85	
Carbon	UT	Recirculating with induced draft cooling tower(s)	Price River		0.35	-19%	60%			
Cardinal	OH	Once through, fresh water	Ohio River		0.15	-89%	8%	220,000–330,000		
Cargill Corn Milling Division	IA					-	20%			
Cargill Corn Wet Milling Plant	TN					-	45%	220,000–330,000	40	
Cayuga	IN	Once through, fresh water	Wabash River		0.09	-93%	8%	220,000–330,000	20	
CC Perry K	IN					-	8%	220,000–330,000	20	
Cedar Bay Generating LP	FL	Recirculating with induced draft cooling tower(s)	Industrial Waste Water		1.23	7%	180%			
Central Power & Lime	FL	Recirculating with cooling pond(s) or canal(s)	Wells		1.23	7%	180%			
Chalk Point LLC	MD	Once through, saline water	Patuxent River		0.11	-91%	50%		177	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Chamois	MO					-	20%			
Charles R. Lowman	AL	Once through, fresh water	River		1.39	14%	45%	150,000–220,000		
Cherokee	CO	Recirculating with forced draft cooling tower(s)	Platte River		0.19	-24%	55%			Highly likely
Chesapeake	VA	Once through, saline water	Elizabeth River		2.39	-79%	45%	150,000–220,000		
Chester Operations	PA					-	50%	150,000–220,000		
Chesterfield	VA	Once through, fresh water	James River		0.29	-89%	45%	150,000–220,000		
Cheswick Power Plant	PA	Once through, fresh water	Allegheny River		0.08	-88%	8%	150,000–220,000		
Cholla	AZ	Recirculating with induced draft cooling tower(s)	Wells		3.74	-18%	55%			Highly likely
Cinergy Solutions of Narrows	VA					-	8%	150,000–220,000		
Clay Boswell	MN	Once through, fresh water	North Blackwater Lake		2.45	145%	14%			
Cliffside	NC	Once through, fresh water	Broad River		2.39	-79%	45%	220,000–330,000	85	
Clifty Creek	IN	Once through, fresh water	Ohio River		0.46	-91%	8%	220,000–330,000	20	
Clover	VA	Recirculating with induced draft cooling tower(s)	Roanoke River		2.39	-79%	45%	150,000–220,000		
Coal Creek	ND	Recirculating with forced draft cooling tower(s)	Missouri River		2.73	45%	14%			
Coffeen	IL	Once through with cooling pond(s) or canal(s)	McDavid Branch			-	20%	220,000–330,000		
Cogen South	SC					-	45%	220,000–330,000	37	
Cogentrix Hopewell	VA	Recirculating with induced draft cooling tower(s)	Municipal		0.29	-89%	45%	150,000–220,000		
Cogentrix of Richmond	VA	Recirculating with induced draft cooling tower(s)	James River		0.29	-89%	45%	150,000–220,000		
Cogentrix Virginia Leasing Corporation	VA	Recirculating with induced draft cooling tower(s)	Wells			-	45%	150,000–220,000		
Coleto Creek	TX	Recirculating with cooling pond(s) or canal(s)	Coleto Creek Reservoir		3.45	-7%	9%			
Colstrip	MT	Recirculating with forced draft cooling tower(s)	Yellowstone River			-	60%			

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Colstrip Energy LP	MT				0.92	-23%	60%			
Columbia	WI	Recirculating with cooling pond(s) or canal(s)	Wisconsin River		0.24	-94%	20%	150,000–220,000		
Columbia	MO					-	20%			
Colver Power Project	PA	Recirculating with induced draft cooling tower(s)	Vetera Reservoir		0.05	-92%	50%	150,000–220,000		
Comanche	CO	Recirculating with forced draft cooling tower(s)	Arkansas River		0.77	-25%	55%			Highly likely
Conemaugh	PA	Recirculating with natural draft cooling tower(s)	Conemaugh River		0.05	-92%	50%	150,000–220,000		
Conesville	OH	Recirculating with induced draft cooling tower(s)	Muskingum River			-	8%	220,000–330,000		
Cooper	KY	Once through, fresh water	Cumberland River		0.26	-91%	8%			
Cope	SC	Recirculating with induced draft cooling tower(s)	South Fork/Edisto River		1.44	-79%	45%	220,000–330,000	37	
Corn Products Illinois	IL					-	20%	220,000–330,000		
Coronado	AZ	Recirculating with forced draft cooling tower(s)	Wells		3.74	-18%	55%			Highly likely
Council Bluffs	IA	Once through, fresh water	Wells		0.74	72%	14%			
Covanta Mid-Connecticut Energy	CT					-	71%	150,000–220,000	57	
Covington Facility	VA					-	45%	150,000–220,000		
Coyote	ND	Recirculating with induced draft cooling tower(s)	Missouri River		2.73	45%	14%			
Craig	CO	Recirculating with forced draft cooling tower(s)	Yampa River		0.43	-19%	55%			
Crawford	IL	Once through, fresh water	Chicago Sanitary and Ship		0.35	-93%	20%	220,000–330,000		
Crawfordsville	IN					-	8%	220,000–330,000	20	
Crisp Plant	GA					-	45%			
Crist	FL	Recirculating with forced draft cooling tower(s)	Escambia River			-	45%			
Cromby Generating Station	PA	Once through, fresh water	Schuylkill River		0.32	-92%	50%	150,000–220,000		
Cross	SC	Recirculating with forced draft cooling tower(s)	Diversion Canal		2.39	-79%	45%	220,000–330,000	37	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Crystal River	FL	Once through, saline water	Gulf of Mexico		1.23	7%	180%			
Cumberland	TN	Once through, fresh water	Cumberland		1	-6%	45%	220,000–330,000	40	
D. B. Wilson	KY	Recirculating with forced draft cooling tower(s)	Green River		0.06	-90%	8%			
Dale	KY	Once through, fresh water	Kentucky River		0.26	-91%	8%			
Dallman	IL	Once through with cooling pond(s) or canal(s)	Lake Springfield			-	20%	220,000–330,000		
Dan E. Karn	MI	Once through, fresh water	Saginaw River		0.5	-91%	8%	150,000–220,000		
Dan River	NC	Once through, fresh water	Dan River		2.39	-79%	45%	220,000–330,000	85	
Danskammer Generating Station	NY	Once through, fresh water	Hudson River		0.26	-92%	900%	150,000–220,000		
Dave Johnston	WY	Once through, fresh water	North Platte River		0.067	-92%	60%			Moderate
Deerhaven Generating Station	FL	Recirculating with forced draft cooling tower(s)	Wells Floridan Aquifer		1.23	7%	180%			
Dickerson	MD	Once through, fresh water	Potomac River		0.11	-91%	50%		177	
Dolet Hills	LA	Recirculating with induced draft cooling tower(s)	Makeup Pond on Property		0.13	-13%	6%	220,000–330,000		
Dolphus M. Grainger	SC	Once through with cooling pond(s) or canal(s)	Waccamaw River		2.39	-79%	45%	220,000–330,000	37	
Dover	OH					-	8%	220,000–330,000		
Dubuque	IA					-	20%			
Duck Creek	IL	Recirculating with cooling pond(s) or canal(s)	Duck Creek Reservoir		0.14	-93%	20%	220,000–330,000		
Dunkirk Generating Station	NY	Once through, fresh water	Lake Erie		0.15	-94%	900%	150,000–220,000		
E. C. Gaston	AL	Once through, fresh water	Coosa River		1.4	14%	45%	150,000–220,000		
E. D. Edwards	IL	Once through, fresh water	Illinois River		0.19	-92%	20%	220,000–330,000		
E. J. Stoneman Station	WI					-	20%	150,000–220,000		
E. W. Brown	KY	Recirculating with induced draft cooling tower(s)	Herrington Lake		0.26	-91%	8%			
Eagle Valley	IN	Once through, fresh water	West of White River		0.46	-91%	8%	220,000–330,000	20	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Earl F Wisdom	IA					-	14%			
East Bend	KY	Recirculating with forced draft cooling tower(s)	Ohio River		0.46	-91%	8%			
Eastlake	OH	Once through, fresh water	Lake Erie			-	8%	220,000–330,000		
Ebensburg Power	PA					-	50%	150,000–220,000		
Eckert Station	MI	Other	Grand River		0.14	-90%	8%	150,000–220,000		
Eddystone Generating Station	PA	Once through, fresh water	Delaware River		0.32	-92%	50%	150,000–220,000		
Edge Moor	DE	Once through, fresh water	Delaware River		0.32	-92%	50%	220,000–330,000	111	
Edgewater	WI	Once through, fresh water	Lake Michigan		0.24	-94%	20%	150,000–220,000		
Edwardsport	IN	Once through, fresh water	West fork White River		0.09	-91%	8%	220,000–330,000	20	
Eielson AFB Central Heat & Power Plant	AK					-				
Elmer Smith	KY	Once through, fresh water	Ohio River		0.09	-91%	8%			
Elrama Power Plant	PA	Once through, fresh water	Monongahela River			-	8%	150,000–220,000		
Endicott Station	MI					-	8%	150,000–220,000		
Erickson Station	MI	Recirculating with forced draft cooling tower(s)	Grand River		0.14	-90%	8%	150,000–220,000		
Escalante	NM	Recirculating with forced draft cooling tower(s)	Wells		0.44	-33%	55%			
Escanaba	MI					-	8%	150,000–220,000		
Escanaba Paper Company	MI					-	8%	150,000–220,000		
F. B. Culley	IN	Once through, fresh water	Ohio River		0.09	-91%	8%	220,000–330,000	20	
Fair Station	IA					-	20%			
Fayette Power Project	TX	Once through with cooling pond(s) or canal(s)	FPP Lake		3.45	-7%	9%			
Fisk Street	IL	Once through, fresh water	Chicago River-South Bra		0.24	-94%	20%	220,000–330,000		
Flint Creek	AR	Recirculating with cooling pond(s) or canal(s)	Flint Creek Reservoir		0.67	-14%	6%	150,000–220,000		
Fort Martin Power Station	WV	Recirculating with natural draft cooling tower(s)	Monongahela River		0.11	-89%	8%	150,000–220,000		
Foster Wheeler Mt. Carmel	PA					-	50%	150,000–220,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Cogen										
Four Corners	NM	Recirculating with cooling pond(s) or canal(s)	San Juan River		0.04	-20%	55%			Unmet rural water needs
Frank E. Ratts	IN	Once through, fresh water	White River			-	8%	220,000–330,000	20	
G. F. Weaton Power Station	PA	Once through, fresh water	Ohio River			-	8%	150,000–220,000		
G. G. Allen	NC	Once through, fresh water	Lake Wylie		2.39	-79%	45%	220,000–330,000	85	
Gadsden	AL	Once through, fresh water	Coosa River		1.39	14%	45%	150,000–220,000		
Gallatin	TN	Once through, fresh water	Cumberland		1	-6%	45%	220,000–330,000	40	
General Chemical	WY					-	60%			
General James M. Gavin	OH	Recirculating with natural draft cooling tower(s)	Ohio River			-	8%	220,000–330,000		
Genoa	WI	Once through, fresh water	Mississippi River		0.35	-93%	14%	150,000–220,000		
George Neal North	IA	Once through, fresh water	Missouri River		6.17	73%	14%			
George Neal South	IA	Once through, fresh water	Missouri River			-	14%			
Georgia Pacific Cedar Springs	GA	Once through, fresh water	Chattahoochee River		1.39	13%	45%		65	
Georgia Pacific Naheola Mill	AL					-	45%	150,000–220,000		
Georgia-Pacific Corp. - Nekoosa Mill	WI					-	20%	150,000–220,000		
Gerald Gentleman	NE	Once through with cooling pond(s) or canal(s)	Sutherland Supply Canal		6.17	73%	14%	150,000–220,000		Moderate
Ghent	KY	Recirculating with forced draft cooling tower(s)	Ohio River		0.46	-91%	8%			
Gibbons Creek	TX	Recirculating with cooling pond(s) or canal(s)	Gibbons Creek		3.45	-7%	9%			
Gibson	IN	Recirculating with cooling pond(s) or canal(s)	Wabash River		0.09	-91%	8%	220,000–330,000	20	
GM WFG Pontiac Site Power Plant	MI					-	8%	150,000–220,000		
Goodyear Power Plant	OH					-	8%	220,000–330,000		
Gorgas	AL	Once through, fresh water	Warrior River		0.24	14%	45%	150,000–220,000		
Grant Town Power Plant	WV					-	8%	150,000–220,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
GRDA	OK	Recirculating with forced draft cooling tower(s)	Grand River		0.44	-14%	6%			
Green Bay West Mill	WI	Once through with cooling pond(s) or canal(s)	Lower Fox River			-	20%	150,000–220,000		
Green River	KY	Once through, fresh water	Green River		0.06	-90%	8%			
Greene County	AL	Once through, fresh water	Black Warrior		1.39	14%	45%	150,000–220,000		
H. B. Robinson	SC	Recirculating with cooling pond(s) or canal(s)	Lake Robinson		2.39	-79%	45%	220,000–330,000	37	
H. L. Spurlock	KY	Recirculating with forced draft cooling tower(s)	Wells and River Water		0.46	-91%	8%			
H. Wilson Sundt Generating Station	AZ	Recirculating with forced draft cooling tower(s)	Wells		3.74	-18%	55%			Substantial
Hamilton	OH	Once through, fresh water	Miami River			-	8%	220,000–330,000		
Hammond	GA	Once through, fresh water	Coosa River		2.39	-79%	45%		65	
Harbor Beach	MI	Once through, fresh water	Lake Huron			-	8%	150,000–220,000		
Harding Street	IN	Once through, fresh water	West fork of White River		0.46	-91%	8%	220,000–330,000	20	
Harllee Branch	GA	Once through, fresh water	Lake Sinclair		1.44	-79%	45%		65	
Harrington	TX	Recirculating with induced draft cooling tower(s)	Municipal		0.67	-14%	6%			
Harrison Power Station	WV	Recirculating with natural draft cooling tower(s)	West Fork River		0.11	-89%	8%	150,000–220,000		
Hatfields Ferry Power Station	PA	Recirculating with natural draft cooling tower(s)	Monongahela River		0.08	-88%	8%	150,000–220,000		
Havana	IL	Recirculating with forced draft cooling tower(s)	Illinois River		0.14	-93%	20%	220,000–330,000		
Hawaiian Comm & Sugar Puunene Mill	HI					-	-			
Hawthorn	MO	Once through, fresh water	Missouri River		0.99	71%	45%			Substantial
Hayden	CO	Recirculating with forced draft cooling tower(s)	Yampa River		0.43	-19%	55%			
Healy	AK					-				
Henderson	MS					-	45%			
Henderson I	KY					-	8%			
Hennepin Power Station	IL	Once through, fresh water	Illinois River		0.19	-92%	20%	220,000–330,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Herbert A. Wagner	MD	Once through, saline water	Pataspsco River			-	50%		177	
Hercules Missouri Chemical Works	MO					-	20%			
Hibbing	MN					-	14%			
High Bridge	MN	Once through, fresh water	River		2.45	145%	14%			
HMP&L Station Two Henderson	KY	Recirculating with forced draft cooling tower(s)	Green River		0.06	-90%	8%			
Holcomb	KS	Recirculating with induced draft cooling tower(s)	Wells		2.82	65%	6%			
Homer City Station	PA	Recirculating with natural draft cooling tower(s)	Two Lick Creek		0.05	-92%	50%	150,000–220,000		
Hoot Lake	MN	Once through, fresh water	Otter Tail River		2.45	145%	14%			
Howard Down	NJ					-	50%	220,000–330,000	185	
Hugo	OK	Recirculating with induced draft cooling tower(s)	Kiamichi River		0.19	-10%	6%			
Hunlock Power Station	PA					-	50%	150,000–220,000		
Hunter	UT	Recirculating with induced draft cooling tower(s)	Cottonwood Creek		1.18	-28%	60%			
Huntington	UT	Recirculating with induced draft cooling tower(s)	Huntington Creek		1.18	-28%	60%			
Hutsonville	IL	Once through, fresh water	Wabash River			-	20%	220,000–330,000		
Iatan	MO	Once through, fresh water	Missouri River		1.54	73%	45%			Unmet rural water needs
Independence	AR	Recirculating with natural draft cooling tower(s)	River		0.48	-13%	45%	150,000–220,000		
Indian River Generating Station	DE	Once through, saline water	Indian River		0.11	-91%	50%	220,000–330,000	111	
Indiantown Cogeneration LP	FL	Recirculating with induced draft cooling tower(s)	Taylor Creek		1.23	7%	180%			
Intermountain Power Project	UT	Recirculating with induced draft cooling tower(s)	DMAD Reservoir		1.18	-28%	60%			
International Paper Augusta Mill	GA					-	45%		65	
International Paper Eastover Facility	SC	Recirculating with forced draft cooling tower(s)	Wateree River		2.39	-79%	45%	220,000–330,000	37	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
International Paper Georgetown Mill	SC					-	45%	220,000–330,000	37	
International Paper Kaukauna Mill	WI					-	20%	150,000–220,000		
International Paper Louisiana Mill	LA					-	45%	220,000–330,000		
International Paper Pensacola	FL					-	45%			
International Paper Prattville Mill	AL					-	45%	150,000–220,000		
International Paper Quinnesec Mich Mill	MI					-	8%	150,000–220,000		
International Paper Riegelwood Mill	NC					-	45%	220,000–330,000	85	
International Paper Roanoke Rapid NC	NC					-	45%	220,000–330,000	85	
International Paper Sartell Mill	MN					-	14%			
International Paper Savanna Mill	GA	Recirculating with forced draft cooling tower(s)	Wells		1.44	-79%	45%		65	
Iowa State University	IA					-	20%			
J. B. Sims	MI					-	8%	150,000–220,000		
J. C. Weadock	MI	Once through, fresh water	Saginaw River			-	8%	150,000–220,000		
J. E. Corette Plant	MT	Once through, fresh water	Yellowstone River		3.23	-23%	60%			
J. H. Campbell	MI	Once through, fresh water	Pigeon Lake		0.5	-91%	8%	150,000–220,000		
J. K. Spruce	TX	Once through with cooling pond(s) or canal(s)	Calaveras Lake			-	9%			
J. M. Stuart	OH	Once through, fresh water	Ohio River		0.46	-91%	8%	220,000–330,000		
J. R. Whiting	MI	Once through, fresh water	North Maumee Bay		0.5	-91%	8%	150,000–220,000		
J. T. Deely	TX	Recirculating with cooling pond(s) or canal(s)	Calaveras Lake Make-up FR		3.45	-7%	9%			Substantial
Jack McDonough	GA	Once through, fresh water	Chattahoochee River		1.44	-79%	45%		65	
Jack Watson	MS	Once through, saline water	Biloxi River		1.39	14%	45%			
James De Young	MI					-	8%	150,000–220,000		
James H. Miller Jr.	AL	Recirculating with natural draft cooling tower(s)	Mulberry Fork		0.24	14%	45%	150,000–220,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
James River Power Station	MO	Once through, fresh water	Lake Springfield			-	45%			
Jasper 2	IN					-	8%	220,000–330,000	20	
Jefferies	SC	Recirculating with forced draft cooling tower(s)	TL RC CNL		1.44	-79%	45%	220,000–330,000	37	
Jefferson Smurfit Fernandina Beach	FL					-	180%		228	
Jeffrey Energy Center	KS	Recirculating with forced draft cooling tower(s)	Kansas River		1.54	73%	6%			Unmet rural water needs
Jim Bridger	WY	Recirculating with induced draft cooling tower(s)	Green River		0.47	-18%	60%			
John B. Rich Memorial Power Station	PA					-	50%	150,000–220,000		
John Deere Dubuque Works	IA					-	20%			
John Deere Harvester Works	IL					-	20%	220,000–330,000		
John P. Madgett	WI	Once through, fresh water	Mississippi River			-	20%	150,000–220,000		
John Sevier	TN	Once through, fresh water	Holston River			-	45%	220,000–330,000	40	
Johnsonburg Mill	PA					-	50%	150,000–220,000		
Johnsonville	TN	Once through, fresh water	Tennessee River		0.25	-90%	45%	220,000–330,000	40	
Joliet 29	IL	Once through, fresh water	Des Plaines River		0.35	-93%	20%	220,000–330,000		
Joliet 9	IL	Once through, fresh water	Des Plaines River			-	20%	220,000–330,000		
Joppa Steam	IL	Once through, fresh water	Ohio River			-	20%	220,000–330,000		
Kammer	WV	Once through, fresh water	Ohio River		0.15	-89%	8%	150,000–220,000		
Kenneth C Coleman	KY	Once through, fresh water	Ohio River		0.09	-91%	8%			
Keystone	PA	Recirculating with natural draft cooling tower(s)	Crooked Creek		0.05	-92%	50%	150,000–220,000		
Killen Station	OH	Recirculating with forced draft cooling tower(s)	Ohio River		0.46	-91%	8%	220,000–330,000		
Kimberly Mill	WI					-	20%	150,000–220,000		
Kincaid Generation LLC	IL	Recirculating with cooling pond(s) or canal(s)	Lake Sangchris		0.19	-92%	20%	220,000–330,000		
Kingston	TN	Once through, fresh water	Emory River		0.25	-90%	45%	220,000–330,000	40	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Kline Township Cogen Facility	PA					-	50%	150,000–220,000		
Kodak Park Site	NY					-	900%	150,000–220,000		
Kraft	GA	Once through, saline water	Savannah River		1.44	-79%	45%		65	
KUCC	UT					-	60%			
Kyger Creek	OH	Once through, fresh water	Ohio River		0.15	-89%	8%	220,000–330,000		
L. V. Sutton	NC	Recirculating with cooling pond(s) or canal(s)	Sutton Lake		2.39	-79%	45%	220,000–330,000	85	
La Cygne	KS	Once through with cooling pond(s) or canal(s)	La Cygne Reservoir		1.54	73%	6%			
Labadie	MO	Once through, fresh water	Missouri River		2.72	73%	20%			
LaFarge Alpena	MI					-	8%	150,000–220,000		
Lake Road	MO	Once through, fresh water	Missouri River		1.54	73%	45%			Unmet rural water needs-pink
Lake Shore	OH	Once through, fresh water	Lake Erie			-	8%	220,000–330,000		
Lakeside	IL					-	20%	220,000–330,000		
Lansing	IA	Once through, fresh water	Mississippi River		0.35	-93%	20%			
Lansing Smith	FL	Once through, saline water	North Bay		1.23	7%	180%		228	
Laramie River Station	WY	Recirculating with forced draft cooling tower(s)	Laramie River		3.23	-23%	60%			Moderate
Lawrence Energy Center	KS	Recirculating with forced draft cooling tower(s)	Kansas River		1.54	73%	6%			Unmet rural water needs
Lee	NC	Recirculating with induced draft cooling tower(s)	H. F. Lee Lake		2.39	-79%	45%	220,000–330,000	85	
Leland Olds	ND	Once through, fresh water	Missouri River		2.73	45%	14%			
Lewis & Clark	MT					-	14%			
Limestone	TX	Recirculating with forced draft cooling tower(s)	Lake Limestone		1.55	-6%	9%		47	
Logan Generating Plant	NJ	Recirculating with induced draft cooling tower(s)	Delaware River		0.32	-92%	50%	220,000–330,000	185	
Logansport	IN					-	8%	220,000–330,000	20	
Lon Wright	NE	Once through, fresh water	Wells		6.17	73%	14%	150,000–220,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Louisa	IA	Recirculating with induced draft cooling tower(s)	Wells			-	20%			
Lovett	NY	Once through, saline water	Hudson River		0.26	-92%	900%	150,000–220,000		
Luke Mill	MD					-	8%		177	
Manitowoc	WI	Once through, fresh water	Lake Michigan		0.24	-94%	20%	150,000–220,000		
Marion	IL	Once through with cooling pond(s) or canal(s)	Lake Egypt		0.09	-93%	20%	220,000–330,000		
Marshall	NC	Once through, fresh water	Lake Norman		2.39	-79%	45%	220,000–330,000	85	
Marshall	MO					-	20%			
Martin Drake	CO	Recirculating with induced draft cooling tower(s)	Municipal		0.77	-25%	55%			Highly likely
Martin Lake	TX	Once through with cooling pond(s) or canal(s)	Martin Lake		1.55	-6%	9%		47	
Mayo	NC	Recirculating with forced draft cooling tower(s)	Mayo Lake		2.39	-79%	45%	220,000–330,000	85	
McIntosh	GA	Once through, fresh water	Savannah River		1.44	-79%	45%		65	
McMeekin	SC	Once through, fresh water	Lake Murray		2.39	-79%	45%	220,000–330,000	37	
Mecklenburg Power Station	VA	Recirculating with induced draft cooling tower(s)	John H. Kerr Reservoir		2.39	-79%	45%	150,000–220,000	69	
Meramec	MO	Once through, fresh water	Mississippi River		0.14	-93%	20%			
Meredosia	IL	Once through, fresh water	Illinois River		0.14	-93%	20%	220,000–330,000		
Merom	IN	Recirculating with cooling pond(s) or canal(s)	Turtle Creek Reservoir		0.09	-91%	8%	220,000–330,000	20	
Merrimack	NH	Once through with cooling pond(s) or canal(s)	Merrimack River		0.43	-26%	71%		44	
Miami Fort	OH	Once through, fresh water	Ohio River		0.46	-91%	8%	220,000–330,000		
Michigan City	IN	Recirculating with natural draft cooling tower(s)	Lake Michigan		0.51	-91%	8%	220,000–330,000	20	
Mill Creek	KY	Recirculating with forced draft cooling tower(s)	Ohio River		0.46	-91%	8%			
Milton L. Kapp	IA	Once through, fresh	Mississippi River		0.14	-93%	20%			

