## Table 3. Field and Laboratory Groundwater Monitoring Parameters

Phase 1 Hydrogeologic Assessment
Grand Tower Power Station; Grand Tower, Illinois

| Field Parameters | | | Analysis Method |
|---|---|---|---|
| Groundwater Elevation | | in-situ | |
| pH (field) | 1 | in-situ | SM 21st ed. 4500-$H^+$ |
| Specific Conductance | | in-situ | SM 21st ed. 2520-B |
| Temperature | | in-situ | SM 21st ed. 2550 |
| **General Chemistry Parameters**[2] | | | **Analysis Method** |
| Chloride | 1 | dissolved | SM21 4500CL C |
| Total Cyanide | 1 | total | EPA 335.4 |
| Fluoride | 1 | dissolved | SM4500 F-B-C |
| Nitrate as N | 1 | dissolved | EPA 353.2 |
| Sulfate | 1 | dissolved | ASTM516-90,02 |
| Total Dissolved Solids | 1 | dissolved | SM21 2540 C |
| **METALS**[2] | | | **Analysis Method**[3] |
| Antimony | 1,3 | dissolved | SW846 6010C |
| Arsenic | 1,3 | dissolved | SW846 6010C |
| Barium | 1,3 | dissolved | SW846 6010C |
| Beryllium | 1,3 | dissolved | SW846 6010C |
| Boron | 1,3 | dissolved | SW846 6010C |
| Cadmium | 1,3 | dissolved | SW846 6010C |
| Chromium | 1,3 | dissolved | SW846 6010C |
| Cobalt | 1,3 | dissolved | SW846 6010C |
| Copper | 1,3 | dissolved | SW846 6010C |
| Iron | 1,3 | dissolved | SW846 6010C |
| Lead | 1,3 | dissolved | SW846 6010C |
| Manganese | 1,3 | dissolved | SW846 6010C |
| Mercury | 1,3 | dissolved | SW846 7470A |
| Nickel | 1,3 | dissolved | SW846 6010C |
| Selenium | 1,3 | dissolved | SW846 6010C |
| Silver | 1,3 | dissolved | SW846 6010C |
| Thallium | 1,3 | dissolved | SW846 6010C |
| Zinc | 1,3 | dissolved | SW846 6010C |

Notes:

[1] Groundwater quality parameters for Class I: Potable Resource Groundwater (IAC 35 Part 620 Section 410).

[2] Samples preserved in field and filtered (except Cyanide) by laboratory.

[3] Sample prep method reference: SW846 3010A.

## Table 4. Statistical Summary of Groundwater Quality Data for Period of November 2010 - August 2012

Phase 1 Hydrogeologic Assessment
Grand Tower Power Station; Grand Tower, Illinois

| | | Monitoring Well APW-1[1] | | | | | | Monitoring Well APW-2[1] | | | | | | Monitoring Well APW-3[1] | | | | | | Monitoring Well APW-4[1] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter, Unit** | Class I GW Standard | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects |
| Field Parameters | | | | | | | | | | | | | | | | | | | | | | | | | |
| pH, Std Units | 6.5 / 9.0* | **6.44** | **6.46** | 6.94 | **5.76** | 0.37 | N/A | 6.92 | 7.04 | 7.30 | **5.93** | 0.45 | N/A | 7.60 | 7.76 | 8.01 | **6.43** | 0.49 | N/A | 7.24 | 7.40 | 7.51 | **6.05** | 0.49 | N/A |
| General Chemistry Parameters (totals) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chloride, mg/L | 200 | 2.2 | 2.0 | 4.0 | <1.0 | 1.0 | 12.5 | 21 | 22 | 24 | 16 | 3.0 | 0 | 19 | 19 | 22 | 17 | 1.6 | 0 | 10 | 10 | 13 | 4.5 | 2.7 | 0 |
| Cyanide, mg/L | 0.2 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Fluoride, mg/L | 4 | 0.27 | 0.29 | 0.31 | 0.20 | 0.036 | 12.5 | 0.27 | 0.29 | 0.31 | 0.20 | 0.036 | 0 | 0.35 | 0.37 | 0.39 | 0.26 | 0.045 | 0 | 0.25 | 0.23 | 0.35 | 0.21 | 0.047 | 0 |
| Nitrate, mg/L | 10 | 2.3 | 2.2 | 3.3 | 1.4 | 0.61 | 0 | 1.0 | 0.080 | 4.3 | <0.011 | 1.7 | 62.5 | nc | nc | nc | nc | nc | 100 | 1.6 | 0.78 | 5.1 | 0.24 | 1.7 | 0 |
| Sulfate, mg/L | 400 | 46 | 47 | 61 | 36 | 12 | 0 | 391 | 391 | **469** | 311 | 52 | 0 | 232 | 229 | 285 | 210 | 24 | 0 | 184 | 170 | 316 | 120 | 66 | 0 |
| Total Dissolved Solids, mg/L | 1,200 | 399 | 275 | **1,310** | 182 | 373 | 0 | 825 | 829 | 892 | 712 | 58 | 0 | 435 | 457 | 536 | 216 | 99 | 0 | 553 | 568 | 627 | 388 | 73 | 0 |
| Metals (dissolved) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Antimony, mg/L | 0.006 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Arsenic, mg/L | 0.01 | nc | nc | nc | nc | nc | 100 | 0.025 | 0.025 | 0.034 | <0.010 | 0.007 | 62.5 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Barium, mg./L | 2 | 0.14 | 0.14 | 0.18 | 0.10 | 0.026 | 0 | 0.30 | 0.31 | 0.38 | 0.18 | 0.057 | 0 | 0.16 | 0.076 | 0.76 | 0.07 | 0.24 | 0 | 0.16 | 0.16 | 0.20 | 0.13 | 0.023 | 0 |
| Beryllium, mg/L | 0.004 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Boron, mg/L | 2 | 0.28 | 0.26 | 0.44 | 0.19 | 0.085 | 0 | **7.1** | **7.0** | **8.6** | **5.8** | 1.0 | 0 | **4.7** | **4.7** | **4.9** | **4.6** | 0.12 | 0 | **4.8** | **4.0** | **8.9** | **2.1** | 2.3 | 0 |
| Cadmium, mg/L | 0.005 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Chromium, mg/L | 0.1 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Cobalt, mg/L | 1.0 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Copper, mg/L | 0.65 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Iron, mg/L | 5 | nc | nc | nc | nc | nc | 100 | **5.6** | **6.1** | **10** | 0.72 | 3.6 | 0 | 0.45 | 0.45 | 0.67 | 0.16 | 0.14 | 0 | 0.051 | 0.10 | 0.024 | <0.01 | 0.041 | 87.5 |
| Lead, mg/L | 0.0075 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Manganese, mg/L | 0.15 | 0.034 | 0.006 | 0.12 | <0.005 | 0.050 | 62.5 | **0.60** | **0.66** | **0.77** | 0.10 | 0.21 | 0 | **0.28** | **0.28** | **0.32** | **0.25** | 0.022 | 0 | 0.12 | 0.10 | **0.25** | 0.064 | 0.059 | 0 |
| Mercury, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Nickel, mg/L | 0.1 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Selenium, mg/L | 0.05 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | 0.043 | 0.050 | 0.050 | <0.050 | 0.013 | 50 |
| Silver, mg/L | 0.05 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Thallium, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Zinc, mg/L | 5 | 0.014 | 0.010 | 0.010 | <0.010 | 0.005 | 87.5 | 0.019 | 0.013 | 0.053 | <0.010 | 0.015 | 75 | nc | nc | nc | nc | nc | 100 | 0.014 | 0.011 | 0.012 | <0.010 | 0.006 | 87.5 |

Notes:

[1] Eight quarterly samples collected for analysis on 11/29/10, 03/23-24/11, 06/22/11, 09/12/11, 11/28/11, 02/15/12, 05/22/12, and 08/08/12.

Groundwater quality standards for Class I: Potable Resource Groundwater (IAC 35 Part 620 Section 410).

Statistics calculated with replacement of non-detect concentrations at 1X reported non-detect concentration: nc indicates that statistics were not calculated because all values were below reporting limits.

Detected Concentration(s) Exceeds Class I Groundwater Quality Standard at time of sampling.

Parameter is 100% Non-Detect in all 4 monitoring wells.

< = Below method reporting limit. N/A = not applicable.

* Lower and Upper limits for pH is the Class I groundwater quality standard of 6.5 and 9.0 Standard Units.

- - Not calculated due to variability in non-detect data limits.

# APPENDIX A

# REGIONAL GEOLOGY

# A REGIONAL GEOLOGY

Regional geologic information was previously presented in the site characterization and groundwater monitoring plan developed by Rapps Engineering & Applied Services (November 2009), and is repeated here for completeness.

## A.1 Physiography

Illinois is situated in the south-central part of the great Central Lowland Province near the confluence of two major lines of drainage, the Mississippi and Ohio Rivers, making it the lowest of the north-central states with a mean elevation of about 600 feet above sea-level and a total relief of only 973 feet (Leighton et al., 1948). The GTEC lies at the western edge of the Shawnee Hills section of the Interior Low Plateaus Province, a complex dissected upland underlain by Mississippian and Pennsylvanian bedrock of varied lithology (Appendix A [Figure 3]). The Shawnee Hills are a preglacial land surface separating Illinoian glacial drift to the north from overlapping Coastal Plain sediments to the south. Their erosional history continued during the glacial period, when the principal events were loess deposition and valley alluviation, and the regional structure has been changed through widespread folding and faulting.

## A.2 Unlithified Geology

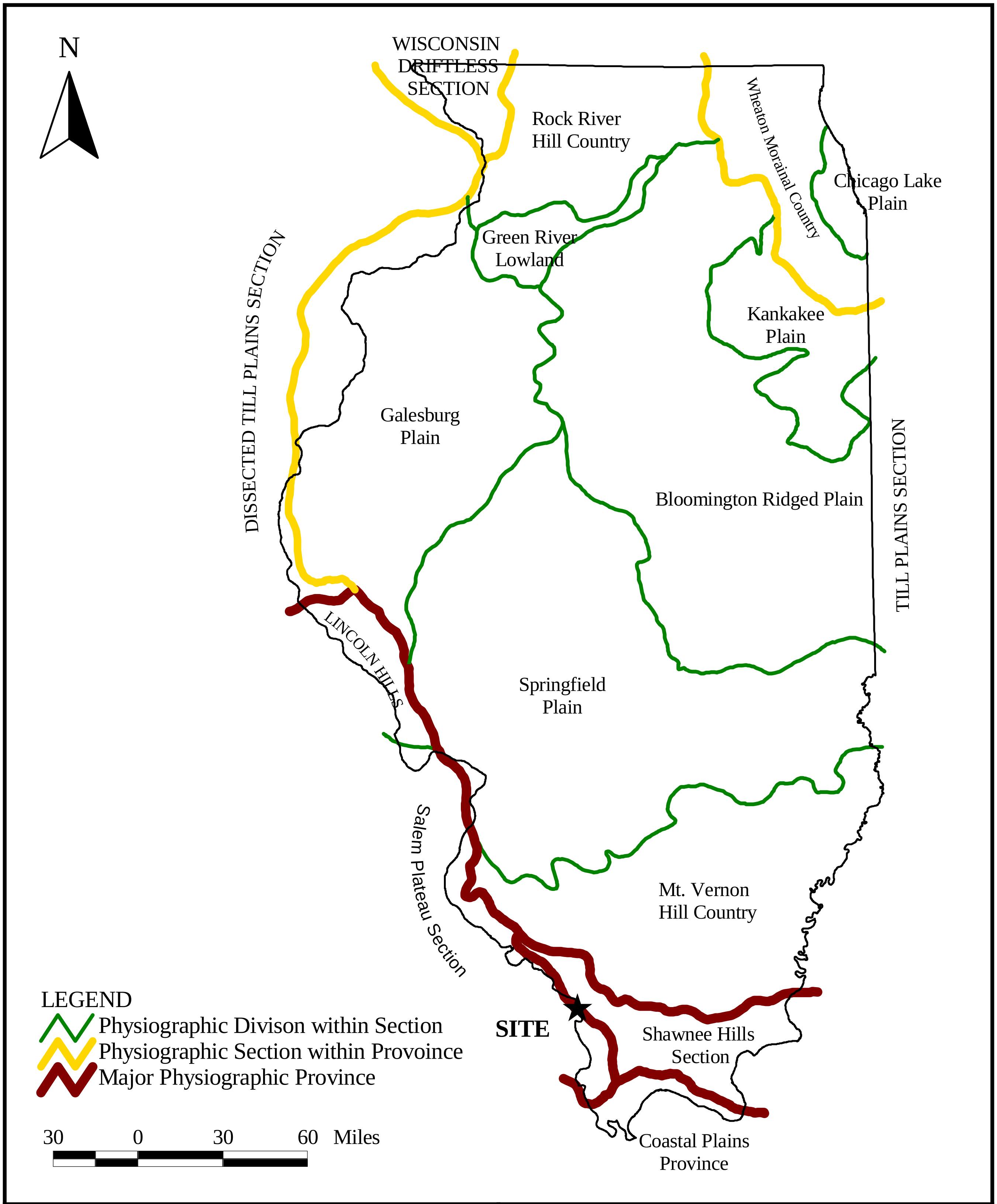
The GTEC is located in the Mississippi Valley, where Quaternary deposits consist of glacial outwash of the Henry Formation overlain by channel and floodplain deposits of the Cahokia Formation (Appendix A [Figure 5]) (Berg and Kempton, 1987; Lineback, 1979). The outwash constituting the Henry Formation consists of sorted and stratified water-laid material that is dominantly sand and gravel. These outwash sediments were deposited by debris-laden meltwater flowing away from the ice fronts during both the advances and retreats of glaciers during the Wisconsinan Age (Wilman and Frye, 1970) and were previously classified with the Mackinaw Member, sand and gravel outwash deposited as valley trains. The lithogenetic Mackinaw Member is now an informal sedimentary facies (Hansel and Johnson, 1996). The Henry Formation generally increases in thickness from the edge of the valley, near the bluffs, towards the center, but its thickness varies due to erosion and irregularities in the bedrock surface. Well logs suggest that the Henry Formation attains a maximum thickness of approximately 150 to 200 feet in vicinity of the GTEC.

The Cahokia Formation consists of deposits in the floodplains and channels of modern rivers and streams, and is comprised of mostly poorly sorted sand, silt, and clay with wood and shell fragments, and local deposits of sandy gravel (Lineback, 1979). The upper part consists of overbank silts and clays, while the coarser-textured lower portion is mainly sandy channel and lateral accretion deposits. The Cahokia is present along all Illinois streams, although locally absent where active stream erosion is occurring. In major valleys, it commonly overlies the well-sorted deposits of the Henry Formation (Willman and Frye, 1970). The Cahokia Formation is generally greater than 20 feet thick in the vicinity of the GTEC (Berg and Kempton, 1987).

## A.3 Bedrock

The GTEC and surrounding areas are underlain by Mississippian age rocks of the Upper Valmeyeran Series and the Upper and Lower Chesterian Series (Appendix A [Figure 4]) (Swann, 1963; Willman et al., 1967). These rocks were described in detail by Willman et al. (1975). The following geologic descriptions are based on this report. The Valmeyeran Series, named for Valmeyer, Monroe County, near the location where the series is exposed, is the middle series of the Mississippian System and includes strata from the top of the Chouteau Limestone upward to the base of the Shelterville Member of the Renault Limestone. It is thickest, over 1800 feet, in southeastern Illinois, and thins to 600 feet or less before being truncated by erosion in northern Illinois. Upper Valmeyeran Formations present in the study area include the Warsaw Shale and the Salem and St. Louis Limestones (Kolata, 2005). The Warsaw Shale is a fossiliferous gray shale containing beds of argillaceous limestone that is widely present in the bluffs of the Mississippi and Illinois Valleys in western and southwestern Illinois. It is overlain by the Salem Limestone, a biocalcarenite consisting of whole fossils and fossil fragments, often with banded overgrowths, embedded in a matrix ranging from micrite to sparite. The St. Louis Limestone, which overlies the Salem, is characterized by fine-grained, micritic to lithographic, cherty limestone, although it contains beds of crystalline and fossiliferous limestone as well as dolomite and evaporites.

The Chesterian Series is the uppermost series of the Mississippian System and is named for Chester, Randolph County, where it is well exposed in the Mississippi River bluffs. It extends from the base of the Pennsylvanian System (marked by the sub-Absaroka unconformity) down to the base of the Shelterville Member of the Renault Formation, which is the top of the Valmeyeran Series. It consists of alternating limestone-shale and sandstone-shale formations depicting cyclic sedimentation sequences resulting from lateral shifts in the mouth of the ancient Michigan River, which transported the clastic sediments in the Chesterian Series, and the position of the shoreline during the progressive sinking of the Illinois Basin. Fossils are ubiquitous in most Chesterian limestones and shales. Sandstones were likely deposited in deltaic environments and are less fossiliferous, but tend to contain thin coal seams. Chesterian strata are more than 1400 feet thick in the southern part of the Illinois Basin and crop out in western and southern Illinois from near Valmeyer south to Grand Tower, then east through Hardin County to the Ohio River.



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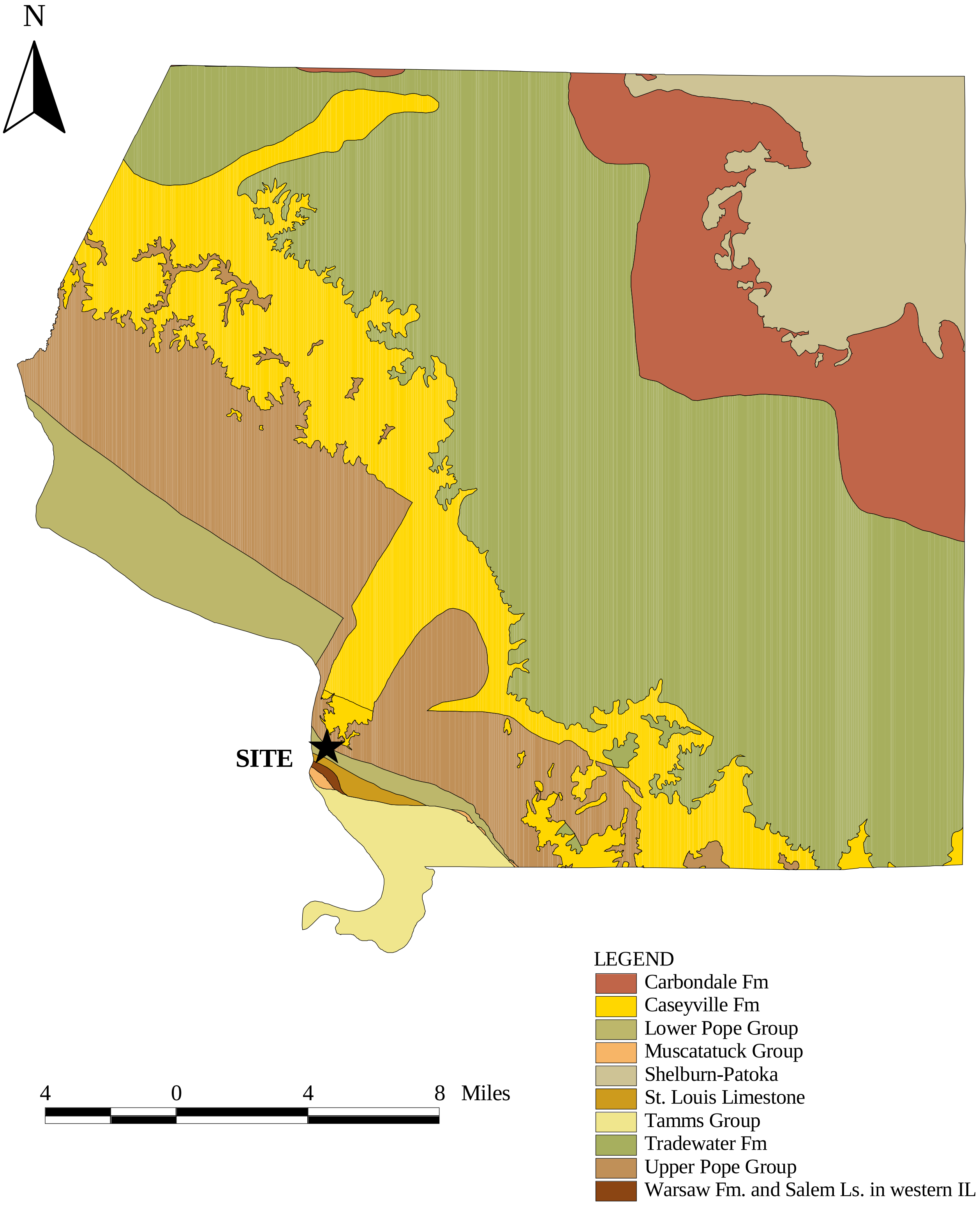
# FIGURE 3
## PHYSIOGRAPHIC DIVISIONS OF ILLINOIS (LEIGHTON ET AL, 1948)

AMERENENERGY GENERATING COMPANY
GRAND TOWER POWER STATION
JACKSON COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Physio DATE: 11/09



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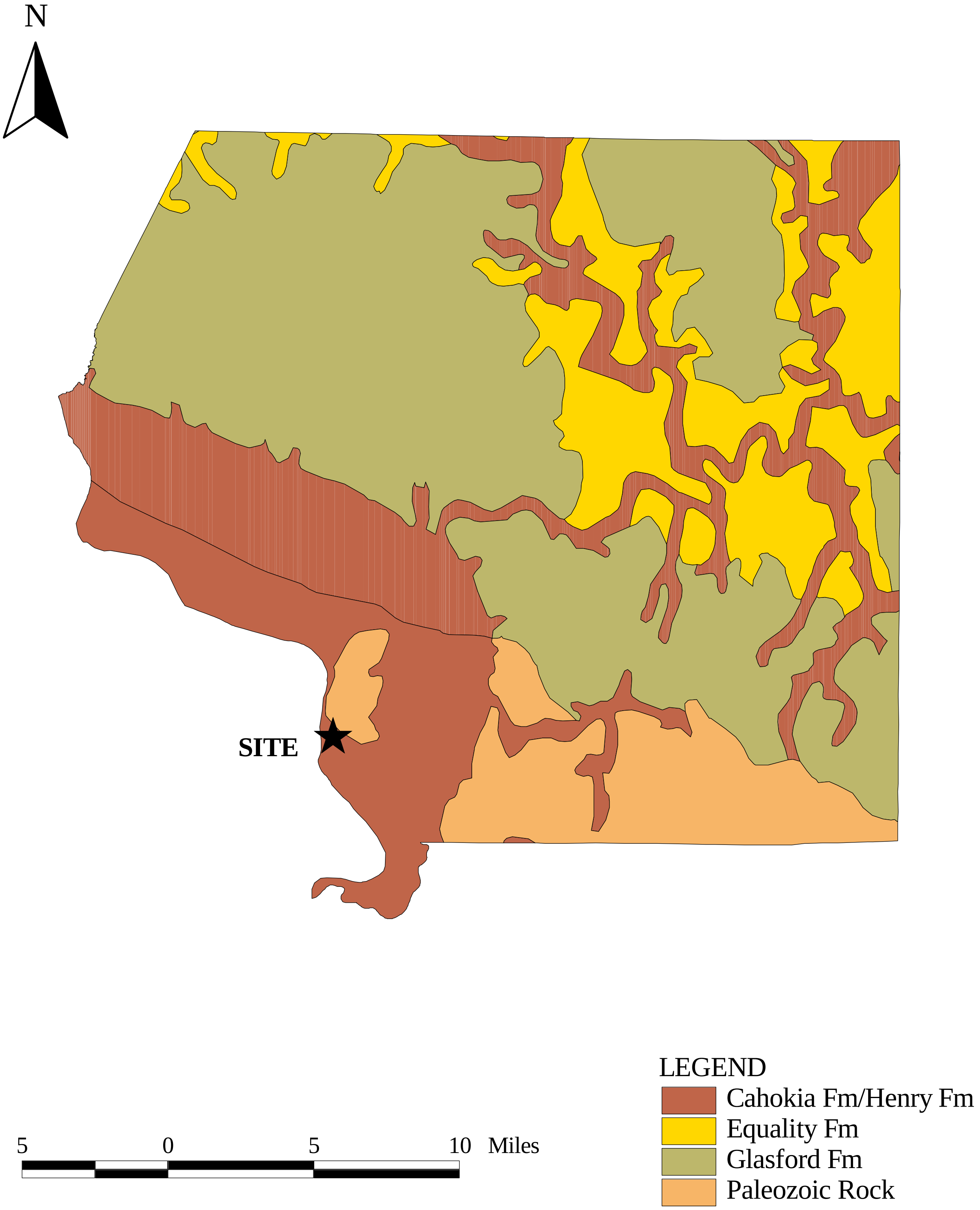
# FIGURE 4

BEDROCK GEOLOGY
(HORBERG, 1950)

AMERENENERGY GENERATING COMPANY
GRAND TOWER POWER STATION
JACKSON COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Bedgeo DATE: 11/09



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## FIGURE 5

QUATERNARY DEPOSITS
(HANSEL AND JOHNSON, 1996)
AMERENENERGY GENERATING COMPANY
GRAND TOWER POWER STATION
JACKSON COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Quat DATE: 11/09

# APPENDIX B

# WELL SURVEY RESULTS

# B WELL SEARCH

---

## B.1 Well Search Overview

The following sources of information were utilized in order to determine community water source and water well locations:

- Illinois State Geological Survey-Water Well Database Query;
- Illinois State Water Survey private well database;
- Illinois EPA web-based Geographic Information System (GIS) files;
- Illinois Department of Public Health; and
- Jackson County Health Department.

## B.2 Illinois State Geological Survey (ISGS)

The ISGS website provided an ArcIMS View Map as well as a database query for water wells. ISGS database information including any boring logs and well construction information is provided in this Appendix..

## B.3 Illinois State Water Survey (ISWS)

All of the wells found through the ISWS Domestic Well Database, were previously identified on the ISGS website. Records contained within the ISWS database, consisting of public, industrial, and commercial water wells, were not all received as of the date of this report. Since the ISWS database generally contains the same well information as the ISGS and Illinois EPA databases, some ISWS well entries on the Appendix B-1 Table were marked as pending. Should any new information be acquired from the ISWS including additional water wells not previously identified from the other sources of the well information, it will be provided as an addendum to this report. Table B-2 lists wells located by RAPPS Engineering & Applied Science, Inc. that were not located and identified in the current well search for this report.

Wells 4 through 7 in Appendix Table B-1 were located from the ISWS database; however, wells 4 through 7 are not mapped in Figure 3 due to insufficient location information provided by the ISWS database. These four wells appear to be owned by Ameren and are Industrial/Commercial wells. Wells 4 through 7 were not found in either the ISGS or IEPA databases.

## B.4 Illinois Environmental Protection Agency (IEPA)

The Illinois EPA database website provided ArcIMS Viewer Maps showing information on community, non-community, and public water supply wells as defined on the Illinois EPA website:

- Community Water Supply (CWS): a public water supply that serves or is intended to serve at least 15 service connections used by residents or regularly serves at least 25 residents.
- Non-Community Water Supply (NCWS): a public water supply that is not a community water supply.
- Public Water Supply: all mains, pipes and structures through which water is obtained and distributed to the public, including wells and well structures, intakes and cribs, pumping stations, treatment plants, reservoirs, storage tanks and appurtenances, collectively or severally, actually used or intended for use for the purpose of furnishing water for drinking or general domestic use and which serve at least 15 service connections or which regularly serve at least 25 persons at least 60 days per year. A public water supply is either a community water supply or a non-community water supply.

Based on the IEPA maps, two CWS wells, wells 2 and 9, are located within Section 25 in the town of Grand Tower. Both CWS wells include a Minimum Setback Zone (MSZ) and a Phase I wellhead protection area (WHPA). A MSZ is an area of 200 or 400 radial feet surrounding a water well supplying public water system through which contaminants from a source are theoretically likely to move and reach the well. A Phase I WHPA was also developed to extend the surface and subsurface area surrounding the water well to 1,000 radial feet. The two CWS wells were also identified in the ISGS database.

Two NCWS wells owned by Ameren were also identified in the IEPA database, located within Section 14, and on the Grand Tower Power Plant property (Figure 3). No MSZ or WHPA were established for these two NCWS wells. The two NCWS were not identified on the ISGS database.

## B.5 Jackson County Health Department

Personnel from the Jackson County Health Department confirmed the two CWS well systems and the two NCWS wells located in the area. No additional information was provided about the area.

## Table B-1. Other Water Wells, Precise Location Not Available
**Phase I Hydrogeologic Assessment**
**Grand Tower Power Station**

| Map | Source of Well Information | | | | Location Name | Well | | Location | | | | Year | Aquifer | | Well |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well # | ISGS | ISWS*** | IEPA | Other | at Time of Well Completion | Depth | County | Township | Range | Section | Subsection | Drilled | Type | Formation | Use |
| 1 | 120770159500 | 209156 | 01595 | -- | Weber, Walter | 155 | Jackson | 10S | 4W | 13 | NW | 1964 | -- | -- | FD |
| 2 | 120770175500 | *** | 01755 | -- | Village of Grand Tower | 155 | Jackson | 10S | 4W | 25 | NENENW | 1971 | -- | -- | CWS |
| 3 | 120770137300 | *** | 01373 | -- | Kunce, James | 60 | Jackson | 10S | 4W | 25 | NW(A) | 1950 | -- | -- | FD |
| 4 | -- | 209157* | -- | -- | C.i.p.s. Co. | 96 | Jackson | 10S | 4W | 14 | -- | 1923 | -- | -- | IC |
| 5 | -- | 209158* | -- | -- | C.i.p.s. Co. | 92 | Jackson | 10S | 4W | 14 | -- | 1924 | -- | -- | IC |
| 6 | -- | 209159* | -- | -- | C.i.p.s. Co. | 102 | Jackson | 10S | 4W | 14 | -- | 1957 | -- | -- | IC |
| 7 | -- | 209160* | -- | -- | C.i.p.s. Co. | 117 | Jackson | 10S | 4W | 14 | -- | 1979 | -- | -- | IC |
| 8 | 120770137400 | *** | 01374 | -- | King, Norman | 60 | Jackson | 10S | 4W | 25 | NW | 1950 | -- | -- | FD |
| 9 | 120772615100 | *** | 26151 | -- | City of Grand Tower | 156 | Jackson | 10S | 4W | 25 | NE | 1951 | unconsolidated | sand and gravel | CWS |
| 10 | -- | *** | 7700040 | -- | Ameren/CIPS | -- | Jackson | 10S | 4W | 14 | -- | -- | -- | -- | NCWS |
| 11 | -- | *** | 7700057 | -- | Ameren/CIPS | -- | Jackson | 10S | 4W | 14 | -- | -- | -- | -- | NCWS |

Sources of Information

| | |
|---|---|
| IEPA | Illinois Environmental Protection Agency |
| ISGS | Illinois State Geological Survey |
| ISWS | Illinois State Water Survey |
| SWA | IEPA Source Water Assessment |

Well Use

| | |
|---|---|
| FD | Farm and/or Domestic Water Well |
| IC | Industrial/Commercial Water Well |
| CWS | Community Water Supply |
| NCWS | Non-Community Water Supply |

Notes

| | |
|---|---|
| - - | Not applicable or no information available |
| *** | ISWS data pending |
| A | Well is mislocated in ISGS and/or IEPA databases |
| #* | insufficient data to map locations |

# Table B-2. Other Water Wells, Precise Location Not Available
## Phase I Hydrogeologic Assessment
## Grand Tower Power Station

| Well ID | Depth | Location | | | Well Use | Driller | Date Drilled |
|---|---|---|---|---|---|---|---|
| | | Township | Range | Section | | | |
| 401812 | | 10S | 4W | 14 | | | |
| 401813 | | 10S | 4W | 14 | | | |
| 401814 | | 10S | 4W | 14 | | | |
| 401815 | | 10S | 4W | 14 | | | |
| 401816 | | 10S | 4W | 14 | | | |

Notes:
none specified

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Municipal Water Supply** | **Top** | **Bottom** |
|---|---|---|
| sandy clay | 0 | 33 |
| fine blue, gray silt | 33 | 56 |
| blue, gray sand | 56 | 69 |
| fine blue, gray silt | 69 | 102 |
| gray sand with gravel | 102 | 105 |
| red sand | 105 | 117 |
| gray brown sand some gravel | 117 | 154 |
| no record | 154 | 156 |
| **Total Depth** | | **156** |

Casing: 10" CASING from -1' to 103'
8" CASING from -3' to 150'
Screen: 10' of 7.5" diameter .04 slot

Static level 15' below casing top which is 3' above GL
Pumping level 24' when pumping at 255 gpm for 8 hours

Address of well: within WTP (south well)

**Permit Date:**
**Permit #:**

**COMPANY** Weldon Well Company
**FARM** Grand Tower, City
**DATE DRILLED** July 1, 1951
**NO.** 1
**ELEVATION** 366
**COUNTY NO.** 26151
**LOCATION** 500'S 4100'W NE/c
**LATITUDE** 37.632184
**LONGITUDE** -89.506438
**COUNTY** **Jackson**
**API** **120772615100**
**25 - 10S - 4W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| **Total Depth** | | **155** |
| Driller's Log filed | | |
| Sample set # 57668 (0' - 155') Received: October 19, 1971 | | |

**Permit Date:**

**Permit #:**

**COMPANY** Luhr Brothers, Inc.

**FARM** Vlge Of Grnd Towr

**DATE DRILLED** August 1, 1971

**NO.** 2

**ELEVATION** 0

**COUNTY NO.** 01755

**LOCATION** 500'N line, 4100'E line of section

**LATITUDE** 37.632184

**LONGITUDE** -89.506438

**COUNTY** **Jackson**

**API** **120770175500**

**25 - 10S - 4W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| **Total Depth** | | **155** |
| Driller's Log filed | | |

**Permit Date:** **Permit #:**

**COMPANY** Gwin Drilling

**FARM** Weber Walter

**DATE DRILLED** March 1, 1964 **NO.**

**ELEVATION** 0 **COUNTY NO.** 01595

**LOCATION** 1800'N line, 400'W line of NW

**LATITUDE** 37.658254 **LONGITUDE** -89.508711

**COUNTY Jackson** **API 120770159500** **13 - 10S - 4W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| **Total Depth** | | **60** |
| Driller's Log filed | | |
| Sample set # 20923 (0' - 60') Received: January 1, 1950 | | |

**Permit Date:**

**Permit #:**

**COMPANY**

**FARM** King Norman

**DATE DRILLED** January 1, 1950

**NO.** 1

**ELEVATION** 0

**COUNTY NO.** 01374

**LOCATION**

**LATITUDE** 37.625675

**LONGITUDE** -89.501443

**COUNTY** **Jackson**

**API** **120770137400**

**25 - 10S - 4W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| **Total Depth** | | **60** |
| Driller's Log filed | | |
| Sample set # 20914 (0' - 55') Received: January 1, 1950 | | |

**Permit Date:** **Permit #:**

**COMPANY**

**FARM** Kunce James N

**DATE DRILLED** January 1, 1950 **NO.** 1

**ELEVATION** 0 **COUNTY NO.** 01373

**LOCATION** NW

**LATITUDE** 37.629627 **LONGITUDE** -89.506823

**COUNTY Jackson** **API 120770137300** **25 - 10S - 4W**

# APPENDIX C

# BORING LOGS WITH WELL DIAGRAMS

Surface Elevation: 363.61

Datum msl

Completion Date: 10/11/10

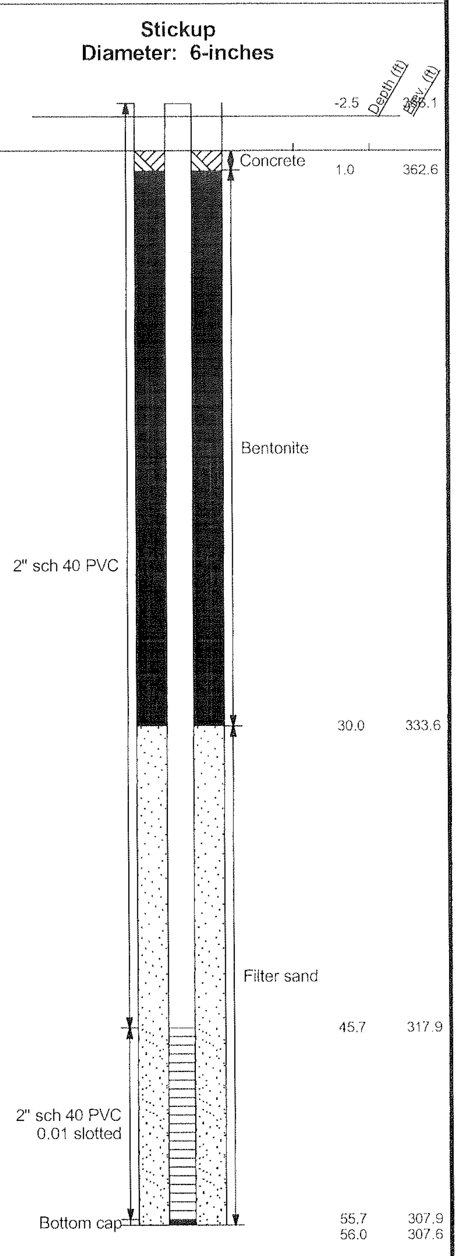
Northing: 360625.76

Easting: 2487059.46

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
|  | FILL: brown, silty clay, trace organics |  | 3-3-4 | SS1 |
|  |  |  | 3-4-5 | SS2 |
| 5 | Brown, silty CLAY - CL |  | 3-3-5 | SS3 |
|  |  |  | 3-5-5 | SS4 |
|  | Brown, fine, silty SAND - SM |  | 1-3-2 | SS5 |
|  | Brown CLAY - CH |  | 1-2-4 | SS6 |
| 10 | Brown, silty CLAY, trace fine sand - CL |  | 1-2-2 | SS7 |
|  | Brown, clayey SILT - ML |  | 0-0-0 | SS8 |
|  | Brown, silty CLAY, trace fine sand - CL |  | 0-1-2 | SS9 |
|  | Brown CLAY - CH |  | 0-2 | SS10 |
| 15 | Brown, fine, sandy SILT - ML |  |  |  |
|  | Brown CLAY with occasional seams of clayey silt - CH |  | 0-0-0 | SS11 |
|  |  |  | 0-0-0 | SS12 |
| 20 |  |  | 0-2-3 | SS13 |
|  |  |  | 0-2-3 | SS14 |
|  |  |  | 2-2-3 | SS15 |
|  | Brown, fine, sandy SILT - ML |  | 1-3-3 | SS16 |
| 25 |  |  | 0-0-0 | SS17 |
|  |  |  | 0-0-0 | SS18 |
|  |  |  | 0-1-2 | SS19 |
| 30 |  |  | 0-0-1 | SS20 |
|  |  |  | 0-0-0 | SS21 |
|  | Brown, silty, fine SAND - SM |  | 5-3-5 | SS22 |
| 35 | Brown, fine SAND - SP |  | 1-2-3 | SS23 |
|  |  |  | 1-0-0 | SS24 |
|  |  |  | 4-6-6 | SS25 |
|  | Brown, fine to coarse SAND - SW |  | 5-5-5 | SS26 |
| 40 | Logging terminated at 40 feet. |  |  |  |
| 45 |  |  |  |  |
| 50 |  |  |  |  |
| 55 |  |  |  |  |
|  | Boring terminated at 58 feet. |  |  |  |

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

## WELL DIAGRAM



### GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

### DRILLING DATA

__ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM __ FEET

MB DRILLER LAH LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

| Drawn by: KSA | Checked by: DTK | App'vd. by: RSP |
|---|---|---|
| Date: 10/18/10 | Date: 2/17/11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