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
		water								
Milton R. Young	ND	Once through with cooling pond(s) or canal(s)	Nelson Lake		2.73	45%	14%			
Milwaukee County	WI					-	20%	150,000–220,000		
Missouri City	MO					-	45%			
Mitchell	GA	Once through, fresh water	Flint River		1.44	-79%	45%		65	
Mitchell	WV	Recirculating with natural draft cooling tower(s)	Ohio River			-	8%	150,000–220,000		
Mitchell Power Station	PA	Once through, fresh water	Monongahela River		0.08	-88%	8%	150,000–220,000		
Mohave	NV	Recirculating with forced draft cooling tower(s)	Colorado River		3.74	-18%	55%		21	Highly likely
Monroe	MI	Once through, fresh water	Raisin River		0.5	-91%	8%	150,000–220,000		
Monticello	TX	Once through with cooling pond(s) or canal(s)	Monticello Reservoir		0.04	0%	6%		47	
Montrose	MO	Once through with cooling pond(s) or canal(s)	Montrose Reservoir		1.54	73%	45%			
Morgantown Energy Facility	WV					-	8%	150,000–220,000		
Morgantown Generating Plant	MD	Once through, saline water	Potomac River		0.11	-91%	50%		177	
Mosinee Paper	WI					-	20%	150,000–220,000		
Mount Tom	MA	Once through, fresh water	Connecticut River		0.43	-94%	71%	150,000-220,000	82	
Mt. Poso Cogeneration	CA					-	200%	150,000–220,000	80	
Mt. Storm	WV	Once through with cooling pond(s) or canal(s)	Stony River		0.01	-83%	8%	150,000-–20,000		
Muscatine Plant #1	IA	Once through, fresh water	Mississippi River		0.14	-93%	20%			
Muskingum River	OH	Once through, fresh water	Muskingum River		0.15	-89%	8%	220,000–330,000		
Muskogee	OK	Recirculating with induced draft cooling tower(s)	Arkansas River		0.44	-14%	6%			
Muskogee Mill	OK	Recirculating with induced draft cooling tower(s)	Arkansas River			-	6%			

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
MW Custom Papers	OH					-	8%	220,000–330,000		
Naughton	WY	Recirculating with induced draft cooling tower(s)	Hams Fork River		0.47	-18%	60%			
Navajo	AZ	Recirculating with forced draft cooling tower(s)	Lake Powell		0.19	-17%	55%		49	Unmet rural water needs
Nearman Creek	KS	Once through, fresh water	Missouri River		1.54	73%	6%			Unmet rural water needs
Nebraska City	NE	Once through, fresh water	Missouri River		0.74	72%	14%	150,000–220,000		
Neil Simpson	WY					-	60%			
Neil Simpson II	WY					-	60%			
Nelson Dewey	WI	Once through, fresh water	Mississippi River		0.35	-93%	20%	150,000–220,000		
New Castle Plant	PA	Once through, fresh water	Beaver River		0.08	-88%	8%	150,000–220,000		
New Madrid	MO	Once through, fresh water	Mississippi River		0.32	52%	20%			
Newton	IL	Once through with cooling pond(s) or canal(s)	Laws Creek, Sandy Creek		0.09	-93%	20%	220,000–330,000		
Niagara Mill	WI					-	20%	150,000–220,000		
Niles	OH	Once through, fresh water	Mahoning River		0.46	-91%	8%	220,000–330,000		
North Branch	WV					-	8%	150,000–220,000		
North Omaha	NE	Once through, fresh water	Missouri River		0.74	72%	14%	150,000–220,000		
North Valmy	NV	Recirculating with forced draft cooling tower(s)	Wells		2.14	-28%	60%		21	
Northampton Generating Company	PA	Recirculating with forced draft cooling tower(s)	Lehigh River		0.32	-92%	50%	150,000–220,000		
Northeastern	OK	Recirculating with forced draft cooling tower(s)	Verdigris River		0.43	-16%	6%			
Northside Generating Station	FL	Once through, saline water	St. Johns River			-	180%		228	
NRG Energy Center Dover	DE					-	50%	220,000–330,000	111	
Nucla	CO	Recirculating with forced draft cooling tower(s)	San Miguel River		1.18	-28%	55%			
O. H. Hutchings	OH	Once through with cooling pond(s) or canal(s)	Great Miami River		0.46	-91%	8%	220,000–330,000		
Oklaunion	TX	Recirculating with	Municipal		0.47	-77%	9%		47	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
		induced draft cooling tower(s)								
Orrville	OH					-	8%	220,000–330,000		
Osage	WY					-	60%			
Ottumwa	IA	Recirculating with forced draft cooling tower(s)	Des Moines River		0.49	145%	20%			
P. H. Glatfelter	PA	Recirculating with cooling pond(s) or canal(s)	North Codorus		0.32	-92%	50%	150,000–220,000		
Packaging Corp. of America	TN					-	45%	220,000–330,000	40	
Packaging of America Tomahawk Mill	WI					-	20%	150,000–220,000		
Painesville	OH					-	8%	220,000–330,000		
Panther Creek Energy Facility	PA					-	50%	150,000–220,000		
Paradise	KY	Recirculating with natural draft cooling tower(s)	Green River		0.06	-90%	8%			
Park 500 Philip Morris USA	VA					-	45%	150,000–220,000	69	
Pawnee	CO	Recirculating with forced draft cooling tower(s)	Wells		0.65	-24%	55%			Moderate
Pearl Station	IL					-	20%	220,000–330,000		
Pella	IA					-	20%			
Peru	IN					-	8%	220,000–330,000	20	
Philip Sporn	WV	Once through, fresh water	Ohio River		0.15	-89%	8%	150,000–220,000		
Picway	OH	Once through, fresh water	Scioto River			-	8%	220,000–330,000		
Piney Creek Project	PA					-	50%	150,000–220,000		
Pirkey	TX	Recirculating with cooling pond(s) or canal(s)	Brandy Branch Reservoir		1.55	-6%	9%		47	
Pleasant Prairie	WI	Recirculating with induced draft cooling tower(s)	Lake Michigan		0.24	-94%	20%	150,000–220,000		
Pleasants Power Station	WV	Recirculating with natural draft cooling tower(s)	Ohio River			-	8%	150,000–220,000		
Port of Stockton District Energy Fac	CA					-	200%	150,000–220,000	41	
Portland	PA	Once through, fresh water	Delaware River		0.32	-92%	50%	150,000–220,000		
Possum Point	VA	Once through, fresh water	Potomac River			-	45%	150,000–220,000	69	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Potomac River	VA	Once through, fresh water	Potomac River		0.11	-91%	45%	150,000–220,000	69	
Powerton	IL	Recirculating with cooling pond(s) or canal(s)	Illinois River		0.35	-93%	20%	220,000–330,000		
PPG Natrium Plant	WV	Once through, fresh water	Ohio River		0.15	-89%	8%	150,000–220,000		
PPL Brunner Island	PA	Once through, fresh water	Susquehanna River		0.32	-92%	50%	150,000–220,000		
PPL Martins Creek	PA	Once through, fresh water	Delaware River		0.32	-92%	50%	150,000–220,000		
PPL Montour	PA	Recirculating with natural draft cooling tower(s)	Susquehanna River		0.32	-92%	50%	150,000–220,000		
Prairie Creek	IA	Once through, fresh water	Cedar River		1.87	143%	20%			
Presque Isle	MI	Once through, fresh water	Lake Superior		0.02	-92%	8%	150,000–220,000		
Primary Energy Roxboro	NC					-	45%	220,000–330,000	85	
Primary Energy Southport	NC	Recirculating with induced draft cooling tower(s)	Municipal			-	45%	220,000–330,000	85	
Procter & Gamble Cincinnati Plant	OH					-	8%	220,000–330,000		
PSEG Hudson Generating Station	NJ	Once through, saline water	Hackensack River			-	50%	220,000–330,000	185	
PSEG Mercer Generating Station	NJ	Once through, fresh water	Delaware River		0.32	-92%	50%	220,000–330,000	185	
Pulliam	WI	Once through, fresh water	Green Bay		0.24	-94%	20%	150,000–220,000		
Purdue University	IN					-	8%	220,000–330,000	20	
Quindaro	KS	Once through, fresh water	Missouri River		1.54	73%	6%			Unmet rural water needs
R. D. Green	KY	Recirculating with forced draft cooling tower(s)	Green River			-	8%			
R. D. Morrow	MS	Recirculating with induced draft cooling tower(s)	Wells		1.39	14%	45%			
R. E. Burger	OH	Once through, fresh water	Ohio River		0.15	-89%	8%	220,000–330,000		
R. Gallagher	IN	Once through, fresh water	Ohio River		0.46	-91%	8%	220,000–330,000	20	
R. M. Heskett	ND	Once through, fresh water	Missouri River		2.73	45%	14%			
R. M. Schahfer	IN	Recirculating with forced draft cooling tower(s)	Kankakee River		0.04	-89%	8%	220,000–330,000	20	
R. Paul Smith Power Station	MD	Once through, fresh	Potomac River		0.11	-91%	50%		177	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
		water								
R. S. Nelson	LA	Recirculating with forced draft cooling tower(s)	Municipal-SRA		2.63	18%	45%	220,000–330,000		
Radford Army Ammunition Plant	VA					-	8%	150,000–220,000	69	
Rapids Energy Center	MN					-	14%			
Rawhide	CO	Recirculating with cooling pond(s) or canal(s)	Municipal Treated Sewage		3.23	-23%	55%			Highly likely
Ray D. Nixon	CO	Recirculating with induced draft cooling tower(s)	Wells		0.77	-25%	55%			Highly likely
Red Hills Generating Facility	MS					-	45%			
Reid Gardner	NV	Recirculating with forced draft cooling tower(s)	Wells		3.74	-18%	55%		21	
Richard Gorsuch	OH	Once through, fresh water	Ohio River		0.15	-89%	8%	220,000–330,000		
Rio Bravo Jasmin	CA					-	200%	150,000–220,000	80	
Rio Bravo Poso	CA					-	200%	150,000–220,000	80	
Rittman Paperboard	OH					-	8%	220,000–330,000		
River Rouge	MI					-	8%	150,000–220,000		
Riverbend	NC	Once through, fresh water	Catawba River		2.39	-79%	45%	220,000–330,000	85	
Riverside	MN	Once through, fresh water	Mississippi River		2.45	145%	14%			
Riverside	IA	Once through, fresh water	Miss River		1.87	143%	20%			
Riverton	KS					-	6%			
Riverwood International Macon Mill	GA					-	45%		65	
Rivesville	WV	Once through, fresh water	Monongahela River		0.11	-89%	8%	150,000–220,000		
Robert A. Reid	KY					-	8%			
Rochester 7	NY	Once through, fresh water	Lake Ontario		0.15	-94%	900%	150,000–220,000		
Rockport	IN	Recirculating with natural draft cooling tower(s)	Ohio River		0.09	-91%	8%	220,000–330,000	20	
Rock-Tenn Mill	AL					-	45%	150,000–220,000		
Rodemacher	LA	Recirculating with cooling pond(s) or canal(s)	Rodemacher Lake			-	6%	220,000–330,000		

TABLE A-1 (Cont.)

		Cooling System Information		Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source	2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Roxboro	NC	Recirculating with cooling pond(s) or canal(s)	Lake Hyco	2.39	-79%	45%	220,000–330,000	85	
Rumford Cogeneration	ME	Recirculating with induced draft cooling tower(s)	Androscoggin River	0.43	-94%	71%			
Rush Island	MO	Once through, fresh water	Mississippi River	0.14	-93%	20%			
S. A. Carlson	NY				-	900%	150,000–220,000		
S. D. Warren Muskegon	MI				-	8%	150,000–220,000		
S. D. Warren Westbrook	ME				-	71%			
Salem Harbor	MA	Once through, saline water	Atlantic Ocean	0.43	-94%	71%	150,000–220,000	82	
San Juan	NM	Recirculating with forced draft cooling tower(s)	San Juan River	0.04	-20%	55%			Unmet rural water needs
San Miguel	TX	Recirculating with forced draft cooling tower(s)	Well	1.55	-6%	9%		47	
Sandow No. 4	TX	Recirculating with cooling pond(s) or canal(s)	Lake Alcoa	3.45	-7%	9%		47	
Sandow Station	TX	Recirculating with cooling pond(s) or canal(s)	Alcoa Lake Treatment System		-	9%		47	
Savannah River Mill	GA				-	45%		65	
Savannah Sugar Refinery	GA				-	45%		65	
Scherer	GA	Recirculating with natural draft cooling tower(s)	Lake Juliette	1.44	-79%	45%		65	
Schiller	NH	Once through, saline water	Piscataqua River		-	71%		44	
Scholz	FL				-	180%		228	
Scrubgrass Generating	PA				-	50%	150,000–220,000		
Seaford Delaware Plant	DE				-	50%	220,000–330,000	111	
Seminole	FL	Recirculating with natural draft cooling tower(s)	St. Johns River	1.23	7%	180%		228	
Seward	PA	Recirculating with forced draft cooling tower(s)	Conemaugh River	0.05	-92%	50%	150,000–220,000		
Shawnee	KY	Once through, fresh water	Ohio River		-	8%			
Shawville	PA	Once through, fresh water	Susquehanna River	0.02	-89%	50%	150,000–220,000		
Shelby Municipal Light Plant	OH				-	8%	220,000–330,000		
Sheldon	NE	Recirculating with induced draft cooling	Wells	6.17	73%	14%	150,000–220,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
		tower(s)								
Sherburne County	MN	Recirculating with forced draft cooling tower(s)	Mississippi River		2.45	145%	14%			
Shiras	MI					-	8%	150,000–220,000		
Sibley	MO	Once through, fresh water	Missouri River		0.99	71%	45%			
Sikeston Power Station	MO	Recirculating with forced draft cooling tower(s)	Wells		0.32	52%	20%			
Silver Bay Power	MN	Once through, fresh water	Lake Superior		0.33	154%	14%			
Silver Lake	MN					-	14%			
Sioux	MO	Once through, fresh water	Mississippi River		0.14	-93%	20%			
Sixth Street	IA					-	20%			
Smart Papers LLC	OH					-	8%	220,000–330,000		
Sooner	OK	Recirculating with cooling pond(s) or canal(s)	Arkansas River		1.67	-15%	6%			
South Oak Creek	WI	Once through, fresh water	Lake Michigan		0.24	-94%	20%	150,000–220,000		
Southampton Power Station	VA					-	45%	150,000–220,000	69	
Southwest Power Station	MO	Recirculating with forced draft cooling tower(s)	Wells			-	45%			
SP Newsprint	GA					-	45%		65	
Springerville	AZ	Recirculating with induced draft cooling tower(s)	Wells		3.74	-18%	55%		49	Highly likely
St. Clair	MI	Once through, fresh water	St. Clair River		0.5	-91%	8%	150,000–220,000		
St. Johns River Power Park	FL	Recirculating with natural draft cooling tower(s)	St. John River		1.23	7%	180%		228	
St. Marys	OH					-	8%	220,000–330,000		
St. Nicholas Cogen Project	PA					-	50%	150,000–220,000		
Stanton	ND	Once through, fresh water	Missouri River			-	14%			
Stanton Energy Center	FL	Recirculating with natural draft cooling tower(s)	Effluent From Sewage Plan		1.23	7%	180%		228	
State Line Energy	IN	Once through, fresh water	Lake Michigan		0.24	-94%	8%	220,000–330,000	20	
Stockton Cogen	CA					-	200%	150,000–220,000	80	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Stone Container Florence Mill	SC	Recirculating with induced draft cooling tower(s)	Great Pee Dee River		2.39	-79%	45%	220,000–330,000	37	
Stone Container Hopewell Mill	VA					-	45%	150,000–220,000	69	
Stone Container Ontonagon Mill	MI					-	8%	150,000–220,000		
Stone Container Panama City Mill	FL					-	180%		228	
Streeter Station	IA					-	20%			
Sunnyside Cogen Associates	UT					-	60%			
Sutherland	IA	Recirculating with forced draft cooling tower(s)	Wells		1.86	142%	20%			
Syl Laskin	MN	Once through, fresh water	Colby Lake		0.33	154%	14%			
T. B. Simon Power Plant	MI					-	8%	150,000–220,000		
Taconite Harbor Energy Center	MN	Once through, fresh water	Lake Superior		0.33	154%	14%			
Tanners Creek	IN	Once through, fresh water	Ohio River		0.46	-91%	8%	220,000–330,000	20	
Tecumseh Energy Center	KS	Recirculating with forced draft cooling tower(s)	Kansas River		1.54	73%	6%			Unmet rural water needs
Tennessee Eastman Operations	TN	Once through, fresh water	South Fork - Holston River			-	45%	220,000–330,000	40	
TES Filer City Station	MI					-	8%	150,000–220,000		
Thomas Hill	MO	Once through, fresh water	Thomas Hill Lake		1.54	73%	20%			
Titus	PA	Recirculating with forced draft cooling tower(s)	Schuylkill River		0.32	-92%	50%	150,000–220,000		
Tolk	TX	Recirculating with induced draft cooling tower(s)	Wells		0.34	-79%	9%		47	
Transalta Centralia Generation	WA	Recirculating with induced draft cooling tower(s)	Skookumchuk River		5.6	-15%	60%		41	Moderate
Trenton Channel	MI	Once through, fresh water	Trenton Channel		0.5	-91%	8%	150,000–220,000		
Trigen Colorado Energy	CO					-	55%			
Trigen Syracuse Energy	NY					-	900%	150,000–220,000		
Trimble County	KY	Recirculating with natural draft cooling tower(s)	Ohio River		0.46	-91%	8%			
Tuscola Station	IL					-	20%	220,000–330,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Twin Oaks Power One	TX	Recirculating with forced draft cooling tower(s)	Wells		3.45	-7%	9%		47	
TXI Riverside Cement Power House	CA					-	200%	150,000–220,000	80	
Tyrone	KY	Once through, fresh water	Kentucky River		0.26	-91%	8%			
U. S. Alliance Coosa Pines	AL					-	45%	150,000–220,000		
Unifi Kinston LLC	NC					-	45%	220,000–330,000	85	
Univ. of NC Chapel Hill Cogen Facility	NC					-	45%	220,000–330,000	85	
University of Alaska Fairbanks	AK					-				
University of Illinois Abbott Power Plt	IL					-	20%	220,000–330,000		
University of Iowa Main Power Plant	IA					-	20%			
University of Missouri Columbia	MO					-	20%			
University of Notre Dame	IN					-	8%	220,000–330,000	20	
Urquhart	SC	Once through, fresh water	Savannah River		1.44	-79%	45%	220,000–330,000	37	
U.S. DOE Savannah River Site (D Area)	SC					-	45%	220,000–330,000	37	
Utility Plants Section	AK					-				
Valley	WI	Once through, fresh water	Menomonee River		0.24	-94%	20%	150,000–220,000		
Valmont	CO	Recirculating with cooling pond(s) or canal(s)	South Boulder Creek		0.65	-24%	55%			Highly likely
Vanderbilt University Power Plant	TN					-	45%	220,000–330,000	40	
Vermilion	IL	Recirculating with forced draft cooling tower(s)	Vermilion Reservoir		0.09	-93%	20%	220,000–330,000		
Victor J. Daniel Jr.	MS	Recirculating with cooling pond(s) or canal(s)	Municipal County		1.39	14%	45%			
Virginia	MN					-	14%			
W. A. Parish	TX	Recirculating with cooling pond(s) or canal(s)	Brazos River		3.45	-7%	9%		47	Highly likely
W. H. Sammis	OH	Once through, fresh water	Ohio River			-	8%	220,000–330,000		
W. H. Weatherspoon	NC	Recirculating with cooling pond(s) or canal(s)	Weatherspoon Lake		2.39	-79%	45%	220,000–330,000	85	
W. H. Zimmer	OH	Recirculating with natural draft cooling tower(s)	Ohio River		0.46	-91%	8%	220,000–330,000		

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
W. N. Clark	CO					-	55%			
W. S. Lee	SC	Once through, fresh water	Saluda River		2.39	-79%	45%	220,000–330,000	37	
Wabash River	IN	Once through, fresh water	Wabash River		0.09	-91%	8%	220,000–330,000	20	
Walter C Beckjord	OH	Once through, fresh water	Ohio River		0.46	-91%	8%	220,000–330,000		
Wansley	GA	Recirculating with induced draft cooling tower(s)	Service Water Pond		1.44	-79%	45%		65	
Warrick	IN	Once through, fresh water	Ohio River			-	8%	220,000–330,000	20	
Wateree	SC	Once through, fresh water	Wateree River		2.39	-79%	45%	220,000–330,000	37	
Waukegan	IL	Once through, fresh water	Lake Michigan		0.35	-93%	20%	220,000-–30,000		
Waynesboro Virginia Plant	VA					-	45%	150,000–220,000	69	
WCI Steel	OH					-	8%	220,000–330,000		
Welsh	TX	Recirculating with forced draft cooling tower(s)	Swauano Creek Reservoir		0.04	0%	6%		47	
West Point Mill	VA	Recirculating with induced draft cooling tower(s)	Wells		0.29	-89%	45%	150,000–220,000	69	
Westmoreland-LG&E Roanoke Valley I	NC	Recirculating with induced draft cooling tower(s)	Municipal		2.39	-79%	45%	220,000–330,000	85	
Westmoreland-LG&E Roanoke Valley II	NC				2.39	-79%	45%	220,000–330,000	85	
Weston	WI	Once through, fresh water	Wisconsin River		0.14	-93%	20%	150,000–220,000		
Weyerhaeuser Longview WA	WA					-	60%		41	
Weyerhaeuser Pine Hill Operations	AL					-	45%	150,000–220,000		
Weyerhaeuser Plymouth NC	NC					-	45%	220,000–330,000	85	
Wheelabrator Frackville Energy	PA					-	50%	150,000–220,000		
Whelan Energy Center	NE					-	14%	150,000–220,000		
White Bluff	AR	Recirculating with natural draft cooling tower(s)	Arkansas River		0.48	-13%	45%	150,000–220,000		
White Pine Electric Power	MI					-	8%	150,000–220,000		
Whitewater Valley	IN					-	8%	220,000–330,000	20	

TABLE A-1 (Cont.)

		Cooling System Information			Area Demand Indicators					
Plant Name	State	Primary Cooling System	Cooling Water Source		2030 Water Consumption – All Users (BGD)	Change (%) in Water Consumption – All Users 2005–2030	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals (GPD/mi^2)	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
Widows Creek	AL	Once through, fresh water	Tennessee River		0.07	17%	45%	150,000–220,000		
Will County	IL	Once through, fresh water	Chicago Sanitary and Ship		0.35	-93%	20%	220,000–330,000		
Williams	SC	Once through, fresh water	Back River		1.44	-79%	45%	220,000–330,000	37	
Willmar	WV					-	8%	150,000–220,000		
Willow Island	SC	Once through, fresh water	Ohio River			-	45%	220,000–330,000	37	
Winyah	SC	Recirculating with cooling pond(s) or canal(s)	Wadmacon Creek		2.39	-79%	45%	220,000–330,000	37	
Wisconsin Rapids Pulp Mill	WI					-	20%	150,000–220,000		
Wood River	IL					-	20%	220,000–330,000		
WPS Energy Servs Sunbury Gen	PA	Once through, fresh water	Susquehanna River		0.32	-92%	50%	150,000–220,000		
WPS Power Niagara	NY					-	900%	150,000–220,000		
WPS Westwood Generation LLC	PA					-	50%	150,000–220,000		
Wyandotte	MI					-	8%	150,000–220,000		
Wygen 1	WY					-	60%			
Wyodak	WY	Other	Municipal		0.067	-92%	60%			
Yates	GA	Recirculating with induced draft cooling tower(s)	Chatte River		1.44	-79%	45%		65	
Yorktown	VA	Once through, saline water	York River			-	45%	150,000–220,000	69	

TABLE A-2 Coal-fired Power Plants in the Analysis Set (Plant-Specific Demand Indicators and Supply Indicators)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
A. B. Brown	IN	3,523,603	0.0	-	0.0	-	3,623,035		<5		55-60	Increasing drought		
ACE Cogeneration Facility	CA	764,480	1.6	771	2.1	987	-					Increasing drought		
AES Beaver Valley Partners Beaver Valley	PA	963,293	0.0	-	113.1	42,856	-							
AES Cayuga	NY	2,410,668	0.5	69	239.9	36,325	2,495,580							
AES Greenidge LLC	NY	889,378	0.0	-	67.9	27,851	994,967							
AES Hawaii	HI	1,547,814	2.1	488	12.5	2,942	-							
AES Petersburg	IN	11,550,170	13.8	435	388.8	12,285	12,980,258							
AES Shady Point	OK	2,384,414	2.8	427	3.1	481	-				60-65	Increasing drought		
AES Somerset LLC	NY	5,226,893	0.0	-	234.0	16,343	4,925,296							
AES Thames	CT	1,258,706	0.0	-	101.9	29,556	-							
AES Warrior Run Cogeneration Facility	MD	1,557,998	0.0	-	0.0	-	-							
AES Westover	NY	799,783	0.0	-	80.4	36,693	801,893							
Albright	WV	1,060,991	0.0	-	0.0	-	1,290,853							
Allen S. King	MN	2,796,588	0.8	110	322.8	42,127	3,009,375							
Allen Steam Plant	TN	5,160,139	0.0	-	405.7	28,697	5,337,930				60-65	Significantly increasing		Drier than normal
Alloy Steam Station	WV	111,491	0.0	-	0.0	-	-							
Alma	WI	943,933	0.0	-	53.1	20,518	1,100,504							
Altavista Power Station	VA	347,843	0.0	-	0.0	-	221,855							Moderately dry
Amalgamated Sugar Twin Falls	ID	50,916	0.0	-	0.0	-	-							
American Eagle Paper Mills	PA	46,073	0.0	-	0.0	-	-							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Ames Electric Services Power Plant	IA	508,139	0.0	-	0.0	-	719,216							
Anheuser Busch St. Louis	MO	109,440	0.0	-	0.0	-	-							
Antelope Valley	ND	6,437,295	9.2	524	9.2	524	7,951,684		12–20					Drier than normal
Apache Station	AZ	2,761,712	3.2	427	3.9	513	3,430,322		5–12		60–65	Increasing drought		
Arapahoe	CO	893,862	1.6	633	1.9	765	1,165,575		12–20					
Archer Daniels Midland Cedar Rapids	IA	970,995	0.4	146	0.5	170	-							
Archer Daniels Midland Clinton	IA	195,854	0.0	-	0.0	-	-							
Archer Daniels Midland Decatur	IL	1,591,666	0.1	13	0.1	15	-					Increasing drought		
Archer Daniels Midland Peoria	IL	52,482	0.0	-	0.0	-	-							
Argus Cogen Plant	CA	349,966	0.0	-	0.0	-	-							
Armstrong Power Station	PA	2,014,304	0.0	-	157.0	28,447	2,064,814							
Asbury	MO	1,368,540	2.4	638	3.0	810	1,573,879				55–60			
Ashdown	AR	842,748	0.0	-	0.0	-	-							
Asheville	NC	2,370,895	1.4	219	1.4	219	2,529,952				55–60	Increasing drought		Moderately dry
Ashtabula	OH	1,408,106	0.0	-	186.1	48,250	1,551,878							
Aurora Energy LLC Chena	AK	180,995	0.0	-	0.0	-	-							
Austin Northeast	MN	140,898	0.0	-	0.0	-	210,310							
Avon Lake	OH	3,541,512	0.0	-	469.5	48,393	3,578,165							
B. C. Cobb	MI	2,053,810	0.0	-	0.0	-	2,334,239							
Bailly	IN	2,699,909	23.8	3,224	297.8	40,263	3,348,175							
Baldwin Energy Complex	IL	12,618,530	0.0	-	32.3	935	12,954,432				55–60	Increasing drought		
Barry	AL	11,698,092	1.4	44	1040.7	32,472	12,368,447				65–70			Moderately dry
Bay Front	WI	337,075	0.0	-	0.0	-	506,128							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Bay Shore	OH	3,132,362	0.0	-	0.0	-	3,442,500							
Belews Creek	NC	15,346,420	11.2	266	1232.6	29,316	14,219,393				55–60	Increasing drought		Moderately dry
Belle River	MI	8,152,189	0.0	-	269.8	12,081	8,627,148							
Ben French	SD	152,534	0.0	-	0.0	-	-							
Big Bend	FL	8,433,410	0.0	-	1188.3	51,428	10,053,275				>70	Increasing drought		
Big Brown	TX	8,549,084	0.0	-	509.9	21,772	10,573,229				65–70			
Big Cajun2	LA	11,734,870	11.5	358	287.8	8,952	13,690,368				65–70	Increasing drought		
Big Sandy	KY	7,345,624	12.2	607	12.2	607	6,952,257					Increasing drought		
Big Stone	SD	2,846,714	3.9	497	3.9	497	3,393,364							
Birchwood Power	VA	1,672,808	2.1	465	2.2	479	-				55–60	Increasing drought		Moderately dry
Biron Mill	WI	245,599	0.0	-	0.0	-	-							
Black Dog	MN	1,853,369	0.0	-	298.9	58,869	2,112,418							
Black River Generation	NY	355,836	0.0	-	0.0	-	-							
Blount Street	WI	452,144	0.0	-	0.0	-	578,539							
Blue Valley	MO	329,318	3.9	4,298	3.9	4,298	229,922							
Boardman	OR	3,587,882	11.6	1,184	11.6	1,184	3,997,133		5–12			Increasing drought		
Bonanza	UT	3,716,487	6.9	673	6.9	673	-		5–12			Increasing drought		
Bowater Newsprint Calhoun Operation	TN	452,546	0.0	-	0.0	-	-							Drier than normal
Bowen	GA	22,337,673	26.4	431	38.8	634	22,156,086				55–60	Increasing drought		Moderately dry
Brandon Shores	MD	8,349,218	3.6	155	9.0	396	8,134,939				55–60	Increasing drought		
Brayton Point	MA	8,048,727	0.0	-	800.3	36,291	7,342,712							
Bremo Bluff	VA	1,434,807	0.0	-	130.6	33,212	1,613,151				55–60			Moderately dry
Bridgeport Station	CT	2,735,970	0.0	-	267.8	35,722	3,102,333							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators						Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Bruce Mansfield	PA	18,343,905	55.0	1,095	63.1	1,255	17,290,117						
Buck	NC	1,647,010	2.7	602	346.9	76,873	1,761,106			55–60	Increasing drought		Moderately dry
Bull Run	TN	6,587,608	0.0	-	551.7	30,568	6,584,729			55–60			Drier than normal
Bunge Milling Cogen	IL	129,766	0.0	-	0.0	-	-						
Burlington	IA	1,143,174	5.2	1,651	96.5	30,822	1,436,452				Increasing drought		
C. D. McIntosh Jr.	FL	2,630,208	0.0	-	0.0	-	2,828,957						
C. P. Crane	MD	2,128,314	0.0	-	351.3	60,254	2,385,667			55–60			
C. R. Huntley Generating Station	NY	2,692,359	0.0	-	595.1	80,681	3,395,650						
Cambria Cogen	PA	791,719	0.0	-	0.0	-	-						
Camden South Carolina	SC	20,879	0.0	-	0.0	-	-						Moderately dry
Cameo	CO	489,849	0.0	-	0.0	-	420,474						
Canadys Steam	SC	2,198,619	6.1	1,019	6.9	1,148	2,398,210			60–65	Significantly increasing drought		Moderately dry
Cane Run	KY	3,685,842	0.0	-	404.9	40,092	3,967,983			55–60	Increasing drought		
Canton North Carolina	NC	361,795	0.0	-	0.0	-	-						Moderately dry
Cape Fear	NC	1,876,174	0.8	151	272.9	53,086	1,963,735			55–60	Increasing drought		Moderately dry
Carbon	UT	1,349,858	2.8	751	2.8	751	1,547,568	12–20			Increasing drought		
Cardinal	OH	11,372,613	8.7	280	965.8	30,997	10,874,807		Moderately Dry,-1.29 to 00.80				
Cargill Corn Milling Division	IA	52,453	0.0	-	0.0	-	-						
Cargill Corn Wet Milling Plant	TN	696	0.0	-	0.0	-	-						Drier than normal
Cayuga	IN	6,621,960	0.0	-	483.4	26,647	6,451,115				Increasing drought		
CC Perry K	IN	1,188	0.0	-	0.0	-	74,089						
Cedar Bay Generating LP	FL	1,811,071	2.9	586	2.9	586	-			65–70	Significantly increasing		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
												drought		
Central Power & Lime	FL	609,429	0.0	-	144.1	86,322	-				>70	Increasing drought		
Chalk Point LLC	MD	4,110,282	0.0	-	582.3	51,712	4,293,417				55–60	Increasing drought		
Chamois	MO	416,804	0.0	-	0.0	-	345,603							
Charles R. Lowman	AL	3,865,846	12.9	1,214	74.6	7,048	4,707,690				60–65	Increasing drought		Moderately dry
Cherokee	CO	5,001,081	7.0	509	9.2	675	5,716,240		12–20					
Chesapeake	VA	3,781,226	0.0	-	544.3	52,544	4,213,781				55–60	Increasing drought		Moderately dry
Chester Operations	PA	389,938	0.0	-	0.0	-	-							
Chesterfield	VA	8,124,294	0.0	-	774.0	34,775	8,656,606				55–60			Moderately dry
Cheswick Power Plant	PA	2,889,720	0.0	-	283.8	35,846	2,921,152							
Cholla	AZ	7,577,570	0.0	-	9.8	470	8,806,578		5–12	Moderately Dry,-1.29 to 00.80				
Cinergy Solutions of Narrows	VA	192,893	0.0	-	0.0	-	-							Moderately dry
Clay Boswell	MN	7,248,188	8.5	426	154.0	7,756	8,180,829							
Cliffside	NC	3,733,245	6.5	632	258.9	25,314	3,929,892				55–60	Increasing drought		Moderately dry
Clifty Creek	IN	8,981,018	0.0	-	1226.7	49,855	8,905,313					Increasing drought		
Clover	VA	6,387,194	0.0	-	0.0	-	6,847,691				55–60			Moderately dry
Coal Creek	ND	8,359,811	12.1	527	12.1	527	10,713,452		12–20					Drier than normal
Coffeen	IL	4,450,529	0.0	-	505.4	41,446	-					Increasing drought		
Cogen South	SC	573,438	0.0	-	0.0	-	-							Moderately dry
Cogentrix Hopewell	VA	642,619	2.6	1,468	2.6	1,468	-				55–60	Increasing drought		Moderately dry
Cogentrix of Richmond	VA	1,531,379	5.0	1,202	5.0	1,202	-				55–60			Moderately dry
Cogentrix Virginia Leasing Corporation	VA	710,463	2.8	1,461	2.8	1,461	-				55–60	Increasing drought		Moderately dry

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Coleto Creek	TX	5,103,360	1.3	92	390.4	27,920	5,266,526				>70	Increasing drought		
Colstrip	MT	16,240,780	27.4	616	27.4	616	19,219,042		12–20			Significantly increasing drought		
Colstrip Energy LP	MT	304,923	0.0	-	0.0	-	-							
Columbia	WI	73,158	0.0	-	1.0	5,003	8,071,269							
Columbia	MO	6,538,816	0.0	-	0.0	-	102,591							
Colver Power Project	PA	806,743	1.2	526	1.2	526	-							
Comanche	CO	4,292,197	6.0	511	7.4	632	5,242,791		12–20					
Conemaugh	PA	12,941,704	13.4	377	15.4	436	12,609,082							
Conesville	OH	9,786,542	25.7	957	219.2	8,176	10,029,698							
Cooper	KY	2,004,931	0.0	-	297.8	54,219	1,987,880				55–60	Increasing drought		
Cope	SC	2,990,506	3.6	434	4.0	489	3,207,575				60–65	Significantly increasing drought		Moderately dry
Corn Products Illinois	IL	292,461	0.0	-	0.0	-	-							
Coronado	AZ	6,070,528	8.0	482	8.5	513	6,677,002		5–12	Moderately Dry,-1.29 to 00.80				
Council Bluffs	IA	6,246,265	0.0	-	480.8	28,095	6,889,705					Increasing drought		
Covanta Mid-Connecticut Energy	CT	411,782	0.0	-	0.0	-	-							
Covington Facility	VA	639,474	0.0	-	0.0	-	-							Moderately dry
Coyote	ND	3,046,077	4.6	550	4.8	581	3,844,011		12–20					Drier than normal
Craig	CO	10,116,199	12.8	462	12.8	462	11,588,735		12–20	Moderately Dry,-1.29 to 00.80		Increasing drought		
Crawford	IL	2,965,873	0.0	-	503.1	61,914	3,377,065							
Crawfordsville	IN	39,782	0.0	-	0.0	-	-							
Crisp Plant	GA	1,033	0.0	-	0.0	-	-							Moderately dry

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Crist	FL	5,009,625	13.3	970	86.6	6,310	5,640,013				65–70	Increasing drought		
Cromby Generating Station	PA	709,134	0.0	-	125.4	64,537	903,580							
Cross	SC	8,149,025	10.1	452	11.9	535	8,760,095				60–65	Significantly increasing drought h		Moderately dry
Crystal River	FL	15,886,134	4.8	111	1133.3	26,039	17,349,808				>70	Increasing drought		
Cumberland	TN	16,371,958	0.0	-	2075.4	46,269	16,883,450				55–60	Increasing drought		Drier than normal
D. B. Wilson	KY	3,403,626	0.0	-	13.7	1,469	4,182,682				55–60	Increasing drought		
Dale	KY	1,232,800	0.0	-	1.0	287	1,121,701				55–60	Increasing drought		
Dallman	IL	2,084,109	9.8	1,721	162.2	28,400	2,934,448					Increasing drought		
Dan E. Karn	MI	3,745,336	0.0	-	312.4	30,441	4,104,041							
Dan River	NC	649,313	1.6	908	252.7	142,057	813,992				55–60	Increasing drought		Moderately dry
Danskammer Generating Station	NY	2,344,416	0.0	-	228.7	35,601	2,214,530							
Dave Johnston	WY	5,684,004	7.0	448	205.3	13,186	7,130,622		12–20			Increasing drought		
Deerhaven Generating Station	FL	1,546,270	0.0	-	0.0	-	1,604,372				65–70	Significantly increasing drought		
Dickerson	MD	3,340,623	0.0	-	440.8	48,161	3,411,227							
Dolet Hills	LA	4,842,592	513.2	38,682	523.2	39,438	6,063,486				60–65	Increasing drought		
Dolphus M. Grainger	SC	1,133,033	0.0	-	122.5	39,476	1,310,922				60–65	Significantly increasing drought		Moderately dry
Dover	OH	69,600	0.0	-	0.0	-	-							
Dubuque	IA	344,295	0.0	-	0.0	-	514,823							
Duck Creek	IL	1,537,832	0.0	-	0.0	-	1,759,193					Increasing drought		
Dunkirk Generating Station	NY	3,345,523	0.0	-	426.8	46,560	3,615,791							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
E. C. Gaston	AL	11,273,368	1.4	44	412.0	13,338	12,234,048				60–65	Increasing drought		Moderately dry
E. D. Edwards	IL	4,393,834	0.0	-	381.8	31,720	4,997,804					Increasing drought		
E. J. Stoneman Station	WI	66,759	0.0	-	0.0	-	91,288							
E. W. Brown	KY	3,223,536	6.7	761	9.7	1,098	3,521,621				55–60	Increasing drought		
Eagle Valley	IN	1,477,173	0.0	-	208.7	51,567	1,634,491							
Earl F. Wisdom	IA	138,410	0.0	-	0.0	-	202,999							
East Bend	KY	3,705,966	0.0	-	347.7	34,247	3,665,437					Increasing drought		
Eastlake	OH	8,380,430	21.3	929	712.2	31,021	8,322,363							
Ebensburg Power	PA	402,684	0.0	-	0.0	-	-							
Eckert Station	MI	1,694,523	221.9	47,807	231.6	49,881	2,118,565							
Eddystone Generating Station	PA	2,907,835	0.8	97	419.0	52,595	3,571,167							
Edge Moor	DE	1,327,127	1.0	267	187.8	51,656	1,466,286					Increasing drought		
Edgewater	WI	4,150,468	0.0	-	277.6	24,412	5,017,778					Increasing drought		
Edwardsport	IN	178,617	0.0	-	136.4	278,675	-							
Eielson AFB Central Heat & Power Plant	AK	85,549	0.0	-	0.0	-	-							
Elmer Smith	KY	2,198,358	0.0	-	200.7	33,324	2,751,995				55–60	Increasing drought		
Elrama Power Plant	PA	1,592,313	11.5	2,637	546.7	125,308	2,009,719							
Endicott Station	MI	424,300	0.0	-	0.0	-	648,613							
Erickson Station	MI	1,082,747	0.3	87	0.8	261	1,223,002							
Escalante	NM	1,910,179	1.7	321	1.7	321	2,057,449		5–12					
Escanaba	MI	148,525	0.0	-	0.0	-	-							
Escanaba Paper Company	MI	718,690	0.0	-	0.0	-	-							
F. B. Culley	IN	2,617,847	0.0	-	276.4	38,533	3,169,926				55–60	Increasing drought		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators						Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Fair Station	IA	365,390	0.0	-	0.0	-	302,521						
Fayette Power Project	TX	11,099,204	0.0	-	876.8	28,834	11,982,386			65–70	Increasing drought		
Fisk Street	IL	1,673,848	0.0	-	215.1	46,903	1,722,764						
Flint Creek	AR	3,556,261	0.1	7	378.0	38,793	3,649,665			55–60	Increasing drought		
Fort Martin Power Station	WV	7,060,815	8.0	414	10.9	561	6,729,297						
Foster Wheeler Mt. Carmel Cogen	PA	321,125	0.0	-	0.0	-	556,712						
Four Corners	NM	15,616,040	22.2	518	22.7	530	16,015,409	5–12					
Frank E. Ratts	IN	1,183,337	0.0	-	154.4	47,626	1,164,589						
G. F. Weaton Power Station	PA	528,419	0.0	-	74.5	51,474	-						
G. G. Allen	NC	6,415,484	6.9	390	667.4	37,970	6,224,197			55–60	Significantly increasing drought		Moderately dry
Gadsden	AL	429,828	0.5	384	143.0	121,403	677,598			60–65	Increasing drought		Moderately dry
Gallatin	TN	7,494,267	0.0	-	940.5	45,804	7,501,399			55–60	Increasing drought		Drier than normal
General Chemical	WY	255,741	0.0	-	0.0	-	-						
General James M. Gavin	OH	19,142,304	40.0	763	40.0	763	18,842,155				Increasing drought		
Genoa	WI	2,414,001	0.0	-	187.5	28,350	2,269,251						
George Neal North	IA	6,512,341	17.3	971	577.2	32,348	7,318,651						
George Neal South	IA	3,953,585	0.0	-	303.8	28,044	4,316,890						
Georgia Pacific Cedar Springs	GA	628,836	37.5	21,759	195.2	113,294	-			65–70	Increasing drought		Moderately dry
Georgia Pacific Naheola Mill	AL	419,389	0.0	-	0.0	-	-						Moderately dry
Georgia-Pacific Corp-Nekoosa Mill	WI	182,697	0.0	-	0.0	-	-						
Gerald Gentleman	NE	9,481,122	4.9	189	667.6	25,703	11,297,844	12–20					
Ghent	KY	12,586,673	55.2	1,601	61.6	1,786	13,051,033				Increasing drought	Severe (-3.91 to-3.00)	

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Gibbons Creek	TX	3,595,378	0.0	-	378.1	38,384	3,568,074				65–70			
Gibson	IN	22,443,805	0.0	-	1858.2	30,219	21,746,394					Increasing drought		
GM WFG Pontiac Site Power Plant	MI	333	0.0	-	0.0	-	-							
Goodyear Power Plant	OH	125,715	0.0	-	0.0	-	-							
Gorgas	AL	7,910,097	22.7	1,047	901.5	41,598	8,449,622				60–65			Moderately dry
Grant Town Power Plant	WV	670,414	0.0	-	0.0	-	-							
GRDA	OK	6,619,398	9.6	530	11.6	641	8,335,683				55–60	Increasing drought		
Green Bay West Mill	WI	599,559	11.0	6,689	69.9	42,573	-					Increasing drought		
Green River	KY	675,303	0.0	-	181.0	97,813	797,913				55–60	Increasing drought		
Greene County	AL	3,785,509	0.6	56	386.2	37,235	4,163,831				60–65	Increasing drought		Moderately dry
H. B. Robinson	SC	1,185,543	0.0	-	120.3	37,051	1,211,065				60–65	Significantly increasing drought		Moderately dry
H. L. Spurlock	KY	6,769,736	3.5	188	3.5	188	7,235,863			Abnormally Dry,-0.79 to -0.51		Increasing drought		
H. Wilson Sundt Generating Station	AZ	783,197	1.3	602	1.5	693	888,304				65–70	Increasing drought		
Hamilton	OH	289,456	0.0	-	64.9	81,826	295,026							
Hammond	GA	4,361,408	0.0	-	535.0	44,775	4,728,708				55–60	Increasing drought		Moderately dry
Harbor Beach	MI	357,180	0.0	-	84.4	86,257	390,425							
Harding Street	IN	3,449,545	122.2	12,932	126.6	13,397	3,728,461							
Harllee Branch	GA	9,797,453	0.0	-	912.4	33,991	9,522,353				60–65	Increasing drought		Moderately dry
Harrington	TX	7,458,711	12.6	617	12.6	617	8,909,676		12–20		55–60			
Harrison Power Station	WV	13,155,331	8.2	227	12.7	351	12,961,435							
Hatfields Ferry Power Station	PA	8,672,771	9.4	397	12.7	533	8,768,387							
Havana	IL	2,903,716	0.0	-	54.0	6,788	3,519,824					Increasing drought		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators						Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Hawaiian Comm & Sugar Puunene Mill	HI	196,965	0.0	-	0.0	-	-						
Hawthorn	MO	3,833,084	0.0	-	188.5	17,946	4,258,457				Increasing drought		
Hayden	CO	3,653,934	2.5	252	2.5	252	4,468,852	12–20	Moderately Dry,-1.29 to 00.80		Increasing drought		
Healy	AK	219,411	0.0	-	0.0	-	-						
Henderson	MS	48,631	0.0	-	0.0	-	-						Drier than normal
Henderson I	KY	74,633	0.0	-	0.0	-	79,279						
Hennepin Power Station	IL	1,982,149	1.2	226	208.0	38,299	2,275,546						
Herbert A. Wagner	MD	2,972,239	0.0	-	0.0	-	3,201,646						
Hercules Missouri Chemical Works	MO	81,070	0.0	-	0.0	-	-						
Hibbing	MN	56,024	0.0	-	0.0	-	-						
High Bridge	MN	1,365,603	0.0	-	126.1	33,703	1,931,746						
HMP&L Station Two Henderson	KY	1,434,959	11.4	2,910	75.0	19,070	2,524,487			55–60	Increasing drought		
Holcomb	KS	2,684,902	3.5	474	3.5	474	2,801,875	12–20					
Homer City Station	PA	13,599,227	16.8	451	18.6	500	13,408,987						
Hoot Lake	MN	930,978	0.0	-	80.3	31,472	1,157,182						
Howard Down	NJ	95,330	0.0	-	0.0	-	-						
Hugo	OK	3,100,097	3.4	396	4.8	571	3,497,474			60–65	Increasing drought		
Hunlock Power Station	PA	236,045	0.0	-	0.0	-	350,219						
Hunter	UT	9,742,633	16.7	627	16.7	627	10,483,054	5–12	Abnormally Dry,-0.79 to -0.51		Increasing drought		
Huntington	UT	6,381,332	11.1	632	11.1	632	6,371,721	5–12	Abnormally Dry,-0.79 to -0.51		Increasing drought		
Hutsonville	IL	755,503	0.0	-	83.6	40,405	-				Increasing drought		
Iatan	MO	4,899,448	0.0	-	427.7	31,865	5,411,749				Increasing drought		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Independence	AR	10,013,103	6.5	236	8.7	316	11,504,415				60–65	Significantly increasing drought		
Indian River Generating Station	DE	3,633,197	5.5	552	382.6	38,439	3,870,525				55–60	Increasing drought-		
Indiantown Cogeneration LP	FL	2,322,170	2.8	447	2.8	447	-				>70	Increasing drought-		
Intermountain Power Project	UT	13,664,259	18.0	482	18.0	482	15,182,583		5–12			Increasing drought	Moderate (-2.99 to -2.00)	
International Paper Augusta Mill	GA	484,584	0.0	-	0.0	-	-							Moderately dry
International Paper Eastover Facility	SC	342,884	0.3	275	0.6	619	-					Increasing drought		Moderately dry
International Paper Georgetown Mill	SC	564,215	0.0	-	0.0	-	-							Moderately dry
International Paper Kaukauna Mill	WI	208,222	0.0	-	0.0	-	-							
International Paper Louisiana Mill	LA	369,993	0.0	-	0.0	-	-							
International Paper Pensacola	FL	401,522	0.0	-	0.0	-	-							
International Paper Prattville Mill	AL	533,703	0.0	-	0.0	-	-							Moderately dry
International Paper Quinnesec Mich Mill	MI	218,538	0.0	-	0.0	-	-							
International Paper Riegelwood Mill	NC	670	0.0	-	0.0	-	-							Moderately dry
International Paper Roanoke Rapid NC	NC	144,157	0.0	-	0.0	-	-							Moderately dry
International Paper Sartell Mill	MN	94,487	0.0	-	0.0	-	-							
International Paper Savanna Mill	GA	370,168	0.6	637	0.6	637	-					Significantly increasing drought		Moderately dry