AmerenUE
Grand Tower

LOG OF BORING: APW-1

Project No. J017150.01.1004A

LOG OF BORING 2002 WL J017150.01ENV - GRAND TWR.GPJ GTINC 0638301.GPJ 12/13/10

Surface Elevation: 362.09

Datum msl

Completion Date: 11/15/10

Northing: 359912.43

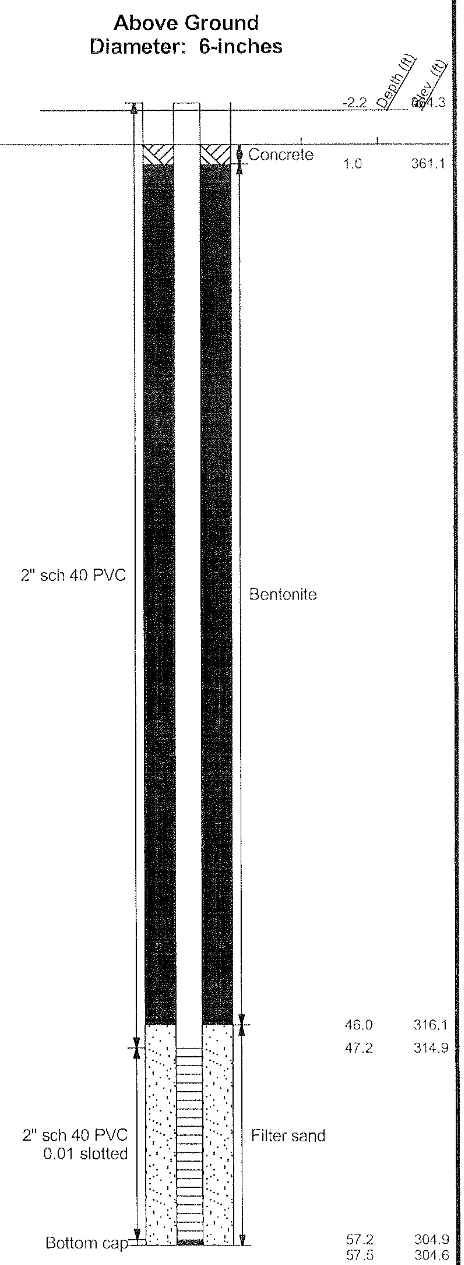
Easting 2486285.25

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | FILL: silty clay, crushed rock, silty fine sand, and fine sand | | 1-2-3 | SS1 |
| | | | 50/1" | SS2 |
| 5 | | | 3-4-3 | SS3 |
| | | | 3-5-7 | SS4 |
| | Gray, fine, sandy SILT - ML | | 2-3-2 | SS5 |
| 10 | Brown, fine SAND - SP | | 2-2-3 | SS6 |
| | Gray and brown, silty, fine SAND - SM | | 2-3-3 | SS7 |
| | | | 0-1-2 | SS8 |
| | | | 0-1-2 | SS9 |
| 15 | Gray, sandy CLAY - CL | | 0-1-3 | SS10 |
| | Gray CLAY - CH | | 0-1-2 | SS11 |
| | | | 0-2-2 | SS12 |
| 20 | | | 1-1-1 | SS13 |
| | Gray, fine, sandy SILT, trace clay - ML | | 0-0-0 | SS14 |
| | | | 1-2-1 | SS15 |
| | | | 1-1-2 | SS16 |
| 25 | | | 1-2-1 | SS17 |
| | | | 1-1-1 | SS18 |
| | | | 1-1-1 | SS19 |
| 30 | | | 1-2-1 | SS20 |
| | Gray, silty, fine SAND - SM | | 0-0-0 | SS21 |
| | | | 0-1-1 | SS22 |
| 35 | | | 2-2-3 | SS23 |
| | | | 1-2-3 | SS24 |
| | | | 1-2-3 | SS25 |
| | | | 1-2-2 | SS26 |
| 40 | Logging terminated at 40 feet. | | | |
| 45 | | | | |
| 50 | | | | |
| 55 | | | | |
| | Boring terminated at 58 feet. | | | |

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01ENV - GRAND TWR.GPJ GTINC 0638301.GPJ 12/13/10

## WELL DIAGRAM



## GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

## DRILLING DATA

___ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM ___ FEET

MB DRILLER LAH LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

| Drawn by: KSA | Checked by: DTK | App'vd. by: RBS |
|---|---|---|
| Date: 10/18/10 | Date: 2/17/11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

AmerenUE
Grand Tower

LOG OF BORING: APW-2B

Project No. J017150.01.1004A

Surface Elevation: 362.62

Datum msl

Completion Date: 10/9/10

Northing: 359291.23

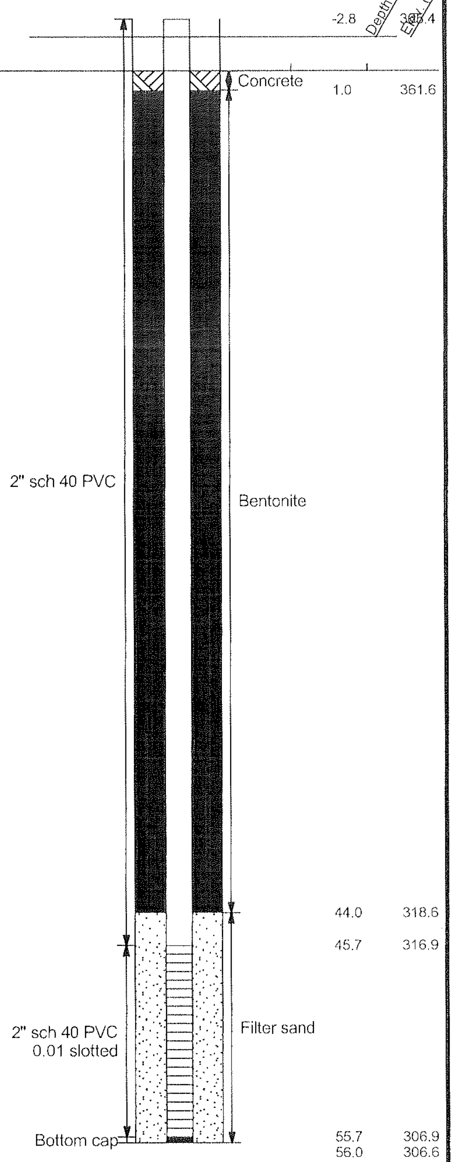
Easting: 2486684.92

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | FILL: brown, silyt clay, some sand and crushed rock | | 3-5-15 | SS1 |
| | | | 5-5-7 | SS2 |
| 5 | Gray, silty CLAY - CL | | 5-6-7 | SS3 |
| | Gray CLAY with occasional fine sand seams - CH | | 4-4-5 | SS4 |
| | | | 3-3-7 | SS5 |
| | | | 5-5-6 | SS6 |
| 10 | Gray and brown, silty CLAY - CL | | 0-3-4 | SS7 |
| | Brownish-gray CLAY - CH | | 2-2-3 | SS8 |
| | Brownish-gray, silty CLAY - CL | | 1-2-2 | SS9 |
| 15 | | | 0-1-2 | SS10 |
| | Grayish-brown, fine, sandy SILT - ML | | 1-1-1 | SS11 |
| | | | 0-0-2 | SS12 |
| 20 | | | 0-1-1 | SS13 |
| | | | 1-1-2 | SS14 |
| | Brown, silty, fine SAND - SM | | 0-2-2 | SS15 |
| | | | 0-1-1 | SS16 |
| 25 | | | 0-0-0 | SS17 |
| | | | 2-2-5 | SS18 |
| | | | 0-2-2 | SS19 |
| 30 | | | 2-2-2 | SS20 |
| | | | 1-2-2 | SS21 |
| | | | 3-3-2 | SS22 |
| 35 | | | 1-2-2 | SS23 |
| | | | 2-3-7 | SS24 |
| | | | 4-8-9 | SS25 |
| | Gray, fine to medium SAND - SP | | 7-4-15 | SS26 |
| 40 | Logging terminated at 40 feet. | | | |
| 45 | | | | |
| 50 | | | | |
| 55 | | | | |
| | Boring terminated at 58 feet. | | | |

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

## WELL DIAGRAM

**Stickup**
**Diameter: 6-inches**



**GROUNDWATER DATA**

X FREE WATER NOT ENCOUNTERED DURING DRILLING

**DRILLING DATA**

__ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM __ FEET

MB DRILLER LAH LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

**REMARKS:**

| Drawn by: KSA | Checked by: DTK | App'vd. by: RSP |
|---|---|---|
| Date: 10/18/10 | Date: 2/17/11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

AmerenUE
Grand Tower

LOG OF BORING: APW-3

**Project No. J017150.01.1004A**

LOG OF BORING 2002 WL J017150.01ENV - GRAND TWR.GPJ GTINC 0638301.GPJ 12/13/10

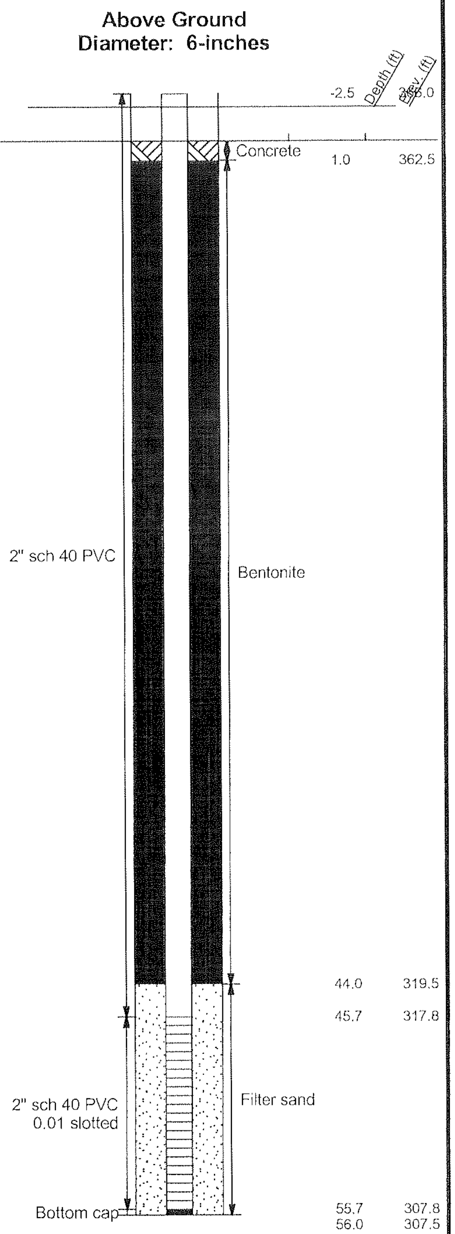
Surface Elevation: 363.46
Datum msl

Completion Date: 10/11/10
Northing: 359794.71
Easting: 2487224.5

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | FILL: brown, silty clay, trace organics | | 6-6-9 | SS1 |
| | | | 5-5-6 | SS2 |
| 5 | | | 4-5-5 | SS3 |
| | | | 3-6-6 | SS4 |
| | Brown, silty CLAY - CL | | 2-4-4 | SS5 |
| | | | 2-3-4 | SS6 |
| 10 | | | 1-2-2 | SS7 |
| | | | 2-1-2 | SS8 |
| | | | 0-2-2 | SS9 |
| 15 | Brown, fine, sandy SILT - ML | | 1-1-2 | SS10 |
| | | | 0-2-3 | SS11 |
| | Grayish-brown CLAY - CH | | 0-2-2 | SS12 |
| 20 | Brown, fine, sandy SILT with occasional layers of clay and silty fine sand - ML | | 0-0-2 | SS13 |
| | | | 0-2-2 | SS14 |
| | | | 3-2-4 | SS15 |
| | | | 0-1-2 | SS16 |
| 25 | | | 0-0-0 | SS17 |
| | | | 0-4-4 | SS18 |
| | Brown, silty, fine SAND with occasional layers of fine, sandy silt - SM | | 0-3-2 | SS19 |
| 30 | | | 0-1-1 | SS20 |
| | | | 0-2-3 | SS21 |
| | | | 3-3-5 | SS22 |
| 35 | | | 2-4-5 | SS23 |
| | Brown and gray, fine to coarse SAND, trace gravel - SW | | 7-21-24 | SS24 |
| | | | 3-5-11 | SS25 |
| | | | 9-13-12 | SS26 |
| 40 | Logging terminated at 40 feet. | | | |
| 45 | | | | |
| 50 | | | | |
| 55 | | | | |
| | Boring terminated at 58 feet. | | | |

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

**WELL DIAGRAM**



**GROUNDWATER DATA**

X FREE WATER NOT ENCOUNTERED DURING DRILLING

**DRILLING DATA**

___ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM ___ FEET
MB DRILLER LAH LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

**REMARKS:**

| Drawn by: KSA | Checked by: DK | App'vd. by: RBP |
|---|---|---|
| Date: 10/18/10 | Date: 2/17/11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

AmerenUE
Grand Tower

LOG OF BORING: APW-4

**Project No. J017150.01.1004A**

# APPENDIX D

# GROUNDWATER QUALITY DATA SUMMARY

December 18, 2012
8:42:48 AM

# Groundwater Monitoring Data: November 2010 - August 2012

**Date Range: 11/29/2010 to 08/08/2012**

| Well Id | Date Sampled | Lab Id | Ag, diss, mg/L | As, diss, mg/L | B, diss, mg/L | Ba, diss, mg/L | Be, diss, mg/L | Cd, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 11/29/2010 | | <0.005 | <0.004 | 0.444 | 0.101 | <0.004 | <0.004 |
| | 03/23/2011 | | <0.005 | <0.004 | 0.297 | 0.130 | <0.004 | <0.004 |
| | 06/22/2011 | | <0.005 | <0.004 | 0.345 | 0.134 | <0.004 | <0.004 |
| | 09/12/2011 | | <0.010 | <0.025 | 0.271 | 0.122 | <0.001 | <0.002 |
| | 11/28/2011 | | <0.010 | <0.025 | 0.241 | 0.170 | <0.001 | <0.002 |
| | 02/15/2012 | | <0.010 | <0.025 | 0.219 | 0.146 | <0.001 | <0.002 |
| | 05/22/2012 | | <0.010 | <0.025 | 0.208 | 0.156 | <0.001 | <0.002 |
| | 08/08/2012 | | <0.010 | <0.025 | 0.185 | 0.182 | <0.001 | <0.002 |
| APW-2 | 11/29/2010 | | <0.005 | 0.031 | 6.160 | 0.313 | <0.004 | <0.004 |
| | 03/24/2011 | | <0.005 | 0.034 | 7.930 | 0.382 | <0.004 | <0.004 |
| | 06/22/2011 | | <0.005 | 0.010 | 8.610 | 0.309 | <0.004 | <0.004 |
| | 09/12/2011 | | <0.010 | <0.025 | 7.060 | 0.273 | <0.001 | <0.002 |
| | 11/28/2011 | | <0.010 | <0.025 | 5.840 | 0.314 | <0.001 | <0.002 |
| | 02/15/2012 | | <0.010 | <0.025 | 6.970 | 0.308 | <0.001 | <0.002 |
| | 05/22/2012 | | <0.010 | <0.025 | 8.070 | 0.327 | <0.001 | <0.002 |
| | 08/08/2012 | | <0.010 | <0.025 | 6.100 | 0.180 | <0.001 | <0.002 |
| APW-3 | 11/29/2010 | | <0.005 | <0.004 | 4.590 | 0.077 | <0.004 | <0.004 |
| | 03/24/2011 | | <0.005 | <0.004 | 4.900 | 0.076 | <0.004 | <0.004 |
| | 06/22/2011 | | <0.005 | <0.004 | 4.790 | 0.077 | <0.004 | <0.004 |
| | 09/12/2011 | | <0.010 | <0.025 | 4.650 | 0.760 | <0.001 | <0.002 |
| | 11/28/2011 | | <0.010 | <0.025 | 4.680 | 0.072 | <0.001 | <0.002 |
| | 02/15/2012 | | <0.010 | <0.025 | 4.900 | 0.069 | <0.001 | <0.002 |
| | 05/22/2012 | | <0.010 | <0.025 | 4.640 | 0.083 | <0.001 | <0.002 |
| | 08/08/2012 | | <0.010 | <0.025 | 4.680 | 0.070 | <0.001 | <0.002 |
| APW-4 | 11/29/2010 | | <0.005 | <0.004 | 4.010 | 0.144 | <0.004 | <0.004 |
| | 03/24/2011 | | <0.005 | <0.004 | 7.010 | 0.185 | <0.004 | <0.004 |
| | 06/22/2011 | | <0.005 | <0.004 | 8.900 | 0.197 | <0.004 | <0.004 |
| | 09/12/2011 | | <0.010 | <0.025 | 6.170 | 0.181 | <0.001 | <0.002 |
| | 11/28/2011 | | <0.010 | <0.025 | 3.910 | 0.163 | <0.001 | <0.002 |
| | 02/15/2012 | | <0.010 | <0.025 | 2.970 | 0.165 | <0.001 | <0.002 |
| | 05/22/2012 | | <0.010 | <0.025 | 3.240 | 0.142 | <0.001 | <0.002 |
| | 08/08/2012 | | <0.010 | <0.025 | 2.060 | 0.133 | <0.001 | <0.002 |

December 20, 2012
9:15:37 AM

# Groundwater Monitoring Data: November 2010 - August 2012

**Date Range: 11/29/2010 to 08/08/2012**

| Well Id | Date Sampled | Lab Id | Cl, diss, mg/L | CN, total, mg/L | Co, diss, mg/L | Cr, diss, mg/L | Cu, diss, mg/L | F, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 11/29/2010 | | 2.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.220 |
| | 03/23/2011 | | 1.200 | <0.010 | <0.050 | <0.010 | <0.025 | 0.260 |
| | 06/22/2011 | | 2.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.190 |
| | 09/12/2011 | | <1.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.170 |
| | 11/28/2011 | | 2.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.140 |
| | 02/15/2012 | | 4.000 | <0.007 | <0.010 | <0.010 | <0.010 | <0.100 |
| | 05/22/2012 | | 3.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.120 |
| | 08/08/2012 | | 2.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.150 |
| APW-2 | 11/29/2010 | | 22.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.310 |
| | 03/24/2011 | | 19.200 | <0.010 | <0.050 | <0.010 | <0.025 | 0.200 |
| | 06/22/2011 | | 21.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.240 |
| | 09/12/2011 | | 22.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.290 |
| | 11/28/2011 | | 16.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.260 |
| | 02/15/2012 | | 24.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.280 |
| | 05/22/2012 | | 24.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.290 |
| | 08/08/2012 | | 17.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.300 |
| APW-3 | 11/29/2010 | | 20.500 | <0.010 | <0.050 | <0.010 | <0.025 | 0.370 |
| | 03/24/2011 | | 18.700 | <0.010 | <0.050 | <0.010 | <0.025 | 0.260 |
| | 06/22/2011 | | 18.500 | <0.010 | <0.050 | <0.010 | <0.025 | 0.310 |
| | 09/12/2011 | | 19.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.380 |
| | 11/28/2011 | | 18.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.370 |
| | 02/15/2012 | | 22.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.390 |
| | 05/22/2012 | | 20.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.340 |
| | 08/08/2012 | | 17.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.380 |
| APW-4 | 11/29/2010 | | 4.500 | <0.010 | <0.050 | <0.010 | <0.025 | 0.210 |
| | 03/24/2011 | | 10.200 | <0.010 | <0.050 | <0.010 | <0.025 | 0.350 |
| | 06/22/2011 | | 10.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.270 |
| | 09/12/2011 | | 7.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.280 |
| | 11/28/2011 | | 11.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.220 |
| | 02/15/2012 | | 12.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.220 |
| | 05/22/2012 | | 13.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.240 |
| | 08/08/2012 | | 10.000 | <0.007 | <0.010 | <0.010 | <0.010 | 0.220 |

December 18, 2012
8:42:49 AM

## Groundwater Monitoring Data: November 2010 - August 2012

**Date Range: 11/29/2010 to 08/08/2012**

| Well Id | Date Sampled | Lab Id | Fe, diss, mg/L | GW Depth (TOC), ft | Hg, diss, mg/L | Mn, diss, mg/L | Ni, diss, mg/L | NO3, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 11/29/2010 | | <0.100 | 25.050 | <0.0002 | 0.121 | <0.040 | 1.400 |
| | 03/23/2011 | | <0.100 | 19.670 | <0.0002 | 0.108 | <0.040 | 1.800 |
| | 06/22/2011 | | <0.100 | 7.640 | <0.0002 | <0.015 | <0.040 | 3.300 |
| | 09/12/2011 | | <0.020 | 24.350 | <0.0002 | <0.005 | <0.010 | 1.890 |
| | 11/28/2011 | | <0.020 | 31.240 | <0.0002 | <0.005 | <0.010 | 2.060 |
| | 02/15/2012 | | <0.020 | 32.400 | <0.0002 | 0.006 | <0.010 | 2.830 |
| | 05/22/2012 | | <0.020 | 23.330 | <0.0002 | <0.005 | <0.010 | 2.360 |
| | 08/08/2012 | | <0.020 | 35.600 | <0.0002 | <0.005 | <0.010 | 2.430 |
| APW-2 | 11/29/2010 | | 7.440 | 22.670 | <0.0002 | 0.774 | <0.040 | <0.011 |
| | 03/24/2011 | | 10.100 | 16.630 | <0.0002 | 0.678 | <0.040 | 3.300 |
| | 06/22/2011 | | 4.680 | 6.010 | <0.0002 | 0.654 | <0.040 | <0.110 |
| | 09/12/2011 | | 3.780 | 22.900 | <0.0002 | 0.691 | <0.010 | <0.050 |
| | 11/28/2011 | | 0.720 | 29.920 | <0.0002 | 0.660 | <0.010 | <0.050 |
| | 02/15/2012 | | 8.530 | 29.680 | <0.0002 | 0.636 | <0.010 | <0.050 |
| | 05/22/2012 | | 8.670 | 20.500 | <0.0002 | 0.643 | <0.010 | 0.407 |
| | 08/08/2012 | | 0.902 | 33.950 | <0.0002 | 0.096 | <0.010 | 4.260 |
| APW-3 | 11/29/2010 | | 0.162 | 23.950 | <0.0002 | 0.315 | <0.040 | <0.011 |
| | 03/24/2011 | | 0.668 | 18.250 | <0.0002 | 0.290 | <0.040 | <0.110 |
| | 06/22/2011 | | 0.399 | 6.700 | <0.0002 | 0.268 | <0.040 | <0.110 |
| | 09/12/2011 | | 0.497 | 23.300 | <0.0002 | 0.252 | <0.010 | <0.050 |
| | 11/28/2011 | | 0.465 | 30.160 | <0.0002 | 0.266 | <0.010 | <0.050 |
| | 02/15/2012 | | 0.424 | 30.600 | <0.0002 | 0.281 | <0.010 | <0.170 |
| | 05/22/2012 | | 0.546 | 22.500 | <0.0002 | 0.311 | <0.010 | <0.050 |
| | 08/08/2012 | | 0.423 | 34.330 | <0.0002 | 0.273 | <0.010 | <0.050 |
| APW-4 | 11/29/2010 | | <0.100 | 25.600 | <0.0002 | 0.253 | <0.040 | 0.240 |
| | 03/24/2011 | | <0.100 | 20.010 | <0.0002 | 0.091 | <0.040 | 0.360 |
| | 06/22/2011 | | <0.100 | 8.580 | <0.0002 | 0.064 | <0.040 | 0.420 |
| | 09/12/2011 | | <0.020 | 24.700 | <0.0002 | 0.099 | <0.010 | 0.597 |
| | 11/28/2011 | | <0.020 | 31.660 | <0.0002 | 0.104 | <0.010 | 0.955 |
| | 02/15/2012 | | 0.024 | 32.200 | <0.0002 | 0.155 | <0.010 | 2.180 |
| | 05/22/2012 | | <0.020 | 24.020 | <0.0002 | 0.087 | <0.010 | 2.940 |
| | 08/08/2012 | | <0.020 | 35.360 | <0.0002 | 0.114 | <0.010 | 5.070 |

December 20, 2012
8:44:05 AM

## Groundwater Monitoring Data: November 2010 - August 2012

**Date Range: 11/29/2010 to 08/08/2012**

| Well Id | Date Sampled | Lab Id | Pb, diss, mg/L | pH (field), STD | Sb, diss, mg/L | Se, diss, mg/L | SO4, diss, mg/L | Spec. Cond. (field), |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 11/29/2010 | | <0.0050 | 5.760 | <0.006 | <0.010 | 37.100 | 571.000 |
| | 03/23/2011 | | <0.0050 | 6.250 | <0.006 | <0.010 | 35.600 | 386.000 |
| | 06/22/2011 | | <0.0050 | 6.690 | <0.006 | <0.010 | 47.500 | 366.000 |
| | 09/12/2011 | | <0.0020 | 6.730 | <0.005 | <0.050 | 36.000 | 374.000 |
| | 11/28/2011 | | <0.0020 | 6.560 | <0.005 | <0.050 | 46.000 | 416.000 |
| | 02/15/2012 | | <0.0020 | 6.940 | <0.005 | <0.050 | 61.000 | 448.000 |
| | 05/22/2012 | | <0.0020 | 6.360 | <0.005 | <0.050 | 57.000 | 414.000 |
| | 08/08/2012 | | <0.0020 | 6.210 | <0.005 | <0.050 | 50.000 | 438.000 |
| APW-2 | 11/29/2010 | | <0.0050 | 5.930 | <0.006 | <0.010 | 342.000 | 1,062.000 |
| | 03/24/2011 | | <0.0050 | 6.860 | <0.006 | <0.010 | 425.000 | 1,129.000 |
| | 06/22/2011 | | <0.0050 | 7.300 | <0.006 | <0.010 | 428.000 | 1,060.000 |
| | 09/12/2011 | | <0.0020 | 7.290 | <0.005 | <0.050 | 372.000 | 949.000 |
| | 11/28/2011 | | <0.0020 | 6.770 | <0.005 | <0.050 | 369.000 | 1,235.000 |
| | 02/15/2012 | | <0.0020 | 6.960 | <0.005 | <0.050 | 410.000 | 1,051.000 |
| | 05/22/2012 | | <0.0020 | 7.170 | <0.005 | <0.050 | 469.000 | 970.000 |
| | 08/08/2012 | | <0.0020 | 7.110 | <0.005 | <0.050 | 311.000 | 886.000 |
| APW-3 | 11/29/2010 | | <0.0050 | 6.430 | <0.006 | <0.010 | 211.000 | 665.000 |
| | 03/24/2011 | | <0.0050 | 7.550 | <0.006 | <0.010 | 226.000 | 656.000 |
| | 06/22/2011 | | <0.0050 | 7.800 | <0.006 | <0.010 | 231.000 | 641.000 |
| | 09/12/2011 | | <0.0020 | 8.010 | <0.005 | <0.050 | 210.000 | 621.000 |
| | 11/28/2011 | | <0.0020 | 7.750 | <0.005 | <0.050 | 231.000 | 728.000 |
| | 02/15/2012 | | <0.0020 | 7.660 | <0.005 | <0.050 | 240.000 | 652.000 |
| | 05/22/2012 | | <0.0020 | 7.840 | <0.005 | <0.050 | 285.000 | 677.000 |
| | 08/08/2012 | | <0.0020 | 7.770 | <0.005 | <0.050 | 222.000 | 618.000 |
| APW-4 | 11/29/2010 | | <0.0050 | 6.050 | <0.006 | 0.014 | 135.000 | 697.000 |
| | 03/24/2011 | | <0.0050 | 7.180 | <0.006 | 0.035 | 244.000 | 898.000 |
| | 06/22/2011 | | <0.0050 | 7.510 | <0.006 | 0.049 | 316.000 | 844.000 |
| | 09/12/2011 | | <0.0020 | 7.490 | <0.005 | 0.050 | 176.000 | 744.000 |
| | 11/28/2011 | | <0.0020 | 7.400 | <0.005 | <0.050 | 177.000 | 864.000 |
| | 02/15/2012 | | <0.0020 | 7.380 | <0.005 | <0.050 | 163.000 | 760.000 |
| | 05/22/2012 | | <0.0020 | 7.510 | <0.005 | <0.050 | 140.000 | 694.000 |
| | 08/08/2012 | | <0.0020 | 7.400 | <0.005 | <0.050 | 120.000 | 668.000 |

December 18, 2012
8:42:50 AM

## Groundwater Monitoring Data: November 2010 - August 2012

**Date Range: 11/29/2010 to 08/08/2012**

| Well Id | Date Sampled | Lab Id | TDS, mg/L | Temp (Fahrenheit), | Tl, diss, mg/L | Zn, diss, mg/L |
|---|---|---|---|---|---|---|
| APW-1 | 11/29/2010 | | 1,310.000 | 57.920 | <0.002 | <0.020 |
| | 03/23/2011 | | 225.000 | 57.380 | <0.002 | <0.020 |
| | 06/22/2011 | | 237.000 | 60.260 | <0.002 | <0.020 |
| | 09/12/2011 | | 272.000 | 60.080 | <0.002 | <0.010 |
| | 11/28/2011 | | 314.000 | 51.980 | <0.002 | <0.010 |
| | 02/15/2012 | | 182.000 | 53.420 | <0.002 | <0.010 |
| | 05/22/2012 | | 278.000 | 61.160 | <0.002 | 0.010 |
| | 08/08/2012 | | 370.000 | 60.080 | <0.002 | <0.010 |
| APW-2 | 11/29/2010 | | 712.000 | 59.180 | <0.002 | 0.053 |
| | 03/24/2011 | | 789.000 | 57.740 | <0.002 | <0.020 |
| | 06/22/2011 | | 806.000 | 61.520 | <0.002 | <0.020 |
| | 09/12/2011 | | 834.000 | 61.160 | <0.002 | <0.010 |
| | 11/28/2011 | | 884.000 | 57.380 | <0.002 | <0.010 |
| | 02/15/2012 | | 824.000 | 57.920 | <0.002 | <0.010 |
| | 05/22/2012 | | 892.000 | 60.800 | <0.002 | 0.016 |
| | 08/08/2012 | | 860.000 | 61.160 | <0.002 | <0.010 |
| APW-3 | 11/29/2010 | | 452.000 | 60.440 | <0.002 | <0.020 |
| | 03/24/2011 | | 400.000 | 58.280 | <0.002 | <0.020 |
| | 06/22/2011 | | 423.000 | 62.240 | <0.002 | <0.020 |
| | 09/12/2011 | | 462.000 | 61.700 | <0.002 | <0.010 |
| | 11/28/2011 | | 216.000 | 57.200 | <0.002 | <0.010 |
| | 02/15/2012 | | 478.000 | 57.380 | <0.002 | <0.010 |
| | 05/22/2012 | | 536.000 | 61.340 | <0.002 | <0.010 |
| | 08/08/2012 | | 514.000 | 61.520 | <0.002 | <0.010 |
| APW-4 | 11/29/2010 | | 388.000 | 58.100 | <0.002 | <0.023 |
| | 03/24/2011 | | 583.000 | 57.200 | <0.002 | <0.020 |
| | 06/22/2011 | | 627.000 | 60.080 | <0.002 | <0.020 |
| | 09/12/2011 | | 570.000 | 62.060 | <0.002 | <0.010 |
| | 11/28/2011 | | 604.000 | 56.480 | <0.002 | <0.010 |
| | 02/15/2012 | | 564.000 | 56.480 | <0.002 | <0.010 |
| | 05/22/2012 | | 524.000 | 60.080 | <0.002 | 0.012 |
| | 08/08/2012 | | 566.000 | 60.080 | <0.002 | <0.010 |

# APPENDIX E

# EXCEEDANCES OF CLASS 1 GROUNDWATER STANDARDS

December 27, 2012
8:22:36 AM

# Exceedances of Class I Groundwater Standards: November 2010 - August 2012

**Date Range: 11/01/2010 to 09/01/2012**

| LimitType | Parameter | Code | Units | Location | Sample Date | Analysis Result | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|---|
| State Std | B, diss | 01020 | mg/L | APW-2 | 11/29/2010 | 6.160 | | 2.000 |
| | | | | | 03/24/2011 | 7.930 | | 2.000 |
| | | | | | 06/22/2011 | 8.610 | | 2.000 |
| | | | | | 09/12/2011 | 7.060 | | 2.000 |
| | | | | | 11/28/2011 | 5.840 | | 2.000 |
| | | | | | 02/15/2012 | 6.970 | | 2.000 |
| | | | | | 05/22/2012 | 8.070 | | 2.000 |
| | | | | | 08/08/2012 | 6.100 | | 2.000 |
| | | | | APW-3 | 11/29/2010 | 4.590 | | 2.000 |
| | | | | | 03/24/2011 | 4.900 | | 2.000 |
| | | | | | 06/22/2011 | 4.790 | | 2.000 |
| | | | | | 09/12/2011 | 4.650 | | 2.000 |
| | | | | | 11/28/2011 | 4.680 | | 2.000 |
| | | | | | 02/15/2012 | 4.900 | | 2.000 |
| | | | | | 05/22/2012 | 4.640 | | 2.000 |
| | | | | | 08/08/2012 | 4.680 | | 2.000 |
| | | | | APW-4 | 11/29/2010 | 4.010 | | 2.000 |
| | | | | | 03/24/2011 | 7.010 | | 2.000 |
| | | | | | 06/22/2011 | 8.900 | | 2.000 |
| | | | | | 09/12/2011 | 6.170 | | 2.000 |
| | | | | | 11/28/2011 | 3.910 | | 2.000 |
| | | | | | 02/15/2012 | 2.970 | | 2.000 |
| | | | | | 05/22/2012 | 3.240 | | 2.000 |
| | | | | | 08/08/2012 | 2.060 | | 2.000 |
| | Fe, diss | 01046 | | APW-2 | 11/29/2010 | 7.440 | | 5.000 |
| | | | | | 03/24/2011 | 10.100 | | 5.000 |
| | | | | | 02/15/2012 | 8.530 | | 5.000 |
| | | | | | 05/22/2012 | 8.670 | | 5.000 |
| | Mn, diss | 01056 | | | 11/29/2010 | 0.774 | | 0.150 |
| | | | | | 03/24/2011 | 0.678 | | 0.150 |
| | | | | | 06/22/2011 | 0.654 | | 0.150 |
| | | | | | 09/12/2011 | 0.691 | | 0.150 |
| | | | | | 11/28/2011 | 0.660 | | 0.150 |
| | | | | | 02/15/2012 | 0.636 | | 0.150 |
| | | | | | 05/22/2012 | 0.643 | | 0.150 |
| | | | | APW-3 | 11/29/2010 | 0.315 | | 0.150 |
| | | | | | 03/24/2011 | 0.290 | | 0.150 |

December 27, 2012
8:22:36 AM

# Exceedances of Class I Groundwater Standards: November 2010 - August 2012

**Date Range: 11/01/2010 to 09/01/2012**

| LimitType | Parameter | Code | Units | Location | Sample Date | Analysis Result | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|---|
| State Std | Mn, diss | 01056 | mg/L | APW-3 | 06/22/2011 | 0.268 | | 0.150 |
| | | | | | 09/12/2011 | 0.252 | | 0.150 |
| | | | | | 11/28/2011 | 0.266 | | 0.150 |
| | | | | | 02/15/2012 | 0.281 | | 0.150 |
| | | | | | 05/22/2012 | 0.311 | | 0.150 |
| | | | | | 08/08/2012 | 0.273 | | 0.150 |
| | | | | APW-4 | 11/29/2010 | 0.253 | | 0.150 |
| | | | | | 02/15/2012 | 0.155 | | 0.150 |
| | pH (field) | 00400 | STD | APW-1 | 11/29/2010 | 5.760 | 6.500 | |
| | | | | | 03/23/2011 | 6.250 | 6.500 | |
| | | | | | 05/22/2012 | 6.360 | 6.500 | |
| | | | | | 08/08/2012 | 6.210 | 6.500 | |
| | | | | APW-2 | 11/29/2010 | 5.930 | 6.500 | |
| | | | | APW-3 | 11/29/2010 | 6.430 | 6.500 | |
| | | | | APW-4 | 11/29/2010 | 6.050 | 6.500 | |
| | SO4, diss | 00946 | mg/L | APW-2 | 03/24/2011 | 425.000 | | 400.000 |
| | | | | | 06/22/2011 | 428.000 | | 400.000 |
| | | | | | 02/15/2012 | 410.000 | | 400.000 |
| | | | | | 05/22/2012 | 469.000 | | 400.000 |
| | TDS | 00515 | | APW-1 | 11/29/2010 | 1,310.000 | | 1,200.000 |

# APPENDIX F

# HYDRAULIC GRADIENT AND BORON LOADING CALCULATIONS

## Appendix F
## Mixing Calculation Showing Effect of Boron Loading on Mississippi River Quality at Low Flow

| | | | | |
|---|---|---|---|---|
| **7-day 10-year low flow at Chester, IL** | | 47600 | cfs | Source: http://il.water.usgs.gov/drought/lowflow.html, 1988 data |
| | $Q_{7,10}$ = | 1.2E+11 | L/day | |
| **Boron loading rate** | | | | |
| Maximum Boron Concentration in Groundwater (Cmax) | | 8.9 | mg/L | APW-4 |
| Maximum Hydraulic Conductivity | | 0.0045 | cm/s | Based on data from Ameren's Venice Ponds 2 and 3 |
| Hydraulic Gradient | | 0.00061 | | Maximum observed gradient toward river |
| Aquifer Thickness | | 100 | ft | Assumed |
| Length of Impoundment + 500 feet (each way) north and south | | 2,600 | ft | |
| Q = KIA | | | | |
| K = Max Hydraulic Conductivity | | 1.5E-04 | ft/s | |
| I = Hydraulic Gradient | | 0.00061 | | |
| A = Cross-Sectional Area | | 260,000 | $ft^2$ | |
| Q (per second) | | 0.02342 | cfs | |
| Q (per day) | | 57,287.74 | L/day | |
| Loading Rate (L) | | 5.1E+05 | mg/day | = Cmax * Q |
| | L = | 1.12 | lb/day | |
| **Boron concentration increase in Mississippi River at low flow due to loading CCP Impoundment** | | | | |
| | $d_B$ = | 4.4E-06 | mg/L | = $L/Q_{7,10}$ |
| **Boron concentration increase near-shore in Mississippi River at low flow due to loading from CCP Impoundment** | | | | |
| Assumes loading distributed within 50 feet of east bank | | 0.0002 | mg/L | relative to a total river width of 2,300 feet |
| Typical boron laboratory detection limit | | 0.0038 | mg/L | Source: USEPA SW-846 Method 6010c |

**Conclusion:**

The calculated boron concentration increase in the Mississippi River at ***low flow*** due to groundwater loading from the CCP impoundment is below our ability to measure, even if we only consider a small portion of the river. These calculations indicate that the effects of boron loading in groundwater discharge to the Mississippi River are negligible.