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Iowa State University	IA	155,874	0.0	-	0.0	-	-							
J. B. Sims	MI	440,810	0.0	-	0.0	-	469,531							
J. C. Weadock	MI	2,056,402	0.0	-	250.3	44,419	2,335,771							
J. E. Corette Plant	MT	1,010,647	0.0	-	41.0	14,822	1,268,274		12–20			Significantly increasing drought		
J. H. Campbell	MI	9,958,129	0.0	-	676.0	24,779	10,433,416							
J. K. Spruce	TX	4,190,501	8.5	737	8.5	737	-							
J. M. Stuart	OH	14,466,481	14.5	367	574.9	14,505	13,817,922			Abnormally Dry,-0.79 to -0.51		Increasing drought		
J. R. Whiting	MI	2,328,211	0.0	-	211.4	33,143	2,810,245							
J. T. Deely	TX	5,915,823	12.1	746	12.1	746	7,182,828				65–70	Increasing drought		
Jack McDonough	GA	3,638,965	0.0	-	466.6	46,806	3,678,327				60–65	Increasing drought		Moderately dry
Jack Watson	MS	3,780,229	10.2	982	156.2	15,086	4,153,166				65–70			Drier than normal
James De Young	MI	301,491	0.0	-	0.0	-	197,460							
James H. Miller Jr.	AL	21,326,149	17.2	295	24.4	417	22,509,467				60–65	Increasing drought		Moderately dry
James River Power Station	MO	1,660,030	5.9	1,307	208.4	45,830	1,685,360				55–60			
Jasper2	IN	21,893	0.0	-	0.0	-	-							
Jefferies	SC	1,909,054	10.0	1,915	11.8	2,261	2,304,293				60–65	Significantly increasing drought		Moderately dry
Jefferson Smurfit Fernandina Beach	FL	598,907	0.0	-	0.0	-	-							
Jeffrey Energy Center	KS	15,145,728	20.7	500	22.6	545	18,123,590					Increasing drought		
Jim Bridger	WY	14,789,512	22.6	558	22.6	558	16,239,775		5–12			Increasing drought	Severe (-3.91 to-3.00)	
John B. Rich Memorial Power Station	PA	672,773	0.0	-	0.0	-	-							
John Deere Dubuque Works	IA	24,680	0.0	-	0.0	-	-							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
John Deere Harvester Works	IL	13,113	0.0	-	0.0	-	-							
John P. Madgett	WI	2,511,359	0.0	-	273.7	39,772	2,813,260							
John Sevier	TN	4,960,614	0.0	-	693.7	51,042	5,042,793				55–60			Drier than normal
Johnsonburg Mill	PA	324,916	0.0	-	0.0	-	-							
Johnsonville	TN	7,597,429	0.0	-	1226.6	58,931	8,479,025				55–60	Increasing drought		Drier than normal
Joliet29	IL	5,500,330	0.0	-	1115.5	74,027	6,359,888							
Joliet9	IL	1,673,848	0.0	-	445.0	97,034	2,119,926							
Joppa Steam	IL	7,878,895	5.3	246	616.4	28,555	8,874,176				55–60	Increasing drought		
Kammer	WV	4,002,739	0.0	-	526.5	48,009	3,722,893			Moderately Dry,-1.29 to 00.80				
Kenneth C. Coleman	KY	2,796,020	0.0	-	267.6	34,938	3,338,574				55–60	Increasing drought		
Keystone	PA	13,472,843	12.3	333	18.7	508	12,950,677							
Killen Station	OH	4,474,802	8.1	659	8.1	659	3,637,462					Increasing drought		
Kimberly Mill	WI	144,564	0.0	-	0.0	-	-							
Kincaid Generation LLC	IL	6,148,117	0.0	-	830.8	49,325	7,068,860					Increasing drought		
Kingston	TN	9,479,726	0.0	-	1280.0	49,285	10,328,583				55–60	Increasing drought		Drier than normal
Kline Township Cogen Facility	PA	299,816	0.0	-	0.0	-	-							
Kodak Park Site	NY	836,887	0.0	-	0.0	-	-							
Kraft	GA	1,113,862	0.0	-	49.1	16,096	1,378,535				65–70	Significantly increasing drought		Moderately dry
KUCC	UT	736,829	0.0	-	0.0	-	-							
Kyger Creek	OH	7,657,479	0.0	-	1086.9	51,808	7,384,962							
L. V. Sutton	NC	3,085,637	19.7	2,326	19.7	2,326	3,522,599				60–65	Significantly increasing drought		Moderately dry
La Cygne	KS	9,038,866	0.0	-	879.8	35,529	10,244,307				55–60			

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Labadie	MO	18,638,954	0.0	-	1144.5	22,412	17,289,637							
LaFarge Alpena	MI	297,632	0.0	-	0.0	-	-							
Lake Road	MO	617,615	0.0	-	83.5	49,350	715,537					Increasing drought		
Lake Shore	OH	950,870	0.0	-	207.1	79,490	1,154,219							
Lakeside	IL	208,451	0.0	-	0.0	-	264,044							
Lansing	IA	1,409,683	0.0	-	192.0	49,702	1,773,175							
Lansing Smith	FL	2,366,453	0.0	-	240.0	37,014	2,682,567				65-–70	Increasing drought		
Laramie River Station	WY	13,024,102	17.4	487	17.4	487	15,337,812		12–20			Increasing drought		
Lawrence Energy Center	KS	3,332,297	2.7	297	3.6	396	4,636,793					Increasing drought		
Lee	NC	2,049,537	21.3	3,798	21.3	3,798	2,366,265				60–65	Increasing drought		Moderately dry
Leland Olds	ND	4,816,733	0.3	20	329.3	24,953	6,009,007		12–20					Drier than normal
Lewis & Clark	MT	288,045	0.0	-	0.0	-	441,039							
Limestone	TX	12,757,227	29.9	855	29.9	855	13,486,035				65–70			
Logan Generating Plant	NJ	1,642,435	2.3	517	2.3	517	-					Increasing drought		
Logansport	IN	173,168	0.0	-	0.0	-	-							
Lon Wright	NE	551,927	0.8	513	1091.8	722,002	573,830					Increasing drought		
Louisa	IA	3,795,667	4.4	423	4.8	460	4,200,142					Increasing drought		
Lovett	NY	1,651,329	0.0	-	298.7	66,029	2,069,742							
Luke Mill	MD	491,410	0.0	-	0.0	-	-							
Manitowoc	WI	318,447	0.0	-	43.1	49,411	415,227							
Marion	IL	1,813,240	4.7	950	104.2	20,972	2,873,245				55–60	Increasing drought		
Marshall	NC	15,499,240	14.3	336	1152.4	27,138	13,331,274				55–60	Increasing drought		Moderately dry
Marshall	MO	15,499,240	0.0	-	0.0	-	-							
Martin Drake	CO	2,048,864	3.1	553	3.4	599	2,426,301		12–20					

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Martin Lake	TX	18,250,189	0.0	-	1943.2	38,864	21,593,119				60–65			
Mayo	NC	4,954,320	15.5	1,143	15.5	1,143	5,259,857				55–60	Increasing drought		Moderately dry
McIntosh	GA	937,852	0.0	-	94.0	36,574	1,066,976				65–70	Significantly increasing drought		Moderately dry
McMeekin	SC	1,791,603	0.0	-	145.4	29,626	1,820,588				60–65	Increasing drought		Moderately dry
Mecklenburg Power Station	VA	817,970	108.5	48,394	118.7	52,980	-				55–60			Moderately dry
Meramec	MO	5,689,770	0.0	-	579.6	37,183	6,663,367							
Meredosia	IL	1,276,348	0.0	-	189.6	54,210	-					Increasing drought		
Merom	IN	6,773,234	0.0	-	439.8	23,701	7,453,525					Increasing drought		
Merrimack	NH	3,117,332	0.0	-	91.6	10,723	3,493,065					Increasing drought		
Miami Fort	OH	7,566,961	0.0	-	252.1	12,159	7,355,473			Abnormally Dry,-0.79 to -0.51		Increasing drought		
Michigan City	IN	2,547,056	5.2	741	21.6	3,093	2,991,116							
Mill Creek	KY	10,115,227	21.5	777	50.7	1,831	10,301,376				55–60	Increasing drought		
Milton L. Kapp	IA	1,225,857	0.0	-	137.0	40,778	1,572,543					Increasing drought		
Milton R. Young	ND	5,117,830	0.0	-	503.2	35,885	6,147,704		12–20					Drier than normal
Milwaukee County	WI	24,791	0.0	-	0.0	-	-							
Missouri City	MO	88,482	0.0	-	0.0	-	-							
Mitchell	GA	6,931,908	0.0	-	118.2	6,224	737,146				65–70	Increasing drought		Moderately dry
Mitchell	WV	636,154	22.9	13,127	22.9	13,127	6,599,845					Increasing drought		
Mitchell Power Station	PA	1,747,605	0.0	-	0.0	-	1,768,519							
Mohave	NV	10,534,540	16.2	560	16.2	560	10,770,045		<5		>70	Significantly increasing drought		
Monroe	MI	18,717,476	0.0	-	1542.9	30,087	18,113,290							
Monticello	TX	14,807,481	0.0	-	1325.0	32,660	17,491,542				60–65			

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Montrose	MO	3,342,902	0.0	-	275.8	30,119	4,007,603				55–60			
Morgantown Energy Facility	WV	422,909	0.0	-	0.0	-	-							
Morgantown Generating Plant	MD	6,435,699	0.0	-	965.5	54,760	6,156,779				55–60	Increasing drought		
Mosinee Paper	WI	104,081	0.0	-	0.0	-	-							
Mount Tom	MA	1,026,279	0.0	-	106.2	37,767	1,154,934							
Mt. Poso Cogeneration	CA	439,168	0.0	-	0.0	-	-							
Mt. Storm	WV	10,763,130	0.0	-	999.5	33,894	12,047,555							
Muscatine Plant #1	IA	1,417,707	0.0	-	196.9	50,702	2,013,763					Increasing drought		
Muskingum River	OH	7,403,428	6.9	338	706.9	34,850	7,093,558			Abnormally Dry,-0.79 to -0.51				
Muskogee	OK	10,191,502	17.6	630	29.3	1,051	10,913,416				60–65	Increasing drought		
Muskogee Mill	OK	503,857	0.2	140	18.2	13,156	-					Increasing drought		
MW Custom Papers	OH	535,411	0.0	-	0.0	-	-							
Naughton	WY	5,238,417	5.4	378	10.1	703	6,077,190		5–12			Increasing drought	Severe (-3.91 to-3.00)	
Navajo	AZ	17,030,700	23.5	503	23.5	503	19,677,241		5-–2	Moderately Dry,-1.29 to 00.80	60–65	Increasing drought		
Nearman Creek	KS	1,478,198	0.0	-	179.0	44,206	1,936,160					Increasing drought		
Nebraska City	NE	4,622,838	0.0	-	466.6	36,844	4,966,130					Increasing drought		
Neil Simpson	WY	147,752	0.0	-	0.0	-	-							
Neil Simpson II	WY	649,495	0.0	-	0.0	-	-							
Nelson Dewey	WI	1,389,935	0.0	-	0.0	-	1,715,122							
New Castle Plant	PA	1,314,907	0.0	-	149.6	41,515	1,497,799							
New Madrid	MO	7,032,640	8.1	419	803.5	41,702	7,230,700				55–60	Increasing drought		
Newton	IL	7,297,242	0.0	-	605.4	30,282	8,337,376					Increasing drought		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Niagara Mill	WI	52,784	0.0	-	0.0	-	-							
Niles	OH	1,015,015	0.0	-	92.5	33,259	1,075,778							
North Branch	WV	563,070	0.0	-	0.0	-	-							
North Omaha	NE	3,417,415	0.0	-	662.5	70,756	3,957,606							
North Valmy	NV	3,954,866	1.6	149	1.6	149	4,388,932		5–12			Significantly increasing drought	Severe (-3.91 to-3.00)	
Northampton Generating Company	PA	809,629	1.1	495	1.1	495	-							
Northeastern	OK	6,511,661	7.9	446	9.2	518	7,091,117				55–60	Increasing drought		
Northside Generating Station	FL	3,916,421	0.0	-	234.2	21,823	-							
NRG Energy Center Dover	DE	91,826	0.0	-	0.0	-	-							
Nucla	CO	736,963	0.1	73	0.2	87	957,536		12–20	Moderately Dry,-1.29 to 00.80		Increasing drought		
O. H. Hutchings	OH	687,686	0.0	-	100.4	53,309	928,314			Abnormally Dry,-0.79 to -0.51				
Oklaunion	TX	4,327,105	6.8	572	6.8	572	4,829,977				60–65			
Orrville	OH	332,240	0.0	-	0.0	-	-							
Osage	WY	245,090	0.0	-	0.0	-	-							
Ottumwa	IA	3,355,680	3.3	359	4.8	518	3,855,163					Increasing drought		
P. H. Glatfelter	PA	433,965	0.5	435	6.4	5,382	-							
Packaging Corp. of America	TN	373,424	0.0	-	0.0	-	-							Drier than normal
Packaging of America Tomahawk Mill	WI	119,901	0.0	-	0.0	-	-							
Painesville	OH	238,132	0.0	-	0.0	-	-							
Panther Creek Energy Facility	PA	647,899	0.0	-	0.0	-	-							
Paradise	KY	13,974,044	0.0	-	351.0	9,168	14,646,095				55–60	Increasing drought		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Park500 Philip Morris USA	VA	78,097	0.0	-	0.0	-	-							Moderately dry
Pawnee	CO	2,938,573	3.9	490	3.9	490	3,532,022		12–20					
Pearl Station	IL	174,493	0.0	-	0.0	-	-							
Pella	IA	110,130	0.0	-	0.0	-	216,151							
Peru	IN	40,710	0.0	-	0.0	-	-							
Philip Sporn	WV	5,153,665	0.0	-	772.7	54,728	5,069,073							
Picway	OH	241,192	0.0	-	53.6	81,181	319,509							
Piney Creek Project	PA	267,275	0.0	-	0.0	-	-							
Pirkey	TX	4,993,784	5.2	378	423.3	30,942	5,925,868				60–65			
Pleasant Prairie	WI	8,459,992	6.1	262	8.1	351	10,040,802							
Pleasants Power Station	WV	8,851,064	18.9	778	20.2	832	8,782,931							
Port of Stockton District Energy Fac	CA	288,687	0.0	-	0.0	-	-							
Portland	PA	2,169,118	1.3	218	286.3	48,168	2,214,002							
Possum Point	VA	127,724	0.0	-	230.0	657,162	86,899							Moderately dry
Potomac River	VA	1,319,771	0.0	-	225.2	62,293	1,620,605				55–60	Increasing drought		Moderately dry
Powerton	IL	9,468,947	25.9	997	25.9	997	10,424,802					Increasing drought		
PPG Natrium Plant	WV	570,704	0.0	-	60.8	38,856	-							
PPL Brunner Island	PA	10,152,144	9.4	339	575.2	20,681	9,020,666							
PPL Martins Creek	PA	718,981	48.2	24,444	48.7	24,707	805,426							
PPL Montour	PA	10,389,372	9.0	318	24.1	847	9,584,669							
Prairie Creek	IA	870,574	0.0	-	196.5	82,377	1,441,310							
Presque Isle	MI	3,431,180	0.0	-	242.8	25,831	4,107,720			Abnormally Dry,-0.79 to -0.51		Significantly increasing drought		
Primary Energy Roxboro	NC	196,835	0.0	-	0.0	-	-							Moderately dry

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Primary Energy Southport	NC	304,261	2.6	3,101	2.6	3,101	-				60–65	Significantly increasing drought		Moderately dry
Procter & Gamble Cincinnati Plant	OH	42,880	0.0	-	0.0	-	-							
PSEG Hudson Generating Station	NJ	3,308,530	0.0	-	609.4	67,231	3,847,175							
PSEG Mercer Generating Station	NJ	3,506,467	3.1	323	646.2	67,264	3,376,850							
Pulliam	WI	2,530,717	0.0	-	26.1	3,765	3,202,132					Increasing drought		
Purdue University	IN	97,614	0.0	-	0.0	-	-							
Quindaro	KS	1,021,868	0.0	-	102.8	36,706	1,353,641					Increasing drought		
R. D. Green	KY	3,561,042	7.1	729	9.5	974	4,082,404							
R. D. Morrow	MS	2,551,294	3.9	555	5.4	777	3,055,780				65–70	Increasing drought		Drier than normal
R. E. Burger	OH	1,994,639	0.0	-	725.7	132,793	2,465,490			Moderately Dry,-1.29 to 00.80				
R. Gallagher	IN	2,876,904	0.0	-	434.3	55,104	3,131,105				55–60	Increasing drought		
R. M. Heskett	ND	607,334	0.0	-	55.4	33,288	620,350		12–20					Drier than normal
R. M. Schahfer	IN	10,558,399	50.0	1,727	0.0	-	13,179,374							
R. Paul Smith Power Station	MD	396,652	0.0	-	0.0	-	488,778							
R. S. Nelson	LA	3,238,276	5.8	649	8.6	974	3,993,862				65–70	Increasing drought		
Radford Army Ammunition Plant	VA	39,819	0.0	-	0.0	-	-							Moderately dry
Rapids Energy Center	MN	128,209	0.0	-	0.0	-	-							
Rawhide	CO	1,921,594	4.5	859	4.5	859	2,337,590		12–20					
Ray D. Nixon	CO	1,488,584	2.5	602	2.5	602	1,707,111		12–20					
Red Hills Generating Facility	MS	3,244,974	0.0	-	0.0	-	4,115,742							Drier than normal
Reid Gardner	NV	3,922,115	3.9	361	3.9	361	5,253,111		<5		65–70			

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Richard Gorsuch	OH	500,779	0.0	-	172.7	125,872	-			Abnormally Dry,-0.79 to -0.51				
Rio Bravo Jasmin	CA	291,375	0.0	-	0.0	-	-							
Rio Bravo Poso	CA	296,560	0.0	-	0.0	-	-							
Rittman Paperboard	OH	15,024	0.0	-	0.0	-	-							
River Rouge	MI	2,949,460	0.0	-	0.0	-	2,872,300							
Riverbend	NC	1,835,789	2.4	475	367.4	73,042	1,992,091				55–60	Increasing drought		Moderately dry
Riverside	MN	656,390	0.0	-	222.7	123,849	2,899,388							
Riverside	IA	2,308,488	0.0	-	0.0	-	687,411					Increasing drought		
Riverton	KS	488,501	0.0	-	0.0	-	693,649							
Riverwood International Macon Mill	GA	251,520	0.0	-	0.0	-	-							Moderately dry
Rivesville	WV	175,511	0.0	-	26.5	55,108	251,002							
Robert A. Reid	KY	307,446	0.0	-	0.0	-	438,984							
Rochester7	NY	981,452	0.0	-	118.5	44,059	1,125,267							
Rockport	IN	17,942,286	33.5	681	33.5	681	17,422,316				55–60	Increasing drought		
Rock-Tenn Mill	AL	204,476	0.0	-	0.0	-	-							Moderately dry
Rodemacher	LA	3,374,169	0.0	-	266.0	28,770	4,111,586				65–70	Increasing drought		
Roxboro	NC	14,799,903	5.2	128	1103.9	27,225	14,907,671				55–60	Increasing drought		Moderately dry
Rumford Cogeneration	ME	753,839	32.3	15,647	32.3	15,647	-							
Rush Island	MO	8,922,079	0.0	-	773.0	31,623	8,688,348					Increasing drought		
S. A. Carlson	NY	129,392	0.0	-	0.0	-	236,231							
S. D. Warren Muskegon	MI	214,249	0.0	-	0.0	-	-							
S. D. Warren Westbrook	ME	392,031	0.0	-	0.0	-	-							
Salem Harbor	MA	2,229,768	0.0	-	278.8	45,631	2,440,019							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
San Juan	NM	12,463,637	17.8	522	17.8	522	13,097,410		5–12					
San Miguel	TX	2,850,653	303.8	38,895	303.8	38,895	3,831,532				>70			
Sandow No.4	TX	4,303,896	0.0	-	0.0	-	5,275,320				65–70	Increasing drought		
Sandow Station	TX	2,569,380	0.0	-	0.0	-	-							
Savannah River Mill	GA	645,670	0.0	-	0.0	-	-							Moderately dry
Savannah Sugar Refinery	GA	61,555	0.0	-	0.0	-	-							Moderately dry
Scherer	GA	24,093,772	34.3	520	59.1	895	26,040,793				60–65	Increasing drought		Moderately dry
Schiller	NH	979,852	0.0	-	12.0	4,454	1,271,807							
Scholz	FL	365,446	0.0	-	0.0	-	491,554							
Scrubgrass Generating	PA	656,034	0.0	-	0.0	-	-							
Seaford Delaware Plant	DE	132,476	0.0	-	0.0	-	-							
Seminole	FL	9,810,229	17.6	654	22.1	822	10,032,384				65–70	Significantly increasing drought		
Seward	PA	2,808,282	3.7	479	4.6	596	3,128,927							
Shawnee	KY	9,293,226	0.0	-	1286.6	50,533	10,444,195				55–60	Increasing drought		
Shawville	PA	3,198,870	0.0	-	345.8	39,454	3,403,902							
Shelby Municipal Light Plant	OH	89,746	0.0	-	0.0	-	-							
Sheldon	NE	1,552,400	2.2	523	2.6	608	2,071,374					Increasing drought		
Sherburne County	MN	14,474,605	16.0	403	18.9	476	16,657,713							
Shiras	MI	304,143	0.0	-	0.0	-	359,175							
Sibley	MO	2,880,028	0.0	-	278.0	35,230	3,040,398							
Sikeston Power Station	MO	1,981,791	1.9	357	3.1	571	2,582,001				55–60	Increasing drought		
Silver Bay Power	MN	742,280	3.2	1,557	133.4	65,597	-					Increasing drought		
Silver Lake	MN	298,147	0.0	-	0.0	-	204,488							
Sioux	MO	6,635,922	0.0	-	613.9	33,769	6,448,783					Increasing		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
												drought		
Sixth Street	IA	153,561	0.0	-	0.0	-	581,540							
Smart Papers LLC	OH	92,388	0.0	-	0.0	-	-							
Sooner	OK	7,135,081	9.9	506	11.9	608	7,719,187				55–60	Increasing drought		
South Oak Creek	WI	5,884,754	0.0	-	825.5	51,200	6,587,045							
Southampton Power Station	VA	343,675	0.0	-	0.0	-	242,193							Moderately dry
Southwest Power Station	MO	1,274,892	1.4	394	1.8	527	1,614,192				55–60			
SP Newsprint	GA	200,340	0.0	-	0.0	-	-							Moderately dry
Springerville	AZ	6,094,037	7.6	457	8.1	484	6,184,283		12–20	Moderately Dry,-1.29 to 00.80				
St. Clair	MI	7,378,286	0.0	-	991.1	49,027	7,802,302							
St. Johns River Power Park	FL	8,697,799	12.2	513	45.0	1,890	9,432,650				65–70	Significantly increasing drought		
St. Marys	OH	43,313	0.0	-	0.0	-	-							
St. Nicholas Cogen Project	PA	673,235	0.0	-	0.0	-	-							
Stanton	ND	1,427,547	0.1	17	143.0	36,570	1,519,927							Drier than normal
Stanton Energy Center	FL	6,529,419	7.4	412	7.4	412	7,118,452				>70	Increasing drought		
State Line Energy	IN	2,729,088	0.0	-	484.7	64,831	3,043,572							
Stockton Cogen	CA	445,218	0.0	-	0.0	-	-							
Stone Container Florence Mill	SC	521,458	0.0	-	0.0	-	-				60–65	Significantly increasing drought		Moderately dry
Stone Container Hopewell Mill	VA	318,336	0.0	-	0.0	-	-							Moderately dry
Stone Container Ontonagon Mill	MI	107,576	0.0	-	0.0	-	-							
Stone Container Panama City Mill	FL	253,324	0.0	-	0.0	-	-							
Streeter Station	IA	160,432	0.0	-	0.0	-	159,931							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
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Sunnyside Cogen Associates	UT	416,603	0.0	-	0.0	-	-							
Sutherland	IA	873,996	0.4	181	1.5	621	1,194,301							
Syl Laskin	MN	695,500	0.8	407	133.8	70,212	1,036,142					Increasing drought		
T. B. Simon Power Plant	MI	315,809	0.0	-	0.0	-	-							
Taconite Harbor Energy Center	MN	1,411,062	0.1	17	157.7	40,793	1,653,235					Increasing drought		
Tanners Creek	IN	4,998,331	0.0	-	875.2	63,914	5,047,476					Increasing drought		
Tecumseh Energy Center	KS	1,404,220	2.4	622	3.0	790	1,772,920					Increasing drought		
Tennessee Eastman Operations	TN	1,298,849	0.0	-	45.5	12,787	-				55–60			Drier than normal
TES Filer City Station	MI	449,575	0.0	-	0.0	-	-							
Thomas Hill	MO	7,796,102	13.2	620	777.8	36,417	8,584,316							
Titus	PA	1,273,181	1.4	389	5.3	1,519	1,404,779							
Tolk	TX	7,418,825	12.3	604	12.3	604	7,538,483		12–20		55–60			
Transalta Centralia Generation	WA	10,483,180	17.8	619	20.6	716	12,517,502					Increasing drought		Drier than normal
Trenton Channel	MI	4,226,915	0.0	-	408.8	35,300	4,528,702							
Trigen Colorado Energy	CO	298,201	0.0	-	0.0	-	-							
Trigen Syracuse Energy	NY	124,284	0.0	-	0.0	-	-							
Trimble County	KY	3,868,555	9.6	903	11.2	1,055	3,585,968					Increasing drought		
Tuscola Station	IL	83,065	0.0	-	0.0	-	-							
Twin Oaks Power One	TX	2,490,416	2.5	360	3.3	483	3,042,707				65–70			
TXI Riverside Cement Power House	CA	148,155	0.0	-	0.0	-	-							
Tyrone	KY	355,762	0.0	-	40.0	41,046	468,036					Increasing drought		
U. S. Alliance Coosa Pines	AL	3,095	0.0	-	0.0	-	-							Moderately dry

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Unifi Kinston LLC	NC	25,122	0.0	-	0.0	-	-							Moderately dry
Univ. of NC Chapel Hill Cogen Facility	NC	90,103	0.0	-	0.0	-	-							Moderately dry
University of Alaska Fairbanks	AK	58,212	0.0	-	0.0	-	-							
University of Illinois Abbott Power Plt	IL	30,644	0.0	-	0.0	-	-							
University of Iowa Main Power Plant	IA	88,068	0.0	-	0.0	-	-							
University of Missouri Columbia	MO	138,063	0.0	-	0.0	-	-							
University of Notre Dame	IN	74,498	0.0	-	0.0	-	-							
Urquhart	SC	602,974	0.0	-	93.9	56,847	641,841				60–65	Increasing drought		Moderately dry
U.S. DOE Savannah River Site (D Area)	SC	192,456	0.0	-	0.0	-	-							Moderately dry
Utility Plants Section	AK	105,389	0.0	-	0.0	-	-							
Valley	WI	1,462,832	0.1	32	155.1	38,688	2,129,467							
Valmont	CO	1,500,721	3.3	802	5.8	1,415	1,622,191		12–20					
Vanderbilt University Power Plant	TN	40,514	0.0	-	0.0	-	-							Drier than normal
Vermilion	IL	633,268	2.0	1,155	2.7	1,565	781,102							
Victor J. Daniel Jr.	MS	7,062,396	2.1	110	2.1	110	8,105,731				65–70			Drier than normal
Virginia	MN	45,000	0.0	-	0.0	-	-							
W. A. Parish	TX	18,540,316	12.6	248	889.5	17,511	19,936,777				65–70			
W. H. Sammis	OH	14,670,198	0.0	-	1091.2	27,149	15,401,306			Moderately Dry,-1.29 to 00.80				
W. H. Weatherspoon	NC	797,575	49.1	22,450	49.1	22,450	1,009,843				60–65	Significantly increasing drought		Moderately dry
W. H. Zimmer	OH	10,340,814	0.0	-	645.0	22,767	8,963,966			Abnormally Dry,-0.79 to-		Increasing drought		

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
										0.51				
W. N. Clark	CO	290,576	0.0	-	0.0	-	-							
W. S. Lee	SC	1,445,779	3.0	751	167.6	42,310	1,594,224				60–65	Increasing drought		Moderately dry
Wabash River	IN	4,530,248	0.0	-	582.3	46,918	4,705,476					Increasing drought		
Walter C. Beckjord	OH	6,508,147	0.0	-	739.4	41,467	6,722,452			Abnormally Dry,-0.79 to -0.51		Increasing drought		
Wansley	GA	12,926,766	22.0	621	64.0	1,807	12,779,890				60–65	Significantly increasing drought		Moderately dry
Warrick	IN	5,308,109	0.0	-	489.4	33,652	6,578,631							
Wateree	SC	5,190,798	0.0	-	469.1	32,985	4,806,560				60–65	Increasing drought		Moderately dry
Waukegan	IL	4,560,504	0.0	-	758.3	60,692	5,254,716							
Waynesboro Virginia Plant	VA	14,622	0.0	-	0.0	-	-							Moderately dry
WCI Steel	OH	74,675	0.0	-	0.0	-	-							
Welsh	TX	9,537,635	1.0	40	1.0	40	10,899,821				60–65			
West Point Mill	VA	199,289	0.0	-	0.0	-	-				55–60	Increasing drought		Moderately dry
Westmoreland-LG&E Roanoke Valley I	NC	1,266,088	1.4	417	1.5	429	-				55–60	Increasing drought		Moderately dry
Westmoreland-LG&E Roanoke Valley II	NC	334,792	0.0	-	0.0	-	-				55–60	Increasing drought		Moderately dry
Weston	WI	3,538,158	2.1	213	96.6	9,961	4,695,699			Moderately Dry,-1.29 to 00.80		Increasing drought		
Weyerhaeuser Longview WA	WA	304,191	0.0	-	0.0	-	-							Drier than normal
Weyerhaeuser Pine Hill Operations	AL	511,850	0.0	-	0.0	-	-							Moderately dry
Weyerhaeuser Plymouth NC	NC	167,189	0.0	-	0.0	-	-							Moderately dry
Wheelabrator Frackville Energy	PA	368,854	0.0	-	0.0	-	-							
Whelan Energy	NE	549,295	0.0	-	0.0	-	709,714							

TABLE A-2 (Cont.)

		Plant-Specific Demand Indicators							Supply Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO2 Emissions (Tons)		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow-Annual2008
Center														
White Bluff	AR	9,786,711	11.0	410	15.5	579	10,944,468				60–65	Significantly increasing drought		
White Pine Electric Power	MI	126,902	0.0	-	0.0	-	-							
Whitewater Valley	IN	545,781	0.0	-	0.0	-	702,167							
Widows Creek	AL	9,851,670	0.0	-	1459.1	54,060	11,010,115				55–60	Increasing drought		Moderately dry
Will County	IL	5,293,858	0.0	-	919.7	63,412	5,956,325							
Williams	SC	4,797,655	0.0	-	509.9	38,796	4,939,569				60–65	Significantly increasing drought		Moderately dry
Willmar	WV	41,783	0.0	-	0.0	-	-			Abnormally Dry,-0.79 to -0.51				
Willow Island	SC	634,414	0.0	-	88.9	51,166	717,517				60–65	Significantly increasing drought		Moderately dry
Winyah	SC	7,842,317	10.0	466	11.1	514	8,860,642				60–65	Significantly increasing drought		Moderately dry
Wisconsin Rapids Pulp Mill	WI	369,736	0.0	-	0.0	-	-							
Wood River	IL	2,944,292	0.0	-	0.0	-	3,213,829							
WPS Energy Servs Sunbury Gen	PA	1,627,644	0.0	-	52.5	11,769	2,299,850							
WPS Power Niagara	NY	230,245	0.0	-	0.0	-	473,567							
WPS Westwood Generation LLC	PA	233,834	0.0	-	0.0	-	-							
Wyandotte	MI	314,609	0.0	-	0.0	-	477,129							
Wygen1	WY	709,117	0.0	-	0.0	-	-							
Wyodak	WY	2,677,908	0.0	-	0.0	-	3,370,621		12–20			Increasing drought		
Yates	GA	6,862,634	15.8	842	31.0	1,650	7,338,093				60–65	Significantly increasing drought		Moderately dry
Yorktown	VA	2,068,318	0.0	-	239.8	42,315	2,182,630				55–60	Increasing drought-		Moderately dry

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APPENDIX B. VULNERABLE PLANTS AND SCORING RESULTS

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Appendix B. Vulnerable Plants and Scoring Results

This appendix lists the names and states of all plants identified as vulnerable to supply concerns, demand concerns, or both demand and supply concerns. It also provides plant-specific data for each indicator. Plants that are considered to have a major vulnerability for a given indicator will have the value for that indicator highlighted in dark orange. Plants considered to have a moderate vulnerability for a given indicator will have the value for that indicator highlighted in light orange. Plants that are highlighted in green (i.e., Dolet Hills, San Miguel, Eckert Station, Harding Street, Mecklenburg Power Station) are plants with extremely high reported water consumption rates. These plants are excluded from the analyses of consumption and withdrawal but are included in the analyses regarding location, cooling system, and cooling water source.

Chapter 2 explains the methodology used to determine whether a plant is considered to be vulnerable from a demand perspective, supply perspective, or both. In this appendix, those plants considered to have an overall demand vulnerability have the number “2” in the column labeled “Demand Score,” and those considered to have an overall supply vulnerability have the number “1” in the column labeled “Supply Score.” The column labeled “Total Score” shows the number of indicators that were either major or moderate for each plant. The plants are listed according to total score (in descending order), so that the first 100 plants in the list are considered the most vulnerable.

For the 100 most vulnerable plants, the columns under the general heading “Nontraditional Sources” contain data indicating whether the plant is located near a particular nontraditional water source. A “yes” indicates that, on the basis of the analysis discussed in Section 3.6, the plant is in the proximity of the source.

TABLE B-1 Vulnerable Plants and Scoring Results (Area Demand Indicators)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
1. Belews Creek	NC	2.39	-79%	45%	220,000–330,000	85	
2. Big Cajun 2	LA	2.63	18%	45%	220,000–330,000		
3. Gorgas	AL	0.24	14%	45%	150,000–220,000		
4. Allen Steam Plant	TN	0.15	15%	45%	220,000–330,000	40	
5. E. C. Gaston	AL	1.4	14%	45%	150,000–220,000		
6. G. G. Allen	NC	2.39	-79%	45%	220,000–330,000	85	
7. Georgia Pacific Cedar Springs	GA	1.39	13%	45%		65	
8. Marshall	NC	2.39	-79%	45%	220,000–330,000	85	
9. Roxboro	NC	2.39	-79%	45%	220,000–330,000	85	
10. Seminole	FL	1.23	7%	180%		228	
11. St. Johns River Power Park	FL	1.23	7%	180%		228	
12. Widows Creek	AL	0.07	17%	45%	150,000–220,000		
13. Barry	AL	1.39	14%	45%	150,000–220,000		
14. Big Bend	FL	1.23	7%	180%			
15. Cumberland	TN	1	-6%	45%	220,000–330,000	40	
16. Gallatin	TN	1	-6%	45%	220,000–330,000	40	
17. Johnsonville	TN	0.25	-90%	45%	220,000–330,000	40	
18. Navajo	AZ	0.19	-17%	55%		49	Unmet rural water needs
19. Stanton Energy Center	FL	1.23	7%	180%		228	
20. Transalta Centralia Generation	WA	5.6	-15%	60%		41	Moderate
21. James H. Miller Jr.	AL	0.24	14%	45%	150,000–220,000		
22. Cliffside	NC	2.39	-79%	45%	220,000–330,000	85	
23. Cross	SC	2.39	-79%	45%	220,000–330,000	37	
24. Mayo	NC	2.39	-79%	45%	220,000–330,000	85	
25. Scherer	GA	1.44	-79%	45%		65	
26. Wansley	GA	1.44	-79%	45%		65	
27. Winyah	SC	2.39	-79%	45%	220,000–330,000	37	
28. Yates	GA	1.44	-79%	45%		65	
29. Hunter	UT	1.18	-28%	60%			
30. Huntington	UT	1.18	-28%	60%			
31. Jim Bridger	WY	0.47	-18%	60%			
32. Antelope Valley	ND	2.73	45%	14%			
33. Charles R Lowman	AL	1.39	14%	45%	150,000–220,000		
34. Coal Creek	ND	2.73	45%	14%			
35. Gerald Gentleman	NE	6.17	73%	14%	150,000–220,000		Moderate
36. Jack Watson	MS	1.39	14%	45%			
37. Jeffrey Energy Center	KS	1.54	73%	6%			Unmet rural water needs
38. Springerville	AZ	3.74	-18%	55%		49	Highly likely
39. Kingston	TN	0.25	-90%	45%	220,000–330,000	40	
40. Buck	NC	2.39	-79%	45%	220,000–330,000	85	
41. Crystal River	FL	1.23	7%	180%			
42. Dan River	NC	2.39	-79%	45%	220,000–330,000	85	
43. Harllee Branch	GA	1.44	-79%	45%		65	
44. Mohave	NV	3.74	-18%	55%		21	Highly likely
45. New Madrid	MO	0.32	52%	20%			

TABLE B-1 (Cont.)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
46. Wateree	SC	2.39	-79%	45%	220,000–330,000	37	
47. Naughton	WY	0.47	-18%	60%			
48. Milton R. Young	ND	2.73	45%	14%			
49. Dave Johnston	WY	0.067	-92%	60%			Moderate
50. J. M. Stuart	OH	0.46	-91%	8%	220,000–330,000		
51. J. T. Deely	TX	3.45	-7%	9%			Substantial
52. Joppa Steam	IL			20%	220,000–330,000		
53. R. S. Nelson	LA	2.63	18%	45%	220,000–330,000		
54. Victor J. Daniel Jr.	MS	1.39	14%	45%			
55. W. A. Parish	TX	3.45	-7%	9%		47	Highly likely
56. Thomas Hill	MO	1.54	73%	20%			
57. Gadsden	AL	1.39	14%	45%	150,000–220,000		
58. Greene County	AL	1.39	14%	45%	150,000–220,000		
59. Bull Run	TN			45%	220,000–330,000	40	
60.John Sevier	TN			45%	220,000–330,000	40	
61. Bowen	GA	2.39	-79%	45%			
62. Canadys Steam	SC	1.44	-79%	45%	220,000–330,000	37	
63. Cape Fear	NC	2.39	-79%	45%	220,000–330,000	85	
64. Coronado	AZ	3.74	-18%	55%			Highly likely
65. George Neal North	IA	6.17	73%	14%			
66. Iatan	MO	1.54	73%	45%			Unmet rural water needs
67. Independence	AR	0.48	-13%	45%	150,000–220,000		
68. Indian River Generating Station	DE	0.11	-91%	50%	220,000-–330,000	111	
69. Intermountain Power Project	UT	1.18	-28%	60%			
70. Jefferies	SC	1.44	-79%	45%	220,000–330,000	37	
71. L. V. Sutton	NC	2.39	-79%	45%	220,000–330,000	85	
72. Laramie River Station	WY	3.23	-23%	60%			Moderate
73. Lee	NC	2.39	-79%	45%	220,000–330,000	85	
74. Mecklenburg Power Station	VA	2.39	-79%	45%	150,000–220,000	69	
75. Morgantown Generating Plant	MD	0.11	-91%	50%		177	
76. Riverbend	NC	2.39	-79%	45%	220,000–330,000	85	
77. W. H. Weatherspoon	NC	2.39	-79%	45%	220,000–330,000	85	
78. W. S. Lee	SC	2.39	-79%	45%	220,000–330,000	37	
79. White Bluff	AR	0.48	-13%	45%	150,000–220,000		
80. Craig	CO	0.43	-19%	55%			
81. Four Corners	NM	0.04	-20%	55%			Unmet rural water needs
82. San Juan	NM	0.04	-20%	55%			Unmet rural water needs
83. Cherokee	CO	0.19	-24%	55%			Highly likely
94. Rockport	IN	0.09	-91%	8%	220,000–330,000	20	
85. Mill Creek	KY	0.46	-91%	8%			
86. Limestone	TX	1.55	-6%	9%		47	
87. Cholla	AZ	3.74	-18%	55%			Highly likely
88. Clifty Creek	IN	0.46	-91%	8%	220,000–330,000	20	
89. Crist	FL			45%			
90. Ghent	KY	0.46	-91%	8%			
91. Harrington	TX	0.67	-14%	6%			
92. Miami Fort	OH	0.46	-91%	8%	220,000–330,000		
93. Powerton	IL	0.35	-93%	20%	220,000–330,000		

TABLE B-1 (Cont.)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
94. R. D. Morrow	MS	1.39	14%	45%			
95. Tanners Creek	IN	0.46	-91%	8%	220,000–330,000	20	
96. Tolk	TX	0.34	-79%	9%		47	
97. W. H. Zimmer	OH	0.46	-91%	8%	220,000–330,000		
98. Walter C Beckjord	OH	0.46	-91%	8%	220,000–330,000		
99. Dolet Hills	LA	0.13	-13%	6%	220,000–330,000		
100. Hammond	GA	2.39	-79%	45%		65	
101. Chesapeake	VA	2.39	-79%	45%	150,000–220,000		
102. Chesterfield	VA	0.29	-89%	45%	150,000–220,000		
103. Clay Boswell	MN	2.45	145%	14%			
104. Clover	VA	2.39	-79%	45%	150,000–220,000		
105. Comanche	CO	0.77	-25%	55%			Highly likely
106. Council Bluffs	IA	0.74	72%	14%			
107. Hawthorn	MO	0.99	71%	45%			Substantial
108. La Cygne	KS	1.54	73%	6%			
109. Labadie	MO	2.72	73%	20%			
110. Lansing Smith	FL	1.23	7%	180%		228	
111. Lon Wright	NE	6.17	73%	14%	150,000–220,000		
112. Mitchell	GA	1.44	-79%	45%		65	
113. Potomac River	VA	0.11	-91%	45%	150,000–220,000	69	
114. Sooner	OK	1.67	-15%	6%			
115. Urquhart	SC	1.44	-79%	45%	220,000–330,000	37	
116. Williams	SC	1.44	-79%	45%	220,000–330,000	37	
117. Kincaid Generation LLC	IL	0.19	-92%	20%	220,000–330,000		
118. Merom	IN	0.09	-91%	8%	220,000–330,000	20	
119. Martin Lake	TX	1.55	-6%	9%		47	
120. Pirkey	TX	1.55	-6%	9%		47	
121. Cardinal	OH	0.15	-89%	8%	220,000–330,000		
122. Conesville	OH			8%	220,000–330,000		
123. General James M. Gavin	OH			8%	220,000–330,000		
124. Baldwin Energy Complex	IL	0.35	-93%	20%	220,000–330,000		
125. Gibson	IN	0.09	-91%	8%	220,000–330,000	20	
126. Leland Olds	ND	2.73	45%	14%			
127. AES Petersburg	IN	0.09	-91%	8%	220,000–330,000	20	
128. Muskingum River	OH	0.15	-89%	8%	220,000–330,000		
129. Willow Island	SC			45%	220,000–330,000	37	
130. Cayuga	IN	0.09	-93%	8%	220,000–330,000	20	
131. Central Power & Lime	FL	1.23	7%	180%			
132. Fayette Power Project	TX	3.45	-7%	9%			
133. Muskogee	OK	0.44	-14%	6%			
134. Newton	IL	0.09	-93%	20%	220,000–330,000		
135. R. Gallagher	IN	0.46	-91%	8%	220,000–330,000	20	
136. R. M. Schahfer	IN	0.04	-89%	8%	220,000–330,000	20	
137. South Oak Creek	WI	0.24	-94%	20%	150,000–220,000		
138. Eastlake	OH			8%	220,000–330,000		
139. Boardman	OR	5.6	-15%	60%			Substantial
140. Brandon Shores	MD	0.11	-91%	50%		177	
141. Burlington	IA	1.87	143%	20%			
142. Cedar Bay Generating LP	FL	1.23	7%	180%			

TABLE B-1 (Cont.)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
143. Chalk Point LLC	MD	0.11	-91%	50%		177	
144. Cope	SC	1.44	-79%	45%	220,000–330,000	37	
145. Dolphus M. Grainger	SC	2.39	-79%	45%	220,000–330,000	37	
146. GRDA	OK	0.44	-14%	6%			
147. H. B. Robinson	SC	2.39	-79%	45%	220,000–330,000	37	
148. Jack McDonough	GA	1.44	-79%	45%		65	
149. Joliet 29	IL	0.35	-93%	20%	220,000–330,000		
150. McMeekin	SC	2.39	-79%	45%	220,000–330,000	37	
151. PPL Brunner Island	PA	0.32	-92%	50%	150,000–220,000		
152. Primary Energy Southport	NC		#DIV/0!	45%	220,000–330,000	85	
153. Shawnee	KY		#DIV/0!	8%			
154. Sherburne County	MN	2.45	145%	14%			
155. Stone Container Florence Mill	SC	2.39	-79%	45%	220,000–330,000	37	
156. Westmoreland-LG&E Roanoke Valley I	NC	2.39	-79%	45%	220,000–330,000	85	
157. Westmoreland-LG&E Roanoke Valley II	NC	2.39	-79%	45%	220,000–330,000	85	
158. Will County	IL	0.35	-93%	20%	220,000–330,000		
159. Yorktown	VA			45%	150,000–220,000	69	
160. Big Sandy	KY			8%			
161. Colstrip	MT			60%			
162. Coyote	ND	2.73	45%	14%			
163. Monticello	TX	0.04	0%	6%		47	
164. Warrick	IN			8%	220,000–330,000	20	
165. W. H. Sammis	OH			8%	220,000–330,000		
166. Philip Sporn	WV	0.15	-89%	8%	150,000–220,000		
167. Big Brown	TX	1.55	-6%	9%			
168. ACE Cogeneration Facility	CA	22.67	-3%	200%	150,000–220,000	80	
169. Coleto Creek	TX	3.45	-7%	9%			
170. Dallman	IL			20%	220,000–330,000		
171. H. L. Spurlock	KY	0.46	-91%	8%			
172. H. Wilson Sundt Generating Station	AZ	3.74	-18%	55%			Substantial
173. Indiantown Cogeneration LP	FL	1.23	7%	180%			
174. International Paper Savanna Mill	GA	1.44	-79%	45%		65	
175. McIntosh	GA	1.44	-79%	45%		65	
176. San Miguel	TX	1.55	-6%	9%		47	
177. Homer City Station	PA	0.05	-92%	50%	150,000–220,000		
178. Northeastern	OK	0.43	-16%	6%			
179. Conemaugh	PA	0.05	-92%	50%	150,000–220,000		
180. Keystone	PA	0.05	-92%	50%	150,000–220,000		
181. Paradise	KY	0.06	-90%	8%			
182. J. H. Campbell	MI	0.5	-91%	8%	150,000–220,000		
183. PPL Montour	PA	0.32	-92%	50%	150,000–220,000		
184. Asbury	MO	0.63	66%	20%			
185. Asheville	NC	0.09	-89%	45%	220,000–330,000	85	
186. Bailly	IN	0.5	-91%	8%	220,000–330,000	20	
187. Brayton Point	MA			71%	150,000–220,000		
188. Cogentrix Hopewell	VA	0.29	-89%	45%	150,000–220,000		
189. Cogentrix of Richmond	VA	0.29	-89%	45%	150,000–220,000		
190. Cogentrix Virginia Leasing Corporation	VA			45%	150,000–220,000		

TABLE B-1 (Cont.)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
191. Deerhaven Generating Station	FL	1.23	7%	180%			
192. Edgewater	WI	0.24	-94%	20%	150,000–220,000		
193. International Paper Eastover Facility	SC	2.39	-79%	45%	220,000–330,000	37	
194. Kraft	GA	1.44	-79%	45%		65	
195. Kyger Creek	OH	0.15	-89%	8%	220,000–330,000		
196. Lake Road	MO	1.54	73%	45%			Unmet rural water needs
197. Monroe	MI	0.5	-91%	8%	150,000–220,000		
198. Montrose	MO	1.54	73%	45%			
199. Nebraska City	NE	0.74	72%	14%	150,000–220,000		
200. North Omaha	NE	0.74	72%	14%	150,000–220,000		
201. North Valmy	NV	2.14	-28%	60%		21	
202. Oklaunion	TX	0.47	-77%	9%		47	
203. Ottumwa	IA	0.49	145%	20%			
204. Pleasant Prairie	WI	0.24	-94%	20%	150,000–220,000		
205. Pleasants Power Station	WV			8%	150,000–220,000		
206. Possum Point	VA			45%	150,000–220,000	69	
207. Prairie Creek	IA	1.87	143%	20%			
208. PSEG Hudson Generating Station	NJ			50%	220,000–330,000	185	
209. Reid Gardner	NV	3.74	-18%	55%		21	
210. Rush Island	MO	0.14	-93%	20%			
211. Sheldon	NE	6.17	73%	14%	150,000–220,000		
212. Sioux	MO	0.14	-93%	20%			
213. St. Clair	MI	0.5	-91%	8%	150,000–220,000		
214. Tecumseh Energy Center	KS	1.54	73%	6%			Unmet rural water needs
215. Waukegan	IL	0.35	-93%	20%	220,000–330,000		
216. West Point Mill	VA	0.29	-89%	45%	150,000–220,000	69	
217. Wabash River	IN	0.09	-91%	8%	220,000–330,000	20	
218. Bruce Mansfield	PA	0.08	-88%	8%	150,000–220,000		
219. Valmont	CO	0.65	-24%	55%			Highly likely
220. Belle River	MI			8%	150,000–220,000		
221. Bonanza	UT	0.35	-19%	60%			
222. A. B. Brown	IN	0.06	-90%	8%	220,000–330,000	20	
223. Apache Station	AZ	3.74	-18%	55%			
224. Coffeen	IL			20%	220,000–330,000		
225. E. D. Edwards	IL	0.19	-92%	20%	220,000–330,000		
226. E W Brown	KY	0.26	-91%	8%			
227. Eagle Valley	IN	0.46	-91%	8%	220,000–330,000	20	
228. Harding Street	IN	0.46	-91%	8%	220,000–330,000	20	
229. Killen Station	OH	0.46	-91%	8%	220,000–330,000		
230. Marion	IL	0.09	-93%	20%	220,000–330,000		
231. Martin Drake	CO	0.77	-25%	55%			Highly likely
232. Meredosia	IL	0.14	-93%	20%	220,000–330,000		
233. R. M. Heskett	ND	2.73	45%	14%			
234. Rawhide	CO	3.23	-23%	55%			Highly likely
235. Ray D. Nixon	CO	0.77	-25%	55%			Highly likely
236. Rodemacher	LA			6%	220,000–330,000		
237. Welsh	TX	0.04	0%	6%		47	
238. Elrama Power Plant	PA			8%	150,000–220,000		

TABLE B-1 (Cont.)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
239. Hatfields Ferry Power Station	PA	0.08	-88%	8%	150,000–220,000		
240. Fort Martin Power Station	WV	0.11	-89%	8%	150,000–220,000		
241. Harrison Power Station	WV	0.11	-89%	8%	150,000–220,000		
242. Mt. Storm	WV	0.01	-83%	8%	150,000–220,000		
243. Nucla	CO	1.18	-28%	55%			
244. Sandow No. 4	TX	3.45	-7%	9%		47	
245. C. R. Huntley Generating Station	NY	0.15	-94%	900%	150,000–220,000		
246. Tennessee Eastman Operations	TN			45%	220,000–330,000	40	
247. Birchwood Power	VA	0.29	-89%	45%	150,000–220,000		
248. Black Dog	MN	2.45	145%	14%			
249. C. P. Crane	MD	0.11	-91%	50%		177	
250. Eddystone Generating Station	PA	0.32	-92%	50%	150,000–220,000		
251. Edge Moor	DE	0.32	-92%	50%	220,000–330,000	111	
252. F. B. Culley	IN	0.09	-91%	8%	220,000-–330,000	20	
253. Flint Creek	AR	0.67	-14%	6%	150,000–220,000		
254. Green Bay West Mill	WI			20%	150,000–220,000		
255. James River Power Station	MO			45%			
256. Lawrence Energy Center	KS	1.54	73%	6%			Unmet rural water needs
257. Logan Generating Plant	NJ	0.32	-92%	50%	220,000–330,000	185	
258. Meramec	MO	0.14	-93%	20%			
259. Michigan City	IN	0.51	-91%	8%	220,000–330,000	20	
260. Mitchell	WV			8%	150,000–220,000		
261. PSEG Mercer Generating Station	NJ	0.32	-92%	50%	220,000–330,000	185	
262. Quindaro	KS	1.54	73%	6%			Unmet rural water needs
263. Riverside	MN	2.45	145%	14%			
264. Riverside	IA	1.87	143%	20%			
265. Sibley	MO	0.99	71%	45%			
266. Sikeston Power Station	MO	0.32	52%	20%			
267. Silver Bay Power	MN	0.33	154%	14%			
268. Weston	WI	0.14	-93%	20%	150,000–220,000		
269. Hayden	CO	0.43	-19%	55%			
270. HMP&L Station Two Henderson	KY	0.06	-90%	8%			
271. R. E. Burger	OH	0.15	-89%	8%	220,000–330,000		
272. Cooper	KY	0.26	-91%	8%			
273. Eckert Station	MI	0.14	-90%	8%	150,000–220,000		
274. Richard Gorsuch	OH	0.15	-89%	8%	220,000–330,000		
275. Cane Run	KY	0.46	-91%	8%			
276. Holcomb	KS	2.82	65%	6%			
277. J. E. Corette Plant	MT	3.23	-23%	60%			
278. Carbon	UT	0.35	-19%	60%			
279. Green River	KY	0.06	-90%	8%			
280. PPL Martins Creek	PA	0.32	-92%	50%	150,000–220,000		
281. Allen S. King	MN	2.45	145%	14%			
282. Archer Daniels Midland Cedar Rapids	IA	1.87	143%	20%			
283. Bremo Bluff	VA	0.29	-89%	45%	150,000–220,000		
284. Bridgeport Station	CT	0.43	-94%	71%	150,000–220,000	57	
285. Camden South Carolina	SC			45%	220,000–330,000	37	
286. Canton North Carolina	NC			45%	220,000–330,000	85	

TABLE B-1 (Cont.)