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

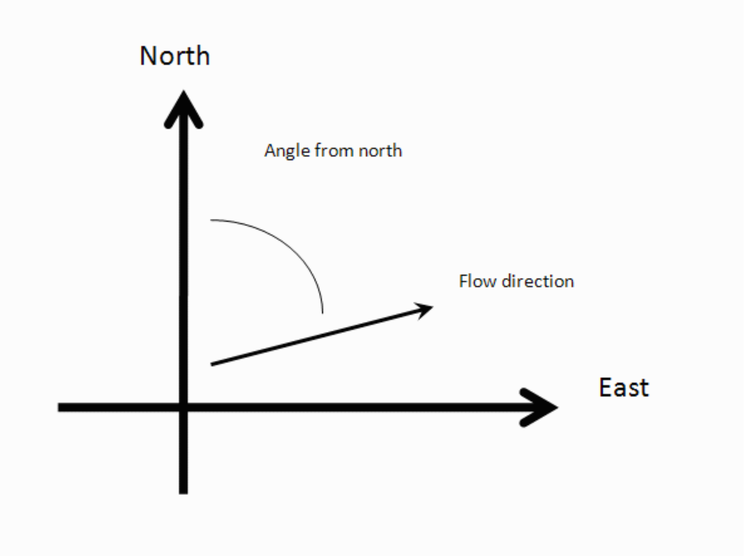
**Gradient Calculation** from fitting a plane to as many as thirty points

$a x_1 + b y_1 + c = h_1$
$a x_2 + b y_2 + c = h_2$
$a x_3 + b y_3 + c = h_3$
. . .
$a x_{30} + b y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back
Site Name: Grand Tower
Date: 8/8/12 | Current Date
Calculation basis: Head
Coordinates: ft

| I.D. | | x-coordinate | y-coordinate | head ft |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 330.96 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 331.29 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 331.26 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 331.84 |
| 5) | | | | |
| 6) | | | | |
| 7) | | | | |
| 8) | | | | |
| 9) | | | | |
| 10) | | | | |
| 11) | | | | |
| 12) | | | | |
| 13) | | | | |
| 14) | | | | |
| 15) | | | | |
| 16) | | | | |
| 17) | | | | |

http://www.epa.gov/athens/learn2model/part-two/onsite/gradient4plus-ns.html

18)
19)
20)
21)
22)
23)
24)
25)
26)
27)
28)
29)
30)

**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.2682 |
| Gradient Magnitude (i) | 0.0006050 |
| Flow direction as degrees from North (positive y axis) | 312.7 |
| Coefficient of Determination ($R^2$) | 0.449 |

WCMS

Last updated on Tuesday, December 11, 2012

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# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

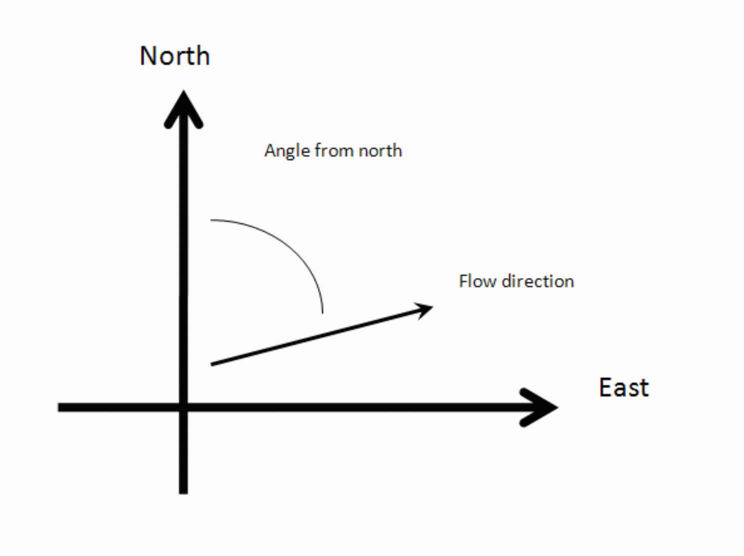
**Gradient Calculation** from fitting a plane to as many as thirty points

a $x_1$ + b $y_1$ + c = $h_1$
a $x_2$ + b $y_2$ + c = $h_2$
a $x_3$ + b $y_3$ + c = $h_3$
. . .
a $x_{30}$ + b $y_{30}$ + c = $h_{30}$

where ($x_i$,$y_i$) are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of ($a^2$ + $b^2$) and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name: Grand Tower
Date: 5/22/12 Current Date
Calculation basis: Head ▾
Coordinates: ft ▾

| I.D. | | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 343.23 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 344.74 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 343.09 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 343.18 |
| 5) | | | | |
| 6) | | | | |
| 7) | | | | |
| 8) | | | | |
| 9) | | | | |
| 10) | | | | |
| 11) | | | | |
| 12) | | | | |
| 13) | | | | |
| 14) | | | | |
| 15) | | | | |
| 16) | | | | |
| 17) | | | | |

http://www.epa.gov/athens/learn2model/part-two/onsite/gradient4plus-ns.html

| | | | | |
|---|---|---|---|---|
| 18) | | | | |
| 19) | | | | |
| 20) | | | | |
| 21) | | | | |
| 22) | | | | |
| 23) | | | | |
| 24) | | | | |
| 25) | | | | |
| 26) | | | | |
| 27) | | | | |
| 28) | | | | |
| 29) | | | | |
| 30) | | | | |

**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.5029 |
| Gradient Magnitude (i) | 0.001795 |
| Flow direction as degrees from North (positive y axis) | 106.3 |
| Coefficient of Determination ($R^2$) | 0.766 |

WCMS

Last updated on Tuesday, December 11, 2012

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# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

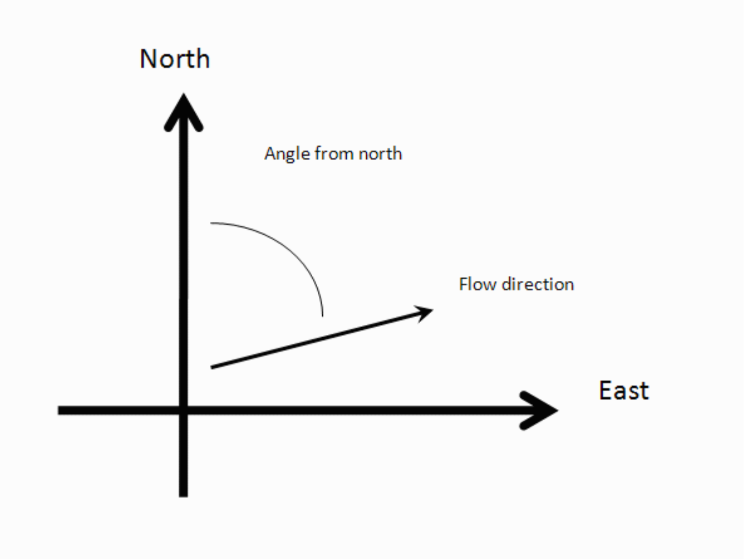
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\ x_1 + b\ y_1 + c = h_1$
$a\ x_2 + b\ y_2 + c = h_2$
$a\ x_3 + b\ y_3 + c = h_3$
. . .
$a\ x_{30} + b\ y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name: Grand Tower
Date: 2/15/12 Current Date
Calculation basis: Head ▾
Coordinates: ft ▾

| I.D. | | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 334.16 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 335.56 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 334.99 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 335.00 |
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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.4267 |
| Gradient Magnitude (i) | 0.0009035 |
| Flow direction as degrees from North (positive y axis) | 57.87 |
| Coefficient of Determination ($R^2$) | 0.670 |

WCMS

Last updated on Tuesday, December 11, 2012

EPA United States Environmental Protection Agency

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

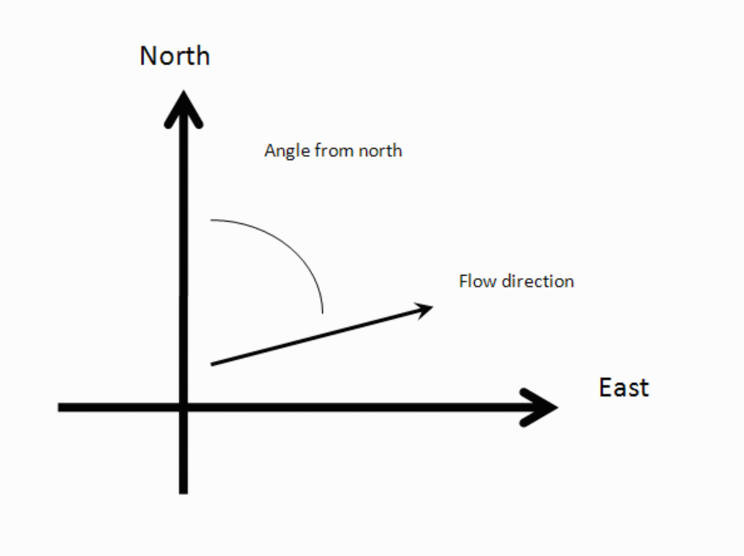
**Gradient Calculation** from fitting a plane to as many as thirty points

$a x_1 + b y_1 + c = h_1$
$a x_2 + b y_2 + c = h_2$
$a x_3 + b y_3 + c = h_3$
. . .
$a x_{30} + b y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name: Grand Tower
Date: 11/28/11 | Current Date
Calculation basis: Head
Coordinates: ft

| | I.D. | x-coordinate | y-coordinate | head ft |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 335.32 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 335.32 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 335.43 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 335.54 |
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http://www.epa.gov/athens/learn2model/part-two/onsite/gradient4plus-ns.html

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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.06706 |
| Gradient Magnitude (i) | 0.0002515 |
| Flow direction as degrees from North (positive y axis) | 306.0 |
| Coefficient of Determination ($R^2$) | 0.876 |

WCMS

Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

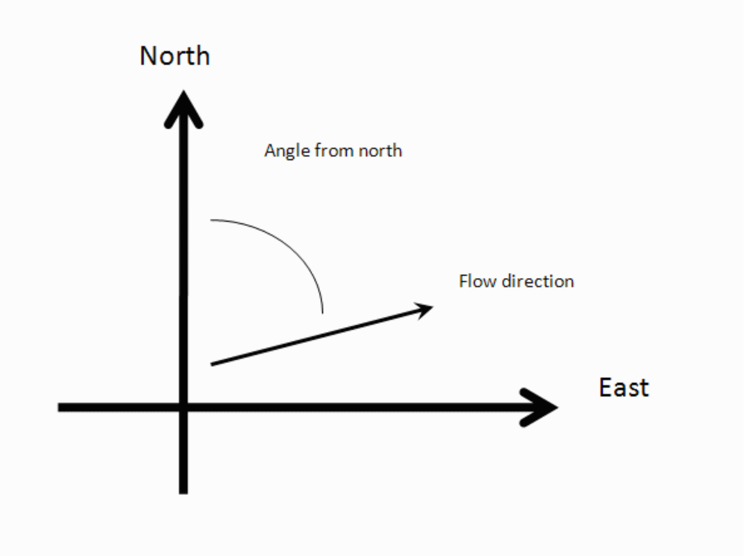
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\ x_1 + b\ y_1 + c = h_1$
$a\ x_2 + b\ y_2 + c = h_2$
$a\ x_3 + b\ y_3 + c = h_3$
. . .
$a\ x_{30} + b\ y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

| | |
|---|---|
| Site Name | Grand Tower |
| Date | 9/12/11 Current Date |
| Calculation basis | Head |
| Coordinates | ft |

| I.D. | | x-coordinate | y-coordinate | head ft |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 342.21 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 342.34 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 342.29 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 342.50 |
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http://www.epa.gov/athens/learn2model/part-two/onsite/gradient4plus-ns.html

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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.08839 |
| Gradient Magnitude (i) | 0.0001693 |
| Flow direction as degrees from North (positive y axis) | 313.6 |
| Coefficient of Determination ($R^2$) | 0.319 |

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Last updated on Tuesday, December 11, 2012

EPA United States Environmental Protection Agency

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

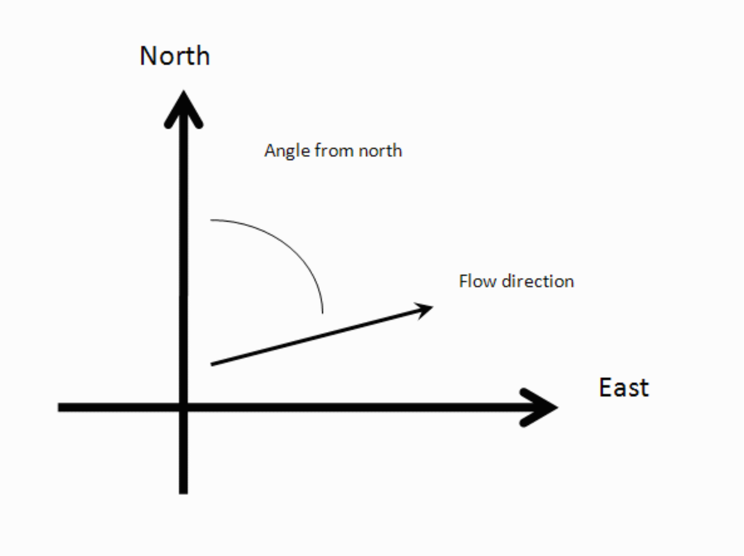
**Gradient Calculation** from fitting a plane to as many as thirty points

$a x_1 + b y_1 + c = h_1$
$a x_2 + b y_2 + c = h_2$
$a x_3 + b y_3 + c = h_3$
. . .
$a x_{30} + b y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

| | |
|---|---|
| Site Name | Grand Tower |
| Date | 6/22/11 Current Date |
| Calculation basis | Head ▾ |
| Coordinates | ft ▾ |

| I.D. | | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 358.92 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 359.23 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 358.89 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 358.62 |
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http://www.epa.gov/athens/learn2model/part-two/onsite/gradient4plus-ns.html

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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.1859 |
| Gradient Magnitude (i) | 0.0006499 |
| Flow direction as degrees from North (positive y axis) | 107.9 |
| Coefficient of Determination ($R^2$) | 0.995 |

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Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

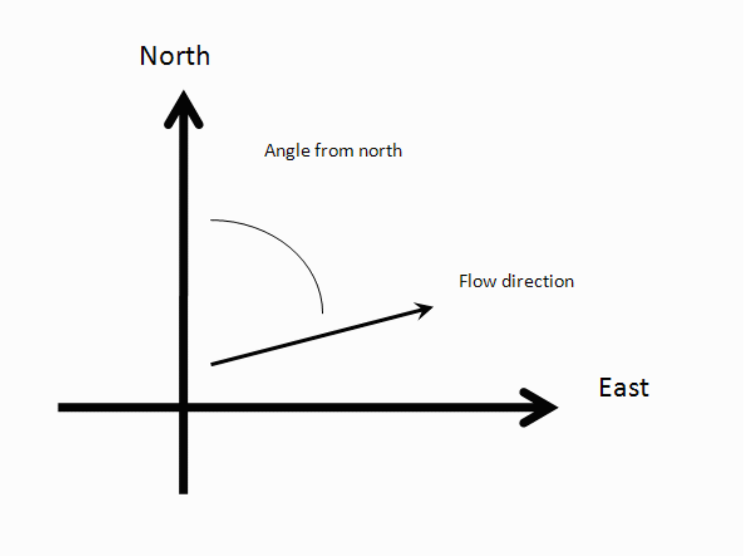
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\ x_1 + b\ y_1 + c = h_1$
$a\ x_2 + b\ y_2 + c = h_2$
$a\ x_3 + b\ y_3 + c = h_3$
. . .
$a\ x_{30} + b\ y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name: Grand Tower
Date: 3/23/11 | Current Date
Calculation basis: Head
Coordinates: ft

| I.D. | | x-coordinate | y-coordinate | head ft |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 346.89 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 348.61 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 347.34 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 347.19 |
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**Results**

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|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.5243 |
| Gradient Magnitude (i) | 0.001623 |
| Flow direction as degrees from North (positive y axis) | 91.43 |
| Coefficient of Determination ($R^2$) | 0.786 |

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Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

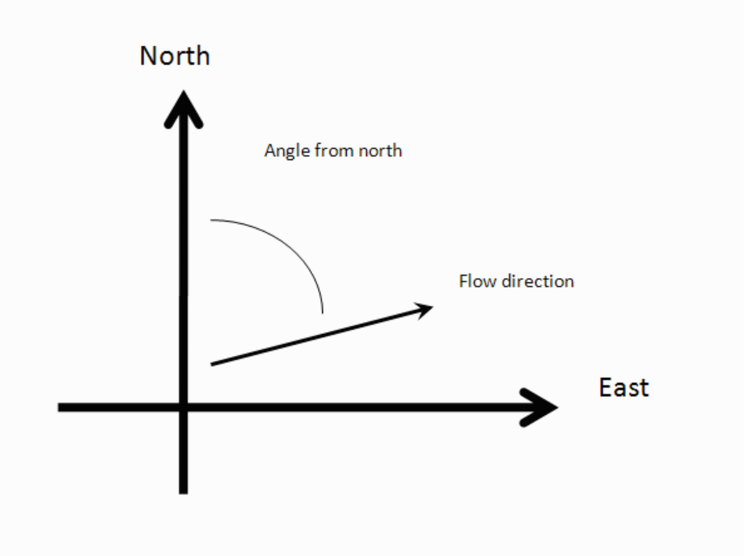
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\ x_1 + b\ y_1 + c = h_1$
$a\ x_2 + b\ y_2 + c = h_2$
$a\ x_3 + b\ y_3 + c = h_3$
. . .
$a\ x_{30} + b\ y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

i = 1,2,3, ... , 30
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name: Grand Tower
Date: 11/29/10 Current Date
Calculation basis: Head
Coordinates: ft

| I.D. | | x-coordinate | y-coordinate | head ft |
|---|---|---|---|---|
| 1) | APW-1 | 2487059.5 | 360625.76 | 341.51 |
| 2) | APW-2 | 2486285.3 | 359912.40 | 342.57 |
| 3) | APW-3 | 2486684.9 | 359291.23 | 341.64 |
| 4) | APW-4 | 2487224.5 | 359794.71 | 341.60 |
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**Results**

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|---|---|
| Number of Points Used in Calculation | 4 |
| Max. Difference Between Head Values | 0.3231 |
| Gradient Magnitude (i) | 0.001101 |
| Flow direction as degrees from North (positive y axis) | 98.19 |
| Coefficient of Determination ($R^2$) | 0.778 |

WCMS

Last updated on Tuesday, December 11, 2012

NATURAL
RESOURCE
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(F) 262.523.9001

# PHASE 1 HYDROGEOLOGICAL ASSESSMENT REPORT

## COAL COMBUSTION PRODUCT IMPOUNDMENTS
## MEREDOSIA POWER STATION
## MORGAN COUNTY, ILLINOIS

**Project No. 2124**

**Prepared For:**

**AMEREN ENERGY GENERATING COMPANY**

**Prepared By:**

**Natural Resource Technology, Inc.**
**23713 West Paul Road, Suite D**
**Pewaukee, WI 53072**

**March 19, 2013**

**Bruce R. Hensel, PG**
**Principal Hydrogeologist**

WWW.NATURALRT.COM

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## FIGURES

## TABLES

## APPENDICES

# 1 INTRODUCTION

## 1.1 Purpose

Ameren Energy Generating Company owns and operated the Meredosia Power Station in Morgan County, Illinois. The Meredosia Power Station formerly operated three coal-fired boilers. Operation of the two smaller units was suspended in 2003 and the larger unit was suspended in February 2012. The plant has three coal combustion product (CCP) impoundments – a Bottom Ash Pond, Fly Ash Pond, and a closed Old Ash Pond (Figure 1). To assess the potential for constituent migration from the impoundments as requested by the Agency in their correspondence dated May 15, 2009, Ameren commissioned a hydrogeologic study, water well survey, development of a groundwater monitoring plan, and an initial groundwater quality assessment.

The objectives of this report are to:

- Summarize hydrogeologic information pertinent to the site.
- Evaluate groundwater quality data to determine whether or not operation of the impoundments has adversely affected groundwater.
- Determine the potential for off-site migration and whether or not there are potential groundwater receptors in the event of a release.

# 2 SETTING

Portions of the information in this section were previously presented and modified from in the site characterization and groundwater monitoring plan developed by Rapps Engineering & Applied Services (December 2009).

## 2.1 Power Plant and CCP Impoundments

The Meredosia Power Station (MPS) is located south of the village of Meredosia in Morgan County in west-central Illinois (Figure 2). The plant, which generated electricity from 1948 until February 2012, is located on the floodplain on the east side of the Illinois River. The impoundments are located in the south half of Section 21 and the north half of Section 28, Township 16 North, Range 13 West

There are three CCP impoundments at the MPS, a Bottom Ash Pond, Fly Ash Pond, and a closed Old Ash Pond. The Bottom Ash Pond was constructed in 1972 and has an area of 11 acres, height of 24 feet, and approximate volume of 90 acre-feet. The Bottom Ash Pond formerly received bottom ash and low-volume wastewater (LVW), but currently only receives storm water runoff and operates per NPDES Permit IL0000116, Outfall 003. The Bottom Ash Pond stopped receiving CCPs when the last boiler unit ceased operation in February 2012, and reportedly dried out within a couple of months. The Fly Ash Pond was constructed in 1968 and has an area of 34 acres, height of 24 feet, and approximate volume of 500 acre-feet. The Fly Ash Pond primarily received fly ash, LVW, and storm water runoff and operates per NPDES Permit IL0000116, Outfall 004. The Fly Ash Pond also stopped receiving CCPs in February 2012 and reportedly dried out by October 2012. Both the Bottom Ash Pond and Fly Ash Pond were reported to be constructed using native materials.

The Old Ash Pond consisted of a bottom ash pond constructed in 1948 and removed from service in 1972, and two fly ash ponds constructed in 1960 and removed from service in 1968. The Old Ash Pond has an area of 17 acres, height of 15 feet, and approximate volume of 65 acre-feet. The Old Ash Pond is reported to be constructed of native materials and was capped with river dredge soil during the 1970's. The cover material is vegetated with grass and trees.

The MPS burned Illinois coal until 2003, at which time the larger of the units switched to Powder River Basin coal. The two smaller units burned Illinois Coal until their operation was suspended in 2009.

## 2.2 Regional Geology

The Meredosia Power Station is located in the Illinois Valley, where the Quaternary deposits consist of glacial outwash deposits belonging to the Henry Formation overlain by channel and floodplain deposits of the Cahokia Formation and fine-grained lacustrine sediments belonging to the Equality Formation (Berg and Kempton, 1987; Lineback, 1979). The Henry Formation consists of sorted and stratified sand and gravel with thickness of 60 to 84 feet in the vicinity of the MPS. The Cahokia Formation consists of deposits in the floodplains and channels of modern rivers and streams, and is comprised of mostly poorly sorted sand, silt, and clay with wood and shell fragments, and local deposits of sandy gravel (Lineback, 1979). The upper part consists of overbank silts and clays, while the coarser-textured lower portion is mainly sandy channel and lateral accretion deposits. The Cahokia Formation is generally greater than 20 feet thick in the vicinity of the MPS (Berg and Kempton, 1987). The Equality Formation consists of brown to gray to red bedded silt and clay deposited in glacial and postglacial lakes. In the study area, the Equality Formation occurs as thin patches (less than 20 feet thick) overlying the Henry Formation on the floodplain of the Illinois River (Berg and Kempton, 1987). The unlithified deposits are underlain by Mississippian age rocks, mostly limestone, of the Lower Valmeyeran Series (Willman et al., 1967). Additional detail is provided in Appendix A.

## 2.3 Water Resources

### 2.3.1 Surface Water

The major surface water body in the study area is the Illinois River, which flows from north to south and is located less than 200 feet west of the Bottom Ash and Fly Ash Ponds. Other surface water bodies in the area include Smith Lake, located less than one mile south of the MPS, and Meredosia Lake, located approximately 1.5 miles to the north. In addition, minor streams and drainage channels cut across the valley floor in the study area. These are either engineered structures or intermittent streams that drain into the Illinois River and its tributaries.

### 2.3.2 Groundwater

Berg, Kempton and Cartwright (1984) classified the area as AX (alluvium, a mixture of gravel, sand, silt, and clay along streams, variable in composition and thickness). Aquifers in the Meredosia area generally fall into two broad categories: (1) unconsolidated sediments that are glacial or alluvial in origin and contain mostly sand and gravel deposits interbedded with clay and silt; and, (2) bedrock aquifers consisting of sandstone and fractured limestone, which vary widely in permeability. The principal aquifer in the study area is the sand and gravel outwash deposits of the Henry Formation in the Illinois Valley. Well logs indicate that high capacity wells with yields up to 1000 gallons per minute (gpm) have been developed in this aquifer. Groundwater wells in the adjacent uplands are either shallow wells screened in thin sand and gravel lenses within Glasford Formation diamicton or bedrock wells installed in the Salem Limestone or the Burlington-Keokuk Limestone. Most upland wells are low-yielding and can only sustain domestic and farm groundwater supplies (Bergstrom and Zeizel, 1957).

### 2.3.3 Water Wells

Public records were searched to identify water wells located within 2,500 feet of the MPS impoundments. The Meredosia Plant property boundary is located in Township 16 North, Range 13 West, and the CCP impoundments are located within Sections 21 and 28. The 2,500-foot search radius encompasses portions of Sections 21, 22, 27, and 28. Wells identified within Sections 21, 22, 27, and 28 are shown on Figure 3 and tabulated in Appendix B.

The following sources of information were queried to identify water well locations:

- Illinois State Geological Survey's Illinois Water Well (ILWATER) Internet Map Service
- Illinois State Water Survey Domestic Well Database
- Illinois EPA's web-based Geographic Information System (GIS) files
- Illinois Department of Public Health
- Morgan County Health Department

Seventy-two well records were identified within the four sections surrounding the CCP impoundments and are numbered 1 through 72 on Figure 3 and in Appendix B, Table B-1. Thirty-one of these records are for borings advanced in 1941 on the MPS property, which coincides with the initiation of power plant construction activities (construction was suspended during World War II). All of these records list Central Illinois Public Service (CIPS) as the owner. These are believed to be site exploration or engineering borings rather than water well records, and as such are not shown on Figure 3; however, they are listed in Appendix B, Table B-1.

Based on state records, there are five community water supply (CWS) wells in the Sections surrounding the CCP impoundments: well numbers 9, 57, 62, 63, and 64 on Figure 3, although all of these wells are outside the 2,500-foor search radius. Four of the CWS wells are located in Section 22 on the northeast side of the village of Meredosia, and one mile from the CCP impoundments. The fifth CWS is the closest to the CCP impoundments, well number 63, located about one-half mile to the west.

According to the IEPA database, CWS wells 63 and 64 have a Minimum Setback Zone (MSZ) of 400 feet, well 64 also has a Phase I Wellhead Protection Area (WHPA) of 1000 ft, and well 09 has a Phase II WHPA, which is an extend area of protection (Figure 3).[1] Neither the CCP impoundments nor any other portion of the MPS property fall within these CWS well setback areas.

Three non-community water supply (NCWS) wells owned by Ameren were also identified in the IEPA database, located within Section 21, and on the MPS property (Figure 3). A phase I WHPA was established for these three NCWS wells. The WHPA does not extend to the CCP impoundments. The plant derived both its potable and production water from these wells while in operation.

Excluding plant wells, there are records for 19 water wells within 2,500 feet of the CCP impoundments. Four of these wells have coordinates in the state databases that incorrectly plot on the MPS property boundary, west of the CCP impoundments, and are listed as belonging to National Starch or WR Grace, suggesting that their actual location is south of their plotted locations. The remaining wells are located southeast of the Fly Ash Pond. As demonstrated in Section 4.2, these wells are all upgradient of the CCP impoundments.

---

[1] The Illinois Environmental Protection Act specifies a minimum setback zone of 200 to 400 feet around all CWS wells, and provides the option for well owners to establish a maximum zone and/or a wellhead protection area. Certain activities are regulated in these areas to reduce potential for contamination of groundwater withdrawn by the well.

# 3 MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

## 3.1 Monitoring Well Installation and Development

Five monitoring wells (APW-1, APW-2, APW-3, APW-4, and APW-5) were installed on October 25 and 26, 2010 (Figure 1) by Geotechnology, Inc. At each well location, subsurface borings were advanced with a rotary drill rig equipped with hollow-stem augers to facilitate soil classification. Soil was continuously sampled through the center of the hollow stem auger. Monitoring wells, constructed of 2” inside diameter schedule 40 PVC riser and screen, with steel above-ground well covers, were installed at each location to monitor groundwater within the uppermost water-bearing unit adjacent to the impoundment. The wells were constructed consistent with monitoring well construction standards per IAC Title 35, Section 811.318. Drilling and sampling equipment was decontaminated before sampling and between sample locations to prevent cross contamination. The monitoring wells were surveyed by a licensed surveyor.

Monitoring well construction and survey data are summarized in Table 1. Boring logs and well diagrams are included in Appendix C. Boring depths were between 23.1 and 30.3 feet below ground surface (bgs). A cross-sectional view of the five monitoring wells showing ground surface and well screen elevations is provided in Figure 4.

Monitoring wells were developed on November 17, 2010, by surging and pumping a minimum of five well volumes and until specific conductivity stabilized or the wells were pumped dry. The depth to groundwater was measured in each monitoring well using an electronic water level indicator. Groundwater levels ranged from approximately 9.1 to 25.6 feet bgs at the time of well installation.

## 3.2 Groundwater Sampling and Chemical Analysis

The monitoring wells were sampled during eight consecutive quarterly monitoring events from December 2010 through September 2012 in order to establish a statistical baseline for groundwater quality. However, as a result of flooding of lower lying areas adjacent to the Illinois River in the first half of 2010, well APW-4 could not be sampled during the second quarterly monitoring event in March and wells APW-2, APW-3, and APW-4 could not be sampled during the third quarterly event in June. The monitoring wells were purged and sampled for the first quarterly sampling event on December 13, 2010 using disposable bailers. Each monitoring well was purged until three well volumes were removed.

Water quality parameters including pH, specific conductivity, and temperature were monitored in the field. Groundwater depths ranged from 6.3 feet to 22.3 feet bgs in the five wells. Table 2 presents the groundwater depths and elevations.

Water samples were field filtered and preserved for all parameters (both general chemistry and metals) with the exception of cyanide. Sample containers were labeled, placed in an ice-filled cooler, and transported using standard chain-of-custody procedures. The first round of groundwater sampling was conducted by Geotechnology, Inc. and sample analyses conducted by Accutest Laboratories located in Marlborough, MA. The groundwater sampling information and laboratory analytical reports are provided in the Geotechnology, Inc. monitoring report dated February 18, 2011. The seven subsequent quarterly monitoring events were sampled by Ameren, and analyzed by PDC, Inc. All eight rounds of groundwater samples were analyzed for the inorganic parameters listed under Title 35, 620.410 with the exception of radium 226 and 228. Table 3 lists the field, general chemistry, and metal parameters monitored during the eight quarters of baseline sampling along with the analytical methods.

# 4 SITE HYDROGEOLOGY

## 4.1 Lithology

The information used to describe site hydrogeology is based on the local geology obtained from published sources as presented in Section 2.2 and Appendix A, and boring data collected at monitoring well locations APW-1 through APW-5. The three APW well borings closest to the Illinois River ranged in depth from 23.4 to 26.1 feet bgs and were advanced through the following unlithified materials in descending order:

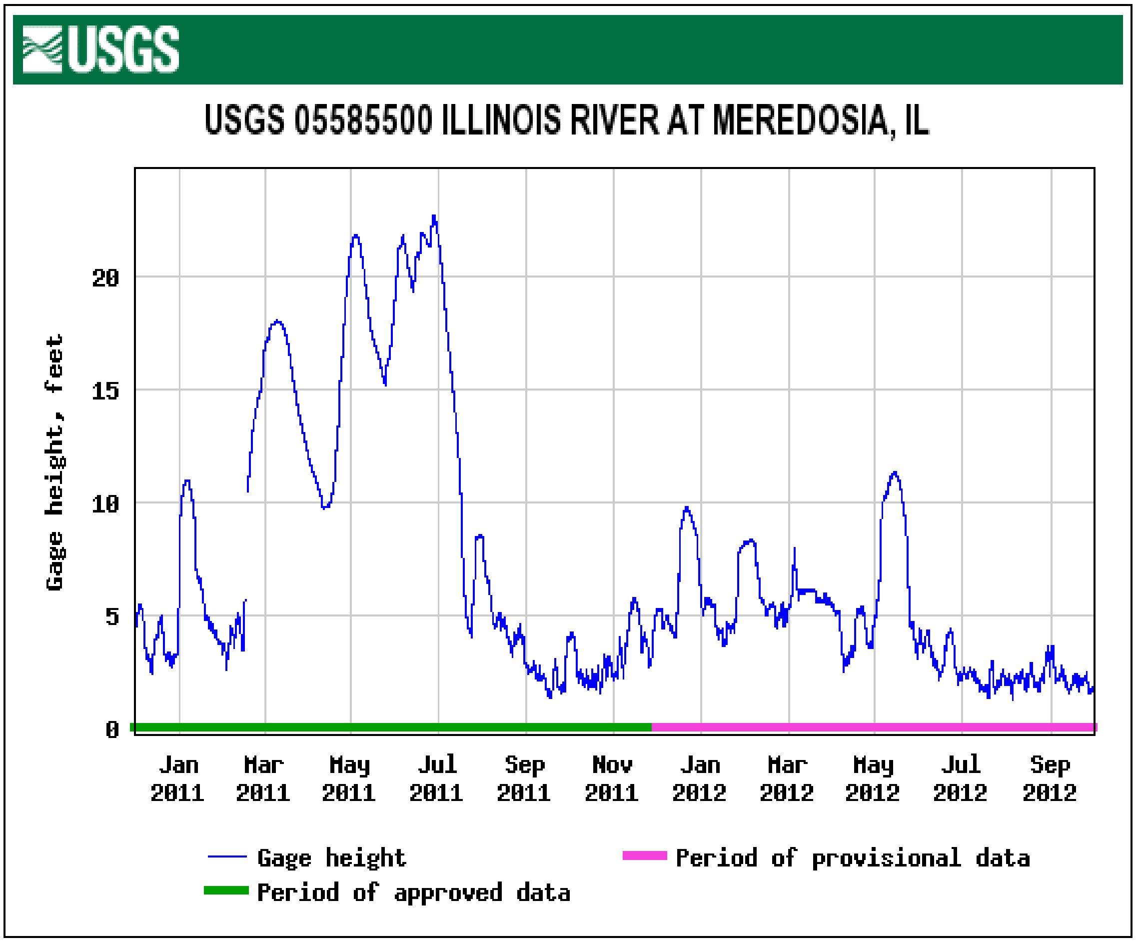
- 11.5 to 17 feet of clay and silty clay with some traces of sand; the two borings closest to the river (APW-2 and APW-3) both had 17 feet of clay, with clay thinning eastward away from the river to 11.5 feet at boring APW-4.
- Greater than 6 feet of fine to medium sand or silty sand with intermittent silty clay seams at borings APW-2 and APW-3, and greater than 14.6 feet of fine sand at boring APW-4.

The two borings furthest from the river, APW-1 and APW-5, were 25.2 and 30.3 feet deep, respectively, and were advanced entirely through fine to coarse sand. The deeper sands had trace to some gravel.

Monitoring wells APW-1, APW-4, and APW-5 were screened entirely within the sand deposits. The lower portion of monitoring wells APW-2 and APW-3 were screened within 0.9 and 5.6 feet of sand, respectively, with the upper portions screened within clay or silty clay.

## 4.2 Groundwater Flow

Groundwater elevation data (potentiometric levels) were collected from the five monitoring wells, all of which were wholly or partially screened within the uppermost sand deposits along the Illinois River. Groundwater depths and elevations are provided on Table 2 and graphically illustrated on time-series plots in Figure 5. Groundwater depths ranged from 2.8 to 26.5 feet bgs from December 2010 through September 2012. The shallowest groundwater depths were observed in June 2011, although only the two wells located at higher topographic elevations (APW-1 and APW-5) were measured due to flooding of low lying areas along the Illinois River, with the other three monitoring wells inaccessible. During this period the USGS Gaging Station on the Illinois River at the MPS intake structure (Station #05585500) recorded gage heights above 20 feet (see graph below), which were the highest river levels recorded during the two-year monitoring period. The deepest groundwater depths were observed in September 2012. During this period the gage height at the USGS Meredosia Station was below 5 feet. The time-series of groundwater elevations from December 2010 through September 2012 (Figure 5) illustrates that the highest groundwater elevations (i.e., shallowest) at each of the individual wells occurred in June 2011 and the lowest groundwater elevations (i.e., deepest) occurred in September 2012.



Potentiometric maps prepared using the December 2010 (Figure 6) and September 2012 (Figure 7) groundwater elevation data illustrate groundwater flow near the CCP impoundments during periods of relatively high and low groundwater levels as observed over the eight quarters of monitoring. Groundwater flow direction during December 2010 (Figure 6) was northwest towards the Illinois River at a horizontal gradient of approximately 0.0024 (Appendix F). Groundwater flow direction during the period of lowest groundwater elevations, as observed during September 2012, was also northwest but at a lower gradient of 0.0017, reflecting a period of below normal precipitation (i.e., drought) within the river basin and very low river stage. The hydraulic gradient calculations in Appendix F indicate a relatively consistent northwest flow direction between 324.2 and 330.3 degrees (from north) for the six quarters when all five monitoring wells were accessible. Flow direction was not calculated when one or more wells were not accessible on March 24 and June 24 2011 because the missing data points affect the results of the calculation. However, review of Table 2 shows that on March 24, 2011, the two monitoring wells closest to the river (APW-2 and APW-3) had lower groundwater elevation than the two wells farthest from the river (APW-1 and APW-5), suggesting a westward flow direction even though river stage was more than 1 foot higher than groundwater elevations. The two available wells on June 24, 2011, near the peak of the flood event, suggest the possibility of a slight flow reversal because the well closer to the river (APW-5) had a slightly higher elevation than the well farther from the river (APW-1).

The predominant northwest direction of groundwater flow suggests low potential for off-site migration from the CCP impoundments. As noted in Section 5, APW-4, which lies close to the south property boundary, has boron concentrations indicating water quality impacts from the CCP impoundment—likely due to a halo effect. However, this monitoring well is within 25 feet of the Fly Ash Pond, while it is about 60 feet from the property boundary. Given the strong northwest gradients measured at the site over most of the monitoring period, there is no evidence for assuming a sustained hydraulic gradient toward the south capable of causing off-site migration.

## 4.3 Potential For Groundwater Receptors

A potential groundwater receptor is a water supply well located in a position that can be interpreted as downgradient from the CCP impoundment, and screened within a geologic formation that can reasonably be expected to be a groundwater migration pathway in the event of a release.

Figure 3 shows water wells located within the vicinity of the CCP impoundment. All active water supply wells within 2,500 of the CCP impoundment, other than plant production wells, are southwest and upgradient of the CCP impoundments. APW-5 lies between the CCP impoundments and many of these wells and, as described in the next section, shows no evidence of groundwater quality impacts from the CCP impoundments. Since this monitoring well is in a position where impacts are expected in the event of a release and groundwater flow reversals, the lack of impacts supports the earlier conclusion that there are no groundwater flow reversals sustained for a sufficient period of time to cause off-site migration. The closest community water supply wells are either more than one-half mile upgradient (well number 63) or one mile sidegradient (wells 9, 57, 62, and 64) of the CCP impoundments (Figure 3), in positions where groundwater beneath the CCP impoundments cannot reasonably be expected to flow given the predominant northwest flow direction observed at the site. These observations indicate no potential for groundwater receptors downgradient of the CCP impoundments at MPS.

# 5 GROUNDWATER CHEMISTRY

## 5.1 Overview

The purpose of the sampling and inorganic analysis of groundwater from monitoring wells at the MPS CCP impoundments was to assess background and downgradient groundwater quality, evaluate elevated concentrations and those exceeding groundwater standards, and identify primary factors potentially influencing groundwater quality changes spatially and temporally.

All of the groundwater quality data collected and analyzed for both field and laboratory parameters, including the full list of inorganic parameters listed in IAC 35 Part 620 Section 410 except for Radium 224/226, are provided in Appendix D for the eight quarters of monitoring conducted from December 2010 through September 2012 for the five monitoring wells APW-1 through APW-5.

A statistical summary of all of the water quality data at each of the five monitoring wells is provided in Table 4, including the mean, median, maximum, minimum, standard deviation, and percent non-detects. Based on the low concentrations of coal ash indicator constituents (boron and sulfate) and groundwater elevation data, monitoring well APW-1, located more than 1,000 feet east of the nearest CCP impoundment, can be regarded as representing upgradient (background) groundwater quality and wells APW-2, APW-3, APW-4, and APW-5 characterize groundwater quality downgradient (APW-2 and APW-3) or sidegradient (APW-4 and APW-5) from the CCP impoundments.

Since the monitored unit at the CCP impoundments consists predominantly of thick sand deposits, the applicable groundwater standard is Class I. Parameter concentrations exceeding the Class I groundwater standards at the time of sampling are highlighted in Table 4.