Plant Name	State	Area Demand Indicators					
		2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
287. Cogen South	SC			45%	220,000–330,000	37	
288. Crawford	IL	0.35	-93%	20%	220,000–330,000		
289. International Paper Georgetown Mill	SC			45%	220,000–330,000	37	
290. International Paper Riegelwood Mill	NC			45%	220,000–330,000	85	
291. International Paper Roanoke Rapid NC	NC			45%	220,000–330,000	85	
292. Joliet 9	IL			20%	220,000–330,000		
293. Lovett	NY	0.26	-92%	900%	150,000–220,000		
294. Nearman Creek	KS	1.54	73%	6%			Unmet rural water needs
295. Park 500 Philip Morris USA	VA			45%	150,000–220,000	69	
296. Presque Isle	MI	0.02	-92%	8%	150,000–220,000		
297. Primary Energy Roxboro	NC			45%	220,000–330,000	85	
298. Salem Harbor	MA	0.43	-94%	71%	150,000–220,000	82	
299. Southampton Power Station	VA			45%	150,000–220,000	69	
300. State Line Energy	IN	0.24	-94%	8%	220,000–330,000	20	
301. Stone Container Hopewell Mill	VA			45%	150,000–220,000	69	
302. Sutherland	IA	1.86	142%	20%			
303. Syl Laskin	MN	0.33	154%	14%			
304. Taconite Harbor Energy Center	MN	0.33	154%	14%			
305. Trenton Channel	MI	0.5	-91%	8%	150,000–220,000		
306. Unifi Kinston LLC	NC			45%	220,000–330,000	85	
307. Univ. of NC Chapel Hill Cogen Facility	NC			45%	220,000–330,000	85	
308. U.S. DOE Savannah River Site (D Area)	SC			45%	220,000–330,000	37	
309. Waynesboro Virginia Plant	VA			45%	150,000–220,000	69	
310. Weyerhaeuser Plymouth NC	NC			45%	220,000–330,000	85	
311. Wyodak	WY	0.067	-92%	60%			
312. Edwardsport	IN	0.09	-91%	8%	220,000–330,000	20	
313. Elmer Smith	KY	0.09	-91%	8%			
314. Kenneth C. Coleman	KY	0.09	-91%	8%			
315. Dunkirk Generating Station	NY	0.15	-94%	900%	150,000–220,000		
316. Avon Lake	OH			8%	220,000–330,000		
317. Covington Facility	VA			45%	150,000–220,000		
318. Radford Army Ammunition Plant	VA			8%	150,000–220,000	69	
319. Dickerson	MD	0.11	-91%	50%		177	
320. Georgia Pacific Naheola Mill	AL			45%	150,000–220,000		
321. High Bridge	MN	2.45	145%	14%			
322. Hoot Lake	MN	2.45	145%	14%			
323. Howard Down	NJ			50%	220,000–330,000	185	
324. International Paper Augusta Mill	GA			45%		65	
325. International Paper Prattville Mill	AL			45%	150,000–220,000		
326. Marshall	MO			20%			
327. Northside Generating Station	FL			180%		228	
328. NRG Energy Center Dover	DE			50%	220,000–330,000	111	
329. Riverwood International Macon Mill	GA			45%		65	
330. Rock-Tenn Mill	AL			45%	150,000–220,000		
331. Rumford Cogeneration	ME	0.43	-94%	71%			
332. Savannah River Mill	GA			45%		65	
333. Savannah Sugar Refinery	GA			45%		65	

TABLE B-1 (Cont.)

		Area Demand Indicators					
Plant Name	State	2030 Water Consumption – All Users (bgd)	Change in Water Consumption – All Users 2005–2030 (%)	Change in Water Consumption – Thermoelectric 2005–2030 (%)	Intensity of water withdrawals GPD/mi^2	Change in Population per mi^2 (by state)	Potential Crisis Areas – 2025
334. Seaford Delaware Plant	DE			50%	220,000–330,000	111	
335. SP Newsprint	GA			45%		65	
336. U. S. Alliance Coosa Pines	AL			45%	150,000–220,000		
337. Weyerhaeuser Pine Hill Operations	AL			45%	150,000–220,000		
338. AES Shady Point	OK	0.44	-14%	6%			
339. D. B. Wilson	KY	0.06	-90%	8%			
340. Dale	KY	0.26	-91%	8%			
341. Cinergy Solutions of Narrows	VA			8%	150,000–220,000		
342. Altavista Power Station	VA			8%	150,000–220,000		
343. Crisp Plant	GA			45%			
344. Hugo	OK	0.19	-10%	6%			
345. Jefferson Smurfit Fernandina Beach	FL			180%		228	
346. Scholz	FL			180%		228	
347. Stone Container Panama City Mill	FL			180%		228	

TABLE B-2 Vulnerable Plants and Scoring Results (Plant-Specific Demand Indicators)

		Plant-Specific Demand Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
1. Belews Creek	NC	15,346,420	11.2	266	1232.6	29,316	14,219,393
2. Big Cajun 2	LA	11,734,870	11.5	358	287.8	8,952	13,690,368
3. Gorgas	AL	7,910,097	22.7	1,047	901.5	41,598	8,449,622
4. Allen Steam Plant	TN	5,160,139	0.0	-	405.7	28,697	5,337,930
5. E. C. Gaston	AL	11,273,368	1.4	44	412.0	13,338	12,234,048
6. G. G. Allen	NC	6,415,484	6.9	390	667.4	37,970	6,224,197
7. Georgia Pacific Cedar Springs	GA	628,836	37.5	21,759	195.2	113,294	-
8. Marshall	NC	15,499,240	14.3	336	1152.4	27,138	13,331,274
9. Roxboro	NC	14,799,903	5.2	128	1103.9	27,225	14,907,671
10. Seminole	FL	9,810,229	17.6	654	22.1	822	10,032,384
11. St. Johns River Power Park	FL	8,697,799	12.2	513	45.0	1,890	9,432,650
12. Widows Creek	AL	9,851,670	0.0	-	1459.1	54,060	11,010,115
13. Barry	AL	11,698,092	1.4	44	1040.7	32,472	12,368,447
14. Big Bend	FL	8,433,410	0.0	-	1188.3	51,428	10,053,275
15. Cumberland	TN	16,371,958	0.0	-	2075.4	46,269	16,883,450
16. Gallatin	TN	7,494,267	0.0	-	940.5	45,804	7,501,399
17. Johnsonville	TN	7,597,429	0.0	-	1226.6	58,931	8,479,025
18. Navajo	AZ	17,030,700	23.5	503	23.5	503	19,677,241
19. Stanton Energy Center	FL	6,529,419	7.4	412	7.4	412	7,118,452
20. Transalta Centralia Generation	WA	10,483,180	17.8	619	20.6	716	12,517,502
21. James H. Miller Jr.	AL	21,326,149	17.2	295	24.4	417	22,509,467
22. Cliffside	NC	3,733,245	6.5	632	258.9	25,314	3,929,892
23. Cross	SC	8,149,025	10.1	452	11.9	535	8,760,095
24. Mayo	NC	4,954,320	15.5	1,143	15.5	1,143	5,259,857
25. Scherer	GA	24,093,772	34.3	520	59.1	895	26,040,793
26. Wansley	GA	12,926,766	22.0	621	64.0	1,807	12,779,890
27. Winyah	SC	7,842,317	10.0	466	11.1	514	8,860,642
28. Yates	GA	6,862,634	15.8	842	31.0	1,650	7,338,093
29. Hunter	UT	9,742,633	16.7	627	16.7	627	10,483,054
30. Huntington	UT	6,381,332	11.1	632	11.1	632	6,371,721
31. Jim Bridger	WY	14,789,512	22.6	558	22.6	558	16,239,775
32. Antelope Valley	ND	6,437,295	9.2	524	9.2	524	7,951,684
33. Charles R. Lowman	AL	3,865,846	12.9	1,214	74.6	7,048	4,707,690
34. Coal Creek	ND	8,359,811	12.1	527	12.1	527	10,713,452
35. Gerald Gentleman	NE	9,481,122	4.9	189	667.6	25,703	11,297,844
36. Jack Watson	MS	3,780,229	10.2	982	156.2	15,086	4,153,166
37. Jeffrey Energy Center	KS	15,145,728	20.7	500	22.6	545	18,123,590
38. Springerville	AZ	6,094,037	7.6	457	8.1	484	6,184,283
39. Kingston	TN	9,479,726	0.0	-	1280.0	49,285	10,328,583
40. Buck	NC	1,647,010	2.7	602	346.9	76,873	1,761,106
41. Crystal River	FL	15,886,134	4.8	111	1133.3	26,039	17,349,808
42. Dan River	NC	649,313	1.6	908	252.7	142,057	813,992
43. Harllee Branch	GA	9,797,453	0.0	-	912.4	33,991	9,522,353
44. Mohave	NV	10,534,540	16.2	560	16.2	560	10,770,045
45. New Madrid	MO	7,032,640	8.1	419	803.5	41,702	7,230,700
46. Wateree	SC	5,190,798	0.0	-	469.1	32,985	4,806,560
47. Naughton	WY	5,238,417	5.4	378	10.1	703	6,077,190

TABLE B-2 (Cont.)

		Plant-Specific Demand Indicators						
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
48. Milton R. Young	ND	5,117,830	0.0	-	503.2	35,885	6,147,704
49. Dave Johnston	WY	5,684,004	7.0	448	205.3	13,186	7,130,622
50. J. M. Stuart	OH	14,466,481	14.5	367	574.9	14,505	13,817,922
51. J. T. Deely	TX	5,915,823	12.1	746	12.1	746	7,182,828
52. Joppa Steam	IL	7,878,895	5.3	246	616.4	28,555	8,874,176
53. R. S. Nelson	LA	3,238,276	5.8	649	8.6	974	3,993,862
54. Victor J. Daniel Jr.	MS	7,062,396	2.1	110	2.1	110	8,105,731
55. W. A. Parish	TX	18,540,316	12.6	248	889.5	17,511	19,936,777
56. Thomas Hill	MO	7,796,102	13.2	620	777.8	36,417	8,584,316
57. Gadsden	AL	429,828	0.5	384	143.0	121,403	677,598
58. Greene County	AL	3,785,509	0.6	56	386.2	37,235	4,163,831
59. Bull Run	TN	6,587,608	0.0	-	551.7	30,568	6,584,729
60.John Sevier	TN	4,960,614	0.0	-	693.7	51,042	5,042,793
61. Bowen	GA	22,337,673	26.4	431	38.8	634	22,156,086
62. Canadys Steam	SC	2,198,619	6.1	1,019	6.9	1,148	2,398,210
63. Cape Fear	NC	1,876,174	0.8	151	272.9	53,086	1,963,735
64. Coronado	AZ	6,070,528	8.0	482	8.5	513	6,677,002
65. George Neal North	IA	6,512,341	17.3	971	577.2	32,348	7,318,651
66. Iatan	MO	4,899,448	0.0	-	427.7	31,865	5,411,749
67. Independence	AR	10,013,103	6.5	236	8.7	316	11,504,415
68. Indian River Generating Station	DE	3,633,197	5.5	552	382.6	38,439	3,870,525
69. Intermountain Power Project	UT	13,664,259	18.0	482	18.0	482	15,182,583
70. Jefferies	SC	1,909,054	10.0	1,915	11.8	2,261	2,304,293
71. L. V. Sutton	NC	3,085,637	19.7	2,326	19.7	2,326	3,522,599
72. Laramie River Station	WY	13,024,102	17.4	487	17.4	487	15,337,812
73. Lee	NC	2,049,537	21.3	3,798	21.3	3,798	2,366,265
74. Mecklenburg Power Station	VA	817,970	108.5	48,394	118.7	52,980	-
75. Morgantown Generating Plant	MD	6,435,699	0.0	-	965.5	54,760	6,156,779
76. Riverbend	NC	1,835,789	2.4	475	367.4	73,042	1,992,091
77. W. H. Weatherspoon	NC	797,575	49.1	22,450	49.1	22,450	1,009,843
78. W. S. Lee	SC	1,445,779	3.0	751	167.6	42,310	1,594,224
79. White Bluff	AR	9,786,711	11.0	410	15.5	579	10,944,468
80. Craig	CO	10,116,199	12.8	462	12.8	462	11,588,735
81. Four Corners	NM	15,616,040	22.2	518	22.7	530	16,015,409
82. San Juan	NM	12,463,637	17.8	522	17.8	522	13,097,410
83. Cherokee	CO	5,001,081	7.0	509	9.2	675	5,716,240
94. Rockport	IN	17,942,286	33.5	681	33.5	681	17,422,316
85. Mill Creek	KY	10,115,227	21.5	777	50.7	1,831	10,301,376
86. Limestone	TX	12,757,227	29.9	855	29.9	855	13,486,035
87. Cholla	AZ	7,577,570	0.0	-	9.8	470	8,806,578
88. Clifty Creek	IN	8,981,018	0.0	-	1226.7	49,855	8,905,313
89. Crist	FL	5,009,625	13.3	970	86.6	6,310	5,640,013
90. Ghent	KY	12,586,673	55.2	1,601	61.6	1,786	13,051,033
91. Harrington	TX	7,458,711	12.6	617	12.6	617	8,909,676
92. Miami Fort	OH	7,566,961	0.0	-	252.1	12,159	7,355,473
93. Powerton	IL	9,468,947	25.9	997	25.9	997	10,424,802
94. R. D. Morrow	MS	2,551,294	3.9	555	5.4	777	3,055,780
95. Tanners Creek	IN	4,998,331	0.0	-	875.2	63,914	5,047,476

TABLE B-2 (Cont.)

		Plant-Specific Demand Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
96. Tolk	TX	7,418,825	12.3	604	12.3	604	7,538,483
97. W. H. Zimmer	OH	10,340,814	0.0	-	645.0	22,767	8,963,966
98. Walter C. Beckjord	OH	6,508,147	0.0	-	739.4	41,467	6,722,452
99. Dolet Hills	LA	4,842,592	513.2	38,682	523.2	39,438	6,063,486
100. Hammond	GA	4,361,408	0.0	-	535.0	44,775	4,728,708
101. Chesapeake	VA	3,781,226	0.0	-	544.3	52,544	4,213,781
102. Chesterfield	VA	8,124,294	0.0	-	774.0	34,775	8,656,606
103. Clay Boswell	MN	7,248,188	8.5	426	154.0	7,756	8,180,829
104. Clover	VA	6,387,194	0.0	-	0.0	-	6,847,691
105. Comanche	CO	4,292,197	6.0	511	7.4	632	5,242,791
106. Council Bluffs	IA	6,246,265	0.0	-	480.8	28,095	6,889,705
107. Hawthorn	MO	3,833,084	0.0	-	188.5	17,946	4,258,457
108. La Cygne	KS	9,038,866	0.0	-	879.8	35,529	10,244,307
109. Labadie	MO	18,638,954	0.0	-	1144.5	22,412	17,289,637
110. Lansing Smith	FL	2,366,453	0.0	-	240.0	37,014	2,682,567
111. Lon Wright	NE	551,927	0.8	513	1091.8	722,002	573,830
112. Mitchell	GA	6,931,908	0.0	-	118.2	6,224	737,146
113. Potomac River	VA	1,319,771	0.0	-	225.2	62,293	1,620,605
114. Sooner	OK	7,135,081	9.9	506	11.9	608	7,719,187
115. Urquhart	SC	602,974	0.0	-	93.9	56,847	641,841
116. Williams	SC	4,797,655	0.0	-	509.9	38,796	4,939,569
117. Kincaid Generation LLC	IL	6,148,117	0.0	-	830.8	49,325	7,068,860
118. Merom	IN	6,773,234	0.0	-	439.8	23,701	7,453,525
119. Martin Lake	TX	18,250,189	0.0	-	1943.2	38,864	21,593,119
120. Pirkey	TX	4,993,784	5.2	378	423.3	30,942	5,925,868
121. Cardinal	OH	11,372,613	8.7	280	965.8	30,997	10,874,807
122. Conesville	OH	9,786,542	25.7	957	219.2	8,176	10,029,698
123. General James M. Gavin	OH	19,142,304	40.0	763	40.0	763	18,842,155
124. Baldwin Energy Complex	IL	12,618,530	0.0	-	32.3	935	12,954,432
125. Gibson	IN	22,443,805	0.0	-	1858.2	30,219	21,746,394
126. Leland Olds	ND	4,816,733	0.3	20	329.3	24,953	6,009,007
127. AES Petersburg	IN	11,550,170	13.8	435	388.8	12,285	12,980,258
128. Muskingum River	OH	7,403,428	6.9	338	706.9	34,850	7,093,558
129. Willow Island	SC	634,414	0.0	-	88.9	51,166	717,517
130. Cayuga	IN	6,621,960	0.0	-	483.4	26,647	6,451,115
131. Central Power & Lime	FL	609,429	0.0	-	144.1	86,322	-
132. Fayette Power Project	TX	11,099,204	0.0	-	876.8	28,834	11,982,386
133. Muskogee	OK	10,191,502	17.6	630	29.3	1,051	10,913,416
134. Newton	IL	7,297,242	0.0	-	605.4	30,282	8,337,376
135. R. Gallagher	IN	2,876,904	0.0	-	434.3	55,104	3,131,105
136. R. M. Schahfer	IN	10,558,399	50.0	1,727	0.0	-	13,179,374
137. South Oak Creek	WI	5,884,754	0.0	-	825.5	51,200	6,587,045
138. Eastlake	OH	8,380,430	21.3	929	712.2	31,021	8,322,363
139. Boardman	OR	3,587,882	11.6	1,184	11.6	1,184	3,997,133
140. Brandon Shores	MD	8,349,218	3.6	155	9.0	396	8,134,939
141. Burlington	IA	1,143,174	5.2	1,651	96.5	30,822	1,436,452
142. Cedar Bay Generating LP	FL	1,811,071	2.9	586	2.9	586	-
143. Chalk Point LLC	MD	4,110,282	0.0	-	582.3	51,712	4,293,417

TABLE B-2 (Cont.)

		Plant-Specific Demand Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
144. Cope	SC	2,990,506	3.6	434	4.0	489	3,207,575
145. Dolphus M. Grainger	SC	1,133,033	0.0	-	122.5	39,476	1,310,922
146. GRDA	OK	6,619,398	9.6	530	11.6	641	8,335,683
147. H. B. Robinson	SC	1,185,543	0.0	-	120.3	37,051	1,211,065
148. Jack McDonough	GA	3,638,965	0.0	-	466.6	46,806	3,678,327
149. Joliet 29	IL	5,500,330	0.0	-	1115.5	74,027	6,359,888
150. McMeekin	SC	1,791,603	0.0	-	145.4	29,626	1,820,588
151. PPL Brunner Island	PA	10,152,144	9.4	339	575.2	20,681	9,020,666
152. Primary Energy Southport	NC	304,261	2.6	3,101	2.6	3,101	-
153. Shawnee	KY	9,293,226	0.0	-	1286.6	50,533	10,444,195
154. Sherburne County	MN	14,474,605	16.0	403	18.9	476	16,657,713
155. Stone Container Florence Mill	SC	521,458	0.0	-	0.0	-	-
156. Westmoreland-LG&E Roanoke Valley I	NC	1,266,088	1.4	417	1.5	429	-
157. Westmoreland-LG&E Roanoke Valley II	NC	334,792	0.0	-	0.0	-	-
158. Will County	IL	5,293,858	0.0	-	919.7	63,412	5,956,325
159. Yorktown	VA	2,068,318	0.0	-	239.8	42,315	2,182,630
160. Big Sandy	KY	7,345,624	12.2	607	12.2	607	6,952,257
161. Colstrip	MT	16,240,780	27.4	616	27.4	616	19,219,042
162. Coyote	ND	3,046,077	4.6	550	4.8	581	3,844,011
163. Monticello	TX	14,807,481	0.0	-	1325.0	32,660	17,491,542
164. Warrick	IN	5,308,109	0.0	-	489.4	33,652	6,578,631
165. W. H. Sammis	OH	14,670,198	0.0	-	1091.2	27,149	15,401,306
166. Philip Sporn	WV	5,153,665	0.0	-	772.7	54,728	5,069,073
167. Big Brown	TX	8,549,084	0.0	-	509.9	21,772	10,573,229
168. ACE Cogeneration Facility	CA	764,480	1.6	771	2.1	987	-
169. Coleto Creek	TX	5,103,360	1.3	92	390.4	27,920	5,266,526
170. Dallman	IL	2,084,109	9.8	1,721	162.2	28,400	2,934,448
171. H. L. Spurlock	KY	6,769,736	3.5	188	3.5	188	7,235,863
172. H. Wilson Sundt Generating Station	AZ	783,197	1.3	602	1.5	693	888,304
173. Indiantown Cogeneration LP	FL	2,322,170	2.8	447	2.8	447	-
174. International Paper Savanna Mill	GA	370,168	0.6	637	0.6	637	-
175. McIntosh	GA	937,852	0.0	-	94.0	36,574	1,066,976
176. San Miguel	TX	2,850,653	303.8	38,895	303.8	38,895	3,831,532
177. Homer City Station	PA	13,599,227	16.8	451	18.6	500	13,408,987
178. Northeastern	OK	6,511,661	7.9	446	9.2	518	7,091,117
179. Conemaugh	PA	12,941,704	13.4	377	15.4	436	12,609,082
180. Keystone	PA	13,472,843	12.3	333	18.7	508	12,950,677
181. Paradise	KY	13,974,044	0.0	-	351.0	9,168	14,646,095
182. J. H. Campbell	MI	9,958,129	0.0	-	676.0	24,779	10,433,416
183. PPL Montour	PA	10,389,372	9.0	318	24.1	847	9,584,669
184. Asbury	MO	1,368,540	2.4	638	3.0	810	1,573,879
185. Asheville	NC	2,370,895	1.4	219	1.4	219	2,529,952
186. Bailly	IN	2,699,909	23.8	3,224	297.8	40,263	3,348,175
187. Brayton Point	MA	8,048,727	0.0	-	800.3	36,291	7,342,712
188. Cogentrix Hopewell	VA	642,619	2.6	1,468	2.6	1,468	-
189. Cogentrix of Richmond	VA	1,531,379	5.0	1,202	5.0	1,202	-
190. Cogentrix Virginia Leasing Corporation	VA	710,463	2.8	1,461	2.8	1,461	-

TABLE B-2 (Cont.)