## 5.2 Comparison of Groundwater Quality to Class I Standards

A listing of all exceedances of Class I groundwater quality standards in effect at the time of sampling, sorted by parameter, well location, and sample date, is provided in Appendix E. Parameters with exceedances are also highlighted on Table 4. The parameters with groundwater quality exceedances were: pH, arsenic, boron, iron, and manganese.

- pH: APW-2 (1 of 7 samples), APW-4 (1 of 6), APW-5 (1 of 8)
- Arsenic: APW-3 (7 of 7), APW-4 (3 of 6)
- Boron: APW-2 (7 of 7), APW-3 (7 of 7), APW-4 (6 of 6)

- Iron: APW-3 (1 of 7), APW-4 (5 of 6)
- Manganese: APW-2 (7 of 7), APW-3 (7 of 7), APW-4 (6 of 6)

The pH values at wells APW-2, APW-4, and APW-5 that were lower than the 6.5 standard occurred only in the first monitoring event and were most likely caused by systematic error due to instrument calibration or non-stabilized groundwater geochemistry at the time of sampling. Coal ash leachate tends to be alkaline and is therefore not a source of low pH.

The boron concentrations and exceedances indicate a release from the Fly Ash Pond. There are no monitoring wells directly downgradient of the Bottom Ash Pond and Old Ash Pond, and no determination was made as to whether or not these impoundments are contributing to the observed concentrations.

Iron and manganese concentrations do not correlate with boron (Figure 8), indicating that these concentrations are due to a different cause. Most likely, the elevated iron and manganese concentrations are in response to local redox conditions.

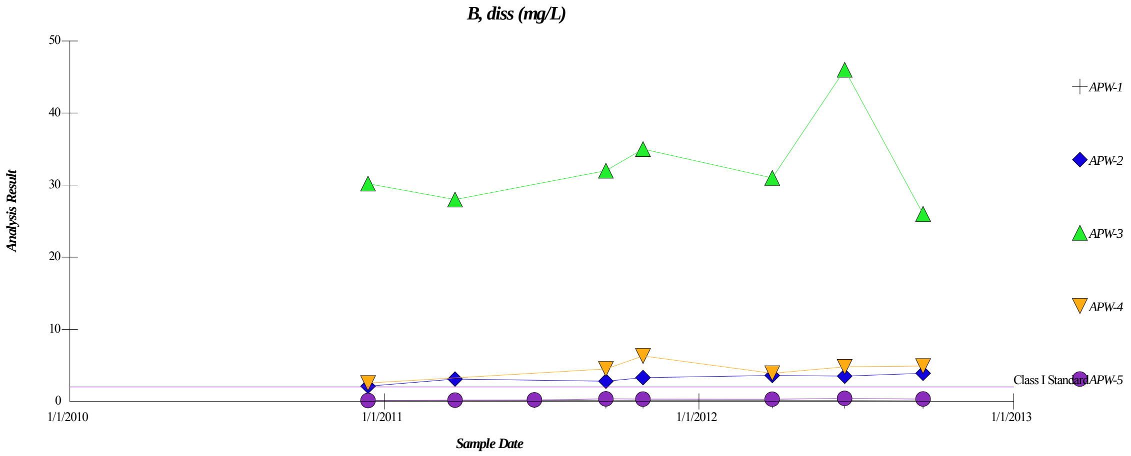
Arsenic concentrations correlate with boron (Figure 9), suggesting that the arsenic exceedances at APW-3 and APW-4 are associated with the Fly Ash Pond. However, there may be other potential sources upgradient of these monitoring wells, specifically industrial impoundments on the Celanese property (see Figures 6 and 7), and because there are no groundwater samples with low arsenic concentrations between the Celanese ponds and APW-3 and APW-4, the effect of a potential release from these ponds on groundwater quality is not determined at this point in time.

## 5.3 Groundwater Quality Analysis

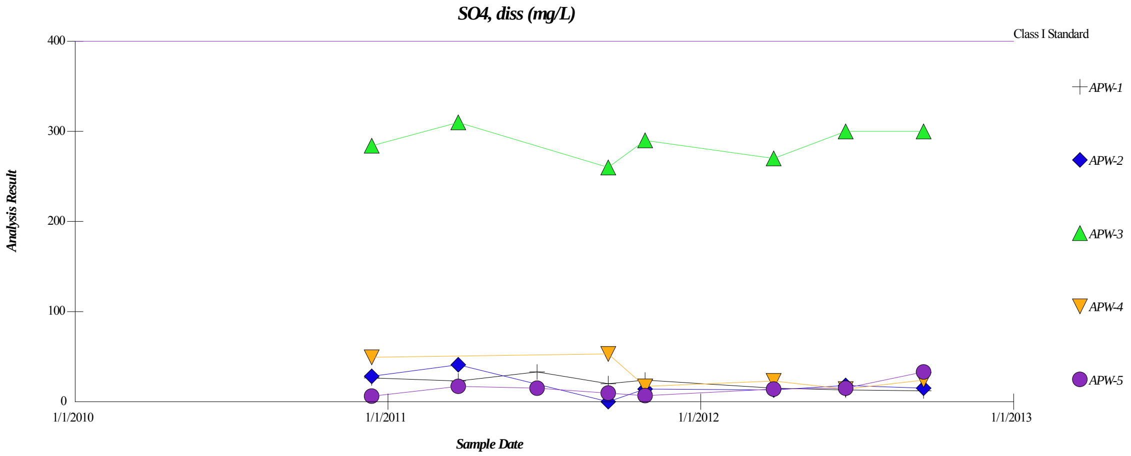
### 5.3.1 Primary Coal Ash Leachate Indicators

Boron and sulfate are the primary indicator constituents for coal ash leachate. Median background boron and sulfate concentrations in groundwater at the CCP impoundment (i.e., at well APW-1) were 0.11 and 22 mg/L, respectively. Median boron concentrations at APW-2, APW-3, and APW-4 ranged from 3.3 to 31 mg/L. These concentrations are indicative of impacts from coal ash leachate. Boron and sulfate both have elevated concentrations in coal ash leachate, and while boron concentrations suggest coal ash leachate at APW-2, APW-3, and APW-4, sulfate concentrations only suggest coal ash impacts at APW-3 because concentrations at APW-2 and APW-4 are at background levels. Neither boron nor sulfate exhibited any concentration trend over the period of monitoring.

| **Well No.** | **Median Concentration** | |
|---|---|---|
| | **Boron mg/L** | **Sulfate mg/L** |
| APW-1 | 0.11 | 22 |
| APW-2 | 3.3 | 18 |
| APW-3 | 31 | 290 |
| APW-4 | 4.7 | 24 |
| APW-5 | 0.31 | 15 |
| *IL Class I Standard* | *2.0* | *400* |



*Graph showing boron concentrations versus time.*



*Graph showing sulfate concentrations versus time.*

One hypothesis for the difference in boron and sulfate concentrations is that there is another source of boron other than coal ash in the area. Since no other sources of boron have been identified in the area, this hypothesis seems less likely.

A second hypothesis is that geochemical conditions in the aquifer are strongly reducing. Reduced conditions can be identified according to the inorganic compound acting as the predominant electron acceptor in a given part of an aquifer. Common reduced conditions (and geochemical indicators of these conditions) in groundwater, from least reducing to most reducing, are nitrate reducing (where dissolved nitrate is depleted), manganese reducing (dissolved manganese concentrations increase), iron reducing (dissolved iron concentrations increase), sulfate reducing (sulfate concentrations decrease), and carbon-dioxide reducing (methane is produced). According to USGS (2006), “nitrate reduction, manganese reduction, and iron reduction commonly are together referred to as mildly reducing conditions, whereas sulfate reduction and methanogenesis commonly are referred to as strongly reducing conditions.”

Evidence of reducing conditions is apparent based on the decreasing nitrate concentrations, and increasing manganese and iron concentrations from upgradient monitoring wells APW-1 and APW-5 to downgradient monitoring wells APW-2, APW-3, and APW-4. USGS (2006) notes that there are several factors that complicate interpretation of redox conditions along a groundwater flow path. One of these conditions is that an increase in sulfate concentrations along the groundwater flow path, as is expected at the MPS CCP impoundments, can mask sulfate consumption by redox reactions. If the hypothesis of sulfate reduction is occurring at MPS, then boron concentrations, which are not affected by redox conditions, are the best indicator of coal ash leachate impacts at this site.

| | **Upgradient Medians** | | **Downgradient Medians** | | |
|---|---|---|---|---|---|
| | **APW-1** | **APW-5** | **APW-2** | **APW-3** | **APW-4** |
| Nitrate (mg/L) | 3.3 | 2.0 | 0.020 | 0.020 | 0.030 |
| Manganese (mg/L) | 0.004 | 0.001 | 0.83 | 0.30 | 3.2 |
| Iron (mg/L) | 0.010 | 0.010 | 0.34 | 0.41 | 10. |
| Sulfate (mg/L) | 22 | 18 | 290 | 24 | 15 |

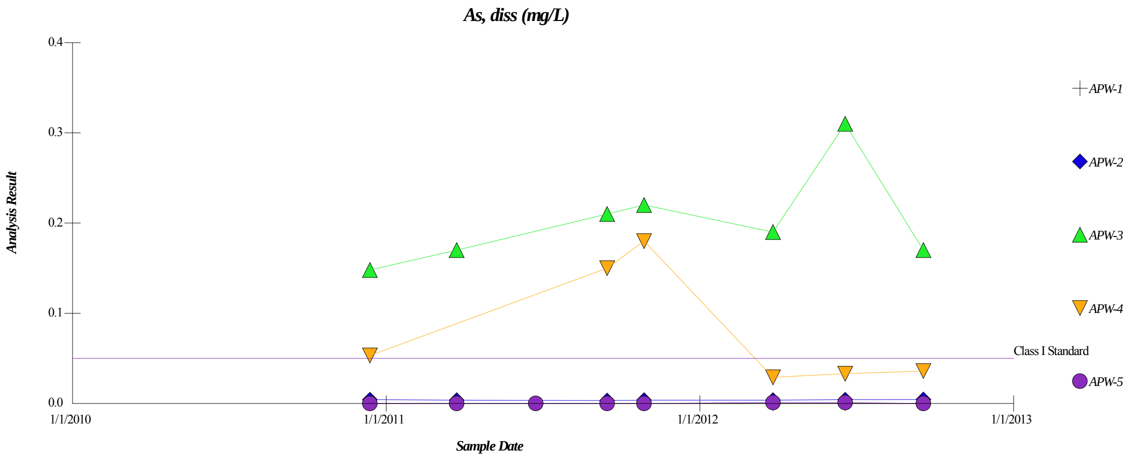
### 5.3.2 Other Constituents Potentially Impacted by Coal Ash Leachate

The constituents listed in the table below had multiple samples from downgradient monitoring wells with concentrations higher than background, suggesting that they are potentially, but not necessarily, associated with coal ash management at the site as described below.

| **Well No.** | **Median Concentration** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **As mg/L** | **Ba mg/L** | **Cd mg/L** | **Cl mg/L** | **Co mg/L** | **F mg/L** | **Ni mg/L** | **pH SU** | **Se mg/L** | **TDS mg/L** |
| APW-1 | <0.001 | 0.015 | <0.001 | 12 | <0.002 | <0.25 | <0.005 | 7.25 | 0.002 | 185 |
| APW-2 | 0.004 | 0.050 | <0.001 | 44 | 0.003 | 0.30 | 0.011 | 7.15 | 0.002 | 460 |
| APW-3 | 0.19 | 0.050 | 0.001 | 54 | <0.002 | 0.32 | 0.010 | 8.21 | 0.002 | 710 |
| APW-4 | 0.045 | 0.070 | <0.001 | 52 | <0.002 | 0.46 | 0.010 | 7.05 | 0.014 | 444 |
| APW-5 | <0.001 | 0.009 | <0.001 | 2.7 | <0.002 | <0.25 | <0.005 | 7.58 | 0.002 | 240 |
| *IL Class I Standard* | *0.05** | *2* | *0.005* | *200* | *1.0* | *4.0* | 0.10 | *<6.5, >9.0* | *0.05* | *1200* |

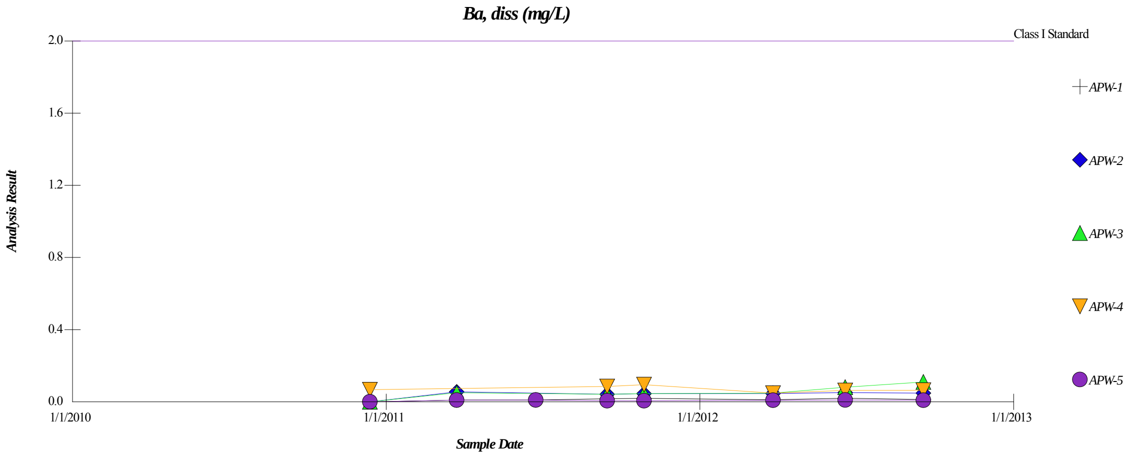
* The arsenic Class I standard was 0.05 mg/L at the time the samples were collected

Arsenic concentrations are below the detection limit in all samples from background well APW-1. Arsenic concentrations are also very low at well APW-2 (next to the Bottom Ash Pond), with median and maximum arsenic concentrations of 0.004 mg/L, and at well APW-5 (next to the Old Ash Pond), with median and maximum arsenic concentrations of 0.001 mg/L and 75 percent non-detects. The two monitoring wells downgradient and sidegradient from the Fly Ash Pond, APW-3 and APW-4, had the highest observed arsenic concentrations with medians of 0.19 and 0.045 mg/L, respectively.



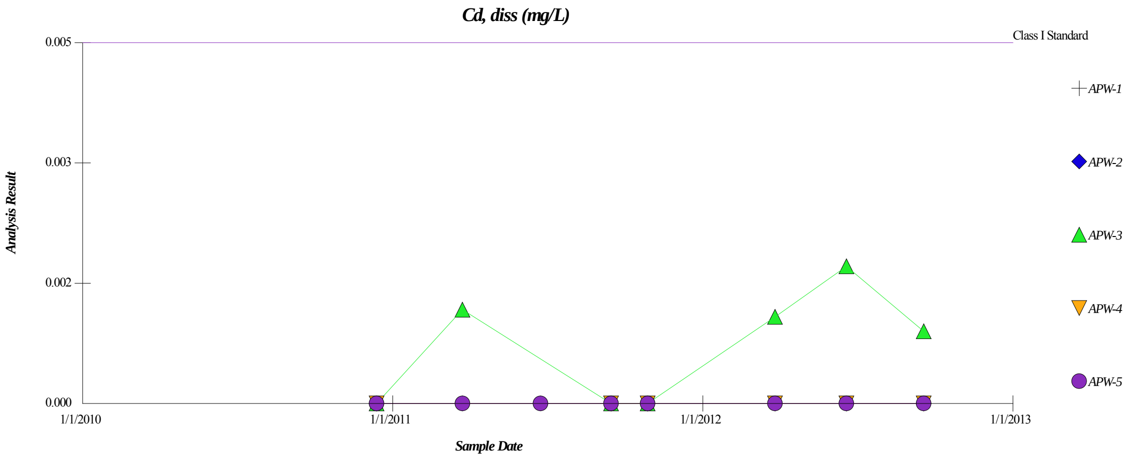
*Graph showing arsenic concentrations versus time. Non-detects are plotted as zero. Class I standard in effect at the time of sampling.*

Median barium concentrations in downgradient wells APW-2, APW-3, and APW-4 were slightly higher than the median background concentration of 0.015 mg/L. These wells also had elevated boron concentrations, suggesting that the barium concentrations in the downgradient wells, which are more than an order of magnitude lower than the Class I standard, are associated with coal ash leachate.



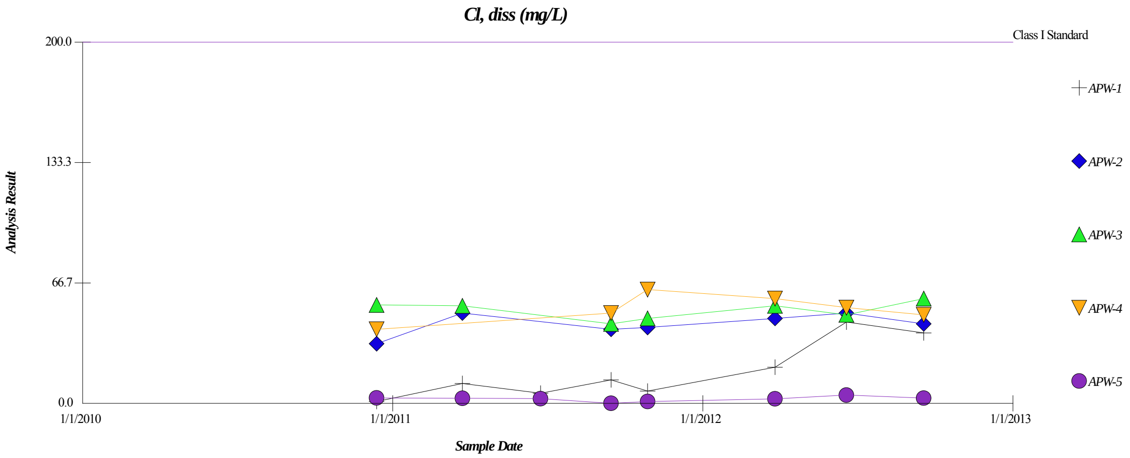
*Graph showing barium concentrations versus time. Non-detects are plotted as zero.*

Cadmium was only detected in APW-3. Concentrations were a factor of two or more lower than the Class I standard; however, it was detected in 4 of the 7 samples. The frequency of cadmium detections, in combination with the high boron concentration at APW-3, suggests that the low cadmium levels observed in this monitoring well is associated with coal ash leachate.



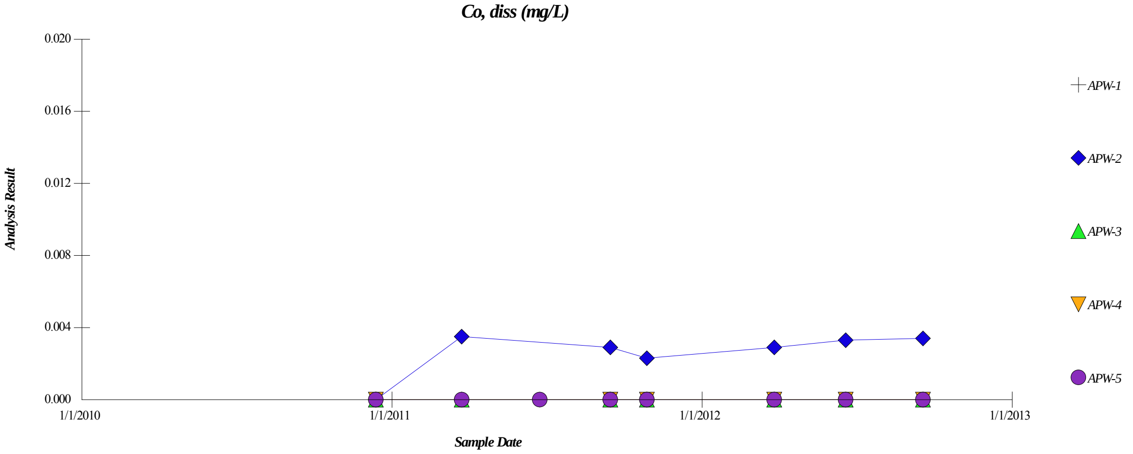
*Graph showing cadmium concentrations versus time. Non-detects are plotted as zero.*

All chloride concentrations are a factor of three or more lower than the Class I standard. The highest median concentrations occur in APW-2, APW-3, and APW-4. These wells also had boron concentrations indicative of impacts by coal ash leachate, suggesting that the chloride concentrations higher than background are also indicative of coal ash leachate. However, coal ash cannot be definitively attributed as the source of chloride because: 1) chloride concentration was similar in all three downgradient wells, while boron concentration was much higher in APW-3 than the other downgradient wells; and 2) the last two chloride concentration in background well APW-1 increased to similar levels as the downgradient monitoring wells. An alternative hypothesis to explain the observed chloride concentrations is that there is an intermittent upgradient source of chloride. Under this hypothesis, the downgradient wells are monitoring an older pulse of chloride while APW-1 is monitoring a newer pulse.



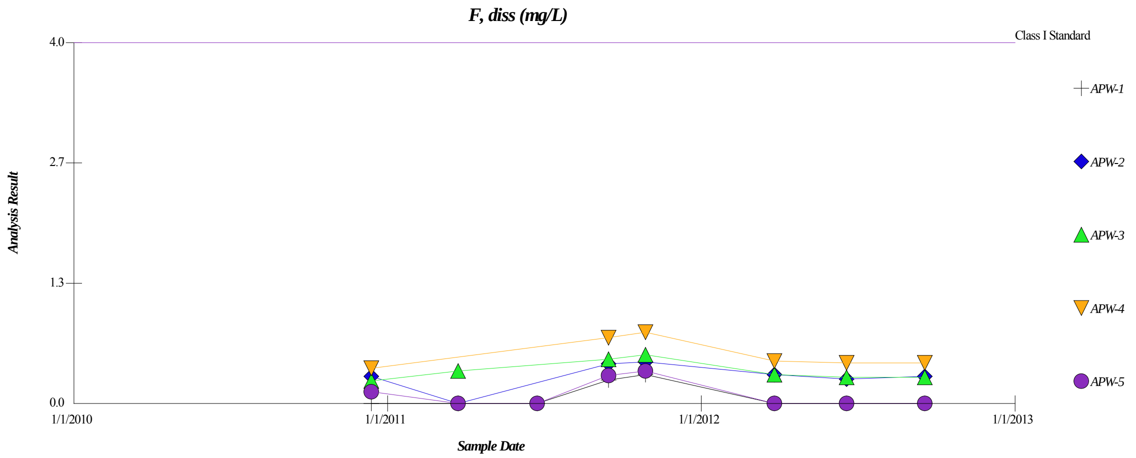
*Graph showing chloride concentrations versus time.*

Cobalt was only detected in APW-2; however it was consistently detected in this monitoring well after the first sample event. All detected concentrations (maximum of 0.004 mg/L) were more than two orders of magnitude lower than the Class I standard. The lack of cobalt in APW-3, which had the highest coal ash indicator (boron) concentration, suggests that the observed cobalt concentrations in APW-2 reflect different geochemistry or a different source than the observed boron concentrations. Since APW-2 is close to the Bottom Ash Pond, a plausible hypothesis is that the cobalt originates from the Bottom Ash Pond, rather than the Fly Ash Pond.



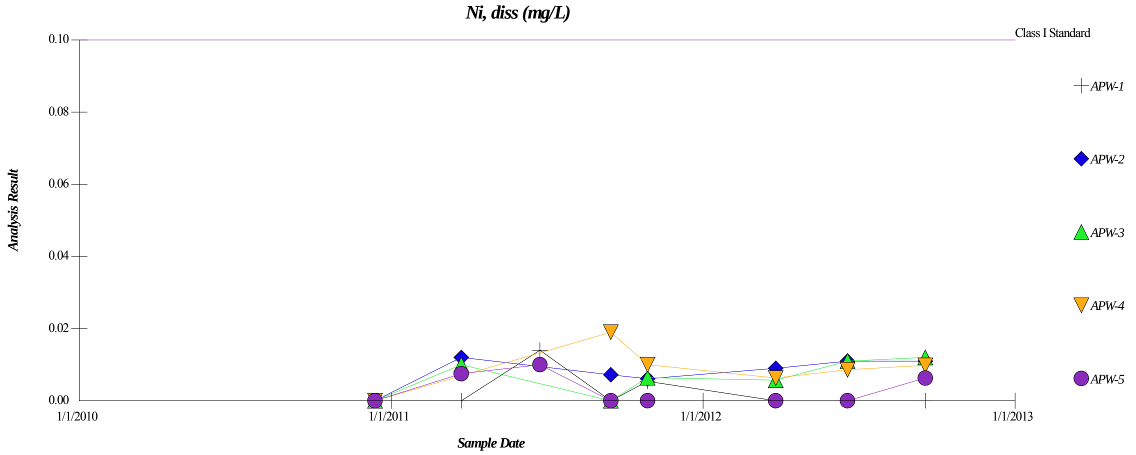
*Graph showing cobalt concentrations versus time. The Y axis is zoomed for clarity, and the Class I standard of 1.0 mg/L is not shown. Non-detects are plotted as zero.*

All fluoride concentrations are a factor of five or more lower than the Class I standard. The highest median concentrations occur in APW-2, APW-3, and APW-4. These wells also had boron concentrations indicative of impacts by coal ash leachate, suggesting that the fluoride concentrations higher than background are also indicative of coal ash leachate. However, coal ash cannot be definitively attributed as the source of fluoride because the distribution of fluoride differed from ash indicator constituent boron, with the highest fluoride concentrations in APW-4 relative to the highest boron concentrations in APW-3. One hypothesis to explain this difference is that fluoride has a higher concentration in leachate at the southern end of the main ash pond, closest to APW-4. An alternative hypothesis, considering that APW-4 is situated on the southern property boundary and groundwater flow is predominantly towards this well from the southeast (off site), is that there is an off-site source of fluoride to the southeast unrelated to the CCP impoundment.



*Graph showing fluoride concentrations versus time. Non-detects are plotted as zero.*

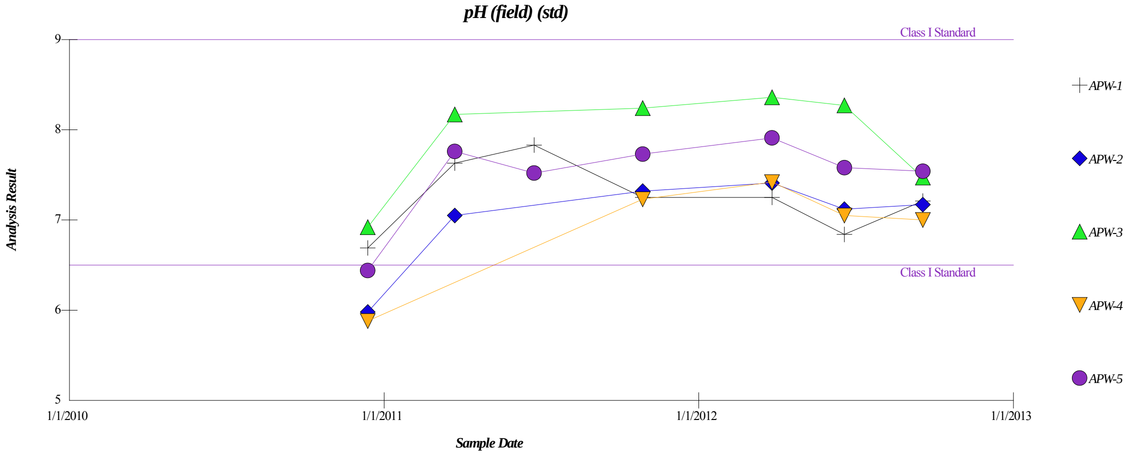
Nickel was detected more frequently in downgradient wells APW-2, APW-3, and APW-4 than background monitoring well APW-1; although detected concentrations were a factor of 5 or more lower than the Class I standard. These wells also had elevated boron concentrations, suggesting that the nickel concentrations in the downgradient wells are associated with coal ash leachate.



*Graph showing nickel concentrations versus time. Non-detects are plotted as zero.*

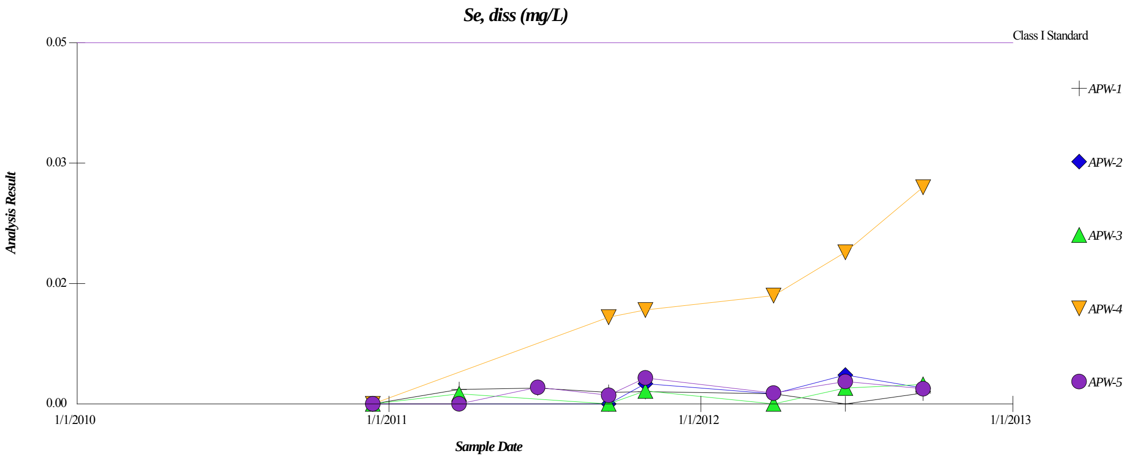
The lowest pH readings at each of the five monitoring wells ranged from 5.88 to 6.92 and occurred in the first quarterly sampling event. No similarly low pH readings were observed in the subsequent seven quarters of monitoring at each individual monitoring well. Given this observation, it appears that the field instrumentation used to measure the pH was not calibrated accurately, leading to a systematic error of low pH readings in all of the groundwater samples in December 2010. An alternative explanation to account for the low pH readings is that the groundwater was not stabilized from the drilling and well installation.

The median pH values for the monitoring wells, with the exception of well APW-3, ranged between 7.05 to 7.58, and the median pH of background well APW-1 was 7.25. Monitoring well APW-3, located downgradient of the fly ash impoundment, had a median pH of 8.21. It is possible that the pH observed at APW-3 is due to a localized naturally-occurring condition; however, given the high boron concentration observed in this well and the fact that coal ash leachate tends to be alkaline, it is also possible that the pH observed at APW-3, while within the Class I standard range, is affected by coal ash leachate.



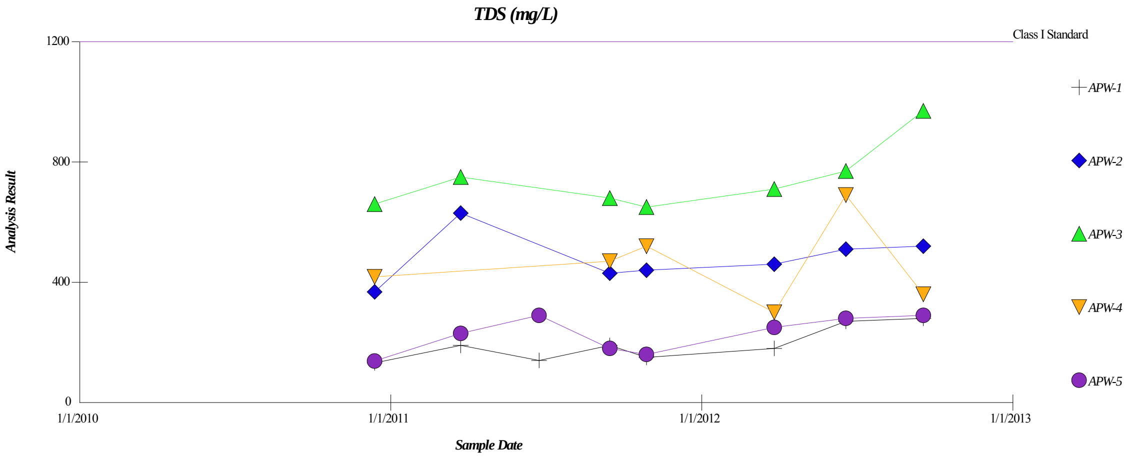
*Graph showing pH values versus time.*

Selenium concentrations were very low in four of the five monitoring wells, with median concentrations of 0.002 mg/L in wells APW-1, APW-2, APW-3, and APW-5. Selenium concentrations were higher than background at APW-4, with a median concentration of 0.014 mg/L and a maximum concentration of 0.030 mg/L. Ignoring the first sample, which appears to be anomalous due to well installation effects, selenium concentrations increased in 2012 at APW-4; although they were lower than the Class I standard. Since coal ash indicator boron had elevated concentration in APW-4, coal ash cannot be eliminated as a potential source of selenium. However, it is difficult to explain why selenium concentrations increased in 2012 while boron concentrations were steady. An alternative hypothesis is that the selenium concentration is from an off-site source. Under this hypothesis, concentration increased in 2012 after the Fly Ash Pond was removed from service and began to dewater, resulting in less hydraulic head beneath the pond and enabling more flow toward APW-4 from the southeast.



*Graph showing selenium concentrations versus time. Non-detects are plotted as zero.*

Total dissolved solids (TDS) were higher than background in each of APW-2, APW-3, and APW-4, with the highest concentrations in APW-3. This distribution is similar to boron, suggesting that TDS concentrations, while lower than the Class I standard, are affected by coal ash leachate.



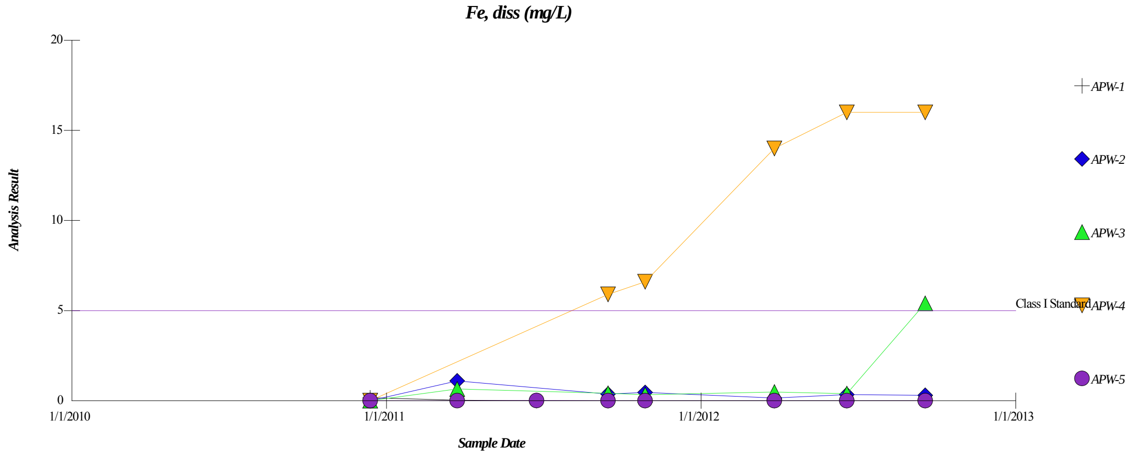
*Graph showing total dissolved solids concentrations versus time.*

### 5.3.3 Constituents with Elevated Concentrations Due to Causes Other than Coal Ash Leachate

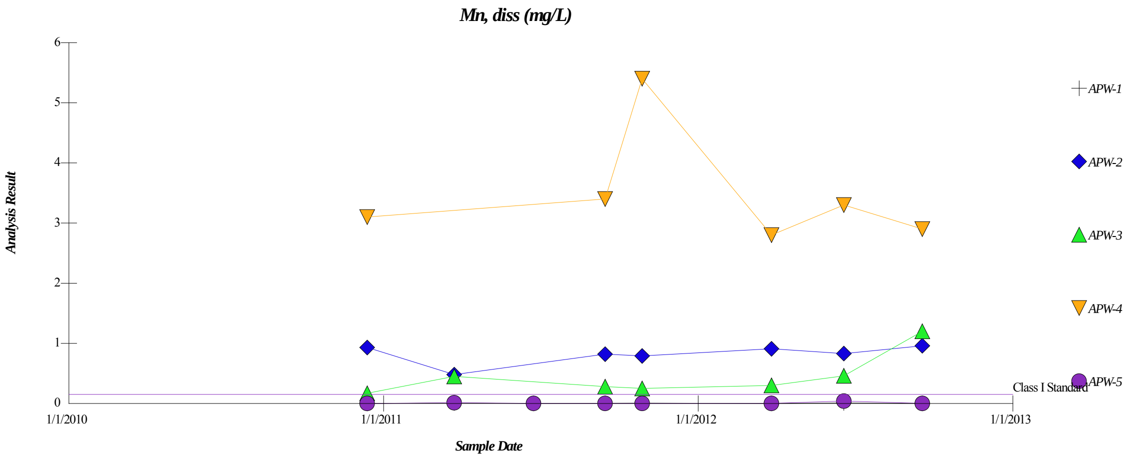
Iron and manganese have concentrations higher than the Class I standard in downgradient groundwater, but these concentrations are not attributed to coal ash leachate because: 1) they do not correlate with ash indicator constituent boron (Figure 8); and 2) they are reflective of the geochemical environment in groundwater. In this case, the geochemical environment is oxic at upgradient wells APW-1 and APW-5, and reduced at downgradient monitoring wells APW-2, APW-3, and APW-4.

| | **Median Concentration** | |
|---|---|---|
| **Well No.** | **Iron mg/L** | **Manganese mg/L** |
| APW-1 | <0.01 | 0.004 |
| APW-2 | 0.34 | 0.83 |
| APW-3 | 0.41 | 0.30 |
| APW-4 | 10. | 3.2 |
| APW-5 | <0.01 | 0.001 |
| *IL Class I Standard* | *5* | *0.15* |

Evidence of a change in redox environment that is causing the difference in concentrations between upgradient wells and downgradient wells includes nitrate concentrations that decrease from upgradient to downgradient, consistent with a change from oxic to reduced conditions, and boring logs that show brown material (indicative of oxic environment) in APW-1 and APW-5 and a combination of brown material and grey material (indicative of a reduced environment) at APW-2, APW-3, and APW-4. The iron concentration increase observed at APW-4 in 2012, and the last sample in 2012 from APW-3, may be indicative of a temporal change in geochemical conditions as the Fly Ash Pond dewatered.