		Plant-Specific Demand Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
191. Deerhaven Generating Station	FL	1,546,270	0.0	-	0.0	-	1,604,372
192. Edgewater	WI	4,150,468	0.0	-	277.6	24,412	5,017,778
193. International Paper Eastover Facility	SC	342,884	0.3	275	0.6	619	-
194. Kraft	GA	1,113,862	0.0	-	49.1	16,096	1,378,535
195. Kyger Creek	OH	7,657,479	0.0	-	1086.9	51,808	7,384,962
196. Lake Road	MO	617,615	0.0	-	83.5	49,350	715,537
197. Monroe	MI	18,717,476	0.0	-	1542.9	30,087	18,113,290
198. Montrose	MO	3,342,902	0.0	-	275.8	30,119	4,007,603
199. Nebraska City	NE	4,622,838	0.0	-	466.6	36,844	4,966,130
200. North Omaha	NE	3,417,415	0.0	-	662.5	70,756	3,957,606
201. North Valmy	NV	3,954,866	1.6	149	1.6	149	4,388,932
202. Oklaunion	TX	4,327,105	6.8	572	6.8	572	4,829,977
203. Ottumwa	IA	3,355,680	3.3	359	4.8	518	3,855,163
204. Pleasant Prairie	WI	8,459,992	6.1	262	8.1	351	10,040,802
205. Pleasants Power Station	WV	8,851,064	18.9	778	20.2	832	8,782,931
206. Possum Point	VA	127,724	0.0	-	230.0	657,162	86,899
207. Prairie Creek	IA	870,574	0.0	-	196.5	82,377	1,441,310
208. PSEG Hudson Generating Station	NJ	3,308,530	0.0	-	609.4	67,231	3,847,175
209. Reid Gardner	NV	3,922,115	3.9	361	3.9	361	5,253,111
210. Rush Island	MO	8,922,079	0.0	-	773.0	31,623	8,688,348
211. Sheldon	NE	1,552,400	2.2	523	2.6	608	2,071,374
212. Sioux	MO	6,635,922	0.0	-	613.9	33,769	6,448,783
213. St. Clair	MI	7,378,286	0.0	-	991.1	49,027	7,802,302
214. Tecumseh Energy Center	KS	1,404,220	2.4	622	3.0	790	1,772,920
215. Waukegan	IL	4,560,504	0.0	-	758.3	60,692	5,254,716
216. West Point Mill	VA	199,289	0.0	-	0.0	-	-
217. Wabash River	IN	4,530,248	0.0	-	582.3	46,918	4,705,476
218. Bruce Mansfield	PA	18,343,905	55.0	1,095	63.1	1,255	17,290,117
219. Valmont	CO	1,500,721	3.3	802	5.8	1,415	1,622,191
220. Belle River	MI	8,152,189	0.0	-	269.8	12,081	8,627,148
221. Bonanza	UT	3,716,487	6.9	673	6.9	673	-
222. A. B. Brown	IN	3,523,603	0.0	-	0.0	-	3,623,035
223. Apache Station	AZ	2,761,712	3.2	427	3.9	513	3,430,322
224. Coffeen	IL	4,450,529	0.0	-	505.4	41,446	-
225. E. D. Edwards	IL	4,393,834	0.0	-	381.8	31,720	4,997,804
226. E. W. Brown	KY	3,223,536	6.7	761	9.7	1,098	3,521,621
227. Eagle Valley	IN	1,477,173	0.0	-	208.7	51,567	1,634,491
228. Harding Street	IN	3,449,545	122.2	12,932	126.6	13,397	3,728,461
229. Killen Station	OH	4,474,802	8.1	659	8.1	659	3,637,462
230. Marion	IL	1,813,240	4.7	950	104.2	20,972	2,873,245
231. Martin Drake	CO	2,048,864	3.1	553	3.4	599	2,426,301
232. Meredosia	IL	1,276,348	0.0	-	189.6	54,210	-
233. R. M. Heskett	ND	607,334	0.0	-	55.4	33,288	620,350
234. Rawhide	CO	1,921,594	4.5	859	4.5	859	2,337,590
235. Ray D. Nixon	CO	1,488,584	2.5	602	2.5	602	1,707,111
236. Rodemacher	LA	3,374,169	0.0	-	266.0	28,770	4,111,586
237. Welsh	TX	9,537,635	1.0	40	1.0	40	10,899,821
238. Elrama Power Plant	PA	1,592,313	11.5	2,637	546.7	125,308	2,009,719

TABLE B-2 (Cont.)

		Plant-Specific Demand Indicators					
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
239. Hatfields Ferry Power Station	PA	8,672,771	9.4	397	12.7	533	8,768,387
240. Fort Martin Power Station	WV	7,060,815	8.0	414	10.9	561	6,729,297
241. Harrison Power Station	WV	13,155,331	8.2	227	12.7	351	12,961,435
242. Mt. Storm	WV	10,763,130	0.0	-	999.5	33,894	12,047,555
243. Nucla	CO	736,963	0.1	73	0.2	87	957,536
244. Sandow No. 4	TX	4,303,896	0.0	-	0.0	-	5,275,320
245. C. R. Huntley Generating Station	NY	2,692,359	0.0	-	595.1	80,681	3,395,650
246. Tennessee Eastman Operations	TN	1,298,849	0.0	-	45.5	12,787	-
247. Birchwood Power	VA	1,672,808	2.1	465	2.2	479	-
248. Black Dog	MN	1,853,369	0.0	-	298.9	58,869	2,112,418
249. C. P. Crane	MD	2,128,314	0.0	-	351.3	60,254	2,385,667
250. Eddystone Generating Station	PA	2,907,835	0.8	97	419.0	52,595	3,571,167
251. Edge Moor	DE	1,327,127	1.0	267	187.8	51,656	1,466,286
252. F. B. Culley	IN	2,617,847	0.0	-	276.4	38,533	3,169,926
253. Flint Creek	AR	3,556,261	0.1	7	378.0	38,793	3,649,665
254. Green Bay West Mill	WI	599,559	11.0	6,689	69.9	42,573	-
255. James River Power Station	MO	1,660,030	5.9	1,307	208.4	45,830	1,685,360
256. Lawrence Energy Center	KS	3,332,297	2.7	297	3.6	396	4,636,793
257. Logan Generating Plant	NJ	1,642,435	2.3	517	2.3	517	-
258. Meramec	MO	5,689,770	0.0	-	579.6	37,183	6,663,367
259. Michigan City	IN	2,547,056	5.2	741	21.6	3,093	2,991,116
260. Mitchell	WV	636,154	22.9	13,127	22.9	13,127	6,599,845
261. PSEG Mercer Generating Station	NJ	3,506,467	3.1	323	646.2	67,264	3,376,850
262. Quindaro	KS	1,021,868	0.0	-	102.8	36,706	1,353,641
263. Riverside	MN	656,390	0.0	-	222.7	123,849	2,899,388
264. Riverside	IA	2,308,488	0.0	-	0.0	-	687,411
265. Sibley	MO	2,880,028	0.0	-	278.0	35,230	3,040,398
266. Sikeston Power Station	MO	1,981,791	1.9	357	3.1	571	2,582,001
267. Silver Bay Power	MN	742,280	3.2	1,557	133.4	65,597	-
268. Weston	WI	3,538,158	2.1	213	96.6	9,961	4,695,699
269. Hayden	CO	3,653,934	2.5	252	2.5	252	4,468,852
270. HMP&L Station Two Henderson	KY	1,434,959	11.4	2,910	75.0	19,070	2,524,487
271. R. E. Burger	OH	1,994,639	0.0	-	725.7	132,793	2,465,490
272. Cooper	KY	2,004,931	0.0	-	297.8	54,219	1,987,880
273. Eckert Station	MI	1,694,523	221.9	47,807	231.6	49,881	2,118,565
274. Richard Gorsuch	OH	500,779	0.0	-	172.7	125,872	-
275. Cane Run	KY	3,685,842	0.0	-	404.9	40,092	3,967,983
276. Holcomb	KS	2,684,902	3.5	474	3.5	474	2,801,875
277. J. E. Corette Plant	MT	1,010,647	0.0	-	41.0	14,822	1,268,274
278. Carbon	UT	1,349,858	2.8	751	2.8	751	1,547,568
279. Green River	KY	675,303	0.0	-	181.0	97,813	797,913
280. PPL Martins Creek	PA	718,981	48.2	24,444	48.7	24,707	805,426
281. Allen S. King	MN	2,796,588	0.8	110	322.8	42,127	3,009,375
282. Archer Daniels Midland Cedar Rapids	IA	970,995	0.4	146	0.5	170	-
283. Bremo Bluff	VA	1,434,807	0.0	-	130.6	33,212	1,613,151
284. Bridgeport Station	CT	2,735,970	0.0	-	267.8	35,722	3,102,333
285. Camden South Carolina	SC	20,879	0.0	-	0.0	-	-
286. Canton North Carolina	NC	361,795	0.0	-	0.0	-	-

TABLE B-2 (Cont.)

		Plant-Specific Demand Indicators						
Plant Name	State	Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO$_2$ Emissions (Tons)
287. Cogen South	SC	573,438	0.0	-	0.0	-	-
288. Crawford	IL	2,965,873	0.0	-	503.1	61,914	3,377,065
289. International Paper Georgetown Mill	SC	564,215	0.0	-	0.0	-	-
290. International Paper Riegelwood Mill	NC	670	0.0	-	0.0	-	-
291. International Paper Roanoke Rapid NC	NC	144,157	0.0	-	0.0	-	-
292. Joliet 9	IL	1,673,848	0.0	-	445.0	97,034	2,119,926
293. Lovett	NY	1,651,329	0.0	-	298.7	66,029	2,069,742
294. Nearman Creek	KS	1,478,198	0.0	-	179.0	44,206	1,936,160
295. Park 500 Philip Morris USA	VA	78,097	0.0	-	0.0	-	-
296. Presque Isle	MI	3,431,180	0.0	-	242.8	25,831	4,107,720
297. Primary Energy Roxboro	NC	196,835	0.0	-	0.0	-	-
298. Salem Harbor	MA	2,229,768	0.0	-	278.8	45,631	2,440,019
299. Southampton Power Station	VA	343,675	0.0	-	0.0	-	242,193
300. State Line Energy	IN	2,729,088	0.0	-	484.7	64,831	3,043,572
301. Stone Container Hopewell Mill	VA	318,336	0.0	-	0.0	-	-
302. Sutherland	IA	873,996	0.4	181	1.5	621	1,194,301
303. Syl Laskin	MN	695,500	0.8	407	133.8	70,212	1,036,142
304. Taconite Harbor Energy Center	MN	1,411,062	0.1	17	157.7	40,793	1,653,235
305. Trenton Channel	MI	4,226,915	0.0	-	408.8	35,300	4,528,702
306. Unifi Kinston LLC	NC	25,122	0.0	-	0.0	-	-
307. Univ. of NC Chapel Hill Cogen Facility	NC	90,103	0.0	-	0.0	-	-
308. U.S. DOE Savannah River Site (D Area)	SC	192,456	0.0	-	0.0	-	-
309. Waynesboro Virginia Plant	VA	14,622	0.0	-	0.0	-	-
310. Weyerhaeuser Plymouth NC	NC	167,189	0.0	-	0.0	-	-
311. Wyodak	WY	2,677,908	0.0	-	0.0	-	3,370,621
312. Edwardsport	IN	178,617	0.0	-	136.4	278,675	-
313. Elmer Smith	KY	2,198,358	0.0	-	200.7	33,324	2,751,995
314. Kenneth C. Coleman	KY	2,796,020	0.0	-	267.6	34,938	3,338,574
315. Dunkirk Generating Station	NY	3,345,523	0.0	-	426.8	46,560	3,615,791
316. Avon Lake	OH	3,541,512	0.0	-	469.5	48,393	3,578,165
317. Covington Facility	VA	639,474	0.0	-	0.0	-	-
318. Radford Army Ammunition Plant	VA	39,819	0.0	-	0.0	-	-
319. Dickerson	MD	3,340,623	0.0	-	440.8	48,161	3,411,227
320. Georgia Pacific Naheola Mill	AL	419,389	0.0	-	0.0	-	-
321. High Bridge	MN	1,365,603	0.0	-	126.1	33,703	1,931,746
322. Hoot Lake	MN	930,978	0.0	-	80.3	31,472	1,157,182
323. Howard Down	NJ	95,330	0.0	-	0.0	-	-
324. International Paper Augusta Mill	GA	484,584	0.0	-	0.0	-	-
325. International Paper Prattville Mill	AL	533,703	0.0	-	0.0	-	-
326. Marshall	MO	15,499,240	0.0	-	0.0	-	-
327. Northside Generating Station	FL	3,916,421	0.0	-	234.2	21,823	-
328. NRG Energy Center Dover	DE	91,826	0.0	-	0.0	-	-
329. Riverwood International Macon Mill	GA	251,520	0.0	-	0.0	-	-
330. Rock-Tenn Mill	AL	204,476	0.0	-	0.0	-	-
331. Rumford Cogeneration	ME	753,839	32.3	15,647	32.3	15,647	-
332. Savannah River Mill	GA	645,670	0.0	-	0.0	-	-
333. Savannah Sugar Refinery	GA	61,555	0.0	-	0.0	-	-

TABLE B-2 (Cont.)

Plant Name	State	Plant-Specific Demand Indicators					
		Net Annual Electrical Generation (MWh)	Cooling Water Annual Average Consumption (mgd)	Cooling Water Consumption Intensity (gal/MWh)	Cooling Water Annual Average Withdrawal (mgd)	Cooling Water Withdrawal Intensity (gal/MWh)	Annual CO_2 Emissions (Tons)
334. Seaford Delaware Plant	DE	132,476	0.0	-	0.0	-	-
335. SP Newsprint	GA	200,340	0.0	-	0.0	-	-
336. U. S. Alliance Coosa Pines	AL	3,095	0.0	-	0.0	-	-
337. Weyerhaeuser Pine Hill Operations	AL	511,850	0.0	-	0.0	-	-
338. AES Shady Point	OK	2,384,414	2.8	427	3.1	481	-
339. D. B. Wilson	KY	3,403,626	0.0	-	13.7	1,469	4,182,682
340. Dale	KY	1,232,800	0.0	-	1.0	287	1,121,701
341. Cinergy Solutions of Narrows	VA	192,893	0.0	-	0.0	-	-
342. Altavista Power Station	VA	347,843	0.0	-	0.0	-	221,855
343. Crisp Plant	GA	1,033	0.0	-	0.0	-	-
344. Hugo	OK	3,100,097	3.4	396	4.8	571	3,497,474
345. Jefferson Smurfit Fernandina Beach	FL	598,907	0.0	-	0.0	-	-
346. Scholz	FL	365,446	0.0	-	0.0	-	491,554
347. Stone Container Panama City Mill	FL	253,324	0.0	-	0.0	-	-

TABLE B-3 Vulnerable Plants and Scoring Results (Supply Indicators)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
1. Belews Creek	NC			55–60	Increasing drought		Moderately dry
2. Big Cajun 2	LA			65–70	Increasing drought		
3. Gorgas	AL			60–65			Moderately dry
4. Allen Steam Plant	TN			60–65	Significantly increasing drought		Drier than normal
5. E. C. Gaston	AL			60–65	Increasing drought		Moderately dry
6. G. G. Allen	NC			55–60	Significantly increasing drought		Moderately dry
7. Georgia Pacific Cedar Springs	GA			65–70	Increasing drought		Moderately dry
8. Marshall	NC			55–60	Increasing drought		Moderately dry
9. Roxboro	NC			55–60	Increasing drought		Moderately dry
10. Seminole	FL			65–70	Significantly increasing drought		
11. St. Johns River Power Park	FL			65–70	Significantly increasing drought		
12. Widows Creek	AL			55–60	Increasing drought		Moderately dry
13. Barry	AL			65–70			Moderately dry
14. Big Bend	FL			>70	Increasing drought		
15. Cumberland	TN			55–60	Increasing drought		Drier than normal
16. Gallatin	TN			55–60	Increasing drought		Drier than normal
17. Johnsonville	TN			55–60	Increasing drought		Drier than normal
18. Navajo	AZ	5–12	Moderately Dry, -1.29 to 00.80	60–65	Increasing drought		
19. Stanton Energy Center	FL			>70	Increasing drought		
20. Transalta Centralia Generation	WA				Increasing drought		Drier than normal
21. James H. Miller Jr.	AL			60–65	Increasing drought		Moderately dry
22. Cliffside	NC			55–60	Increasing drought		Moderately dry
23. Cross	SC			60–65	Significantly increasing drought		Moderately dry
24. Mayo	NC			55–60	Increasing drought		Moderately dry
25. Scherer	GA			60–65	Increasing drought		Moderately dry
26. Wansley	GA			60–65	Significantly increasing drought		Moderately dry
27. Winyah	SC			60–65	Significantly increasing drought		Moderately dry
28. Yates	GA			60–65	Significantly increasing drought		Moderately dry
29. Hunter	UT	5–12	Abnormally Dry, -0.79 to -0.51		Increasing drought		
30. Huntington	UT	5–12	Abnormally Dry, -0.79 to -0.51		Increasing drought		

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
31. Jim Bridger	WY	5–12			Increasing drought	Severe (-3.91 to -3.00)	
32. Antelope Valley	ND	12–20					Drier than normal
33. Charles R. Lowman	AL			60–65	Increasing drought		Moderately dry
34. Coal Creek	ND	12–20					Drier than normal
35. Gerald Gentleman	NE	12–20					
36. Jack Watson	MS			65–70			Drier than normal
37. Jeffrey Energy Center	KS				Increasing drought		
38. Springerville	AZ	12–20	Moderately Dry, -1.29 to 00.80				
39. Kingston	TN			55–60	Increasing drought		Drier than normal
40. Buck	NC			55–60	Increasing drought		Moderately dry
41. Crystal River	FL			>70	Increasing drought		
42. Dan River	NC			55–60	Increasing drought		Moderately dry
43. Harllee Branch	GA			60–65	Increasing drought		Moderately dry
44. Mohave	NV	<5		>70	Significantly increasing drought		
45. New Madrid	MO			55–60	Increasing drought		
46. Wateree	SC			60–65	Increasing drought		Moderately dry
47. Naughton	WY	5–12			Increasing drought	Severe (-3.91 to -3.00)	
48. Milton R. Young	ND	12–20					Drier than normal
49. Dave Johnston	WY	12–20			Increasing drought		
50. J. M. Stuart	OH		Abnormally Dry, -0.79 to -0.51		Increasing drought		
51. J. T. Deely	TX			65–70	Increasing drought		
52. Joppa Steam	IL			55–60	Increasing drought		
53. R. S. Nelson	LA			65–70	Increasing drought		
54. Victor J. Daniel Jr.	MS			65–70			Drier than normal
55. W. A. Parish	TX			65–70			
56. Thomas Hill	MO						
57. Gadsden	AL			60–65	Increasing drought		Moderately dry
58. Greene County	AL			60–65	Increasing drought		Moderately dry
59. Bull Run	TN			55–60			Drier than normal
60.John Sevier	TN			55–60			Drier than normal
61. Bowen	GA			55–60	Increasing drought		Moderately dry
62. Canadys Steam	SC			60–65	Significantly increasing drought		Moderately dry
63. Cape Fear	NC			55–60	Increasing drought		Moderately dry
64. Coronado	AZ	5–12	Moderately Dry, -1.29 to 00.80				
65. George Neal North	IA						
66. Iatan	MO				Increasing drought		
67. Independence	AR			60–65	Significantly increasing drought		
68. Indian River Generating Station	DE			55–60	Increasing drought		
69. Intermountain Power Project	UT	5–12			Increasing drought	Moderate (-2.99 to -2.00)	

TABLE B-3 (Cont.)

Plant Name	State	Supply Indicators					
		Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
70. Jefferies	SC			60–65	Significantly increasing drought		Moderately dry
71. L. V. Sutton	NC			60–65	Significantly increasing drought		Moderately dry
72. Laramie River Station	WY	12–20			Increasing drought		
73. Lee	NC			60–65	Increasing drought		Moderately dry
74. Mecklenburg Power Station	VA			55–60			Moderately dry
75. Morgantown Generating Plant	MD			55–60	Increasing drought		
76. Riverbend	NC			55–60	Increasing drought		Moderately dry
77. W. H. Weatherspoon	NC			60–65	Significantly increasing drought		Moderately dry
78. W. S. Lee	SC			60–65	Increasing drought		Moderately dry
79. White Bluff	AR			60–65	Significantly increasing drought		
80. Craig	CO	12–20	Moderately Dry, -1.29 to 00.80		Increasing drought		
81. Four Corners	NM	5–12					
82. San Juan	NM	5–12					
83. Cherokee	CO	12–20					
94. Rockport	IN			55–60	Increasing drought		
85. Mill Creek	KY			55–60	Increasing drought		
86. Limestone	TX			65–70			
87. Cholla	AZ	5–12	Moderately Dry, -1.29 to 00.80				
88. Clifty Creek	IN				Increasing drought		
89. Crist	FL			65–70	Increasing drought		
90. Ghent	KY				Increasing drought	Severe (-3.91 to -3.00)	
91. Harrington	TX	12–20		55–60			
92. Miami Fort	OH		Abnormally Dry, -0.79 to -0.51		Increasing drought		
93. Powerton	IL				Increasing drought		
94. R. D. Morrow	MS			65–70	Increasing drought		Drier than normal
95. Tanners Creek	IN				Increasing drought		
96. Tolk	TX	12–20		55–60			
97. W. H. Zimmer	OH		Abnormally Dry, -0.79 to -0.51		Increasing drought		
98. Walter C. Beckjord	OH		Abnormally Dry, -0.79 to -0.51		Increasing drought		
99. Dolet Hills	LA			60–65	Increasing drought		
100. Hammond	GA			55–60	Increasing drought		Moderately dry
101. Chesapeake	VA			55–60	Increasing drought		Moderately dry
102. Chesterfield	VA			55–60			Moderately dry
103. Clay Boswell	MN						
104. Clover	VA			55–60			Moderately dry
105. Comanche	CO	12–20					
106. Council Bluffs	IA				Increasing drought		
107. Hawthorn	MO				Increasing drought		
108. La Cygne	KS			55–60			
109. Labadie	MO						
110. Lansing Smith	FL			65–70	Increasing drought		

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
111. Lon Wright	NE				Increasing drought		
112. Mitchell	GA			65–70	Increasing drought		Moderately dry
113. Potomac River	VA			55–60	Increasing drought		Moderately dry
114. Sooner	OK			55–60	Increasing drought		
115. Urquhart	SC			60–65	Increasing drought		Moderately dry
116. Williams	SC			60–65	Significantly increasing drought		Moderately dry
117. Kincaid Generation LLC	IL				Increasing drought		
118. Merom	IN				Increasing drought		
119. Martin Lake	TX			60–65			
120. Pirkey	TX			60–65			
121. Cardinal	OH		Moderately Dry, -1.29 to 00.80				
122. Conesville	OH						
123. General James M Gavin	OH				Increasing drought		
124. Baldwin Energy Complex	IL			55–60	Increasing drought		
125. Gibson	IN				Increasing drought		
126. Leland Olds	ND	12–20					Drier than normal
127. AES Petersburg	IN						
128. Muskingum River	OH		Abnormally Dry, -0.79 to -0.51				
129. Willow Island	SC			60–65	Significantly increasing drought		Moderately dry
130. Cayuga	IN				Increasing drought		
131. Central Power & Lime	FL			>70	Increasing drought		
132. Fayette Power Project	TX			65–70	Increasing drought		
133. Muskogee	OK			60–65	Increasing drought		
134. Newton	IL				Increasing drought		
135. R. Gallagher	IN			55–60	Increasing drought		
136. R. M. Schahfer	IN						
137. South Oak Creek	WI						
138. Eastlake	OH						
139. Boardman	OR	5–12			Increasing drought		
140. Brandon Shores	MD			55–60	Increasing drought		
141. Burlington	IA				Increasing drought		
142. Cedar Bay Generating LP	FL			65–70	Significantly increasing drought		
143. Chalk Point LLC	MD			55–60	Increasing drought		
144. Cope	SC			60–65	Significantly increasing drought		Moderately dry
145. Dolphus M. Grainger	SC			60–65	Significantly increasing drought		Moderately dry
146. GRDA	OK			55–60	Increasing drought		
147. H. B. Robinson	SC			60–65	Significantly increasing drought		Moderately dry
148. Jack McDonough	GA			60–65	Increasing drought		Moderately dry
149. Joliet 29	IL						
150. McMeekin	SC			60–65	Increasing drought		Moderately dry
151. PPL Brunner Island	PA						
152. Primary Energy Southport	NC			60–65	Significantly increasing drought		Moderately dry
153. Shawnee	KY			55–60	Increasing drought		

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
154. Sherburne County	MN						
155. Stone Container Florence Mill	SC			60–65	Significantly increasing drought		Moderately dry
156. Westmoreland-LG&E Roanoke Valley I	NC			55–60	Increasing drought		Moderately dry
157. Westmoreland-LG&E Roanoke Valley II	NC			55–60	Increasing drought		Moderately dry
158. Will County	IL						
159. Yorktown	VA			55–60	Increasing drought		Moderately dry
160. Big Sandy	KY				Increasing drought		
161. Colstrip	MT	12–20			Significantly increasing drought		
162. Coyote	ND	12–20					Drier than normal
163. Monticello	TX			60–65			
164. Warrick	IN						
165. W. H. Sammis	OH		Moderately Dry, -1.29 to 00.80				
166. Philip Sporn	WV						
167. Big Brown	TX			65–70			
168. ACE Cogeneration Facility	CA				Increasing drought		
169. Coleto Creek	TX			>70	Increasing drought		
170. Dallman	IL				Increasing drought		
171. H. L. Spurlock	KY		Abnormally Dry, -0.79 to -0.51		Increasing drought		
172. H. Wilson Sundt Generating Station	AZ			65–70	Increasing drought		
173. Indiantown Cogeneration LP	FL			>70	Increasing drought		
174. International Paper Savanna Mill	GA				Significantly increasing drought		Moderately dry
175. McIntosh	GA			65–70	Significantly increasing drought		Moderately dry
176. San Miguel	TX			>70			
177. Homer City Station	PA						
178. Northeastern	OK			55–60	Increasing drought		
179. Conemaugh	PA						
180. Keystone	PA						
181. Paradise	KY			55–60	Increasing drought		
182. J. H. Campbell	MI						
183. PPL Montour	PA						
184. Asbury	MO			55–60			
185. Asheville	NC			55–60	Increasing drought		Moderately dry
186. Bailly	IN						
187. Brayton Point	MA						
188. Cogentrix Hopewell	VA			55–60	Increasing drought		Moderately dry
189. Cogentrix of Richmond	VA			55–60			Moderately dry
190. Cogentrix Virginia Leasing Corporation	VA			55–60	Increasing drought		Moderately dry
191. Deerhaven Generating Station	FL			65–70	Significantly increasing drought		
192. Edgewater	WI				Increasing drought		
193. International Paper Eastover Facility	SC				Increasing drought		Moderately dry
194. Kraft	GA			65–70	Significantly increasing drought		Moderately dry
195. Kyger Creek	OH						
196. Lake Road	MO				Increasing drought		