*Graph showing iron concentrations versus time. Non-detects are plotted as zero.*

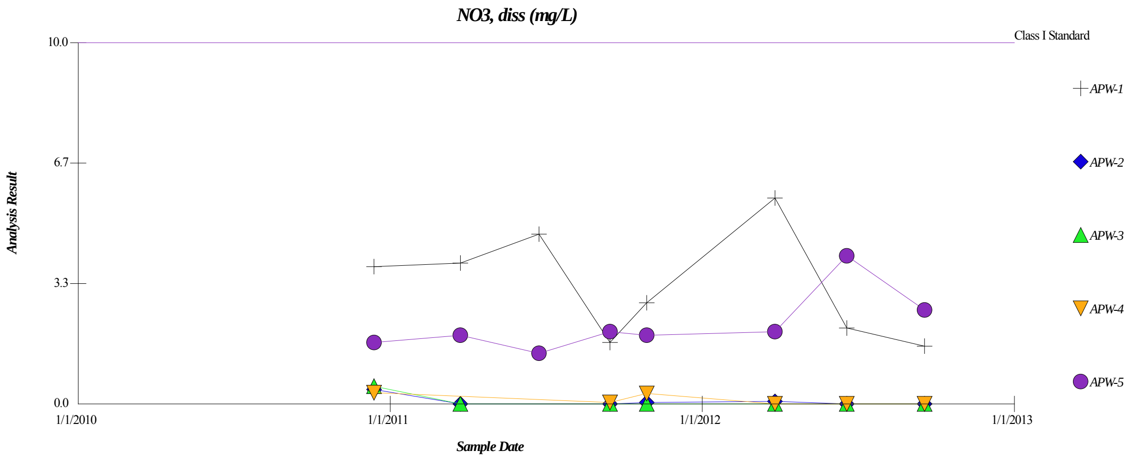


*Graph showing manganese concentrations versus time. Non-detects are plotted as zero.*

### 5.3.4 Constituents with Concentrations Near or Below Background

Nitrate concentrations in the groundwater samples were highest in background well APW-1, with a median concentration of 3.3 mg/L, and next highest in APW-5, which is sidegradient of the CCP impoundments and showed no groundwater quality impacts associated with coal ash management at the site. A potential upgradient source of nitrate is the agricultural fields east and southeast of the MPS property.

| **Well No.** | **Median Concentration** |
|---|---|
| | **Nitrate mg/L** |
| APW-1 | 3.3 |
| APW-2 | <0.02 |
| APW-3 | <0.02 |
| APW-4 | 0.03 |
| APW-5 | 2.0 |
| *IL Class I Standard* | *10* |



*Graph showing nitrate concentrations versus time. Non-detects are plotted as zero.*

### 5.3.5 Constituents That Were infrequently or Not Detected

The following constituents were below their respective detection limits during the eight sample events from 2010 through 2012 at all five monitoring wells: antimony, copper, cyanide, mercury, and silver. Beryllium, chromium, lead, thallium, and zinc were detected in less than two-thirds of the samples, and when detected had low concentrations.

| | | **Beryllium mg/L** | **Chromium mg/L** | **Lead mg/L** | **Thallium mg/L** | **Zinc mg/L** |
|---|---|---|---|---|---|---|
| APW-1 | Max | n/a | n/a | n/a | n/a | n/a |
| | % BDL | 100% | 100% | 100% | 100% | 100% |
| APW-2 | Max | n/a | n/a | 0.001 | n/a | 0.006 |
| | % BDL | 100% | 100% | 87.5% | 100% | 87.5% |
| APW-3 | Max | 0.001 | n/a | 0.001 | 0.001 | 0.012 |
| | % BDL | 87.5% | 100% | 87.5% | 87.5% | 87.5% |
| APW-4 | Max | 0.002 | 0.007 | n/a | n/a | 0.007 |
| | % BDL | 66.7% | 83.3% | 100% | 100% | 83.3% |
| APW-5 | Max | n/a | n/a | n/a | n/a | n/a |
| | % BDL | 100% | 100% | 100% | 100% | 100% |
| *Illinois Class I Standard* | | *0.004* | *0.1* | *0.0075* | *0.002* | *5.0* |

## 5.4 Boron and Arsenic Loading to the Illinois River

Groundwater in the vicinity of the MPS CCP impoundments discharges to the Illinois River. A mixing calculation was performed to conservatively estimate the impact of boron and arsenic discharge to the river on concentrations in river water. The loading rate was calculated by multiplying the volume of groundwater flowing into the river by the concentration of boron and arsenic in groundwater.

$L = C * Q$ and

$Q = K * I * A$

Where

C = Concentration in groundwater. To be conservative, the highest single concentration in groundwater monitoring wells at the site was initially used in this calculation (Cmax). A second calculation was performed using the median of the three monitoring wells near the river (APW-2, APW-3, and APW-4).

Q = Volume of groundwater discharging to the river.

K = Hydraulic conductivity of the aquifer. The monitoring wells were not tested for hydraulic conductivity; however, Gibb et al. (1979) published hydraulic conductivity values for wells along the Illinois waterway, which included a site-specific value of 1,200 gpd/ft$^2$ ($5.7 \times 10^{-2}$ cm/s) for a MPS production well.

I = Maximum hydraulic gradient for the site. A second calculation was performed using the median of the six hydraulic gradients calculated for the site (hydraulic gradients were not calculated for the two measurement events when some wells were not accessible due to flooding).

A = Cross-sectional area through which this groundwater discharge to the river occurs. To be conservative, it was assumed that the concentration used in the calculation occurred over the entire thickness of the aquifer, and along the entire length of the Fly Ash Pond parallel to the river, plus 500 feet north and south of the pond. In reality, concentration will decrease with depth in the aquifer and with distance north and south of the pond.

The loading rate (L) was then divided by: 1) the 7-day 10-year low flow ($Q_{7,10}$); and 2) the median of average annual flow at the Meredosia gaging station to estimate the incremental concentration increase ($d_B$) in the river due to discharge from the Fly Ash Pond. Due to the size of the Illinois River, it is unlikely that concentration would initially be distributed across the entire width of the river. Therefore, an additional calculation was performed to determine the incremental concentration increase assuming that mixing occurred within 50 feet of the shoreline. This calculation was performed by multiplying $d_B$ by 750/50 (750 feet being total river width and 50 feet being the assumed mixing width).

The result of the boron calculation based on maximum concentration, maximum hydraulic gradient, and the $Q_{7,10}$ (Appendix F) is a very conservative estimate of the increase in boron loading to the Illinois River. This result (0.27 mg/L) suggests that a measurable boron increase could occur near shore for worst case conditions at low flow. However, the incremental increase of 0.0035 mg/L calculated using median concentration, median hydraulic gradient, and median annual river discharge is lower than the instrument detection limit for boron as listed by the United States Environmental Protection Agency in method SW-846, 6010c, and suggests that the impact will not be measurable under typical conditions.

The calculations for arsenic suggest that it may be measurable in river water under worst case conditions (incremental increase of 0.0018 mg/L), assuming that it does not precipitate or sorb from solution prior to reaching the groundwater/surface water interface. However, under typical conditions arsenic will not have a measurable impact (incremental concentration increase of 0.000033 mg/L) on concentrations within the Illinois River.

# 6 CONCLUSIONS

## 6.1 Conclusions

The primary conclusion from voluntary monitoring of groundwater at the Meredosia Power Station CCP impoundments is that the operation of the impoundments has caused exceedances of Class I groundwater quality standards for boron and possibly arsenic. Class I standards for manganese and iron are also exceeded in places, although these concentrations are attributed to local redox conditions rather than CCP impoundment operation. Exceedances of Class I standards for pH are not related to CCP impoundment operation.

Furthermore:

- The surficial lithologic unit at the site consists of fine- to coarse-grained alluvium. Boron concentrations in underlying groundwater indicate that there is a vertical migration pathway through the surficial deposits.
- Groundwater flow at the site was northwest toward the Illinois River during all events in which it could be measured.
- Based on consistent hydraulic gradients to the northwest, toward the Illinois River, there is no evidence of off-site migration and there are no potential groundwater receptors downgradient of the MPS impoundment.
- Sulfate, barium, cadmium, cobalt, nickel, and TDS had concentrations in downgradient groundwater that, while lower than Class I standards, are higher than background and have been attributed to coal ash impacts.
- Chloride, fluoride, and selenium also have downgradient concentrations higher than background. Coal ash is a potential source for these constituents, but the distribution of concentrations also suggests potential for an alternative off-site source. Specifically, the strongest CCP impoundment impacts, as indicated by the highest boron concentrations, were observed in monitoring well APW-3, which is directly downgradient of the Fly Ash Pond. Yet, the highest concentrations for fluoride and selenium were observed in APW-4, which is adjacent to the south property boundary. The distribution of these constituents suggests potential for an off-site source contributing to the concentrations of these, and possibly other constituents in the MPS monitoring wells.
- There are other industrial impoundments southeast and upgradient of the CCP impoundments that have not been evaluated as potential sources.
- Estimated boron loading to the Illinois River suggests that the incremental boron concentration increase in the river caused by leachate released from the CCP impoundment may be measurable under worst-case conditions, but not under typical conditions. Estimated arsenic loading to the river suggests that it is less likely to result in a measurable concentration increase under worst case conditions than boron, and should not be measureable under typical conditions.

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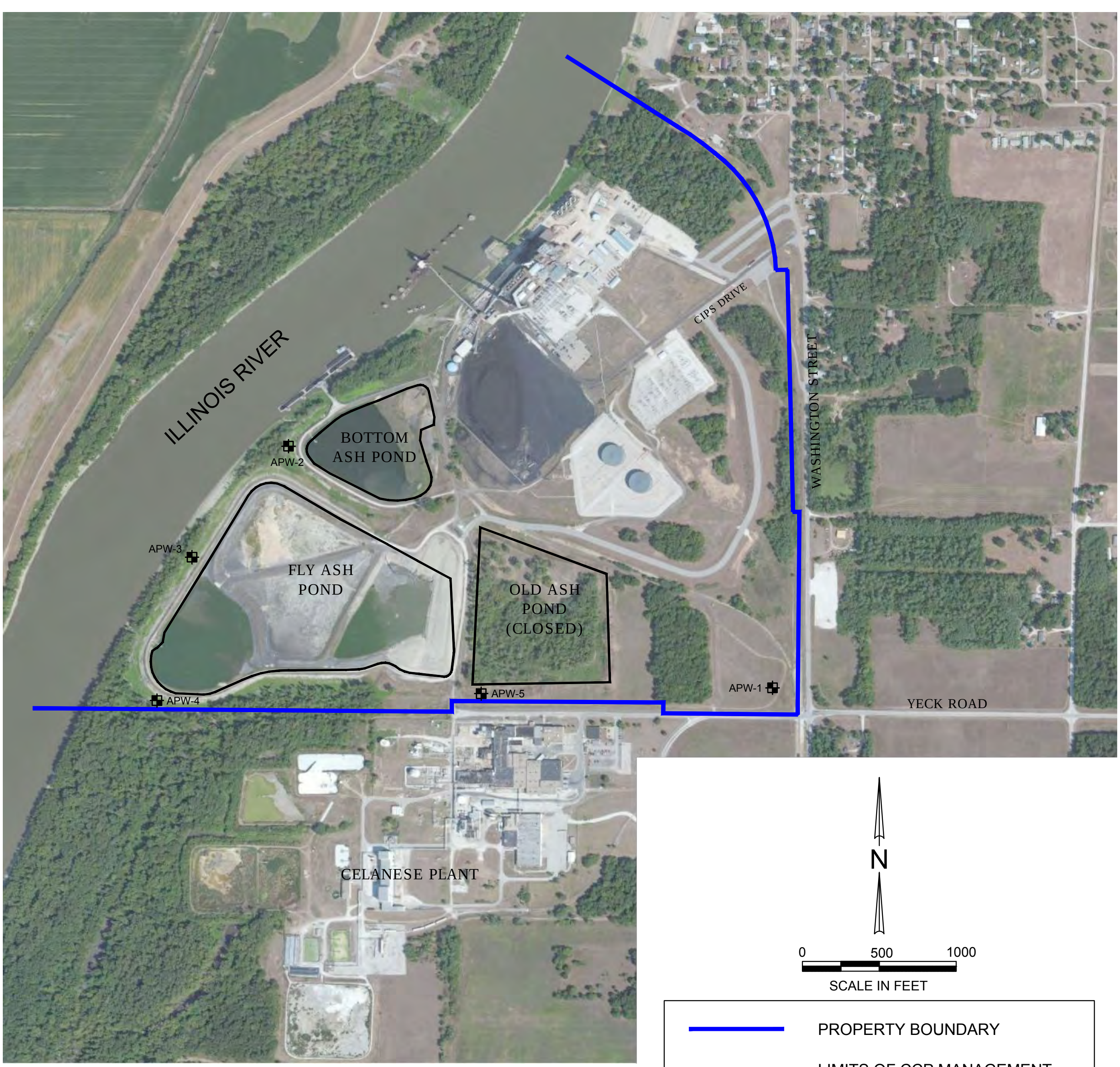
# FIGURES



| | |
|---|---|
| ▬ | PROPERTY BOUNDARY |
| ― | LIMITS OF CCP MANAGEMENT |
| ⊕ APW-1 | MONITORING WELL LOCATION |

SOURCE NOTES:

1. BINGMAPSAERIAL - IMAGE COURTESY OF USGS © 2012 MICROSOFT CORPORATION
2. BASEMAP FEATURES PROVIDED BY AMEREN, DRAWING "AEG HYDRO PROPERTY CONTROL BLOCK".
3. COORDINATE SYSTEM IS REFERENCED TO NAD83, ILLINOIS STATE PLANE, WEST ZONE, US FOOT.

# SITE OVERVIEW MAP

NATURAL RESOURCE TECHNOLOGY

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
MEREDOSIA ENERGY CENTER
MORGAN COUNTY, ILLINOIS

DRAWN: NWD DATE: 02/05/13 CHK'D: BRH DATE: 02/05/13 APP'D: BRH DATE: 03/05/13

PROJECT NO.
2124/2.0

DRAWING NO.
2124-2-A01C-SITE OVER

FIGURE NO.
1

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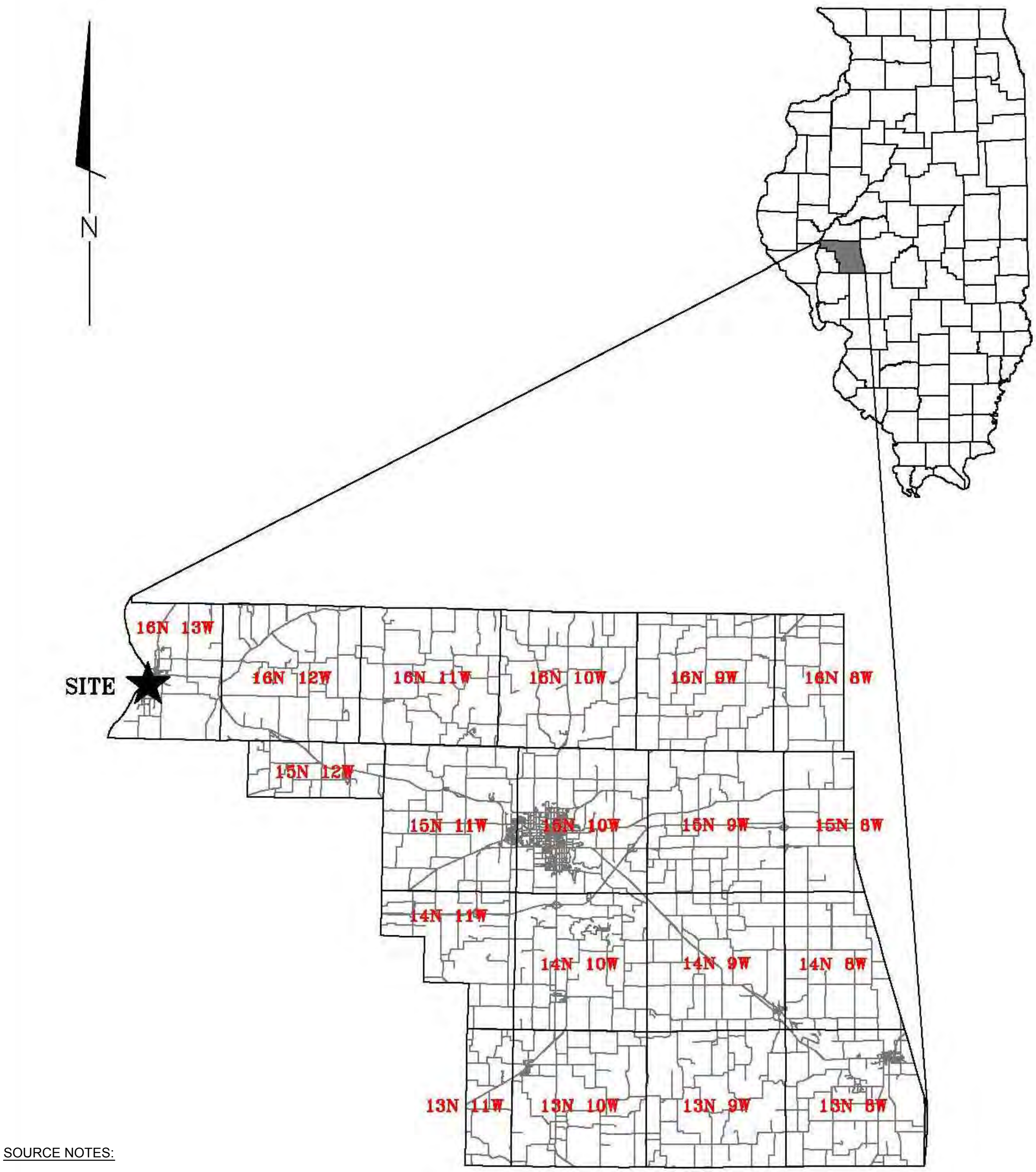

SOURCE NOTES:

1. FIGURE CONTENTS TAKEN FROM RAPPS ENGINEERING & APPLIED SCIENCE, INC. SITE LOCATION MAP, FIGURE 1 FROM PROJECT: SA09035, DRAWING: LOCMAP, DATED 11/09.

# SITE LOCATION MAP

NATURAL
RESOURCE
TECHNOLOGY

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
MEREDOSIA ENERGY CENTER
MORGAN COUNTY, ILLINOIS

DRAWN: NWD DATE: 02/05/13 CHK'D: BRH DATE: 02/05/13 APP'D: BRH DATE: 03/05/13

PROJECT NO.
2124/2.0

DRAWING NO.
2124-2-A02C-SITE LOC

FIGURE NO.
2

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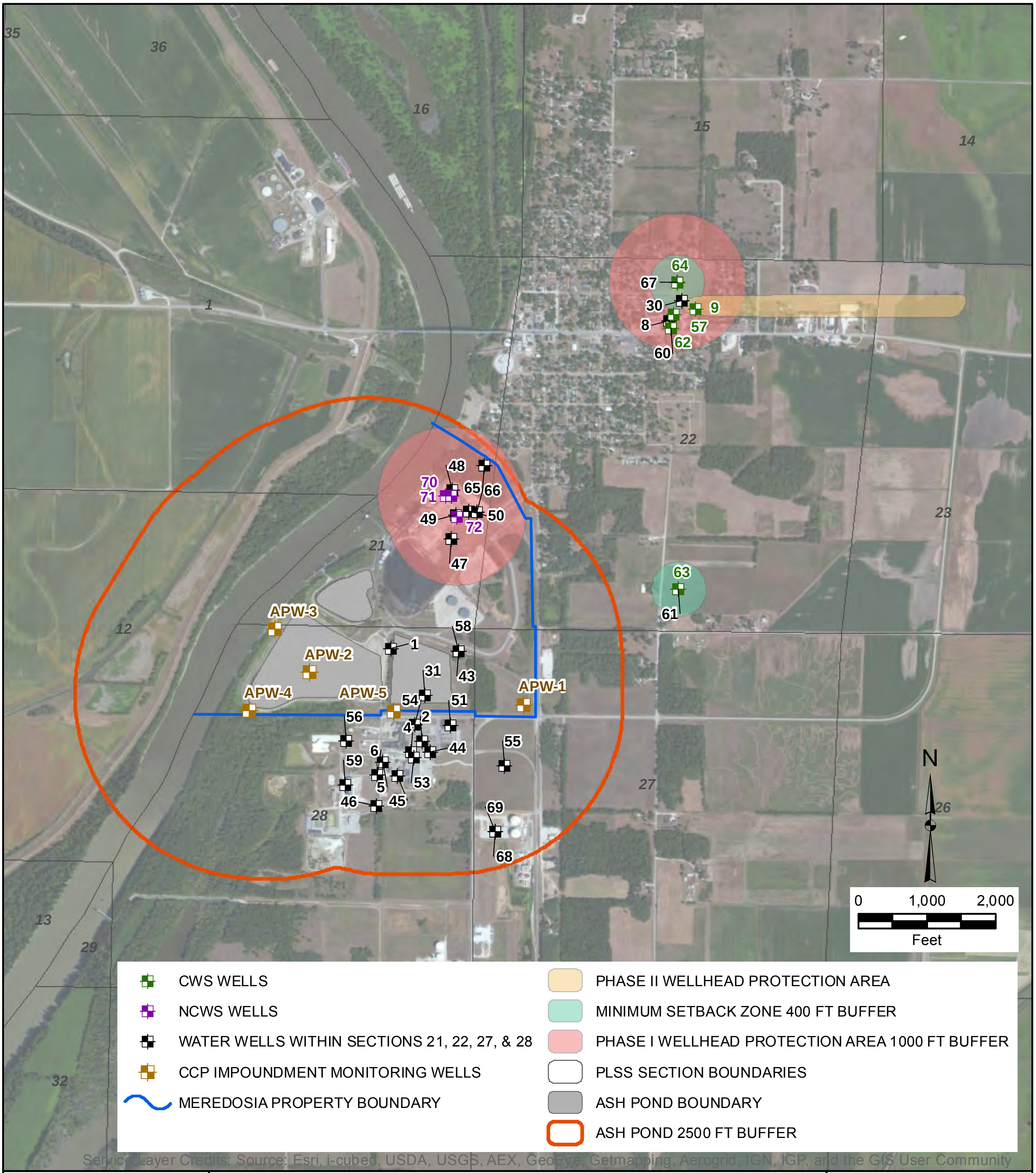


Y:\Mapping\Projects\21\2124\MXD\Fig 3.Well Search Results-Meredosia_1.mxd Author: nkron; Date/Time: 3/5/2013, 8:09:48 AM

DRAWN BY/DATE:
NDK 2/18/13
REVIEWED BY/DATE:
RLH 2/18/13
APPROVED BY/DATE:
BRH 2/18/13

# WELL SEARCH RESULTS

PHASE I HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
MEREDOSIA ENERGY CENTER
MORGAN COUNTY, ILLINOIS

PROJECT NO: 2124

FIGURE NO: 3

NATURAL
RESOURCE
TECHNOLOGY

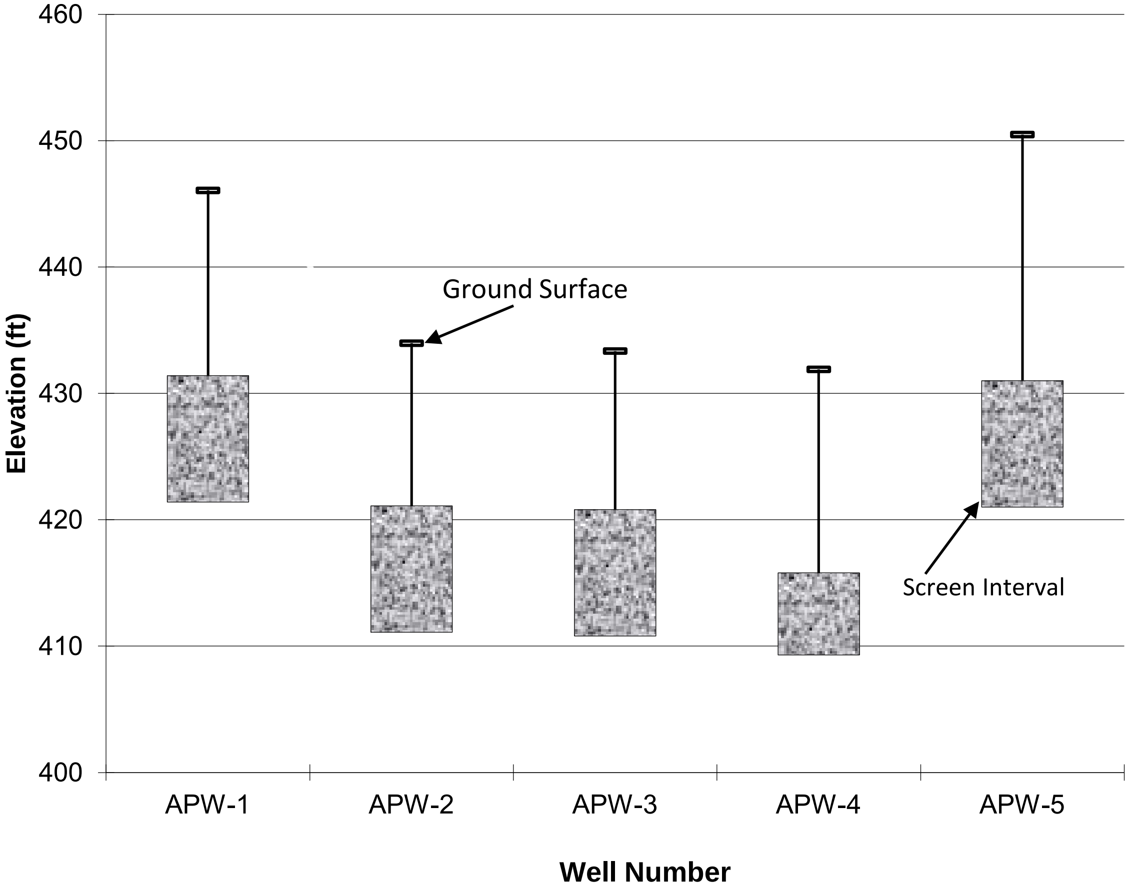


Figure 4. Monitoring Well Screen Elevations.

NATURAL RESOURCE TECHNOLOGY

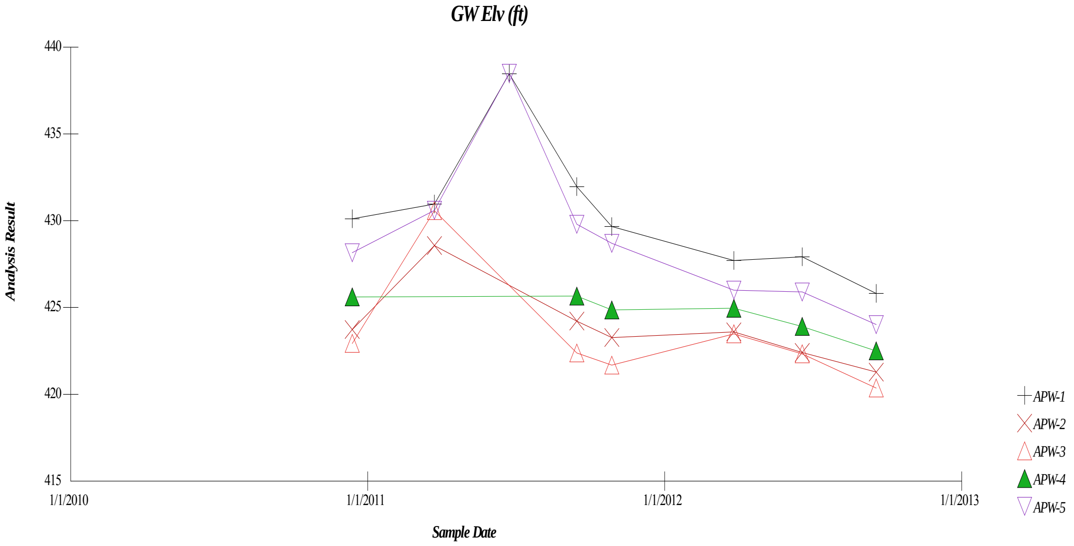
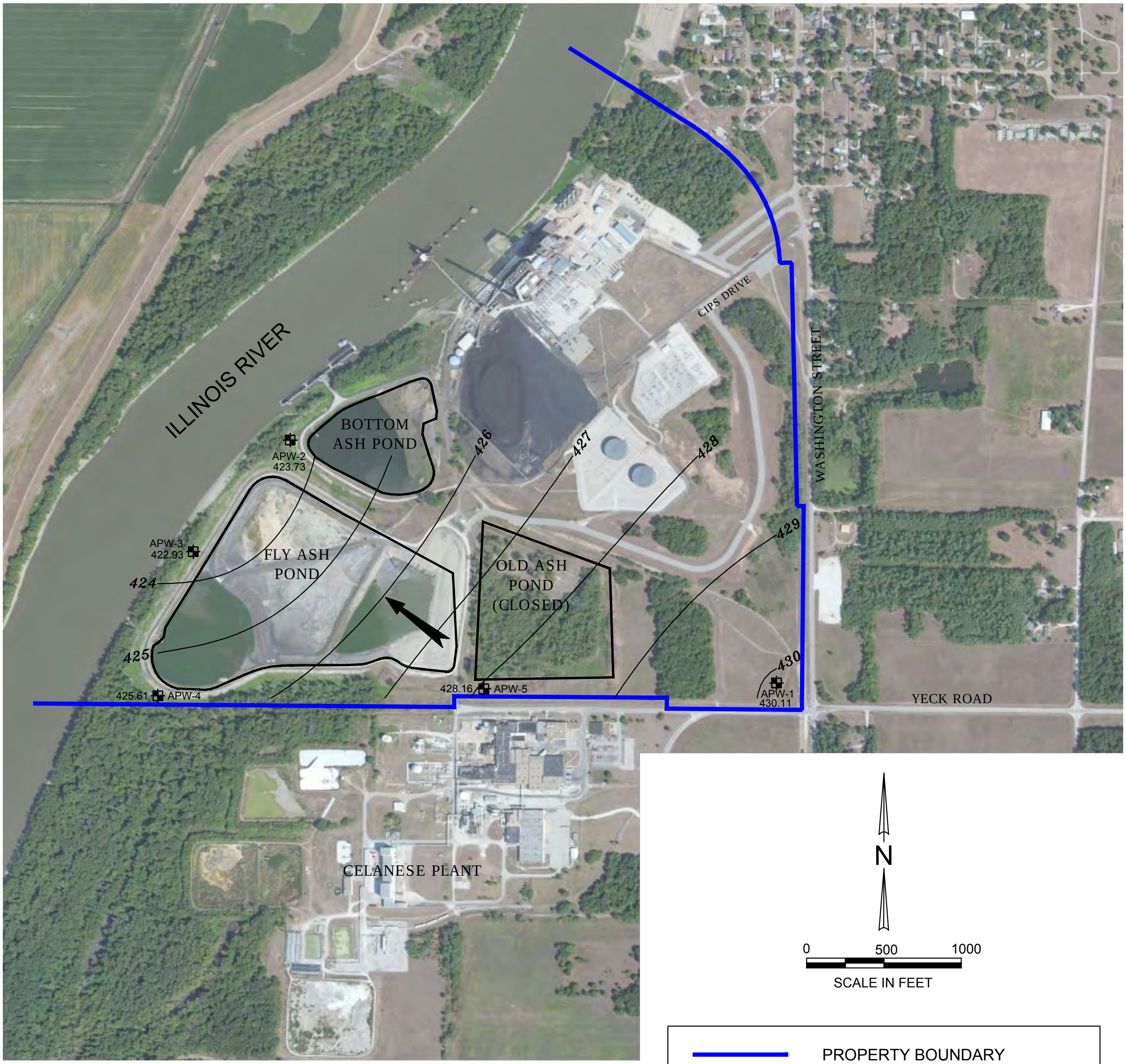


Figure 5. Groundwater Elevation Time Series.



| | |
|---|---|
| 🟦 | PROPERTY BOUNDARY |
| — | LIMITS OF CCP MANAGEMENT |
| ⊕ APW-1 | MONITORING WELL LOCATION |
| 426 | GROUNDWATER ELEVATION CONTOUR, FT. |
| ➤ | GROUNDWATER FLOW DIRECTION |

SOURCE NOTES:

1. BINGMAPSAERIAL - IMAGE COURTESY OF USGS © 2012 MICROSOFT CORPORATION
2. BASEMAP FEATURES PROVIDED BY AMEREN, DRAWING "AEG HYDRO PROPERTY CONTROL BLOCK".
3. COORDINATE SYSTEM IS REFERENCED TO NAD83, ILLINOIS STATE PLANE, WEST ZONE, US FOOT.

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# GROUNDWATER ELEVATION CONTOURS
# DECEMBER 14, 2010

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
MEREDOSIA ENERGY CENTER
MORGAN COUNTY, ILLINOIS

NATURAL RESOURCE TECHNOLOGY

PROJECT NO.
2124/2.0

DRAWING NO.
2124-2-A06C-GW-DEC10

FIGURE NO.
6

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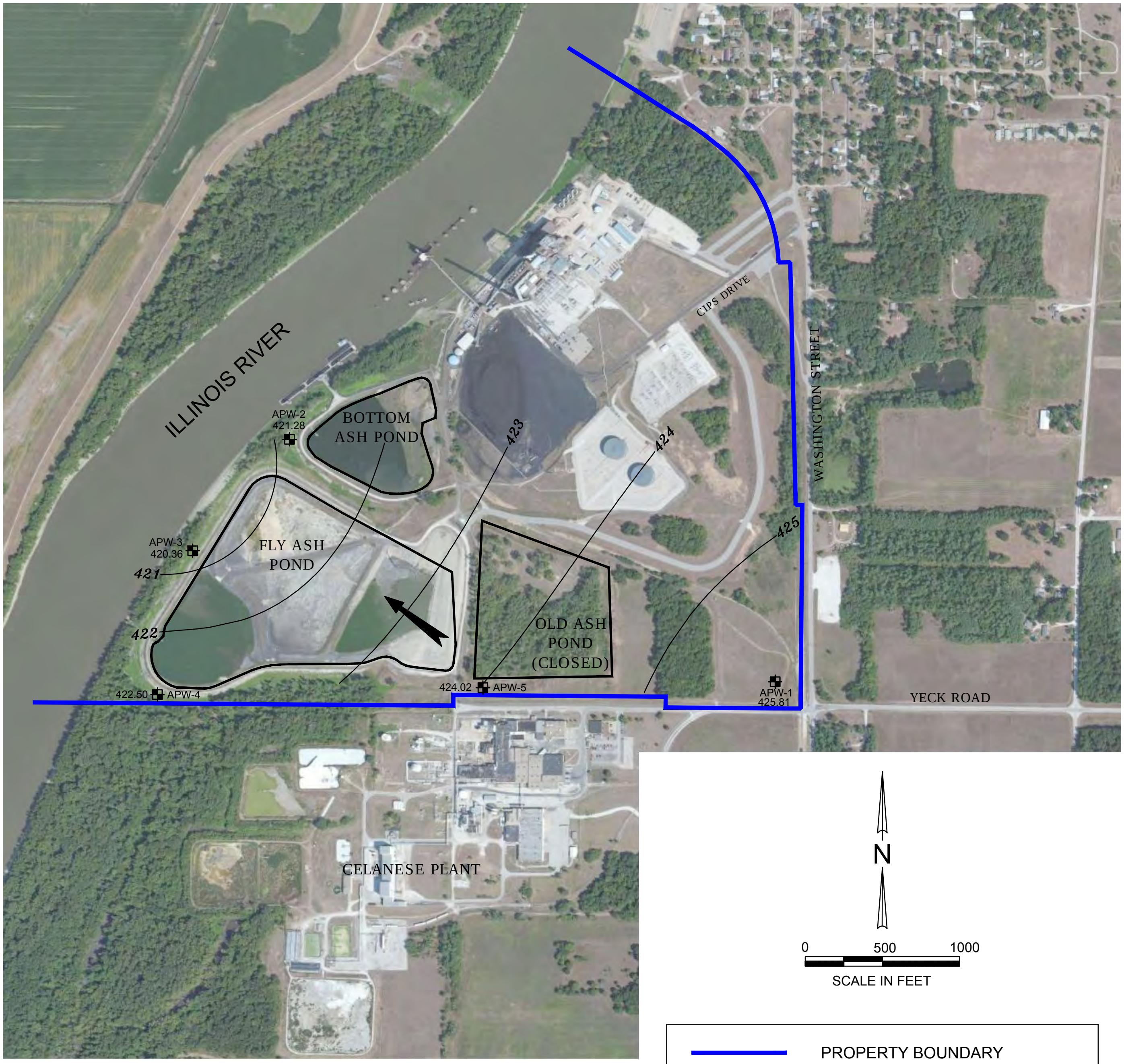

━ PROPERTY BOUNDARY

─ LIMITS OF CCP MANAGEMENT

⌖ APW-1 MONITORING WELL LOCATION

426 ⌒ GROUNDWATER ELEVATION CONTOUR, FT.

➞ GROUNDWATER FLOW DIRECTION

SOURCE NOTES:

1. BINGMAPSAERIAL - IMAGE COURTESY OF USGS © 2012 MICROSOFT CORPORATION
2. BASEMAP FEATURES PROVIDED BY AMEREN, DRAWING "AEG HYDRO PROPERTY CONTROL BLOCK".
3. COORDINATE SYSTEM IS REFERENCED TO NAD83, ILLINOIS STATE PLANE, WEST ZONE, US FOOT.

Mar 05, 2013 11:33am PLOTTED BY: ndraskovich SAVED BY: ndraskovich
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# GROUNDWATER ELEVATION CONTOURS
# SEPTEMBER 17, 2012

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
MEREDOSIA ENERGY CENTER
MORGAN COUNTY, ILLINOIS

NATURAL
RESOURCE
TECHNOLOGY

PROJECT NO.
2124/2.0

DRAWING NO.
2124-2-A07C-GW-SEPT12

FIGURE NO.
7

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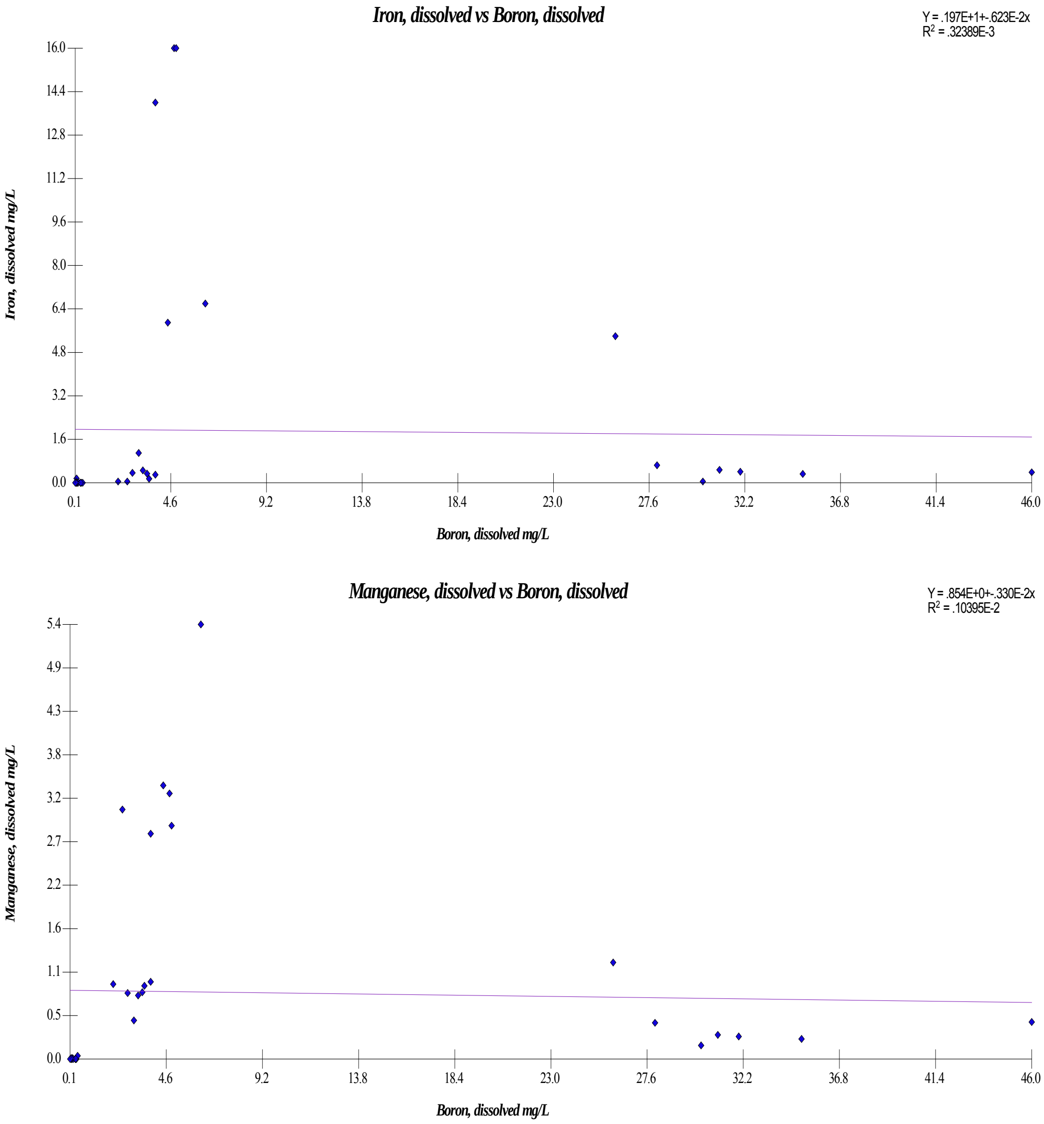


Figure 8. Boron vs iron (top) and boron vs manganese (bottom) scatter plots showing no correlation.