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
197. Monroe	MI						
198. Montrose	MO			55–60			
199. Nebraska City	NE				Increasing drought		
200. North Omaha	NE						
201. North Valmy	NV	5–12			Significantly increasing drought	Severe (-3.91 to -3.00)	
202. Oklaunion	TX			60–65			
203. Ottumwa	IA				Increasing drought		
204. Pleasant Prairie	WI						
205. Pleasants Power Station	WV						
206. Possum Point	VA						Moderately dry
207. Prairie Creek	IA						
208. PSEG Hudson Generating Station	NJ						
209. Reid Gardner	NV	<5		65–70			
210. Rush Island	MO				Increasing drought		
211. Sheldon	NE				Increasing drought		
212. Sioux	MO				Increasing drought		
213. St. Clair	MI						
214. Tecumseh Energy Center	KS				Increasing drought		
215. Waukegan	IL						
216. West Point Mill	VA			55–60	Increasing drought		Moderately dry
217. Wabash River	IN				Increasing drought		
218. Bruce Mansfield	PA						
219. Valmont	CO	12–20					
220. Belle River	MI						
221. Bonanza	UT	5–12			Increasing drought		
222. A. B. Brown	IN	<5		55–60	Increasing drought		
223. Apache Station	AZ	5–12		60–65	Increasing drought		
224. Coffeen	IL				Increasing drought		
225. E. D. Edwards	IL				Increasing drought		
226. E. W. Brown	KY			55–60	Increasing drought		
227. Eagle Valley	IN						
228. Harding Street	IN						
229. Killen Station	OH				Increasing drought		
230. Marion	IL			55–60	Increasing drought		
231. Martin Drake	CO	12–20					
232. Meredosia	IL				Increasing drought		
233. R. M. Heskett	ND	12–20					Drier than normal
234. Rawhide	CO	12–20					
235. Ray D. Nixon	CO	12–20					
236. Rodemacher	LA			65–70	Increasing drought		
237. Welsh	TX			60–65			
238. Elrama Power Plant	PA						
239. Hatfields Ferry Power Station	PA						
240. Fort Martin Power Station	WV						
241. Harrison Power Station	WV						
242. Mt. Storm	WV						
243. Nucla	CO	12–20	Moderately Dry, -1.29 to 00.80		Increasing drought		

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
244. Sandow No. 4	TX			65–70	Increasing drought		
245. C. R. Huntley Generating Station	NY						
246. Tennessee Eastman Operations	TN			55–60			Drier than normal
247. Birchwood Power	VA			55–60	Increasing drought		Moderately dry
248. Black Dog	MN						
249. C. P. Crane	MD			55–60			
250. Eddystone Generating Station	PA						
251. Edge Moor	DE				Increasing drought		
252. F. B. Culley	IN			55–60	Increasing drought		
253. Flint Creek	AR			55–60	Increasing drought		
254. Green Bay West Mill	WI				Increasing drought		
255. James River Power Station	MO			55–60			
256. Lawrence Energy Center	KS				Increasing drought		
257. Logan Generating Plant	NJ				Increasing drought		
258. Meramec	MO						
259. Michigan City	IN						
260. Mitchell	WV				Increasing drought		
261. PSEG Mercer Generating Station	NJ						
262. Quindaro	KS				Increasing drought		
263. Riverside	MN						
264. Riverside	IA				Increasing drought		
265. Sibley	MO						
266. Sikeston Power Station	MO			55–60	Increasing drought		
267. Silver Bay Power	MN				Increasing drought		
268. Weston	WI		Moderately Dry, -1.29 to 00.80		Increasing drought		
269. Hayden	CO	12–20	Moderately Dry, -1.29 to 00.80		Increasing drought		
270. HMP&L Station Two Henderson	KY			55–60	Increasing drought		
271. R. E. Burger	OH		Moderately Dry, -1.29 to 00.80				
272. Cooper	KY			55–60	Increasing drought		
273. Eckert Station	MI						
274. Richard Gorsuch	OH		Abnormally Dry, -0.79 to -0.51				
275. Cane Run	KY			55–60	Increasing drought		
276. Holcomb	KS	12-–20					
277. J. E. Corette Plant	MT	12–20			Significantly increasing drought		
278. Carbon	UT	12–20			Increasing drought		
279. Green River	KY			55–60	Increasing drought		
280. PPL Martins Creek	PA						
281. Allen S. King	MN						
282. Archer Daniels Midland Cedar Rapids	IA						
283. Bremo Bluff	VA			55–60			Moderately dry
284. Bridgeport Station	CT						
285. Camden South Carolina	SC						Moderately dry
286. Canton North Carolina	NC						Moderately dry

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
287. Cogen South	SC						Moderately dry
288. Crawford	IL						
289. International Paper Georgetown Mill	SC						Moderately dry
290. International Paper Riegelwood Mill	NC						Moderately dry
291. International Paper Roanoke Rapid NC	NC						Moderately dry
292. Joliet 9	IL						
293. Lovett	NY						
294. Nearman Creek	KS				Increasing drought		
295. Park 500 Philip Morris USA	VA						Moderately dry
296. Presque Isle	MI		Abnormally Dry, -0.79 to -0.51		Significantly increasing drought		
297. Primary Energy Roxboro	NC						Moderately dry
298. Salem Harbor	MA						
299. Southampton Power Station	VA						Moderately dry
300. State Line Energy	IN						
301. Stone Container Hopewell Mill	VA						Moderately dry
302. Sutherland	IA						
303. Syl Laskin	MN				Increasing drought		
304. Taconite Harbor Energy Center	MN				Increasing drought		
305. Trenton Channel	MI						
306. Unifi Kinston LLC	NC						Moderately dry
307. Univ. of NC Chapel Hill Cogen Facility	NC						Moderately dry
308. U.S. DOE Savannah River Site (D Area)	SC						Moderately dry
309. Waynesboro Virginia Plant	VA						Moderately dry
310. Weyerhaeuser Plymouth NC	NC						Moderately dry
311. Wyodak	WY	12–20			Increasing drought		
312. Edwardsport	IN						
313. Elmer Smith	KY			55–60	Increasing drought		
314. Kenneth C. Coleman	KY			55–60	Increasing drought		
315. Dunkirk Generating Station	NY						
316. Avon Lake	OH						
317. Covington Facility	VA						Moderately dry
318. Radford Army Ammunition Plant	VA						Moderately dry
319. Dickerson	MD						
320. Georgia Pacific Naheola Mill	AL						Moderately dry
321. High Bridge	MN						
322. Hoot Lake	MN						
323. Howard Down	NJ						
324. International Paper Augusta Mill	GA						Moderately dry
325. International Paper Prattville Mill	AL						Moderately dry
326. Marshall	MO						
327. Northside Generating Station	FL						
328. NRG Energy Center Dover	DE						
329. Riverwood International Macon Mill	GA						Moderately dry
330. Rock-Tenn Mill	AL						Moderately dry
331. Rumford Cogeneration	ME						
332. Savannah River Mill	GA						Moderately dry
333. Savannah Sugar Refinery	GA						Moderately dry

TABLE B-3 (Cont.)

		Supply Indicators					
Plant Name	State	Mean Annual Precipitation (inches)	Standardized Precipitation Index	Mean Annual Temperature (°F)	Drought Trends	Palmer Hydrological Drought Index	Streamflow – Annual 2008
334. Seaford Delaware Plant	DE						
335. SP Newsprint	GA						Moderately dry
336. U. S. Alliance Coosa Pines	AL						Moderately dry
337. Weyerhaeuser Pine Hill Operations	AL						Moderately dry
338. AES Shady Point	OK			60–65	Increasing drought		
339. D. B. Wilson	KY			55–60	Increasing drought		
340. Dale	KY			55–60	Increasing drought		
341. Cinergy Solutions of Narrows	VA						Moderately dry
342. Altavista Power Station	VA						Moderately dry
343. Crisp Plant	GA						Moderately dry
344. Hugo	OK			60–65	Increasing drought		
345. Jefferson Smurfit Fernandina Beach	FL						
346. Scholz	FL						
347. Stone Container Panama City Mill	FL						

TABLE B-4 Vulnerable Plants and Scoring Results (In Proximity to Nontraditional Water Source and Vulnerability Scores)

		In Proximity to Nontraditional Water Source						Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations		Demand Score	Supply Score	Total Score
1. Belews Creek	NC							2	1	13
2. Big Cajun 2	LA			Yes				2	1	12
3. Gorgas	AL	Yes			Yes			2	1	12
4. Allen Steam Plant	TN							2	1	12
5. E. C. Gaston	AL							2	1	12
6. G. G. Allen	NC							2	1	12
7. Georgia Pacific Cedar Springs	GA							2	1	12
8. Marshall	NC							2	1	12
9. Roxboro	NC							2	1	12
10. Seminole	FL							2	1	12
11. St. Johns River Power Park	FL							2	1	12
12. Widows Creek	AL							2	1	12
13. Barry	AL			Yes				2	1	11
14. Big Bend	FL			Yes				2	1	11
15. Cumberland	TN			Yes				2	1	11
16. Gallatin	TN			Yes				2	1	11
17. Johnsonville	TN			Yes				2	1	11
18. Navajo	AZ			Yes				2	1	11
19. Stanton Energy Center	FL			Yes				2	1	11
20. Transalta Centralia Generation	WA			Yes				2	1	11
21. James H. Miller Jr.	AL	Yes			Yes			2	1	11
22. Cliffside	NC							2	1	11
23. Cross	SC							2	1	11
24. Mayo	NC							2	1	11
25. Scherer	GA							2	1	11
26. Wansley	GA							2	1	11
27. Winyah	SC							2	1	11
28. Yates	GA							2	1	11
29. Hunter	UT	Yes	Yes	Yes	Yes			2	1	10
30. Huntington	UT	Yes	Yes	Yes	Yes			2	1	10
31. Jim Bridger	WY	Yes	Yes	Yes	Yes			2	1	10
32. Antelope Valley	ND			Yes				2	1	10
33. Charles R. Lowman	AL			Yes				2	1	10
34. Coal Creek	ND			Yes				2	1	10
35. Gerald Gentleman	NE			Yes				2		10
36. Jack Watson	MS			Yes				2	1	10
37. Jeffrey Energy Center	KS			Yes				2	1	10
38. Springerville	AZ			Yes				2	1	10
39. Kingston	TN		Yes					2	1	10
40. Buck	NC							2	1	10
41. Crystal River	FL							2	1	10
42. Dan River	NC							2	1	10
43. Harllee Branch	GA							2	1	10
44. Mohave	NV							2	1	10
45. New Madrid	MO							2	1	10
46. Wateree	SC							2	1	10
47. Naughton	WY			Yes	Yes	Yes		2	1	9
48. Milton R. Young	ND			Yes	Yes			2	1	9

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source					Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations	Demand Score	Supply Score	Total Score
49. Dave Johnston	WY			Yes			2	1	9
50. J. M. Stuart	OH			Yes			2	1	9
51. J. T. Deely	TX			Yes			2	1	9
52. Joppa Steam	IL			Yes			2	1	9
53. R. S. Nelson	LA			Yes			2	1	9
54. Victor J. Daniel Jr.	MS			Yes			2	1	9
55. W. A. Parish	TX			Yes			2		9
56. Thomas Hill	MO				Yes		2		9
57. Gadsden	AL		Yes				2	1	9
58. Greene County	AL		Yes				2	1	9
59. Bull Run	TN		Yes				2	1	9
60.John Sevier	TN		Yes				2	1	9
61. Bowen	GA						2	1	9
62. Canadys Steam	SC						2	1	9
63. Cape Fear	NC						2	1	9
64. Coronado	AZ						2	1	9
65. George Neal North	IA						2		9
66. Iatan	MO						2		9
67. Independence	AR						2	1	9
68. Indian River Generating Station	DE						2	1	9
69. Intermountain Power Project	UT						2	1	9
70. Jefferies	SC						2	1	9
71. L. V. Sutton	NC						2	1	9
72. Laramie River Station	WY						2	1	9
73. Lee	NC						2	1	9
74. Mecklenburg Power Station	VA						2	1	9
75. Morgantown Generating Plant	MD						2	1	9
76. Riverbend	NC						2	1	9
77. W. H. Weatherspoon	NC						2	1	9
78. W. S. Lee	SC						2	1	9
79. White Bluff	AR						2	1	9
80. Craig	CO	Yes	Yes	Yes	Yes		2	1	8
81. Four Corners	NM	Yes		Yes	Yes		2		8
82. San Juan	NM			Yes	Yes		2		8
83. Cherokee	CO		Yes	Yes			2		8
94. Rockport	IN		Yes	Yes			2	1	8
85. Mill Creek	KY		Yes	Yes			2	1	8
86. Limestone	TX			Yes		Yes	2		8
87. Cholla	AZ			Yes			2	1	8
88. Clifty Creek	IN			Yes			2		8
89. Crist	FL			Yes			2	1	8
90. Ghent	KY			Yes			2	1	8
91. Harrington	TX			Yes			2	1	8
92. Miami Fort	OH			Yes			2	1	8
93. Powerton	IL			Yes			2		8
94. R. D. Morrow	MS			Yes			2	1	8
95. Tanners Creek	IN			Yes			2		8
96. Tolk	TX			Yes			2	1	8
97. W. H. Zimmer	OH			Yes			2	1	8
98. Walter C. Beckjord	OH			Yes			2	1	8

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source					Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations	Demand Score	Supply Score	Total Score
99. Dolet Hills	LA		Yes		Yes		2	1	8
100. Hammond	GA		Yes				2	1	8
101. Chesapeake	VA						2	1	8
102. Chesterfield	VA						2	1	8
103. Clay Boswell	MN						2		8
104. Clover	VA						2	1	8
105. Comanche	CO						2		8
106. Council Bluffs	IA						2		8
107. Hawthorn	MO						2		8
108. La Cygne	KS						2		8
109. Labadie	MO						2		8
110. Lansing Smith	FL						2	1	8
111. Lon Wright	NE						2		8
112. Mitchell	GA						2	1	8
113. Potomac River	VA						2	1	8
114. Sooner	OK						2	1	8
115. Urquhart	SC						2	1	8
116. Williams	SC						2	1	8
117. Kincaid Generation LLC	IL	Yes		Yes	Yes		2		7
118. Merom	IN	Yes	Yes	Yes			2		7
119. Martin Lake	TX		Yes	Yes	Yes	Yes	2		7
120. Pirkey	TX		Yes	Yes	Yes	Yes	2		7
121. Cardinal	OH		Yes	Yes	Yes		2		7
122. Conesville	OH		Yes	Yes	Yes		2		7
123. General James M Gavin	OH		Yes	Yes	Yes		2		7
124. Baldwin Energy Complex	IL			Yes	Yes		2	1	7
125. Gibson	IN			Yes	Yes		2		7
126. Leland Olds	ND			Yes	Yes		2	1	7
127. AES Petersburg	IN		Yes	Yes			2		7
128. Muskingum River	OH		Yes	Yes			2		7
129. Willow Island	SC		Yes	Yes			2	1	7
130. Cayuga	IN			Yes			2		7
131. Central Power & Lime	FL			Yes			2	1	7
132. Fayette Power Project	TX			Yes			2	1	7
133. Muskogee	OK			Yes			2	1	7
134. Newton	IL			Yes			2		7
135. R. Gallagher	IN			Yes			2	1	7
136. R. M. Schahfer	IN			Yes			2		7
137. South Oak Creek	WI			Yes			2		7
138. Eastlake	OH		Yes				2		7
139. Boardman	OR						2	1	7
140. Brandon Shores	MD						2	1	7
141. Burlington	IA						2		7
142. Cedar Bay Generating LP	FL						2	1	7
143. Chalk Point LLC	MD						2	1	7
144. Cope	SC						2	1	7
145. Dolphus M. Grainger	SC						2	1	7
146. GRDA	OK						2	1	7
147. H. B. Robinson	SC						2	1	7
148. Jack McDonough	GA						2	1	7

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source						Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations		Demand Score	Supply Score	Total Score
149. Joliet 29	IL							2		7
150. McMeekin	SC							2	1	7
151. PPL Brunner Island	PA							2		7
152. Primary Energy Southport	NC							2	1	7
153. Shawnee	KY							2	1	7
154. Sherburne County	MN							2		7
155. Stone Container Florence Mill	SC							2	1	7
156. Westmoreland-LG&E Roanoke Valley I	NC							2	1	7
157. Westmoreland-LG&E Roanoke Valley II	NC							2	1	7
158. Will County	IL							2		7
159. Yorktown	VA							2	1	7
160. Big Sandy	KY		Yes	Yes	Yes			2		6
161. Colstrip	MT			Yes	Yes			2	1	6
162. Coyote	ND			Yes	Yes			2	1	6
163. Monticello	TX			Yes	Yes			2		6
164. Warrick	IN		Yes	Yes				2		6
165. W. H. Sammis	OH		Yes	Yes				2		6
166. Philip Sporn	WV		Yes	Yes				2		6
167. Big Brown	TX			Yes		Yes		2		6
168. ACE Cogeneration Facility	CA			Yes				2		6
169. Coleto Creek	TX			Yes				2	1	6
170. Dallman	IL			Yes				2		6
171. H. L. Spurlock	KY			Yes				2	1	6
172. H. Wilson Sundt Generating Station	AZ			Yes				2	1	6
173. Indiantown Cogeneration LP	FL			Yes				2	1	6
174. International Paper Savanna Mill	GA			Yes				2	1	6
175. McIntosh	GA			Yes					1	6
176. San Miguel	TX			Yes				2	1	6
177. Homer City Station	PA	Yes	Yes		Yes			2		6
178. Northeastern	OK	Yes	Yes					2	1	6
179. Conemaugh	PA		Yes		Yes			2		6
180. Keystone	PA		Yes		Yes			2		6
181. Paradise	KY		Yes					2	1	6
182. J. H. Campbell	MI		Yes					2		6
183. PPL Montour	PA		Yes					2		6
184. Asbury	MO							2		6
185. Asheville	NC								1	6
186. Bailly	IN							2		6
187. Brayton Point	MA							2		6
188. Cogentrix Hopewell	VA								1	6
189. Cogentrix of Richmond	VA							2	1	6
190. Cogentrix Virginia Leasing Corporation	VA								1	6
191. Deerhaven Generating Station	FL							2	1	6
192. Edgewater	WI							2		6
193. International Paper Eastover Facility	SC							2	1	6
194. Kraft	GA								1	6
195. Kyger Creek	OH							2		6
196. Lake Road	MO							2		6

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source						Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations		Demand Score	Supply Score	Total Score
197. Monroe	MI							2		6
198. Montrose	MO							2		6
199. Nebraska City	NE							2		6
200. North Omaha	NE							2		6
201. North Valmy	NV							2	1	6
202. Oklaunion	TX							2		6
203. Ottumwa	IA							2		6
204. Pleasant Prairie	WI							2		6
205. Pleasants Power Station	WV							2		6
206. Possum Point	VA							2	1	6
207. Prairie Creek	IA							2		6
208. PSEG Hudson Generating Station	NJ							2		6
209. Reid Gardner	NV							2	1	6
210. Rush Island	MO							2		6
211. Sheldon	NE							2		6
212. Sioux	MO							2		6
213. St. Clair	MI							2		6
214. Tecumseh Energy Center	KS							2		6
215. Waukegan	IL							2		6
216. West Point Mill	VA								1	6
217. Wabash River	IN		Yes	Yes	Yes			2		5
218. Bruce Mansfield	PA		Yes	Yes	Yes			2		5
219. Valmont	CO		Yes	Yes				2		5
220. Belle River	MI		Yes	Yes				2		5
221. Bonanza	UT		Yes	Yes					1	5
222. A. B. Brown	IN			Yes					1	5
223. Apache Station	AZ			Yes					1	5
224. Coffeen	IL			Yes				2		5
225. E. D. Edwards	IL			Yes				2		5
226. E. W. Brown	KY			Yes					1	5
227. Eagle Valley	IN			Yes				2		5
228. Harding Street	IN			Yes				2		5
229. Killen Station	OH			Yes				2		5
230. Marion	IL			Yes					1	5
231. Martin Drake	CO			Yes				2		5
232. Meredosia	IL			Yes				2		5
233. R. M. Heskett	ND			Yes				2	1	5
234. Rawhide	CO			Yes				2		5
235. Ray D. Nixon	CO			Yes				2		5
236. Rodemacher	LA			Yes				2	1	5
237. Welsh	TX			Yes				2		5
238. Elrama Power Plant	PA		Yes		Yes			2		5
239. Hatfields Ferry Power Station	PA		Yes		Yes			2		5
240. Fort Martin Power Station	WV		Yes		Yes			2		5
241. Harrison Power Station	WV		Yes		Yes			2		5
242. Mt. Storm	WV		Yes		Yes			2		5
243. Nucla	CO				Yes				1	5
244. Sandow No. 4	TX				Yes				1	5
245. C. R. Huntley Generating Station	NY		Yes					2		5
246. Tennessee Eastman Operations	TN		Yes						1	5

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source					Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations	Demand Score	Supply Score	Total Score
247. Birchwood Power	VA							1	5
248. Black Dog	MN						2		5
249. C. P. Crane	MD						2		5
250. Eddystone Generating Station	PA						2		5
251. Edge Moor	DE						2		5
252. F. B. Culley	IN							1	5
253. Flint Creek	AR							1	5
254. Green Bay West Mill	WI						2		5
255. James River Power Station	MO						2		5
256. Lawrence Energy Center	KS						2		5
257. Logan Generating Plant	NJ						2		5
258. Meramec	MO						2		5
259. Michigan City	IN						2		5
260. Mitchell	WV						2		5
261. PSEG Mercer Generating Station	NJ						2		5
262. Quindaro	KS						2		5
263. Riverside	MN						2		5
264. Riverside	IA						2		5
265. Sibley	MO						2		5
266. Sikeston Power Station	MO						2	1	5
267. Silver Bay Power	MN						2		5
268. Weston	WI							1	5
269. Hayden	CO		Yes	Yes	Yes			1	4
270. HMP&L Station Two Henderson	KY		Yes	Yes	Yes			1	4
271. R. E. Burger	OH		Yes	Yes	Yes		2		4
272. Cooper	KY			Yes	Yes			1	4
273. Eckert Station	MI		Yes	Yes			2		4
274. Richard Gorsuch	OH		Yes	Yes			2		4
275. Cane Run	KY			Yes				1	4
276. Holcomb	KS			Yes			2		4
277. J. E. Corette Plant	MT			Yes				1	4
278. Carbon	UT	Yes	Yes		Yes			1	4
279. Green River	KY		Yes		Yes			1	4
280. PPL Martins Creek	PA		Yes				2		4
281. Allen S. King	MN						2		4
282. Archer Daniels Midland Cedar Rapids	IA						2		4
283. Bremo Bluff	VA							1	4
284. Bridgeport Station	CT						2		4
285. Camden South Carolina	SC							1	4
286. Canton North Carolina	NC							1	4
287. Cogen South	SC							1	4
288. Crawford	IL						2		4
289. International Paper Georgetown Mill	SC							1	4
290. International Paper Riegelwood Mill	NC							1	4
291. International Paper Roanoke Rapid NC	NC							1	4
292. Joliet 9	IL						2		4
293. Lovett	NY						2		4
294. Nearman Creek	KS						2		4
295. Park 500 Philip Morris USA	VA							1	4

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source						Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations		Demand Score	Supply Score	Total Score
296. Presque Isle	MI								1	4
297. Primary Energy Roxboro	NC								1	4
298. Salem Harbor	MA							2		4
299. Southampton Power Station	VA								1	4
300. State Line Energy	IN							2		4
301. Stone Container Hopewell Mill	VA								1	4
302. Sutherland	IA							2		4
303. Syl Laskin	MN							2		4
304. Taconite Harbor Energy Center	MN							2		4
305. Trenton Channel	MI							2		4
306. Unifi Kinston LLC	NC								1	4
307. Univ. of NC Chapel Hill Cogen Facility	NC								1	4
308. U.S. DOE Savannah River Site (D Area)	SC								1	4
309. Waynesboro Virginia Plant	VA								1	4
310. Weyerhaeuser Plymouth NC	NC								1	4
311. Wyodak	WY	Yes		Yes	Yes				1	3
312. Edwardsport	IN		Yes	Yes	Yes			2		3
313. Elmer Smith	KY		Yes	Yes					1	3
314. Kenneth C Coleman	KY		Yes	Yes					1	3
315. Dunkirk Generating Station	NY		Yes					2		3
316. Avon Lake	OH		Yes					2		3
317. Covington Facility	VA		Yes						1	3
318. Radford Army Ammunition Plant	VA		Yes						1	3
319. Dickerson	MD							2		3
320. Georgia Pacific Naheola Mill	AL								1	3
321. High Bridge	MN							2		3
322. Hoot Lake	MN							2		3
323. Howard Down	NJ							2		3
324. International Paper Augusta Mill	GA								1	3
325. International Paper Prattville Mill	AL								1	3
326. Marshall	MO							2		3
327. Northside Generating Station	FL							2		3
328. NRG Energy Center Dover	DE							2		3
329. Riverwood International Macon Mill	GA								1	3
330. Rock-Tenn Mill	AL								1	3
331. Rumford Cogeneration	ME							2		3
332. Savannah River Mill	GA								1	3
333. Savannah Sugar Refinery	GA								1	3
334. Seaford Delaware Plant	DE							2		3
335. SP Newsprint	GA								1	3
336. U. S. Alliance Coosa Pines	AL								1	3
337. Weyerhaeuser Pine Hill Operations	AL								1	3
338. AES Shady Point	OK	Yes		Yes	Yes				1	2
339. D. B. Wilson	KY		Yes	Yes	Yes				1	2
340. Dale	KY			Yes					1	2
341. Cinergy Solutions of Narrows	VA		Yes						1	2
342. Altavista Power Station	VA								1	2
343. Crisp Plant	GA								1	2
344. Hugo	OK								1	2

TABLE B-4 (Cont.)

		In Proximity to Nontraditional Water Source						Vulnerability Scores		
Plant Name	State	Coal Bed Methane Fields	Shale Gas Plays	Deep Saline Formations	Coal Mines	Top 100 Oil and Gas Locations		Demand Score	Supply Score	Total Score
345. Jefferson Smurfit Fernandina Beach	FL							2		2
346. Scholz	FL							2		2
347. Stone Container Panama City Mill	FL							2		2