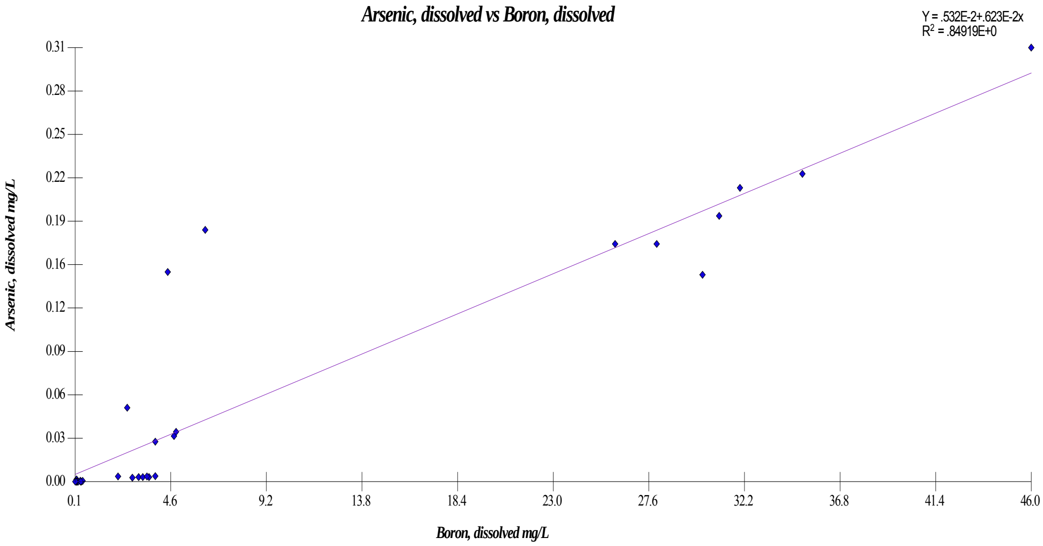


Figure 9. Boron vs arsenic scatter plot showing correlation between arsenic and boron concentrations.

NATURAL RESOURCE TECHNOLOGY

# TABLES

# Table 1. Monitoring Well Construction Details

## Phase I Hydrogeologic Assessment
## Ameren Energy Resources
## Meredosia Power Station; Morgan County, IL

| Monitoring Well Number | Installation Date[1,2] | Top of Well Riser Elevation | Ground Elevation | Screen Top Depth (BGS) | Screen Bottom Depth (BGS) | Screen Top Elevation | Screen Bottom Elevation | Bottom of Boring Elevation | Slotted Screen Length | Bottom Screen Depth from Ground Surface | Bottom Screen Depth from Top of Casing | Total Boring Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APW-1 | 10/26/10 | 449.26 | 446.06 | 14.7 | 24.7 | 431.4 | 421.4 | 420.9 | 10.00 | 24.7 | 27.9 | 25.2 |
| APW-2 | 10/25/10 | 436.87 | 433.97 | 12.9 | 22.9 | 421.1 | 411.1 | 410.6 | 10.00 | 22.9 | 25.8 | 23.4 |
| APW-3 | 10/25/10 | 436.28 | 433.35 | 12.6 | 22.6 | 420.8 | 410.8 | 410.3 | 10.00 | 22.6 | 25.5 | 23.1 |
| APW-4 | 10/26/10 | 434.86 | 431.90 | 16.1 | 22.6 | 415.8 | 409.3 | 405.8 | 6.50 | 22.6 | 25.6 | 26.1 |
| APW-5 | 10/26/10 | 453.20 | 450.48 | 19.5 | 29.5 | 431.0 | 421.0 | 420.2 | 10.00 | 29.5 | 32.2 | 30.3 |

| Monitoring Well Number | Northing[3] | Easting[3] |
|---|---|---|
| APW-1 | 1,147,018.7 | 2,185,605.2 |
| APW-2 | 1,148,489.7 | 2,182,485.2 |
| APW-3 | 1,148,118.6 | 2,181,973.8 |
| APW-4 | 1,146,935.9 | 2,181,603.0 |
| APW-5 | 1,146,922.6 | 2,183,711.1 |

Notes:

All depth and elevation measurements are in feet relative to NAVD 1988.

BGS = below ground surface.

[1] Drilling and well installation by Geotechnology, Inc.

[2] All wells constructed with 2-inch diametrer, 10-slot, Schedule 40 PVC screens.

[3] Coordinates are referenced to Illinois State Plane Coordinates, East Zone - NAD 1983.

# Table 2.  Groundwater Levels and Elevations

## Phase I Hydrogeologic Assessment
## Ameren Energy Resources
## MeredosiaTower Power Station; Morgan County, Illinois

| Monitoring Well Number | Ground Surface Elevation[1] (feet) | Measuring Point Elevation[1] (feet) | Groundwater Depth (feet below measuring point) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 12/13/2010 | 2 3/24/2011 | 3 6/24/2011 | 4 9/15/2011 | 5 10/28/2011 | 6 3/26/2012 | 7 6/18/2012 | 8 9/17/2012 |
| APW-1 | 446.06 | 449.26 | 19.15 | 18.30 | 10.80 | 17.30 | 19.60 | 21.55 | 21.34 | 23.45 |
| APW-2 | 433.97 | 436.87 | 13.14 | 8.30 | NM | 12.65 | 13.60 | 13.27 | 14.46 | 15.59 |
| APW-3 | 433.35 | 436.28 | 13.35 | 5.70 | NM | 13.90 | 14.60 | 12.80 | 13.95 | 15.92 |
| APW-4 | 431.90 | 434.86 | 9.25 | NM | NM | 9.20 | 10.00 | 9.90 | 10.95 | 12.36 |
| APW-5 | 450.48 | 453.20 | 25.04 | 22.6 | 14.70 | 23.40 | 24.5 | 27.20 | 27.30 | 29.18 |

| Monitoring Well Number | Groundwater Depth (feet below ground surface) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 12/13/2010 | 2 3/24/2011 | 3 6/24/2011 | 4 9/15/2011 | 5 10/28/2011 | 6 3/26/2012 | 7 6/18/2012 | 8 9/17/2012 |
| APW-1 | 15.95 | 15.10 | 7.60 | 14.10 | 16.40 | 18.35 | 18.14 | 20.25 |
| APW-2 | 10.24 | 5.40 | NM | 9.75 | 10.70 | 10.37 | 11.56 | 12.69 |
| APW-3 | 10.42 | 2.77 | NM | 10.97 | 11.67 | 9.87 | 11.02 | 12.99 |
| APW-4 | 6.29 | NM | NM | 6.24 | 7.04 | 6.94 | 7.99 | 9.40 |
| APW-5 | 22.32 | 19.88 | 11.98 | 20.68 | 21.78 | 24.48 | 24.58 | 26.46 |

| Monitoring Well Number | Groundwater Elevation (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 12/13/2010 | 2 3/24/2011 | 3 6/24/2011 | 4 9/15/2011 | 5 10/28/2011 | 6 3/26/2012 | 7 6/18/2012 | 8 9/17/2012 |
| APW-1 | 430.11 | 430.96 | 438.46 | 431.96 | 429.66 | 427.71 | 427.92 | 425.81 |
| APW-2 | 423.73 | 428.57 | NM | 424.22 | 423.27 | 423.60 | 422.41 | 421.28 |
| APW-3 | 422.93 | 430.58 | NM | 422.38 | 421.68 | 423.48 | 422.33 | 420.36 |
| APW-4 | 425.61 | NM | NM | 425.66 | 424.86 | 424.96 | 423.91 | 422.50 |
| APW-5 | 428.16 | 430.60 | 438.50 | 429.80 | 428.70 | 426.00 | 425.90 | 424.02 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Illinois River Stage** | 420.58 | 432.01 | 438.93 | 419.20 | 420.75 | 423.27 | 420.36 | 419.77 |

Notes:

[1] All groundwater depth and elevation measurements are in feet relative to NAVD 1988.

NM Monitoring well not sampled on the date indicated due to flood conditions; well could not be accessed for groundwater sampling.

## Table 3. Field and Laboratory Groundwater Monitoring Parameters

Phase 1 Hydrogeologic Assessment
Ameren Energy Resources
Meredosia Power Station; Morgan County, Illinois

| **Field Parameters** | | | **Analysis Method** |
|---|---|---|---|
| Groundwater Elevation | | in-situ | |
| pH (field) | [1] | in-situ | SM 21st ed. 4500-$H^+$ |
| Specific Conductance | | in-situ | SM 21st ed. 2520-B |
| Temperature | | in-situ | SM 21st ed. 2550 |
| **General Chemistry Parameters**[2] | | | **Analysis Method** |
| Chloride | [1] | dissolved | SM21 4500CL C |
| Total Cyanide | [1] | total | EPA 335.4 |
| Fluoride | [1] | dissolved | SM4500 F-B-C |
| Nitrate as N | [1] | dissolved | EPA 353.2 |
| Sulfate | [1] | dissolved | ASTM516-90,02 |
| Total Dissolved Solids | [1] | dissolved | SM21 2540 C |
| **METALS**[2] | | | **Analysis Method** |
| Antimony | [1,3] | dissolved | SW846 6010C |
| Arsenic | [1,3] | dissolved | SW846 6010C |
| Barium | [1,3] | dissolved | SW846 6010C |
| Beryllium | [1,3] | dissolved | SW846 6010C |
| Boron | [1,3] | dissolved | SW846 6010C |
| Cadmium | [1,3] | dissolved | SW846 6010C |
| Chromium | [1,3] | dissolved | SW846 6010C |
| Cobalt | [1,3] | dissolved | SW846 6010C |
| Copper | [1,3] | dissolved | SW846 6010C |
| Iron | [1,3] | dissolved | SW846 6010C |
| Lead | [1,3] | dissolved | SW846 6010C |
| Manganese | [1,3] | dissolved | SW846 6010C |
| Mercury | [1,3] | dissolved | SW846 7470A |
| Nickel | [1,3] | dissolved | SW846 6010C |
| Selenium | [1,3] | dissolved | SW846 6010C |
| Silver | [1,3] | dissolved | SW846 6010C |
| Thallium | [1,3] | dissolved | SW846 6010C |
| Zinc | [1,3] | dissolved | SW846 6010C |

Notes:

[1] Groundwater quality parameters for Class I: Potable Resource Groundwater (IAC 35 Part 620 Section 410).

[2] Samples preserved in field and filtered (except Cyanide) by laboratory.

[3] Sample prep method reference: SW846 3010A.

## Table 4. Statistical Summary of Groundwater Quality Data for Period of December 2010 - September 2012

Phase I Hydrogeologic Assessment
Meredosia Power Station; Morgan County, Illinois

| | | **Monitoring Well APW-1**[1] | | | | | | **Monitoring Well APW-2**[2] | | | | | | **Monitoring Well APW-3**[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter, Unit** | Class I GW Standard | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects |
| Field Parameters | | | | | | | | | | | | | | | | | | | |
| pH, Std Units | 6.5 / 9.0* | 7.24 | 7.25 | 7.83 | 6.69 | 0.40 | N/A | 7.01 | 7.15 | 7.41 | **5.98** | 0.22 | N/A | 7.91 | 8.21 | 8.36 | 6.92 | 0.58 | N/A |
| General Chemistry Parameters (totals) | | | | | | | | | | | | | | | | | | | |
| Chloride, mg/L | 200 | 18 | 12 | 45 | 1.0 | 16 | 0 | 44 | 44 | 50 | 33 | 6.0 | 0 | 52 | 54 | 58 | 44 | 4.9 | 0 |
| Cyanide, mg/L | 0.2 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Fluoride, mg/L | 4 | 0.24 | 0.25 | 0.32 | <0.10 | 0.062 | 75 | 0.33 | 0.30 | 0.46 | 0.25 | 0.082 | 14.3 | 0.36 | 0.32 | 0.54 | 0.25 | 0.11 | 0 |
| Nitrate, mg/L | 10 | 3.3 | 3.3 | 5.7 | 1.6 | 1.5 | 0 | 0.084 | 0.020 | 0.40 | <0.02 | 0.14 | 57.1 | 0.087 | 0.020 | 0.49 | <0.02 | 0.18 | 87.5 |
| Sulfate, mg/L | 400 | 21 | 22 | 33 | 12 | 7.3 | 0 | 22 | 18 | 41 | 13 | 10 | 14.3 | 288 | 290 | 310 | 260 | 18 | 0 |
| Total Dissolved Solids | 1,200 | 192 | 185 | 280 | 132 | 56 | 0 | 480 | 460 | 630 | 368 | 84 | 0 | 741 | 710 | 970 | 650 | 110 | 0 |
| Metals (dissolved) | | | | | | | | | | | | | | | | | | | |
| Antimony, mg/L | 0.006 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Arsenic, mg/L | 0.01** | nc | nc | nc | nc | nc | 100 | 0.004 | 0.004 | 0.004 | 0.003 | 0 | 0 | **0.20** | **0.19** | **0.31** | **0.15** | 0.053 | 0 |
| Barium, mg./L | 2 | 0.019 | 0.015 | 0.020 | <0.050 | 0.013 | 12.5 | 0.048 | 0.050 | 0.055 | <0.050 | 0 | 14.3 | 0.061 | 0.050 | 0.11 | <0.050 | 0.025 | 14.3 |
| Beryllium, mg/L | 0.004 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | 0.001 | 0.001 | 0.001 | <0.001 | 0.001 | 87.5 |
| Boron, mg/L | 2 | 0.11 | 0.11 | 0.14 | 0.055 | 0.026 | 0 | **3.2** | **3.3** | **3.9** | **2.1** | 0.59 | 0 | **33** | **31** | **46** | **26** | 6.6 | 0 |
| Cadmium, mg/L | 0.005 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | 0.002 | 0.001 | 0.002 | <0.001 | 0.001 | 42.9 |
| Chromium, mg/L | 0.1 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Cobalt, mg/L | 1.0 | nc | nc | nc | nc | nc | 100 | 0.010 | 0.003 | 0.004 | <0.050 | 0.018 | 14.3 | nc | nc | nc | nc | nc | 100 |
| Copper, mg/L | 0.65 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Iron, mg/L | 5 | 0.032 | 0.010 | 0.16 | <0.010 | 0.053 | 75 | 0.40 | 0.34 | 1.1 | <0.10 | 0.33 | 14.3 | 1.1 | 0.41 | **5.4** | .<0.10 | 1.9 | 14.3 |
| Lead, mg/L | 0.0075 | nc | nc | nc | nc | nc | 100 | 0.002 | 0.001 | 0.001 | <0.001 | 0.002 | 87.5 | 0.002 | 0.001 | 0.001 | <0.001 | 0.002 | 87.5 |
| Manganese, mg/L | 0.15 | 0.006 | 0.004 | 0.015 | <0.001 | 0.005 | 50 | **0.82** | **0.83** | **0.96** | **0.48** | 0.162 | 0 | **0.44** | **0.30** | **1.2** | **0.17** | 0.35 | 0 |
| Mercury, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Nickel, mg/L | 0.1 | 0.011 | 0.005 | 0.014 | <0.005 | 0.012 | 75 | 0.014 | 0.011 | 0.012 | <0.040 | 0.012 | 14.3 | 0.013 | 0.010 | 0.012 | <0.005 | 0.012 | 28.6 |
| Selenium, mg/L | 0.05 | 0.003 | 0.002 | 0.002 | <0.001 | 0.003 | 25 | 0.003 | 0.002 | 0.004 | <0.001 | 0.003 | 42.9 | 0.003 | 0.002 | 0.003 | <0.001 | 0.003 | 42.9 |
| Silver, mg/L | 0.05 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Thallium, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | 0.001 | 0.001 | 0.001 | <0.001 | 0 | 87.5 |
| Zinc, mg/L | 5 | nc | nc | nc | nc | nc | 100 | 0.008 | 0.006 | 0.006 | <0.006 | 0.005 | 87.5 | 0.009 | 0.006 | 0.012 | <0.006 | 0.005 | 87.5 |

| | | **Monitoring Well APW-4**[1] | | | | | | **Monitoring Well APW-5**[1] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter, Unit** | Class I GW Standard | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects |
| Field Parameters | | | | | | | | | | | | | |
| pH, Std Units | 6.5 / 9.0* | 6.92 | 7.05 | 7.42 | **5.88** | 0.60 | N/A | 7.50 | 7.58 | 7.91 | **6.44** | 0.49 | N/A |
| General Chemistry Parameters (totals) | | | | | | | | | | | | | |
| Chloride, mg/L | 200 | 52 | 52 | 63 | 41 | 7.6 | 0 | 2.6 | 2.7 | 4.6 | <1.0 | 1.2 | 12.5 |
| Cyanide, mg/L | 0.2 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Fluoride, mg/L | 4 | 0.55 | 0.46 | 0.79 | 0.39 | 0.17 | 0 | 0.26 | 0.25 | 0.36 | <0.25 | 0.065 | 62.5 |
| Nitrate, mg/L | 10 | 0.12 | 0.030 | 0.31 | <0.02 | 0.14 | 0 | 2.2 | 2.0 | 4.1 | 1.4 | 0.84 | 0 |
| Sulfate, mg/L | 400 | 30 | 24 | 53 | 14 | 16.8 | 0 | 15 | 15 | 33 | 6.1 | 8.5 | 0 |
| Total Dissolved Solids | 1,200 | 460 | 444 | 690 | 300 | 137 | 0 | 227 | 240 | 290 | 138 | 61 | 0 |
| Metals (dissolved) | | | | | | | | | | | | | |
| Antimony, mg/L | 0.006 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Arsenic, mg/L | 0.01** | **0.080** | 0.045 | **0.18** | 0.029 | 0.067 | 0 | 0.001 | 0.001 | 0.001 | <0.001 | 0.001 | 75 |
| Barium, mg./L | 2 | 0.070 | 0.070 | 0.095 | 0.048 | 0.017 | 0 | 0.014 | 0.009 | 0.010 | <0.050 | 0.015 | 12.5 |
| Beryllium, mg/L | 0.004 | 0.002 | 0.001 | 0.002 | <0.001 | 0.001 | 66.7 | nc | nc | nc | nc | nc | 100 |
| Boron, mg/L | 2 | **4.5** | **4.7** | **6.3** | **2.6** | 1.2 | 0 | 0.27 | 0.31 | 0.41 | 0.12 | 0.10 | 0 |
| Cadmium, mg/L | 0.005 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Chromium, mg/L | 0.1 | 0.005 | 0.004 | 0.007 | <0.004 | 0.002 | 83.3 | nc | nc | nc | nc | nc | 100 |
| Cobalt, mg/L | 1.0 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Copper, mg/L | 0.65 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Iron, mg/L | 5 | **9.8** | **10** | **16** | <0.01 | 6.5 | 16.7 | 0.022 | 0.010 | 0.012 | <0.01 | 0.032 | 87.5 |
| Lead, mg/L | 0.0075 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Manganese, mg/L | 0.15 | **3.5** | **3.2** | **5.4** | **2.8** | 0.97 | 0 | 0.009 | 0.001 | 0.040 | <0.001 | 0.014 | 37.5 |
| Mercury, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Nickel, mg/L | 0.1 | 0.016 | 0.010 | 0.019 | <0.040 | 0.013 | 16.7 | 0.010 | 0.006 | 0.010 | <0.005 | 0.012 | 62.5 |
| Selenium, mg/L | 0.05 | 0.017 | 0.014 | 0.030 | <0.001 | 0.007 | 16.7 | 0.003 | 0.002 | 0.004 | <0.001 | 0.003 | 25 |
| Silver, mg/L | 0.05 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Thallium, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Zinc, mg/L | 5 | 0.009 | 0.006 | 0.007 | <0.006 | 0.006 | 83.3 | nc | nc | nc | nc | nc | 100 |

Notes:

[1] Eight quarterly samples collected for analysis on 12/13/10, 03/24/11, 06/24/11, 09/15/11, 10/28/11, 3/26/12, 06/18/12, and 09/17/12.

[2] Seven quarterly samples collected for analysis on 12/13/10, 03/24/11, 09/15/11, 10/28/11, 3/26/12, 06/18/12, and 09/17/12.

[3] Six quarterly samples collected for analysis on 12/13/10, 10/28/11, 3/26/12, 09/15/11, 06/18/12, and 09/17/12.

Statistics calculated with replacement of non-detect concentrations at 1X reported non-detect concentration: nc indicates that statistics were not calculated because all values were below detection limits.

🟧 Detected Concentration(s) Exceeds Class I Groundwater Quality Standard.

< = Below method reporting limit. N/A = not applicable.

🟩 Parameter is 100% Non-Detect in all 5 monitoring wells

* Lower and Upper limits for pH is the Class I groundwater quality standard of 6.5 and 9.0 Standard Units.

** Current arsenic standard is listed. Arsenic standard at time of sampling was 0.05 mg/L.

Meredosia Table 4 ver3.xlsx

# APPENDIX A

# REGIONAL GEOLOGY

# A REGIONAL GEOLOGY

Regional geologic information was previously presented in the site characterization and groundwater monitoring plan developed by Rapps Engineering & Applied Services (December 2009), and is repeated here for completeness.

## A.1 Physiography

Illinois is situated in the south-central part of the Central Lowland province near the confluence of two major lines of drainage, the Mississippi and Ohio Rivers, making it the lowest of the north-central states with a mean elevation of about 600 feet above sea level and a total relief of only 973 feet (Leighton et al., 1948). The MPS lies near the western edge of the Springfield Plain of the Till Plains section, the largest physiographic division in Illinois, covering approximately four-fifths of the state, characterized by broad till plains in an uneroded or youthful stage of erosion (Appendix A [Figure 3]). The Springfield Plain includes the level portion of the Illinoian drift sheet in central and south-central Illinois, distinguished by its flatness and shallowly entrenched drainage. Drainage systems are well developed, and the district is in a late youthful stage of dissection (Ibid.).

## A.2 Unlithified Geology

The Meredosia Power Station is located in the Illinois Valley, where the Quaternary deposits consist of glacial outwash deposits belonging to the Henry Formation overlain by channel and floodplain deposits of the Cahokia Formation and fine-grained lacustrine sediments belonging to the Equality Formation (Appendix A [Figure 5]) (Berg and Kempton, 1987; Lineback, 1979). The outwash constituting the Henry Formation consists of sorted and stratified water-laid material that is predominantly sand and gravel. These outwash sediments were deposited by debris-laden meltwater flowing away from the ice fronts during both the advances and retreats of glaciers during the Wisconsinan Age (Wilman and Frye, 1970) and were previously classified with the Mackinaw Member, sand and gravel outwash deposited as valley trains. The lithogenetic Mackinaw Member is now an informal sedimentary facies (Hansel and Johnson, 1996). The Henry Formation generally increases in thickness from the edge of the valley, near the bluffs, towards the center but varies due to erosion and irregularities in the bedrock surface. Well logs indicate that the thickness of the Henry Formation ranges from 60 to 84 feet in the vicinity of the MPS.

The Cahokia Formation consists of deposits in the floodplains and channels of modern rivers and streams, and is comprised of mostly poorly sorted sand, silt, and clay with wood and shell fragments, and local deposits of sandy gravel (Lineback, 1979). The upper part consists of overbank silts and clays, while the coarser-textured lower portion is mainly sandy channel and lateral accretion deposits. The

Cahokia is present along all Illinois streams, although locally absent where active stream erosion is occurring. In major valleys, it commonly overlies the well-sorted deposits of the Henry Formation (Willman and Frye, 1970). The Cahokia Formation is generally greater than 20 feet thick in the vicinity of the MPS (Berg and Kempton, 1987).

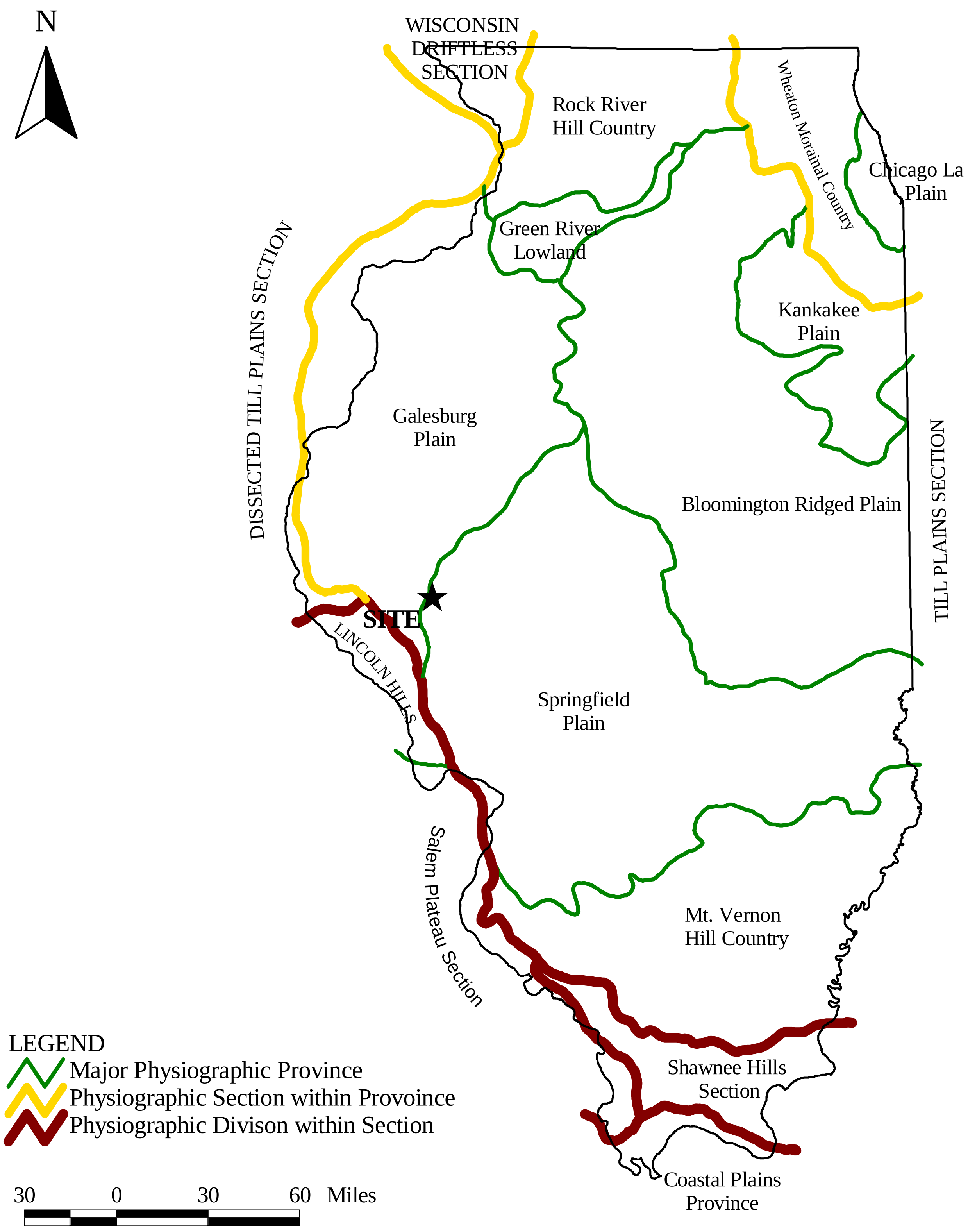
The Equality Formation consists of brown to gray to red bedded silt and clay deposited in glacial and postglacial lakes. Lenses of gravel, sand, diamicton, wood, and organic debris are present locally (Hansel and Johnson, 1996). The Equality intertongues with diamicton units of the Wedron Group and other formations of the Mason Group, particularly the Henry Formation. In the study area, the Equality occurs as thin patches (less than 20 feet thick) overlying the Henry Formation on the floodplain of the Illinois River (Berg and Kempton, 1987).

## A.3 Bedrock

The MPS and surrounding areas are underlain by Mississippian age rocks of the Lower Valmeyeran Series (Appendix A [Figure 4]) (Willman et al., 1967). These rocks were described in detail by Willman et al. (1975) as follows. The Valmeyeran Series, named for Valmeyer, Monroe County, near the location where the series is exposed, is the middle series of the Mississippian System and includes strata from the top of the Chouteau Limestone upward to the base of the Shelterville Member of the Renault Limestone. It is thickest, greater than 1,800 feet, in southeastern Illinois, and thins to 600 feet or less before being truncated by erosion in northern Illinois. Lower Valmeyeran formations present in the study area include the Meppen Limestone, Fern Glen Formation, and the Burlington and Keokuk Limestones (Kolata, 2005). The Meppen Limestone is named for the village of Meppen, Calhoun County, near the type section and is a tan or buff, very fine-grained dolomitic limestone or calcareous dolomite. It tends to be slightly crinoidal and commonly contains many calcite geodes up to 2 inches in diameter. The formation is present along the western edge of Illinois and is well exposed in Calhoun and Jersey counties with a maximum thickness of 22 feet. The Meppen Limestone shows an unconformable relationship with the underlying Chouteau Limestone, but is conformable with the overlying Fern Glen Formation. The Fern Glen Formation is named for Fern Glen Station on the Missouri Pacific Railroad near the type section, and typically consists of calcareous shale, limestone, and dolomite. It is less than 50 feet thick throughout most of its extent but can reach a maximum thickness of 100 feet. The dolomite is partly argillaceous while the upper limestone strata contain small nodules of greenish gray chert. It grades vertically and laterally into the overlying Burlington Limestone.

The Burlington Limestone is named for the city of Burlington, Des Moines County, Iowa, where the type locality exists. The formation is typically 100 to 150 feet thick but can attain a maximum thickness of 200 feet. It exists in the west-central part of Illinois and is sharply terminated to the east by the deltaic Borden Siltstone. In the northwestern part of its extent it consists of pure, coarsely crystalline, fossiliferous light gray limestone which grades to the south into more cherty, fine grained limestone where fossils are less abundant. It is overlain by the Keokuk Limestone whose extent is roughly identical to the underlying Burlington. The Keokuk Limestone is named for Keokuk, Lee County, Iowa, where the type section exists. It is 60 to 80 feet thick in most parts and is a biocalcarenite. The lower 30 fee is extremely cherty and is differentiated as the Montrose Chert Member while the rest consists of fossiliferous, crinoidal limestone interbedded with fine-grained limestone, argillaceous dolomite, and gray calcareous shale. The shale beds become numerous and thicker in the upper part.

The elevation of the bedrock surface in the vicinity of the MPS is approximately 350 feet above mean sea level (Herzog et al., 1994). Well logs indicate that the depth to bedrock is approximately 93 to 109 feet and the lithology of the uppermost bedrock is interbedded limestone and chert.



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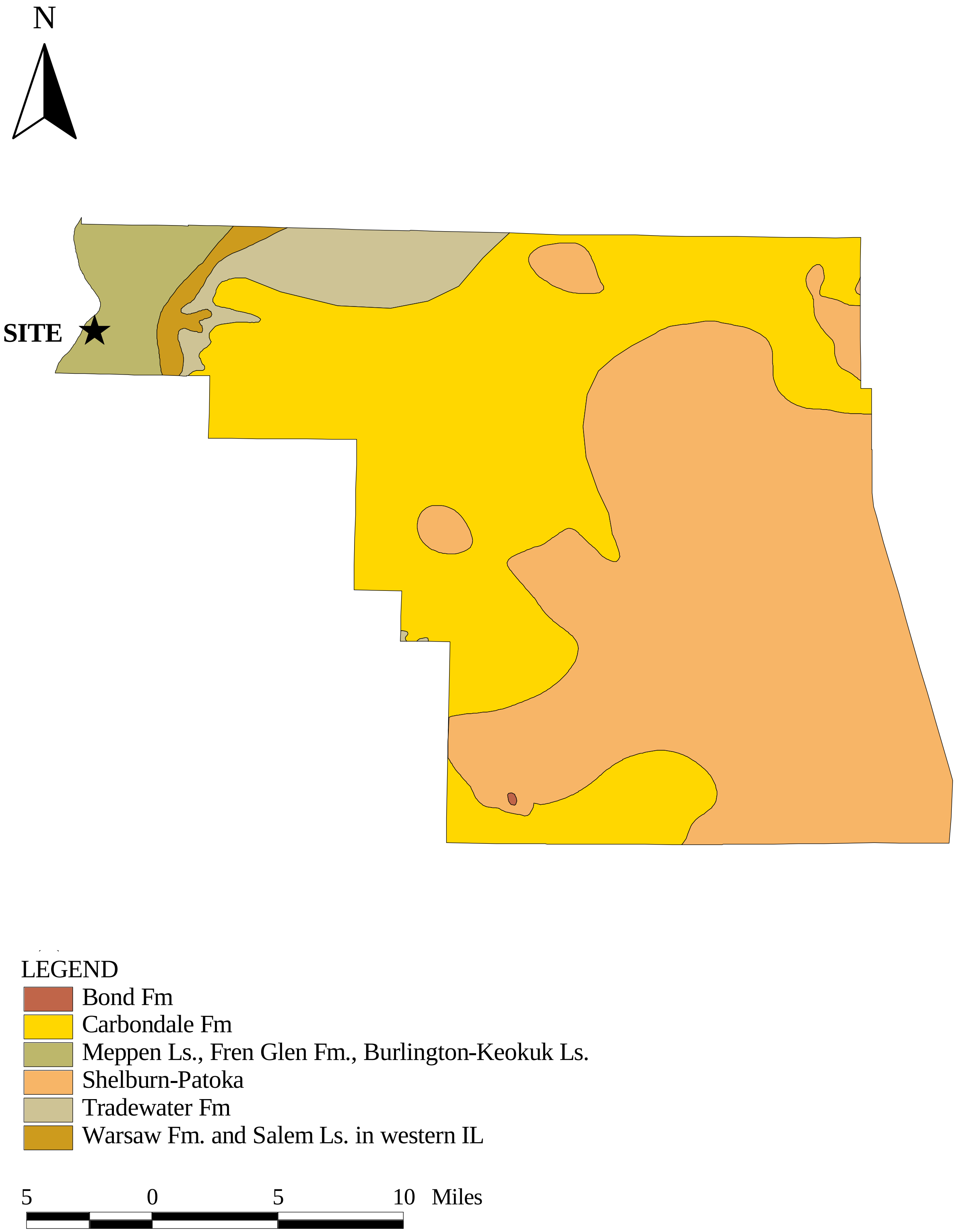
# FIGURE 3
## PHYSIOGRAPHIC DIVISIONS OF ILLINOIS (LEIGHTON ET AL, 1948)

AMERENENERGY GENERATING COMPANY
MEREDOSIA POWER STATION
MORGAN COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Physio DATE: 11/09



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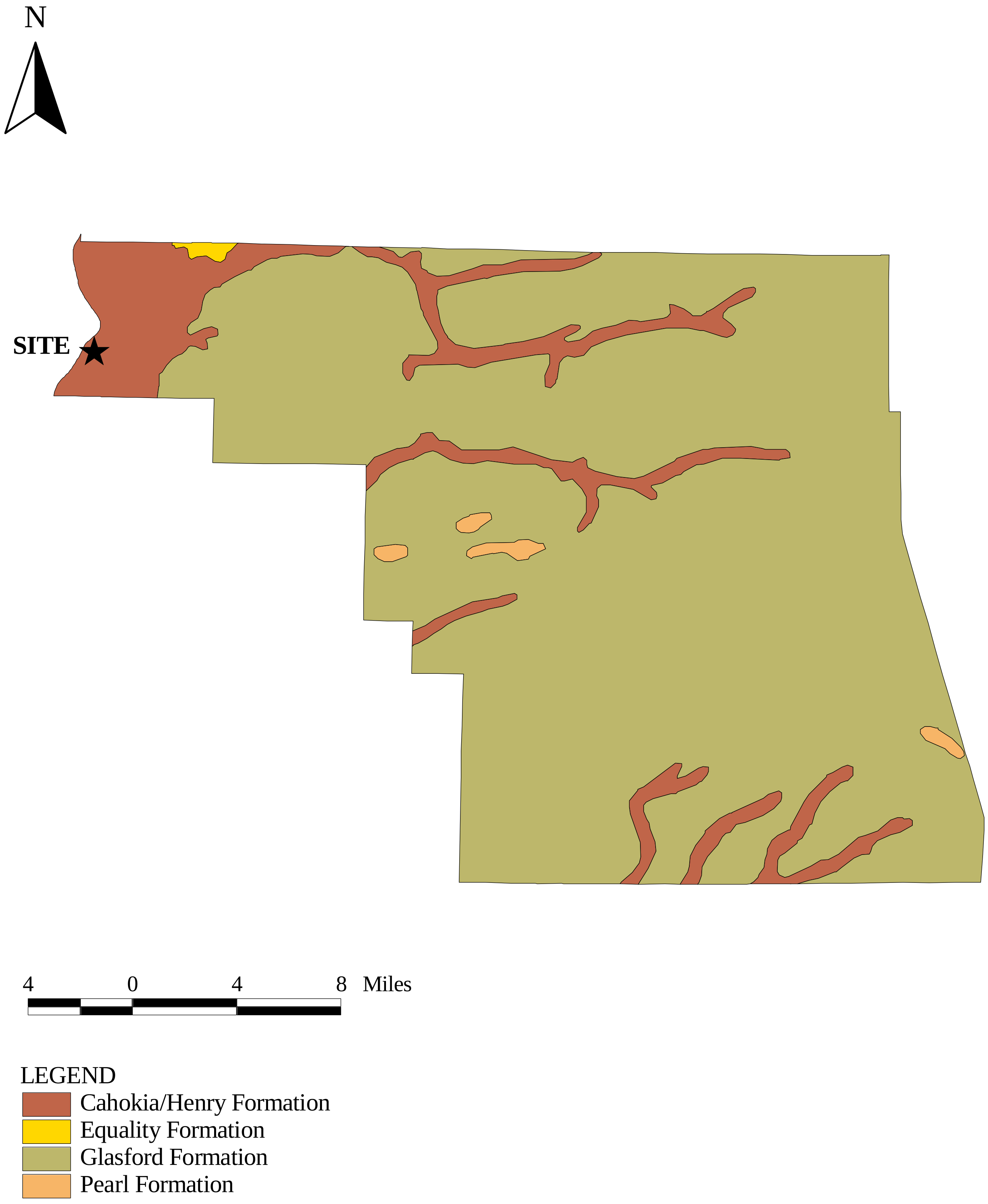
# FIGURE 4
## BEDROCK GEOLOGY
## (HORBERG, 1950)

AMERENENERGY GENERATING COMPANY
MEREDOSIA POWER STATION
MORGAN COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Bedgeo DATE: 11/09



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# FIGURE 5
## QUATERNARY DEPOSITS
## (HANSEL AND JOHNSON, 1996)

AMERENENERGY GENERATING COMPANY
MEREDOSIA POWER STATION
MORGAN COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Quat DATE: 11/09

# APPENDIX B

# WELL SURVEY RESULTS

# B WELL SEARCH

## B.1 Well Search Overview

The following sources of information were utilized in order to determine community water source and water well locations:

- Illinois State Geological Survey's Illinois Water Well (ILWATER) Internet Map Service
- Illinois State Water Survey Domestic Well Database
- Illinois EPA web-based Geographic Information System (GIS) files
- Illinois Department of Public Health
- Morgan County Health Department.

## B.2 Illinois State Geological Survey (ISGS)

The ISGS website provided an ArcIMS View Map as well as a database query for water wells. ISGS database information including any boring logs and well construction information is provided in this Appendix. In Figure 3, Wells 60 and 62 appear to have the same coordinates, well identification number and boring log description; however, their API numbers differ (Appendix B Table B-1). Wells 60 and 62 are likely the same well. Wells 61 and 63 also appear to have the same coordinates, well identification number and boring log description but their API number differs. Wells 61 and 63 are also likely the same well.

## B.3 Illinois State Water Survey (ISWS)

All of the wells found on-line through the ISWS Domestic Well Database were previously identified on the ISGS website. Records contained within the ISWS database, consisting of public, industrial, and commercial water wells, were not all received as of the date of this report. Since the ISWS database generally contains the same well information as the ISGS and Illinois EPA databases, some ISWS well entries on the Appendix B-1 Table were marked as pending. Should any new information be acquired from the ISWS including additional water wells not previously identified from the other sources of the well information, it will be provided as an addendum to this report. Table B-2 lists wells located by RAPPS Engineering & Applied Science, Inc. that were not located and identified in the current well search for this report.

## B.4 Illinois Environmental Protection Agency (IEPA)

The Illinois EPA database website provided ArcIMS Viewer Maps showing information on community, non-community, and public water supply wells as defined on the Illinois EPA website:

- Community Water Supply (CWS): a public water supply that serves or is intended to serve at least 15 service connections used by residents or regularly serves at least 25 residents.
- Non-Community Water Supply (NCWS): a public water supply that is not a community water supply.
- Public Water Supply: all mains, pipes and structures through which water is obtained and distributed to the public, including wells and well structures, intakes and cribs, pumping stations, treatment plants, reservoirs, storage tanks and appurtenances, collectively or severally, actually used or intended for use for the purpose of furnishing water for drinking or general domestic use and which serve at least 15 service connections or which regularly serve at least 25 persons at least 60 days per year. A public water supply is either a community water supply or a non-community water supply.

Based on the IEPA maps, there are five CWS wells in the vicinity of the MPS. Two CWS wells include a Minimum Setback Zone (MSZ) of 400 feet, and one of these wells also has a Phase I wellhead protection area (WHPA) of 1000 ft. A MSZ is an area of 200 or 400 radial feet surrounding a water well supplying public water system through which contaminants from a source are theoretically likely to move and reach the well. The Phase I WHPA extends the surface and subsurface area surrounding the water well to 1,000 radial feet. The five CWS wells were also identified in the ISGS database. A Phase II WHPA was created for CWS well 9. A Phase II WHPA is an extended area of protection that is usually based on computer modeling using a time of travel component of five years (i.e. five-year capture zone).

Three NCWS wells owned by Ameren were also identified in the IEPA database, located within Section 21, and within the Meredosia Power Station property (Figure 3). A phase I WHPA was established for these three NCWS wells. The three NCWS were not identified on the ISGS database.

## B.5 Morgan County Health Department

Personnel from the Morgan County Health Department confirmed the CWS and NCWS well systems located in the area. No additional information was provided about the area.

### Table B-1. Other Water Wells, Precise Location Not Available

**Phase I Hydrogeologic Assessment**

**Meredosia Power Station**

| Map | Source of Well Information | | | | Location Name | Well | | Location | | | | Year | Aquifer | | Well |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well # | ISGS | ISWS*** | IEPA | Other | at Time of Well Completion | Depth | County | Township | Range | Section | Subsection | Drilled | Type | Formation | Use |
| 1 | 121370014700 | *** | 00147 | -- | National starch and Chemical Company | 92 | Morgan | 16N | 13W | 28 | NE (A) | 1958 | unconsolidated | sand and gravel | IC |
| 2 | 121372152400 | *** | 21524 | -- | National starch and Chemical Company | 62 | Morgan | 16N | 13W | 28 | NWSENE | 1993 | unconsolidated | sand and gravel | IC |
| 3 | 121372157900 | *** | 21579 | -- | CIPS Power Station | 104 | Morgan | 16N | 13W | 21 | SENESE | 1994 | unconsolidated | sand and gravel | IC |
| 4 | 121370039600 | *** | 00396 | -- | National starch and Chemical Company | 90 | Morgan | 16N | 13W | 28 | NE | 1968 | unconsolidated | sand and gravel | IC |
| 5 | 121370042100 | *** | 00421 | -- | National starch and Chemical Company | 96 | Morgan | 16N | 13W | 28 | NWSENE | 1968 | unconsolidated | sand and gravel | IC |
| 6 | 121370042200 | *** | 00422 | -- | National starch and Chemical Company | 92 | Morgan | 16N | 13W | 28 | NE | 1968 | unconsolidated | sand and gravel | IC |
| 7 | 121372161300 | *** | 21613 | -- | Central Illinois Public Service | 104 | Morgan | 16N | 13W | 21 | SENESE | 1994 | unconsolidated | sand and gravel | IC |
| 8 | 121370051400 | *** | 00514 | -- | Village of Meredosia | 40 | Morgan | 16N | 13W | 22 | -- | 1950 | unconsolidated | sand | IC |
| 9 | 121370051500 | *** | 00515 | -- | Village of Meredosia | 40 | Morgan | 16N | 13W | 22 | NENW | 1950 | unconsolidated | sand | CWS |
| 10 | 121370053500 | *** | 00535 | -- | Central Illinois Public Service | 25 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 11 | 121370053600 | *** | 00536 | -- | Central Illinois Public Service | 25 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 12 | 121370053700 | *** | 00537 | -- | Central Illinois Public Service | 25 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 13 | 121370053800 | *** | 00538 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 14 | 121370053900 | *** | 00539 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 15 | 121370054000 | *** | 00540 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 16 | 121370054100 | *** | 00541 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 17 | 121370054200 | *** | 00542 | -- | Central Illinois Public Service | 25 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 18 | 121370054300 | *** | 00543 | -- | Central Illinois Public Service | 25 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 19 | 121370054400 | *** | 00544 | -- | Central Illinois Public Service | 25 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 20 | 121370054500 | *** | 00545 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 21 | 121370054600 | *** | 00546 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 22 | 121370054700 | *** | 00547 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 23 | 121370054800 | *** | 00548 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 24 | 121370054900 | *** | 00549 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 25 | 121370055000 | *** | 00550 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 26 | 121370055100 | *** | 00551 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 27 | 121370055200 | *** | 00552 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 28 | 121370055300 | *** | 00553 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 29 | 121370055400 | *** | 00554 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 30 | 121372164500 | *** | 21645 | -- | City of Meredosia | -- | Morgan | 16N | 13W | 22 | NW | -- | -- | -- | IC |
| 31 | 121372164700 | *** | 21647 | -- | National Starch & Chemical | 81 | Morgan | 16N | 13W | 28 | SWNENE (A) | 1991 | unconsolidated | samd | IC |
| 32 | 121370055500 | *** | 00555 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 33 | 121370055600 | *** | 00556 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 34 | 121370055700 | *** | 00557 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 35 | 121370055800 | *** | 00558 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 36 | 121370055900 | *** | 00559 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 37 | 121370056000 | *** | 00560 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand | IC |
| 38 | 121370056100 | *** | 00561 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 39 | 121370056200 | *** | 00562 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 40 | 121370056300 | *** | 00563 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 41 | 121370056400 | *** | 00564 | -- | Central Illinois Public Service | 100 | Morgan | 16N | 13W | 21 | NESE | 1941 | Bedrock | Limestone | IC |
| 42 | 121370056500 | *** | 00565 | -- | Central Illinois Public Service | 50 | Morgan | 16N | 13W | 21 | NESE | 1941 | unconsolidated | sand and gravel | IC |
| 43 | 121370060700 | *** | 00607 | -- | W.R. Grace Company | 90 | Morgan | 16N | 13W | 28 | NENENE (A) | 1969 | unconsolidated | sand and gravel | IC |
| 44 | 121370062800 | *** | 00628 | -- | National Starch & Chemical | 95 | Morgan | 16N | 13W | 28 | NE | 1970 | Bedrock | -- | IC |
| 45 | 121370062900 | *** | 00629 | -- | National Starch & Chemical | 60 | Morgan | 16N | 13W | 28 | NE | 1971 | unconsolidated | sand | IC |
| 46 | 121370063800 | *** | 00638 | -- | National Starch & Chemical | 96 | Morgan | 16N | 13W | 28 | NE | 1973 | unconsolidated | sand and gravel | IC |
| 47 | 121370063900 | *** | 00639 | -- | CIPS Meredosia Power sta. unit 4, # | 105 | Morgan | 16N | 13W | 21 | SE | 1973 | unconsolidated | sand and gravel | IC |
| 48 | 121372065600 | *** | 20656 | -- | Central Illinois Public Service | 105 | Morgan | 16N | 13W | 21 | -- | 1960 | unconsolidated | sand and gravel | IC |
| 49 | 121372065700 | *** | 20657 | -- | Central Illinois Public Service | 109 | Morgan | 16N | 13W | 21 | -- | 1957 | unconsolidated | sand and gravel | IC |
| 50 | 121372065800 | *** | 20658 | -- | Central Illinois Public Service | 106 | Morgan | 16N | 13W | 21 | SE | 1974 | unconsolidated | sand and gravel | IC |
| 51 | 121372068200 | *** | 20682 | -- | National starch and Chemical Company | 90 | Morgan | 16N | 13W | 28 | NE | 1976 | unconsolidated | sand and gravel | IC |
| 52 | 121372075800 | *** | 20758 | -- | Central Illinois Public Service | 104 | Morgan | 16N | 13W | 21 | SWNESE | 1978 | unconsolidated | sand and gravel | IC |
| 53 | 121372075900 | *** | 20759 | -- | National starch and Chemical Company | 89 | Morgan | 16N | 13W | 28 | NE | 1977 | unconsolidated | sand and gravel | IC |
| 54 | 121372076000 | *** | 20760 | -- | National starch and Chemical Company | 90 | Morgan | 16N | 13W | 28 | NE | 1978 | unconsolidated | sand and gravel | IC |
| 55 | 121372077000 | *** | 20770 | -- | W.R. Grace Company | 91 | Morgan | 16N | 13W | 27 | NW | 1979 | unconsolidated | gravel | IC |

### Table B-1. Other Water Wells, Precise Location Not Available

**Phase I Hydrogeologic Assessment**
**Meredosia Power Station**

| Map | Source of Well Information | | | | Location Name | Well | | Location | | | | Year | Aquifer | | Well |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well # | ISGS | ISWS*** | IEPA | Other | at Time of Well Completion | Depth | County | Township | Range | Section | Subsection | Drilled | Type | Formation | Use |
| 56 | 121372080200 | *** | 20802 | -- | National Starch & Chemical | 98 | Morgan | 16N | 13W | 28 | NE | 1964 | unconsolidated | sand and gravel | IC |
| 57 | 121372097100 | *** | 20971 | -- | Village of Meredosia | 88 | Morgan | 16N | 13W | 22 | NE | -- | -- | -- | CWS |
| 58 | 121372139800 | *** | 21398 | -- | National Starch & Chemical | 91 | Morgan | 16N | 13W | 28 | NENENE (A) | 1988 | unconsolidated | sand and gravel | IC |
| 59 | 121372176900 | *** | 21769 | -- | National Starch & Chemical | -- | Morgan | 16N | 13W | 28 | SWSWNE | 1996 | -- | -- | IC |
| 60 | 121352194400 | *** | 21944 | -- | Village of Meredosia | 84 | Morgan | 16N | 13W | 22 | SENENW | 1973 | unconsolidated | sand | IC |
| 61 | 121352194500 | *** | 21945 | -- | Village of Meredosia | 92 | Morgan | 16N | 13W | 22 | -- | 1980 | unconsolidated | sand and gravel | IC |
| 62 | 121372194400 | *** | 21944 | -- | Village of Meredosia | 84 | Morgan | 16N | 13W | 22 | SENENW | 1973 | -- | -- | CWS |
| 63 | 121372194500 | *** | 21945 | -- | Village of Meredosia | 92 | Morgan | 16N | 13W | 22 | -- | 1980 | unconsolidated | sand and gravel | CWS |
| 64 | 121372198300 | *** | 21983 | -- | Village of Meredosia | -- | Morgan | 16N | 13W | 22 | NENENW | -- | -- | -- | CWS |
| 65 | 121372198000 | *** | 21980 | -- | CIPS | 104 | Morgan | 16N | 13W | 21 | SENESE | 1994 | unconsolidated | sand and gravel | IC |
| 66 | 121372198100 | *** | 21981 | -- | CIPS | 105 | Morgan | 16N | 13W | 21 | NENESE | 1960 | unconsolidated | sand and gravel | IC |
| 67 | 121372198200 | *** | 21982 | -- | CIPS | 78 | Morgan | 16N | 13W | 21 | NWNESE | 1957 | unconsolidated | sand and gravel | IC |
| 68 | 121372213300 | *** | 22133 | -- | T.A. Terminal | 100 | Morgan | 16N | 13W | 27 | NWNWSW | 2011 | unconsolidated | sand and gravel | IC |
| 69 | 121372213400 | *** | 22134 | -- | T.A. Terminal | 95 | Morgan | 16N | 13W | 27 | NWNWSW | 2011 | unconsolidated | sand and gravel | IC |
| 70 | -- | *** | -- | 13700208-NCWS | AMERENCIPS/JANINEMAXWELL | -- | Morgan | 16N | 13W | 21 | -- | -- | -- | -- | NCWS |
| 71 | -- | *** | -- | 13700182-NCWS | AMERENCIPS/JANINEMAXWELL | -- | Morgan | 16N | 13W | 21 | -- | -- | -- | -- | NCWS |
| 72 | -- | *** | -- | 13700190-NCWS | AMERENCIPS/JANINEMAXWELL | -- | Morgan | 16N | 13W | 21 | -- | -- | -- | -- | NCWS |

Sources of Information

| | |
|---|---|
| IEPA | Illinois Environmental Protection Agency |
| ISGS | Illinois State Geological Survey |
| ISWS | Illinois State Water Survey |
| SWA | IEPA Source Water Assessment |

Well Use

| | |
|---|---|
| FD | Farm and/or Domestic Water Well |
| IC | Industrial/Commercial Water Well |
| CWS | Community Water Supply |
| NCWS | Non-Community Water Supply |

Notes

| | |
|---|---|
| - - | Not applicable or no information available |
| *** | ISWS data pending |
| A | Well is mislocated in ISGS and/or IEPA databases |

# Table B-2. Other Water Wells, Precise Location Not Available
## Phase I Hydrogeologic Assessment
## Meredosia Power Station

| | | Location | | | Well | | Date |
|---|---|---|---|---|---|---|---|
| Well ID | Depth | Township | Range | Section | Use | Driller | Drilled |
| 116139 | 20 | 16N | 13W | 28 | IC | | 12/26/1968 |
| 116140 | 20 | 16N | 13W | 28 | IC | | 12/26/1968 |
| 116142 | 20 | 16N | 13W | 28 | IC | | 12/26/1968 |
| 116143 | 20 | 16N | 13W | 28 | IC | | 12/26/1968 |
| 116144 | 17 | 16N | 13W | 28 | IC | W H WALLER | 1968 |
| 116146 | 77 | 16N | 13W | 28 | IC | LAYNE WESTERN | |
| 116152 | 20 | 16N | 13W | 28 | IC | | |
| 116155 | 20 | 16N | 13W | 28 | IC | | |
| 249901 | 97 | 16N | 13W | 28 | TH | J.P. MILLER ARTESIAN | 02/ /1955 |
| 249907 | 95 | 16N | 13W | 28 | IC | | 07/ /1961 |
| 403177 | 94 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1955 |
| 403178 | 92 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1958 |
| 403179 | 96 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1968 |
| 403180 | 98 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1964 |
| 403182 | 90 | 16N | 13W | 28 | IC | DIEHL PUMP & SUPPLY | //1968 |
| 403183 | 92 | 16N | 13W | 28 | IC | DIEHL PUMP & SUPPLY | //1968 |
| 403184 | 95 | 16N | 13W | 28 | IC | DIEHL PUMP & SUPPLY | //1970 |
| 403185 | 96 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1973 |
| 403188 | 90 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1976 |
| 403189 | 90 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1978 |
| 403190 | 90 | 16N | 13W | 28 | IC | LAYNE-WESTERN CO | //1988 |
| 403191 | 95 | 16N | 13W | 28 | IC | LAYNE-WESTERN CO | //1989 |
| 403192 | 81 | 16N | 13W | 28 | IC | MARION SKOUBY | //1991 |
| 403193 | 89 | 16N | 13W | 28 | IC | J P MILLER ART WELL | //1977 |
| 403194 | 60 | 16N | 13W | 28 | IC | DIEHL PUMP & SUPPLY | //1971 |
| 403196 | 90 | 16N | 13W | 28 | | DIEHL PUMP & SUPPLY | //1969 |
| 404792 | 62 | 16N | 13W | 28 | IC | GROSCH IRRIGATION | //1993 |
| 404878 | 82 | 16N | 13W | 28 | IC | LAYNE-WESTERN CO | //1993 |
| 405452 | | 16N | 13W | 28 | IC | | //1995 |
| 405453 | 86 | 16N | 13W | 28 | IC | LAYNE-WESTERN CO | //1996 |
| 403181 | 98 | 16N | 13W | 27 | IC | DIEHL PUMP & SUPPLY | //1966 |
| 403197 | 91 | 16N | 13W | 27 | | J P MILLER ART WELL | //1979 |
| 116121 | | 16N | 13W | 21 | IC | LAYNE WESTERN | 8/29/1973 |
| 116122 | 104 | 16N | 13W | 21 | IC | LAYNE WESTERN | 8/24/1973 |
| 116128 | | 16N | 13W | 21 | IC | LAYNE WESTERN | 5/25/1974 |
| 261851 | 104 | 16N | 13W | 21 | IC | T. KELLY/BROTCKE | 6/21/1994 |
| 403171 | 78 | 16N | 13W | 21 | IC | LAYNE-WESTERN CO | //1957 |
| 403172 | 105 | 16N | 13W | 21 | | | //1960 |
| 403173 | 106 | 16N | 13W | 21 | IC | | //1974 |
| 403174 | 104 | 16N | 13W | 21 | IC | | //1977 |

# Table B-2. Other Water Wells, Precise Location Not Available

## Phase I Hydrogeologic Assessment

## Meredosia Power Station

| Well ID | Depth | Location |  |  | Well Use | Driller | Date Drilled |
|---|---|---|---|---|---|---|---|
|  |  | Township | Range | Section |  |  |  |
| 403176 |  | 16N | 13W | 21 |  |  | // |
| 404922 | 104 | 16N | 13W | 21 | IC |  | //1994 |
| 124483 | 73 | 3S | 2W | 1 | IC | G W CHADWICK | 12/20/1975 |
| 289236 | 360 | 3S | 2W | 12 | DO | COLE/J&R | 11/3/1994 |

Notes:

| | |
|---|---|
| DO | Domestic |
| IC | not specified |
| IN | not specified |
| TH | not specified |
| BLANK | Assumed Drilled |

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Industrial Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine to medium sand | 0 | 40 |
| medium to coarse sand | 40 | 50 |
| medium sand | 50 | 62 |
| coarse sand to fine gravel | 62 | 73 |
| medium to coarse sand | 73 | 78 |
| fine to medium sand with gravel | 78 | 85 |
| coarse sand & fine to medium gravel | 85 | 90 |
| medium sand to fine gravel | 90 | 91 |
| coarse sand, gravel & boulders | 91 | 95 |
| **Total Depth** | | **95** |

Casing: 24" STEEL from -2' to 65'
24" STAINLESS STL SCREEN from 65' to 94'

Screen: 29' of 24" diameter .05 slot

Grout: NEAT CEMENT from 0 to 20.

Grout: BENTONITE CHIPS from 20 to 27.

Grout: SILICA #2 NORTHERN from 27 to 94.

Water from sand & gravel at 16' to 94'.
Static level 16' below casing top which is 2' above GL
Pumping level 40' when pumping at 2503 gpm for 20 hours

Permanent pump installed at 60' on January 25, 2011, with a capacity of 1850 gpm

Remarks: driller's est. well yield 3000 gpm

Sample set # 69973 (0' - 95') Received: January 9, 2012

Address of well: 1994 Old Grace Road

Location source: Location from permit

**Permit Date:** **Permit #:**

**COMPANY** Water Well Solutions
**FARM** T.A. Terminal
**DATE DRILLED** November 23, 2011 **NO.** 6
**ELEVATION** **COUNTY NO.** 22134
**LOCATION** NW NW SW
**LATITUDE** 39.81073 **LONGITUDE** -90.563186
**COUNTY** **Morgan** **API** **121372213400** **27 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Industrial Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine to medium sand | 0 | 40 |
| medium to coarse sand | 40 | 50 |
| medium sand | 50 | 62 |
| coarse sand to fine gravel | 62 | 73 |
| medium to coarse sand | 73 | 78 |
| fine to medium sand with gravel | 78 | 85 |
| coarse sand & fine to medium gravel | 85 | 90 |
| medium sand to fine gravel | 90 | 91 |
| coarse sand, gravel & flat boulders | 91 | 95 |
| **Total Depth** | | **100** |

Casing: 24" STEEL from -2' to 65'
24" STAINLESS STL SCREEN from 65' to 94'
Screen: 29' of 24" diameter .05 slot
Grout: NEAT CEMENT from 0 to 20.
Grout: BENTONITE CHIPS from 20 to 27.
Grout: SILICA #3 NORTHERN from 27 to 94.

Water from sand & gravel at 20' to 94'.
Static level 20' below casing top which is 2' above GL
Pumping level 43' when pumping at 2485 gpm for 24 hours
Permanent pump installed at 60' on January 19, 2011, with a capacity of 1850 gpm
Remarks: driller's est. well yield 3000 gpm
Sample set # 69972 (0' - 100') Received: January 9, 2012
Address of well: 1994 Old Grace Road

Location source: Location from permit

**Permit Date:** **Permit #:**

**COMPANY** Water Well Solutions
**FARM** T.A. Terminal
**DATE DRILLED** November 23, 2011 **NO.** 5
**ELEVATION** **COUNTY NO.** 22133
**LOCATION** NW NW SW
**LATITUDE** 39.81073 **LONGITUDE** -90.563186
**COUNTY** Morgan **API** 121372213300 **27 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Noncommunity - Public Water Well** | **Top** | **Bottom** |
|---|---|---|
| no record | 0 | 0 |
| **Total Depth** | | |

**Permit Date:**

**Permit #:**

**COMPANY**

**FARM** Meredosia

**DATE DRILLED**

**NO.** 6

**ELEVATION** 0

**COUNTY NO.** 21983

**LOCATION** NE NE NW

**LATITUDE** 39.832741

**LONGITUDE** -90.553904

**COUNTY Morgan**

**API 121372198300**

**22 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Noncommunity - Public Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine-medium sand | 0 | 24 |
| medium sand & fine gravel | 24 | 55 |
| fine sand | 55 | 68 |
| sand & gravel | 68 | 73 |
| medium sand, gravel & boulders | 73 | 78 |
| **Total Depth** | | **78** |

Pumping level 0' when pumping at 165 gpm for 1 hour

**Permit Date:**

**Permit #:**

**COMPANY**

**FARM** CIPS

**DATE DRILLED** November 21, 1957

**NO.** 3

**ELEVATION** 460

**COUNTY NO.** 21982

**LOCATION** NW NE SE

**LATITUDE** 39.825368

**LONGITUDE** -90.564994

**COUNTY** **Morgan**

**API** **121372198200**

**21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Noncommunity - Public Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine sand | 0 | 25 |
| medium sand-fine gravel | 25 | 40 |
| fine sand | 40 | 48 |
| fine-coarse sand & gravel | 48 | 52 |
| fine-medium sand | 52 | 65 |
| fine pink sand | 65 | 81 |
| coarse sand, gravel & small boulders | 81 | 105 |
| **Total Depth** | | **105** |

Static level 38' below casing top which is 0' above GL
Pumping level 40' when pumping at 503 gpm for 8 hours

**Permit Date:** **Permit #:**

**COMPANY**
**FARM** CIPS
**DATE DRILLED** December 1, 1960 **NO.** 4
**ELEVATION** 460 **COUNTY NO.** 21981
**LOCATION** NE NE SE
**LATITUDE** 39.825356 **LONGITUDE** -90.563863
**COUNTY** **Morgan** **API** **121372198100** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Noncommunity - Public Water Well** | **Top** | **Bottom** |
|---|---|---|
| fill sand | 0 | 20 |
| fine sand | 20 | 40 |
| medium sand | 40 | 85 |
| medium sand w/ gravel | 85 | 104 |
| rock @ | 104 | 104 |
| **Total Depth** | | **104** |

Casing: 36" STEEL from -2' to 30'
16" STEEL from -2' to 79'

Grout: NEAT from 0 to 30.

Water from sand & gravel at 32' to 104'.
Static level 32' below casing top which is 2' above GL
Permanent pump installed at 75' on July 11, 1994, with a capacity
Remarks: IEPA well #13700182 of 600 gpm

Address of well: 800 Washington
Meredosia, IL

Location source: Location from the driller

**Permit Date:** June 9, 1994 **Permit #:**

**COMPANY** Brotcke Engineering
**FARM** CIPS
**DATE DRILLED** June 21, 1994 **NO.** 7
**ELEVATION** 0 **COUNTY NO.** 21980
**LOCATION** SE NE SE
**LATITUDE** 39.823501 **LONGITUDE** -90.564221
**COUNTY** **Morgan** **API** **121372198000** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Municipal Water Supply** | **Top** | **Bottom** |
|---|---|---|
| no record | 0 | 92 |
| **Total Depth** | | **92** |

Casing: 10" CASING from -1' to 72'
Screen: 20' of 10" diameter slot
Water from sand & gravel at 25' to 92'.
Static level 27' below casing top which is 1' above GL
Pumping level 32' when pumping at 300 gpm for 3 hours

**Permit Date:** **Permit #:**

**COMPANY**
**FARM** Meredosia, Village o
**DATE DRILLED** September 2, 1980 **NO.** 5
**ELEVATION** 455 **COUNTY NO.** 21945
**LOCATION** 612'S line, 2425'E line of section
**LATITUDE** 39.820473 **LONGITUDE** -90.553748
**COUNTY** **Morgan** **API** **121372194500** **22 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Municipal Water Supply** | **Top** | **Bottom** |
|---|---|---|
| no record | 0 | 84 |
| **Total Depth** | | **84** |

Casing: 8" CASING from 0' to 70'

Screen: 14' of 8" diameter 25 slot

Water from coarse sand at 69' to 84'.

Address of well: 120' NNE of water treatment
plant

Location source: Location from EPA

**Permit Date:** **Permit #:**

**COMPANY** Elmer W. Franke/Calhoun Drlg.

**FARM** Meredosia, Village o

**DATE DRILLED** September 1, 1973 **NO.** 3

**ELEVATION** 0 **COUNTY NO.** 21944

**LOCATION** SE NE NW

**LATITUDE** 39.830881 **LONGITUDE** -90.554188

**COUNTY** **Morgan** **API** **121372194400** **22 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Non Potable Water Well** | **Top** | **Bottom** |
|---|---|---|
| brown silty sand | 0 | 5 |
| fine sand | 5 | 18 |
| medium to large sand w/1" gravel | 18 | 83 |
| sand w/medium to large gravel | 83 | 85 |
| gravel | 85 | 86 |
| **Total Depth** | | **86** |

Casing: 24" STEEL 94.62#/FT from -2' to 51'

Screen: 15' of 24" diameter 100 slot

Grout: CEMENT from 0 to 20.

Size hole below casing: 42"

Water from sand & gravel at 0' to 0'.
Static level 18' below casing top which is 2' above GL
Pumping level 33' when pumping at 1500 gpm for 8 hours

Permanent pump installed at 65' on September 17, 1996, with a capacity of 1500 gpm

Additional location info: Lot: Subdivision:
Process water only

Address of well: S. Washington St.
Meredosia, IL

Location source: Location from permit

**Permit Date:** August 28, 1996 **Permit #:** 137-046

**COMPANY** Stollhans, Jeff
**FARM** National Starch & Chem. Co
**DATE DRILLED** September 13, 1996 **NO.** 16
**ELEVATION** 0 **COUNTY NO.** 21769
**LOCATION** SW SW NE
**LATITUDE** 39.812578 **LONGITUDE** -90.570974
**COUNTY** **Morgan** **API** **121372176900** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Monitoring** | **Top** | **Bottom** |
|---|---|---|
| no samples collected | 0 | 10 |
| sandy clay loam yl brn 10YR 5/6-5/8 | 10 | 12 |
| no samples collected, water at 14.9' | 12 | 25 |
| sand yl brn crs grain well mod sorting | 25 | 27 |
| no samples collected | 0 | 10 |
| sandy clay loam yellowish brown 10YR 5/6-5/8 some structure | 10 | 12 |
| no samples collected water @ 14.9' | 12 | 25 |
| sand yellowish brown coarse grained abundant subrounded pebbles noncohesive well oxidized moderate sorting | 25 | 27 |
| **Total Depth** | | **27** |

Remarks: IDOA Pesticide Monit.#1-11-521

Core #C 14287 (10' - 26') Received: December 23, 1996

**Permit Date:** **Permit #:**

**COMPANY** IL State Water Survey

**FARM** Yeck, Harlan

**DATE DRILLED** May 29, 1996 **NO.** 1-11-521

**ELEVATION** 0GL **COUNTY NO.** 21698

**LOCATION** NW NE SE

**LATITUDE** 39.839915 **LONGITUDE** -90.546758

**COUNTY** Morgan **API** 121372169800 **15 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Industrial Water Well** | **Top** | **Bottom** |
|---|---|---|
| SS #67434 (0'-80.5') | 0 | 0 |
| fine reddish brown sand | 0 | 15 |
| fine-med lt brown to reddish brown sand | 15 | 25 |
| fine-medium light brown sand | 25 | 30 |
| med lt brn sand, some cobbles in samples | 30 | 45 |
| medium light brown sand | 45 | 50 |
| med lt brown sand, lignite in sample | 50 | 55 |
| medium to fine light brown sand | 55 | 60 |
| medium light brown sand | 60 | 80 |
| medium to fine light brown sand | 80 | 81 |
| **Total Depth** | | **81** |

Casing: 8" CARBON STEEL 24.7# from -2' to 58'

Screen: 20' of 8" diameter 60 slot

Grout: CONCRETE from 0 to 20.

Size hole below casing: 34"

Water from at 24' to 81'.
Static level 24' below casing top which is 2' above GL
Pumping level 26' when pumping at 0 gpm for 1 hour

Permanent pump installed at 50' on March 8, 1991, with a capacity of 80 gpm

Sample set # 67434 (0' - 80.5') Received: April 17, 1981

Location source: Location from the driller

**Permit Date:** January 15, 1991 **Permit #:** 13736

**COMPANY** Skouby, Marion
**FARM** National Starch
**DATE DRILLED** February 13, 1991 **NO.**
**ELEVATION** 0 **COUNTY NO.** 21647
**LOCATION** SW NE NE
**LATITUDE** 39.816167 **LONGITUDE** -90.56688
**COUNTY** **Morgan** **API** **121372164700** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well Test Hole** | **Top** | **Bottom** |
|---|---|---|
| SS #62943 (0'-105') | 0 | 0 |
| **Total Depth** | | |

Remarks: Rec'd. 5/7/81

Sample set # 62943 (0' - 105') Received: May 7, 1981

**Permit Date:** August 29, 1980 **Permit #:** 95802

**COMPANY** owner

**FARM** Meredosia, City of

**DATE DRILLED** **NO.**

**ELEVATION** 0 **COUNTY NO.** 21645

**LOCATION** 612'S 215'W NE/c NW

**LATITUDE** 39.831979 **LONGITUDE** -90.553617

**COUNTY** **Morgan** **API** **121372164500** **22 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Noncommunity - Public Water Well** | **Top** | **Bottom** |
|---|---|---|
| fill sand | 0 | 20 |
| fine sand | 20 | 40 |
| medium sand | 40 | 85 |
| medium sand with gravel | 85 | 104 |
| rock at | 104 | 104 |
| **Total Depth** | | **104** |

Casing: 36" STEEL 166.35#/FT from -2' to 30'
16" STEEL 62.58#/FT from -2' to 79'

Screen: 25' of 16" diameter .05 slot

Grout: NEAT from 0 to 30.

Water from sand & gravel at 32' to 104'.
Static level 32' below casing top which is 2' above GL
Permanent pump installed at 75' on July 11, 1994, with a capacity of 600 gpm

Location source: Location from permit

**Permit Date:** June 9, 1994 **Permit #:**

**COMPANY** Brotcke Engineering
**FARM** Central IL Public Service C
**DATE DRILLED** June 21, 1994 **NO.** 7
**ELEVATION** 0 **COUNTY NO.** 21613
**LOCATION** SE NE SE
**LATITUDE** 39.823501 **LONGITUDE** -90.564221
**COUNTY Morgan** **API 121372161300** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| crushed stone | 0 | 1 |
| silty sand | 1 | 5 |
| fine sand | 5 | 20 |
| fine to medium sand | 20 | 25 |
| fine to coarse sand | 25 | 35 |
| coarse sand | 35 | 40 |
| med. to coarse sand w/gravel | 40 | 45 |
| fine to medium sand | 45 | 50 |
| fine to coarse sand | 50 | 70 |
| fine to coarse sand w/gravel | 70 | 75 |
| silty, fine to medium sand | 75 | 85 |
| fine to coarse sand | 85 | 95 |
| medium to coarse sand | 95 | 101 |
| fine to coarse sand w/boulders | 101 | 104 |
| **Total Depth** | | **104** |

Sample set # 67974 (5' - 103') Received: July 1, 1994

Location source: Location from the driller

**Permit Date:** **Permit #:** none

**COMPANY** Brotcke, Paul
**FARM** CIPS Power Station
**DATE DRILLED** June 21, 1994 **NO.** 7
**ELEVATION** 0 **COUNTY NO.** 21579
**LOCATION** SE NE SE
**LATITUDE** 39.823501 **LONGITUDE** -90.564221
**COUNTY** **Morgan** **API** **121372157900** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Semi-Private Water Well** | **Top** | **Bottom** |
|---|---|---|
| top soil | 0 | 2 |
| fine sand | 2 | 17 |
| medium-coarse sand | 17 | 40 |
| medium-coarse gravel | 40 | 62 |
| coarse sand at | 62 | 62 |
| **Total Depth** | | **62** |

Casing: 5" SS SCREEN from 0' to 4'
5" PLAIN CASING from 4' to 62'

Screen: 4' of 5" diameter .012 slot

Grout: BENTONITE from 4 to 25.

Permanent pump installed at 45' on , with a capacity of 10 gpm

Address of well: Co. Rd. #1975N

Location source: Location from permit

**Permit Date:** July 16, 1993 **Permit #:**

**COMPANY** Dirks, Michael J.
**FARM** National Starch & Chemical Co.
**DATE DRILLED** July 26, 1993 **NO.**
**ELEVATION** 0 **COUNTY NO.** 21524
**LOCATION** NW SE NE
**LATITUDE** 39.814361 **LONGITUDE** -90.567035
**COUNTY** **Morgan** **API** **121372152400** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Industrial Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine brown sand | 0 | 40 |
| fine light brown sand | 40 | 55 |
| medium to coarse brown sand & gravel | 55 | 90 |
| **Total Depth** | | **91** |

Casing: 16" BLACK 375 from -2' to 64'

Screen: 25' of 16" diameter .08 slot

Grout: CEMENT from 0 to 20.

Water from sand & gravel at 64' to 91'.
Static level 28' below casing top which is 2' above GL
Pumping level 36' when pumping at 800 gpm for 6 hours

Permanent pump installed at 50' on November 10, 1988, with a capacity of 800 gpm

Location source: Location from permit

**Permit Date:** September 23, 1988 **Permit #:** 006133

**COMPANY** Peterson, Steven R.
**FARM** National Starch-Chemical Co.
**DATE DRILLED** October 11, 1988 **NO.**
**ELEVATION** 0 **COUNTY NO.** 21398
**LOCATION** NE NE NE
**LATITUDE** 39.817955 **LONGITUDE** -90.565139
**COUNTY** Morgan **API** 121372139800 **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| Water Well | Top | Bottom |
|---|---|---|
| Total Depth | | 88 |

**Permit Date:**

**Permit #:** 37760

**COMPANY**

**FARM** Meredosia Village

**DATE DRILLED**

**NO.** 4

**ELEVATION** 0

**COUNTY NO.** 20971

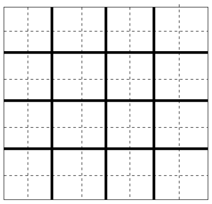
**LOCATION** 805'N line, 2950'E line of NE

**LATITUDE** 39.83145

**LONGITUDE** -90.554082

**COUNTY** Morgan

**API** 121372097100



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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand | 0 | 40 |
| medium to fine sand | 40 | 70 |
| sand & gravel | 70 | 94 |
| gravel & boulders | 94 | 98 |
| **Total Depth** | | **98** |

Casing: 12" STEEL CASING from 0' to 78'

Static level 25' below casing top which is 0' above GL

Pumping level 34' when pumping at 600 gpm for 15 hours

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** National Starch & Chem. Co

**DATE DRILLED** July 7, 1964 **NO.** 4

**ELEVATION** 435GL **COUNTY NO.** 20802

**LOCATION** 1669'N line, 1850'E line of NE

**LATITUDE** 39.814322 **LONGITUDE** -90.570968

**COUNTY** **Morgan** **API** **121372080200** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand | 0 | 36 |
| sand & gravel | 36 | 67 |
| fine to medium gravel | 67 | 91 |
| **Total Depth** | | **91** |

Casing: 16" STEEL .375 from 3' to 66'
Screen: 25' of 16" diameter .08 slot
Water from drift at 66' to 91'.
Static level 12' below casing top which is 0' above GL
Pumping level 22' when pumping at 1000 gpm for 8 hours

Location source: Location from permit

**Permit Date:** May 11, 1979 **Permit #:** 85480

**COMPANY** Hakala, Richard L.
**FARM** Grace, W.R. & Co.
**DATE DRILLED** May 15, 1979 **NO.** 4
**ELEVATION** 0 **COUNTY NO.** 20770
**LOCATION** 1980'N line, 450'W line of NW
**LATITUDE** 39.813373 **LONGITUDE** -90.562736
**COUNTY** **Morgan** **API** **121372077000** **27 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand | 0 | 45 |
| sand & gravel | 45 | 90 |
| **Total Depth** | | **90** |

Casing: 16" STEEL 3/8 WALL from -2' to 65'

Screen: 25' of 16" diameter .8 slot
Water from drift at 65' to 90'.

Location source: Location from permit

**Permit Date:** October 13, 1978 **Permit #:** 80737

**COMPANY** owner
**FARM** National Starch
**DATE DRILLED** October 24, 1978 **NO.** 11
**ELEVATION** 0 **COUNTY NO.** 20760
**LOCATION** 1408'N line, 855'E line of NE
**LATITUDE** 39.815 **LONGITUDE** -90.567407
**COUNTY** Morgan **API** 121372076000 **28 - 16N - 13W**

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand & gravel | 0 | 89 |
| **Total Depth** | | **89** |

Casing: 16" OD STEEL 3/8"WALL from 0' to 63'
Screen: 25' of 16" diameter .08 slot
Water from sand & gravel at 63' to 88'.
Static level 26' below casing top which is 2' above GL
Pumping level 33' when pumping at 600 gpm for 8 hours

Location source: Location from permit

**Permit Date:** October 16, 1977 **Permit #:** 61809

**COMPANY** Miller, J.P. Artesian Well Co.
**FARM** Natl. Starch & Chem.
**DATE DRILLED** June 21, 1977 **NO.** 6A
**ELEVATION** 0 **COUNTY NO.** 20759
**LOCATION** 1889'N line, 871'E line of NE
**LATITUDE** 39.813672 **LONGITUDE** -90.567465
**COUNTY** **Morgan** **API** **121372075900** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand fill | 0 | 20 |
| clay | 20 | 30 |
| coarse sand & gravel | 30 | 104 |
| rock at | 104 | 104 |
| **Total Depth** | | **104** |

Casing: 30" STEEL .312 from 0' to 30'
12" STEEL .375 from 0' to 79'

Screen: 25' of 12" diameter 6 slot

Size hole below casing: 38"

Water from alluvial at 30' to 102'.
Static level 25' below casing top which is 2' above GL

Driller's Log filed
Location source: Platbook verified

**Permit Date:** September 8, 1977 **Permit #:** 66466

**COMPANY** Ruester, John T.
**FARM** Central Ill. Public Ser.Co.
**DATE DRILLED** April 25, 1978 **NO.** 6
**ELEVATION** 448GL **COUNTY NO.** 20758
**LOCATION** 100'S line, 50'W line of SW NE SE
**LATITUDE** 39.822865 **LONGITUDE** -90.566098
**COUNTY** Morgan **API** 121372075800 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| ss #60435 | 0 | 0 |
| sand | 0 | 40 |
| sand & fine gravel | 40 | 90 |
| rock at | 90 | 90 |
| **Total Depth** | | **90** |

Casing: 16" from -2' to 65'

Screen: 25' of 16" diameter slot

Static level 25' below casing top which is 0' above GL

Pumping level 38' when pumping at 1075 gpm for 2 hours

Sample set # 60435 (0' - 90') Received: August 30, 1976

Location source: Location from permit

**Permit Date:** January 20, 1976 **Permit #:** 44276

**COMPANY** owner

**FARM** National Starch & Chem.Co

**DATE DRILLED** February 17, 1976 **NO.** 10

**ELEVATION** 0 **COUNTY NO.** 20682

**LOCATION** 1403'N line, 332'E line of NE

**LATITUDE** 39.81499 **LONGITUDE** -90.565535

**COUNTY Morgan** **API 121372068200** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| silty sand | 0 | 15 |
| coarse sand & gravel | 15 | 30 |
| medium sand & gravel | 30 | 50 |
| gravel, coarse sand | 50 | 60 |
| fine sand | 60 | 67 |
| sand & gravel | 67 | 80 |
| fine sand | 80 | 85 |
| gravel | 85 | 106 |
| rock at | 106 | 106 |
| **Total Depth** | | **106** |

Casing: 12" from -2' to 81'
20" from 0' to 30'

Water from sand & gravel at 0' to 0'.

Static level 27' below casing top which is 2' above GL

Pumping level 33' when pumping at 503 gpm for 24 hours

Driller's Log filed

Location source: Location from permit

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** CIPS Meredosia Unit 4

**DATE DRILLED** May 1, 1974 **NO.** 5

**ELEVATION** 455TM **COUNTY NO.** 20658

**LOCATION** 1700'S line, 300'E line of SE

**LATITUDE** 39.823541 **LONGITUDE** -90.564662

**COUNTY** **Morgan** **API** **121372065800** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine to medium sand | 0 | 24 |
| medium sand & fine gravel | 24 | 55 |
| fine sand | 55 | 68 |
| sand & gravel | 68 | 73 |
| medium sand, gravel & boulders | 73 | 78 |
| total depth | 78 | 109 |
| **Total Depth** | | **109** |

Casing: 30" from 0' to 30'
10" from 4' to 84'

Pumping level 3' when pumping at 165 gpm for 1 hour

Driller's Log filed

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** Central Ill.Public Ser.

**DATE DRILLED** November 21, 1957 **NO.** 3

**ELEVATION** 460GL **COUNTY NO.** 20657

**LOCATION** 1643'S line, 473'E line of section

**LATITUDE** 39.823391 **LONGITUDE** -90.565304

**COUNTY** **Morgan** **API** **121372065700** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine sand | 0 | 25 |
| medium sand fine gravel | 25 | 40 |
| fine sand | 40 | 48 |
| fine coarse sand & gravel | 48 | 52 |
| fine medium sand | 52 | 65 |
| fine pink sand, | 65 | 81 |
| coarse sand, gravel & small boulders | 81 | 105 |
| **Total Depth** | | **105** |

Static level 38' below casing top which is 0' above GL
Pumping level 40' when pumping at 503 gpm for 8 hours

Driller's Log filed

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Central Ill.Public Service
**DATE DRILLED** December 1, 1960 **NO.** 4
**ELEVATION** 460GL **COUNTY NO.** 20656
**LOCATION** 2003'S line, 577'E line of section
**LATITUDE** 39.824389 **LONGITUDE** -90.565516
**COUNTY** **Morgan** **API** **121372065600** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine brown sand | 0 | 30 |
| coarse sand | 30 | 50 |
| medium sand | 50 | 70 |
| fine to medium sand | 70 | 90 |
| sand & gravel | 90 | 105 |
| rock at | 105 | 105 |
| **Total Depth** | | **105** |

Casing: 12" from -1' to 79'
30" from 0' to 31'

Water from sand & gravel at 0' to 0'.

Static level 32' below casing top which is 0' above GL

Pumping level 39' when pumping at 517 gpm for 22 hours

Driller's Log filed

Sample set # 58921 (0' - 103') Received: December 8, 1973

Location source: Location from permit

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** CIPS Meredosia Power Sta unit 4,#

**DATE DRILLED** August 30, 1973 **NO.** 5

**ELEVATION** 445TM **COUNTY NO.** 00639

**LOCATION** 1300'S line, 500'E line of SE

**LATITUDE** 39.822448 **LONGITUDE** -90.565551

**COUNTY** Morgan **API** 121370063900 21 - 16N - 13W

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| drift- sand & gravel | 0 | 96 |
| **Total Depth** | | **96** |

Casing: 16" STEEL 62.58 LB. from 0' to 70'

Screen: 25' of 16" diameter .08 slot

Water from drift at 50' to 96'.

Static level 17' below casing top which is 0' above GL

Pumping level 24' when pumping at 800 gpm for 8 hours

Remarks: see file for detail sample study

Driller's Log filed

Sample set # 58824 (0' - 95') Received: September 19, 1973

Location source: Location from permit

**Permit Date:** May 1, 1973 **Permit #:** 18880

**COMPANY** Miller, J.P. Artesian Well Co.

**FARM** National Starch & Chemical

**DATE DRILLED** May 1, 1973 **NO.** 9

**ELEVATION** 0 **COUNTY NO.** 00638

**LOCATION** 2600'N line, 1400'E line of NE

**LATITUDE** 39.811734 **LONGITUDE** -90.569358

**COUNTY** **Morgan** **API** **121370063800** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| fine sand, not clean | 0 | 18 |
| fine sand, clean | 18 | 60 |
| **Total Depth** | | **60** |

Casing: 16" STEEL 3/8" WALL from 0' to 49'
8" STEEL 25# from 0' to 52'

Screen: 10' of 8" diameter 40 slot

Water from aluvium at 0' to 62'.

Static level 20' below casing top which is 2' above GL

Pumping level 25' when pumping at 120 gpm for 2 hours

Driller's Log filed

Location source: Location from permit

**Permit Date:** January 1, 1971 **Permit #:** 10077

**COMPANY** Diehl Pump and Supply Co.

**FARM** National Starch

**DATE DRILLED** January 1, 1971 **NO.** 2A

**ELEVATION** 0 **COUNTY NO.** 00629

**LOCATION** 2154'N line, 1108'E line of NE

**LATITUDE** 39.812952 **LONGITUDE** -90.568313

**COUNTY Morgan** **API 121370062900** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| ss #57364 | 0 | 0 |
| sandy top soil | 0 | 18 |
| fine sand | 18 | 45 |
| fine sand, small gravel | 45 | 55 |
| fine sand | 55 | 65 |
| fine sand, small gravel | 65 | 93 |
| very large boulders | 93 | 95 |
| rock at | 95 | 95 |
| **Total Depth** | | **95** |

Casing: 26" 3/8 WALL from 0' to 63'
12" 48 POUND from 0' to 68'

Screen: 25' of 12" diameter 40 slot

Water from glacial drift at 0' to 95'.

Static level 25' below casing top which is 2' above GL

Pumping level 34' when pumping at 1000 gpm for 6 hours

Remarks: see file for detail sample study

Driller's Log filed

Sample set # 57364 (2' - 93') Received: February 4, 1971

Location source: Location from permit

**Permit Date:** June 24, 1970 **Permit #:** 10077

**COMPANY** Diehl Pump and Supply Co.

**FARM** National Starch

**DATE DRILLED** December 18, 1970 **NO.** 8

**ELEVATION** 0 **COUNTY NO.** 00628

**LOCATION** 1800'N line, 625'E line of NE

**LATITUDE** 39.813907 **LONGITUDE** -90.566585

**COUNTY** **Morgan** **API** **121370062800** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| ss #56380 | 0 | 0 |
| fine sand | 0 | 20 |
| fine sand, small gravel | 20 | 45 |
| fine sand, coarse gravel | 45 | 55 |
| fine sand, small gravel | 55 | 71 |
| medium sand, small gravel | 71 | 85 |
| medium sand, large gravel | 85 | 90 |
| **Total Depth** | | **90** |

Casing: 24" 3/8 WALL from 0' to 60'
12" 52 LB. from 0' to 64'

Screen: 26' of 12" diameter 60 slot

Water from sand & gravel at 0' to 90'.

Static level 14' below casing top which is 2' above GL

Pumping level 32' when pumping at 1000 gpm for 8 hours

Remarks: see file for detail sample study

Driller's Log filed

Sample set # 56380 (0' - 90') Received: August 26, 1969

Location source: Location from permit

**Permit Date:** June 29, 1969 **Permit #:** 06700

**COMPANY** Lorenz D A

**FARM** W.R. Grace Co.

**DATE DRILLED** September 11, 1969 **NO.** DL-3

**ELEVATION** 0 **COUNTY NO.** 00607

**LOCATION** NE NE NE

**LATITUDE** 39.817955 **LONGITUDE** -90.565139

**COUNTY** **Morgan** **API** **121370060700** **28 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 8 |
| sand, medium, clay content | 8 | 10 |
| sand, brown, medium grain | 10 | 15 |
| sand, brown, medium grain | 15 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand & medium gravel | 30 | 35 |
| sand, coarse; medium gravel | 35 | 40 |
| sand, coarse; medium gravel | 40 | 45 |
| sand, coarse; fine gravel | 45 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 31
**ELEVATION** 454CO **COUNTY NO.** 00565
**LOCATION** 40'N 70'E SW/c NE SE
**LATITUDE** 39.8227 **LONGITUDE** -90.566074
**COUNTY** Morgan **API** 121370056500 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, slight clay content | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 19 |
| sand, course; medium gravel | 19 | 20 |
| sand, course; medium gravel | 20 | 30 |
| sand, coarse; small gravel | 30 | 40 |
| sand, coarse; medium gravel | 40 | 50 |
| sand, fine | 50 | 60 |
| sand, coarse | 60 | 70 |
| sand, coarse | 70 | 80 |
| sand, coarse | 80 | 89 |
| sand, coarse;small gvl w/tr of lignite | 89 | 90 |
| limestone | 90 | 96 |
| limestone | 96 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 30
**ELEVATION** 442CO **COUNTY NO.** 00564
**LOCATION** 115'N 5'W SE/c NW SE
**LATITUDE** 39.822911 **LONGITUDE** -90.566281
**COUNTY** Morgan **API** 121370056400 **21 - 16N - 13W**

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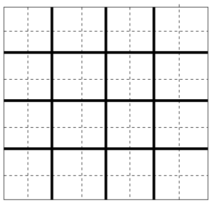
# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| silt, sandy, dark brown | 0 | 3 |
| silt, sandy, dark brown | 3 | 6 |
| sand, medium & silt | 6 | 10 |
| sand, fine, light brown | 10 | 15 |
| sand, medium; fine gravel | 15 | 20 |
| sand, coarse; coarse gravel | 20 | 30 |
| sand, fine; small stones | 30 | 40 |
| sand, fine | 40 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 29
**ELEVATION** 429CO **COUNTY NO.** 00563
**LOCATION** 200'N 95'W SE/c NW SE
**LATITUDE** 39.823148 **LONGITUDE** -90.566536
**COUNTY** **Morgan** **API** **121370056300**



**21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, medium; silt & pebbles | 0 | 5 |
| sand, medium; fine gravel | 5 | 14 |
| sand, medium; fine gravel | 14 | 24 |
| sand, fine grain | 24 | 34 |
| sand, fine grain | 34 | 44 |
| sand, fine grain | 44 | 54 |
| sand, coarse; small pebbles | 54 | 64 |
| sand, coarse; medium gravel | 64 | 67 |
| limestone (broken), core | 67 | 77 |
| limestone (broken), core | 77 | 87 |
| limestone (broken), core | 87 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 28
**ELEVATION** 417CO **COUNTY NO.** 00562
**LOCATION** 290'N 180'W SE/c NW SE
**LATITUDE** 39.823398 **LONGITUDE** -90.566769
**COUNTY** Morgan **API** 121370056200 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, fine; silt & pebbles | 0 | 5 |
| sand, medium grain | 5 | 11 |
| sand, medium grain | 11 | 22 |
| sand, medium; small pebbles | 22 | 32 |
| sand, medium; small pebbles | 32 | 42 |
| sand, medium; small pebbles | 42 | 52 |
| sand, medium; small pebbles | 52 | 62 |
| sand, coarse;medium gravel & rock | 62 | 67 |
| limestone, chert bands; core | 67 | 77 |
| limestone, chert bands; core | 77 | 88 |
| limestone, chert bands; core | 88 | 94 |
| limestone, chert bands; core | 94 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 27
**ELEVATION** 418CO **COUNTY NO.** 00561
**LOCATION** 460'N line, 20'W line of NW SE
**LATITUDE** 39.82506 **LONGITUDE** -90.567886
**COUNTY** **Morgan** **API** **121370056100** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, medium grain | 0 | 3 |
| sand, medium grain | 3 | 6 |
| sand, medium grain | 6 | 10 |
| sand, medium grain | 10 | 15 |
| sand, fine grain | 15 | 25 |
| sand, medium; fine gravel | 25 | 35 |
| sand, fine grain | 35 | 45 |
| sand, fine grain | 45 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 26
**ELEVATION** 423CO **COUNTY NO.** 00560
**LOCATION** 395'N 45'E SW/c NE SE
**LATITUDE** 39.823679 **LONGITUDE** -90.565885
**COUNTY** **Morgan** **API** **121370056000** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 5 |
| sand, brown, medium grain | 5 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, light brown, medium grain | 20 | 30 |
| no record | 30 | 31 |
| sand, coarse; medium gravel | 31 | 35 |
| sand, coarse; medium gravel | 35 | 40 |
| sand, fine grain | 40 | 50 |
| sand, fine grain | 50 | 60 |
| gravel, small, pea size | 60 | 70 |
| sand, coarse; small gravel | 70 | 80 |
| sand, coarse; small gravel | 80 | 86 |
| limestone | 86 | 92 |
| limestone | 92 | 95 |
| limestone | 95 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 25
**ELEVATION** 436CO **COUNTY NO.** 00559
**LOCATION** 245'N 25'E SW/c NE SE
**LATITUDE** 39.823266 **LONGITUDE** -90.566072
**COUNTY** Morgan **API** 121370055900 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, fine grain | 0 | 3 |
| sand, medium grain | 3 | 6 |
| sand, fine grain | 6 | 10 |
| sand, fine grain | 10 | 15 |
| sand, medium, small pebbles | 15 | 25 |
| sand, fine grain | 25 | 35 |
| sand, medium grain | 35 | 45 |
| sand, fine grain | 45 | 55 |
| sand, fine grain | 55 | 65 |
| sand, coarse; fine gravel | 65 | 75 |
| sand, coarse; medium gravel | 75 | 81 |
| limestone core | 81 | 86 |
| limestone with chert bands | 86 | 89 |
| limestone | 89 | 91 |
| limestone | 91 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 24
**ELEVATION** 431CO **COUNTY NO.** 00558
**LOCATION** 310'N 95'E SW/c NE SE
**LATITUDE** 39.823442 **LONGITUDE** -90.565774
**COUNTY** **Morgan** **API** **121370055800** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, fine grain | 0 | 3 |
| sand, fine grain | 3 | 6 |
| sand, medium grain | 6 | 10 |
| sand, medium grain | 10 | 15 |
| sand, medium; fine gravel | 15 | 25 |
| sand, coarse; medium gravel | 25 | 35 |
| sand, fine grain | 35 | 45 |
| sand, fine grain | 45 | 55 |
| sand, medium; small gravel | 55 | 65 |
| sand, coarse; small gravel | 65 | 75 |
| sand, coarse; medium gravel | 75 | 82 |
| limestone | 82 | 85 |
| limestone | 85 | 95 |
| limestone | 95 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 23
**ELEVATION** 432CO **COUNTY NO.** 00557
**LOCATION** 380'N 160'E SW/c NE SE
**LATITUDE** 39.823633 **LONGITUDE** -90.565487
**COUNTY** **Morgan** **API** **121370055700** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 5 |
| sand, brown, medium grain | 5 | 7 |
| sand, coarse; fine gravel | 7 | 11 |
| sand, coarse; fine gravel | 11 | 16 |
| sand, medium grain | 16 | 26 |
| sand, medium; medium gravel | 26 | 36 |
| sand, medium; medium gravel | 36 | 46 |
| sand, fine grain | 46 | 56 |
| sand, fine grain | 56 | 66 |
| sand, medium grain | 66 | 76 |
| sand, coarse; medium gravel | 76 | 82 |
| limestone | 82 | 88 |
| limestone | 88 | 91 |
| limestone, interbedded with flint | 91 | 98 |
| limestone | 98 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 22
**ELEVATION** 434CO **COUNTY NO.** 00556
**LOCATION** 445'N 230'E SW/c NE SE
**LATITUDE** 39.823809 **LONGITUDE** -90.565185
**COUNTY** Morgan **API** 121370055600 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 3 |
| sand, brown, medium grain | 3 | 6 |
| sand, brown, fine grain | 6 | 10 |
| sand, brown, coarse grain | 10 | 15 |
| sand, coarse; fine gravel | 15 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, medium, small pebbles | 30 | 40 |
| sand, brown, medium grain | 40 | 50 |
| sand, brown, fine grain | 50 | 60 |
| sand, coarse; medium gravel | 60 | 70 |
| sand, brown, fine grain | 70 | 80 |
| sand, coarse; coarse gravel | 80 | 83 |
| limestone, 2 1/8" core | 83 | 86 |
| limestone, 2 1/8" core | 86 | 91 |
| limestone, crystallized bands, very hard | 91 | 96 |
| limestone, 2 1/8" core | 96 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 21
**ELEVATION** 433CO **COUNTY NO.** 00555
**LOCATION** 530'N 315'E SW/c NE SE
**LATITUDE** 39.824039 **LONGITUDE** -90.564817
**COUNTY** Morgan **API** 121370055500 **21 - 16N - 13W**

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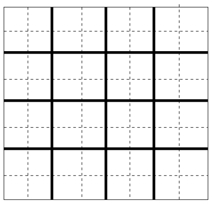
# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, medium, light brown | 0 | 3 |
| sand, medium, clay content | 3 | 6 |
| sand, brown, medium grain | 6 | 10 |
| sand, medium, slight clay content | 10 | 15 |
| sand, brown, fine grain | 15 | 20 |
| sand, brown, fine grain | 20 | 30 |
| sand, coarse; fine gravel | 30 | 40 |
| sand, brown, fine grain | 40 | 50 |
| sand, coarse; fine gravel | 50 | 60 |
| sand, coarse; small gravel | 60 | 70 |
| sand, coarse; coarse gravel | 70 | 80 |
| sand, fine | 80 | 90 |
| sand, fine | 90 | 98 |
| boulders, small | 98 | 99 |
| sand, coarse; small gravel | 99 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co
**DATE DRILLED** January 1, 1941 **NO.** 20
**ELEVATION** 450CO **COUNTY NO.** 00554
**LOCATION** 485'N 350'E SW/c NE SE
**LATITUDE** 39.823913 **LONGITUDE** -90.564729
**COUNTY** Morgan **API** 121370055400



**21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, fine grain | 0 | 3 |
| sand, fine grain | 3 | 6 |
| sand, fine grain | 6 | 10 |
| sand, fine grain | 10 | 15 |
| sand, fine grain | 15 | 25 |
| sand, medium, clay content | 25 | 35 |
| sand, coarse, small pebbles | 35 | 45 |
| sand, coarse, small pebbles | 45 | 55 |
| sand, fine grain | 55 | 65 |
| sand, fine grain | 65 | 75 |
| sand, medium grain | 75 | 85 |
| sand, coarse; fine gravel | 85 | 92 |
| sand, coarse; medium gravel (rock) | 92 | 94 |
| limestone (core) | 94 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 19
**ELEVATION** 444CO **COUNTY NO.** 00553
**LOCATION** 400'N 270'E SW/c NE SE
**LATITUDE** 39.823683 **LONGITUDE** -90.56508
**COUNTY** **Morgan** **API** **121370055300** **21 - 16N - 13W**

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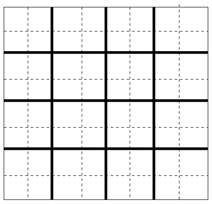
# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, fine; little clay | 0 | 3 |
| sand, fine grain | 3 | 6 |
| sand, medium grain | 6 | 10 |
| sand, medium grain | 10 | 15 |
| sand, coarse; fine gravel | 15 | 25 |
| sand, coarse; fine gravel | 25 | 35 |
| sand, medium, small pebbles | 35 | 45 |
| sand, coarse; fine gravel | 45 | 55 |
| sand, fine grain | 55 | 65 |
| sand, fine grain | 65 | 75 |
| sand, medium, small pebbles | 75 | 85 |
| sand, coarse; coarse gravel | 85 | 93 |
| limestone core | 93 | 97 |
| limestone, chert bands, core | 97 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 18
**ELEVATION** 443CO **COUNTY NO.** 00552
**LOCATION** 335'N 200'E SW/c NE SE
**LATITUDE** 39.823507 **LONGITUDE** -90.565381
**COUNTY** Morgan **API** 121370055200 **21 - 16N - 13W**



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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, medium grain | 0 | 3 |
| sand, medium grain | 3 | 10 |
| sand, medium grain | 10 | 20 |
| sand, medium grain; small gravel | 20 | 30 |
| sand, medium grain | 30 | 40 |
| sand, coarse; large gravel | 40 | 50 |
| sand, coarse; large gravel | 50 | 56 |
| sand, fine | 56 | 60 |
| sand, fine; small gravel | 60 | 70 |
| sand, fine; small gravel | 70 | 80 |
| sand, coarse; coarse gravel | 80 | 90 |
| gravel, medium, clay content | 90 | 95 |
| limestone | 95 | 96 |
| limestone | 96 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 17
**ELEVATION** 446CO **COUNTY NO.** 00551
**LOCATION** 270'N 135'E SW/c NE SE
**LATITUDE** 39.82333 **LONGITUDE** -90.565661
**COUNTY** **Morgan** **API** **121370055100** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 4 |
| clay, sandy | 4 | 5 |
| sand, brown, medium grain | 5 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, medium; medium gravel | 20 | 30 |
| sand, medium; medium gravel | 30 | 40 |
| sand, coarse; medium gravel | 40 | 50 |
| sand, fine; coarse gravel | 50 | 60 |
| sand, fine | 60 | 70 |
| sand; medium gravel | 70 | 80 |
| sand, coarse; small gravel | 80 | 90 |
| sand, coarse; small gravel | 90 | 93 |
| sand, coarse; small gravel | 93 | 95 |
| limestone | 95 | 96 |
| limestone | 96 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 16
**ELEVATION** 446CO **COUNTY NO.** 00550
**LOCATION** 190'N 80'E SW/c NE SE
**LATITUDE** 39.823113 **LONGITUDE** -90.565919
**COUNTY** Morgan **API** 121370055000 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, medium grain; small gravel | 30 | 40 |
| sand, medium grain; small gravel | 40 | 50 |
| sand; small gravel | 50 | 60 |
| sand; coarse gravel | 60 | 70 |
| sand, fine grain; traces small gravel | 70 | 80 |
| sand, fine grain | 80 | 90 |
| sand, coarse | 90 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 15
**ELEVATION** 454CO **COUNTY NO.** 00549
**LOCATION** 175'N 160'E SW/c NE SE
**LATITUDE** 39.823068 **LONGITUDE** -90.565647
**COUNTY** **Morgan** **API** **121370054900** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, medium grain; small gravel | 30 | 40 |
| sand, medium grain; small gravel | 40 | 50 |
| sand, medium grain; small gravel | 50 | 60 |
| sand, medium grain; medium gravel | 60 | 70 |
| sand, medium grain; small gravel | 70 | 80 |
| sand, medium grain; small gravel | 80 | 90 |
| sand, medium grain; small gravel | 90 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 14
**ELEVATION** 456CO **COUNTY NO.** 00548
**LOCATION** 240'N 230'E SW/c NE SE
**LATITUDE** 39.823245 **LONGITUDE** -90.565349
**COUNTY** **Morgan** **API** **121370054800** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, medium grain | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 15 |
| sand, medium grain, clay content | 15 | 17 |
| sand, brown, medium grain | 17 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, coarse; small gravel | 30 | 40 |
| sand, coarse; small gravel | 40 | 50 |
| sand, coarse; medium gravel | 50 | 60 |
| sand, coarse; medium gravel | 60 | 70 |
| sand, medium grain | 70 | 80 |
| sand, medium grain | 80 | 90 |
| sand, medium grain; medium gravel | 90 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service Co.
**DATE DRILLED** January 1, 1941 **NO.** 13
**ELEVATION** 456CO **COUNTY NO.** 00547
**LOCATION** 305'N 295'E SW/c NE SE
**LATITUDE** 39.823421 **LONGITUDE** -90.565065
**COUNTY** **Morgan** **API** **121370054700** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, brown, medium grain | 30 | 40 |
| sand, coarse grain, small gravel | 40 | 50 |
| sand, coarse, grain, medium gravel | 50 | 60 |
| sand, coarse grain, small gravel | 60 | 70 |
| sand, coarse grain, small gravel | 70 | 80 |
| sand, coarse, grain, med gvl, tr lignite | 80 | 90 |
| sand, coarse grain, medium gravel | 90 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 12
**ELEVATION** 457CO **COUNTY NO.** 00546
**LOCATION** 370'N 360'E SW/c NE SE
**LATITUDE** 39.823598 **LONGITUDE** -90.564781
**COUNTY** Morgan **API** 121370054600 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty, brown | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, brown, medium grain | 30 | 40 |
| sand, brown, coarse grain, medium gravel | 40 | 50 |
| sand, coarse, small gravel | 50 | 60 |
| gravel, medium | 60 | 70 |
| gravel, medium | 70 | 80 |
| gravel, medium;sand, medium brown | 80 | 90 |
| medium gravel & sand, traces of lignite | 90 | 100 |
| **Total Depth** | | **100** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 11
**ELEVATION** 456CO **COUNTY NO.** 00545
**LOCATION** 420'N 405'E SW/c NE SE
**LATITUDE** 39.823732 **LONGITUDE** -90.564583
**COUNTY** **Morgan** **API** **121370054500** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty, brown | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 25 |
| **Total Depth** | | **25** |

Driller's Log filed

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 10
**ELEVATION** 456CO **COUNTY NO.** 00544
**LOCATION** 255'N 350'E SW/c NE SE
**LATITUDE** 39.823282 **LONGITUDE** -90.564909
**COUNTY** **Morgan** **API** **121370054400** **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty, brown | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain, small gravel | 20 | 25 |
| **Total Depth** | | **25** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 9
**ELEVATION** 456CO **COUNTY NO.** 00543
**LOCATION** 215'N 310'E SW/c NE SE
**LATITUDE** 39.823173 **LONGITUDE** -90.565083
**COUNTY** Morgan **API** 121370054300 **21 - 16N - 13W**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 2 |
| sand, brown, medium grain | 2 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 25 |
| **Total Depth** | | **25** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 8
**ELEVATION** 457CO **COUNTY NO.** 00542
**LOCATION** 175'N 270'E SW/c NE SE
**LATITUDE** 39.823063 **LONGITUDE** -90.565256
**COUNTY** **Morgan** **API** **121370054200** **21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, medium grain | 0 | 3 |
| sand, brown, medium grain | 3 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium grain | 20 | 30 |
| sand, medium coarse grain, small gravel | 30 | 40 |
| sand, medium coarse grain, small gravel | 40 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 7
**ELEVATION** 456CO **COUNTY NO.** 00541
**LOCATION** 130'N 230'E SW/c NE SE
**LATITUDE** 39.822943 **LONGITUDE** -90.565434
**COUNTY** **Morgan** **API** **121370054100** **21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty, brown | 0 | 2 |
| sand, brown, medium grain | 2 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, medium coarse grain | 20 | 30 |
| sand, brown, small gravel | 30 | 40 |
| sand, medium coarse, medium gravel | 40 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:**

**Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941
**NO.** 6
**ELEVATION** 454CO
**COUNTY NO.** 00540
**LOCATION** 85'N 190'E SW/c NE SE
**LATITUDE** 39.82282
**LONGITUDE** -90.565614
**COUNTY** Morgan
**API** 121370054000
**21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty, brown | 0 | 3 |
| sand, brown, medium grain | 3 | 5 |
| sand, brown, medium grain | 5 | 10 |
| sand, brown, slight clay content | 10 | 15 |
| sand, brown, medium grain | 15 | 20 |
| sand, brown, medium grain | 20 | 29 |
| sand, medium gravel, water showing | 29 | 30 |
| sand, medium grain, medium gravel | 30 | 40 |
| sand, medium grain, medium gravel | 40 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** Cen. Ill. Pub. Service

**DATE DRILLED** January 1, 1941 **NO.** 5

**ELEVATION** 454CO **COUNTY NO.** 00539

**LOCATION** 25'N 250'E SW/c NE SE

**LATITUDE** 39.822653 **LONGITUDE** -90.565447

**COUNTY** **Morgan** **API** **121370053900** **21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty,brown | 0 | 1 |
| sand, brown, medium grain | 1 | 5 |
| sand, brown, medium grain | 5 | 10 |
| sand,brown,medium grain,slight clay | 10 | 10 |
| sand, brown, medium grain | 10 | 28 |
| sand, medium gravel | 28 | 30 |
| sand, medium gravel, water showing | 30 | 40 |
| sand, medium gravel, water showing | 40 | 50 |
| **Total Depth** | | **50** |

Driller's Log filed

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** Cen. Ill. Pub. Service

**DATE DRILLED** January 1, 1941 **NO.** 4

**ELEVATION** 454CO **COUNTY NO.** 00538

**LOCATION** 65'N 290'E SW/c NE SE

**LATITUDE** 39.82276 **LONGITUDE** -90.565273

**COUNTY** Morgan **API** 121370053800 **21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, brown, silty | 0 | 3 |
| sand, brown, medium grain | 3 | 5 |
| sand, brown, medium grain | 5 | 10 |
| sand, brown, medium grain | 10 | 20 |
| sand, brown, traces of fine gravel | 20 | 25 |
| **Total Depth** | | **25** |

Driller's Log filed

Location source: Location from the driller

**Permit Date:**

**Permit #:**

**COMPANY** owner

**FARM** Cen. Ill. Pub. Service

**DATE DRILLED** January 1, 1941

**NO.** 3

**ELEVATION** 454CO

**COUNTY NO.** 00537

**LOCATION** 105'N 330'E SW/c NE SE

**LATITUDE** 39.822869

**LONGITUDE** -90.5651

**COUNTY** Morgan

**API** 121370053700

**21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| sand, silty | 0 | 2 |
| sand, brown, medium grain | 2 | 5 |
| sand, brown, medium grain | 5 | 10 |
| sand, brown, medium grain | 10 | 14 |
| sand,brown,medium grain,slight clay | 14 | 15 |
| sand, brown, medium grain | 15 | 20 |
| sand, brown, medium grain | 20 | 25 |
| **Total Depth** | | **25** |

Driller's Log filed
Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Cen. Ill. Pub. Service
**DATE DRILLED** January 1, 1941 **NO.** 2
**ELEVATION** 454CO **COUNTY NO.** 00536
**LOCATION** 150'N 370'E SW/c NE SE
**LATITUDE** 39.822992 **LONGITUDE** -90.564922
**COUNTY** Morgan **API** 121370053600 **21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| Water Well | Top | Bottom |
|---|---|---|
| sand, silty, medium grain | 0 | 1 |
| sand, brown, medium grain | 1 | 7 |
| sand, brown, medium grain | 7 | 10 |
| sand, brown, slight clay content | 10 | 13 |
| sand, brown, slight clay content | 13 | 19 |
| sand, dark brown, medium grain | 19 | 25 |
| **Total Depth** | | **25** |

Driller's Log filed

**Permit Date:** **Permit #:**

**COMPANY** C.I.P.S.

**FARM** Cen. Ill. Pub. Service

**DATE DRILLED** January 1, 1941 **NO.** 1

**ELEVATION** 454CO **COUNTY NO.** 00535

**LOCATION** 190'N 410'E SW/c NE SE

**LATITUDE** 39.823098 **LONGITUDE** -90.564749

**COUNTY** **Morgan** **API** **121370053500** **21 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| ss #20135 | 0 | 0 |
| s,lgt brn,f,rndd,well srtd,drty,noncalc | 0 | 5 |
| s,lgt brn,f,rndd,well srtd,few calc grns | 5 | 10 |
| s,f,rndd,well srtd,few calc grns,clean | 10 | 25 |
| sand,light brown,fine/med,clean,noncalc | 25 | 30 |
| s,lgt brn,f/med,clean,few calc grns | 30 | 35 |
| sand,lgt brn,f/vy crd,clean,mly calc | 35 | 40 |
| Pleistocene | 5 | 40 |
| **Total Depth** | | **40** |

Casing: 8" from 0' to 0'

Screen: 10' of " diameter 16 slot

Remarks: see logbook for detail sample study

Driller's Log filed
Survey Sample Study filed
Sample set # 20135 (0' - 40') Received: January 1, 1950

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** Meredosia, Village of
**DATE DRILLED** April 1, 1950 **NO.** 2
**ELEVATION** 0 **COUNTY NO.** 00515
**LOCATION** 725'S 10'W NE/c NW
**LATITUDE** 39.831665 **LONGITUDE** -90.552929
**COUNTY** **Morgan** **API** **121370051500** **22 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| ss #20134 | 0 | 0 |
| sand | 0 | 30 |
| sand, coarse | 30 | 40 |
| **Total Depth** | | **40** |

Casing: 8" from 0' to 0'

Screen: 10' of " diameter 16 slot

Driller's Log filed

Sample set # 20134 (0' - 40') Received: January 1, 1950

Location source: Location from the driller

**Permit Date:** **Permit #:**

**COMPANY** owner

**FARM** Meredosia, Village of

**DATE DRILLED** April 1, 1950 **NO.** 1

**ELEVATION** 455GL **COUNTY NO.** 00514

**LOCATION** 900'N line, 3000'E line of section

**LATITUDE** 39.831189 **LONGITUDE** -90.5543

**COUNTY** **Morgan** **API** **121370051400** **22 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| ss #55587 | 0 | 0 |
| sandy brown clay | 0 | 20 |
| sandy gravel | 20 | 92 |
| **Total Depth** | | **92** |

Casing: 24" STEEL 3/8" WALL from 0' to 50'
12" STEEL 3/8" WALL from 0' to 62'

Screen: 30' of 12" diameter 50 slot

Water from drift at 0' to 92'.

Static level 26' below casing top which is 0' above GL

Remarks: see file for detail sample study

Driller's Log filed

Sample set # 55587 (0' - 93') Received: October 1, 1968

Location source: Location from permit

**Permit Date:** January 1, 1968 **Permit #:** NF 4615

**COMPANY** Diehl Pump and Supply Co.

**FARM** National Starch

**DATE DRILLED** August 31, 1968 **NO.** 8

**ELEVATION** 0 **COUNTY NO.** 00422

**LOCATION** 2150'N line, 1400'E line of NE

**LATITUDE** 39.812976 **LONGITUDE** -90.569359

**COUNTY** **Morgan** **API** **121370042200** **28 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| ss #55586 | 0 | 0 |
| sandy brown clay | 0 | 24 |
| fine sand & gravel | 24 | 69 |
| medium sand & small gravel | 69 | 96 |
| **Total Depth** | | **96** |

Casing: 8" STEEL 3/8" WALL from 0' to 96'

Screen: 16' of 8" diameter 25 slot

Water from drift at 0' to 96'.

Static level 26' below casing top which is 0' above GL

Driller's Log filed

Sample set # 55586 (0' - 97') Received: October 1, 1968

Location source: Location from permit

**Permit Date:** January 1, 1968 **Permit #:** NF 4614

**COMPANY** Diehl Pump and Supply Co.

**FARM** National Starch

**DATE DRILLED** August 31, 1968 **NO.** 7

**ELEVATION** 0 **COUNTY NO.** 00421

**LOCATION** NW SE NE

**LATITUDE** 39.813492 **LONGITUDE** -90.569044

**COUNTY** **Morgan** **API** **121370042100** **28 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Test Hole** | **Top** | **Bottom** |
|---|---|---|
| ss #54997 | 0 | 0 |
| sandy clay | 0 | 21 |
| fine sand, very little gravel | 21 | 60 |
| sand & gravel | 60 | 90 |
| **Total Depth** | | **90** |

Casing: 18" CASING STEEL 3/8" from 0' to 60'
12" STEEL WALL from 0' to 67'

Screen: 25' of 10" diameter 35 slot

Size hole below casing: 18"

Water from glacial drift at 0' to 0'.
Static level 27' below casing top which is 0' above GL
Pumping level 47' when pumping at 780 gpm for 3 hours

Driller's Log filed
Sample set # 54997 (50' - 91.5') Received: December 14, 1967

Location source: Location from permit

**Permit Date:** January 1, 1967 **Permit #:** 3350

**COMPANY** Diehl Pump and Supply Co.
**FARM** National Starch
**DATE DRILLED** February 1, 1968 **NO.** 6
**ELEVATION** 0 **COUNTY NO.** 00396
**LOCATION** 1800'N line, 900'E line of NE
**LATITUDE** 39.81392 **LONGITUDE** -90.567569
**COUNTY** **Morgan** **API 121370039600** **28 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| ss #31677 | 0 | 0 |
| sand | 0 | 20 |
| sand & gravel | 20 | 60 |
| coarse sand & gravel | 60 | 92 |
| **Total Depth** | | **92** |

Casing: 12" ID from -2' to 72'

Water from at 70' to 90'.

Static level 25' below casing top which is 0' above GL

Pumping level 0' when pumping at 500 gpm for 0 hours

Remarks: see file for detail sample study

Driller's Log filed

Sample set # 31677 (0' - 92') Received: October 21, 1958

Location source: Location from permit

**Permit Date:** September 9, 1958 **Permit #:**

**COMPANY** owner

**FARM** National Starch Prod.

**DATE DRILLED** October 1, 1958 **NO.** 2

**ELEVATION** 442GL **COUNTY NO.** 00147

**LOCATION** 310'N line, 1200'E line of NE

**LATITUDE** 39.818045 **LONGITUDE** -90.568641

**COUNTY** **Morgan** **API** **121370014700** **28 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Municipal Water Supply** | **Top** | **Bottom** |
|---|---|---|
| no record | 0 | 25 |
| sand & gravel | 25 | 92 |
| **Total Depth** | | **92** |

Casing: 10" CASING from -1' to 72'
10" SCREEN from 72' to 92'

Screen: 20' of 10" diameter slot

Water from sand & gravel at 25' to 92'.

Static level 27' below casing top which is 1' above GL

Pumping level 32' when pumping at 300 gpm for 3 hours

Address of well: 200' NNW of WTP

**Permit Date:** **Permit #:**

**COMPANY** Albrecht Well Drilling Inc

**FARM** Meredosia, Village

**DATE DRILLED** September 2, 1980 **NO.** 5

**ELEVATION** 0 **COUNTY NO.** 21945

**LOCATION** 612'S line, 2425'E line of section

**LATITUDE** 39.820473 **LONGITUDE** -90.553748

**COUNTY** **Montgomery** **API** **121352194500** **22 - 16N - 13W**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Municipal Water Supply** | **Top** | **Bottom** |
|---|---|---|
| no record | 0 | 84 |
| **Total Depth** | | **84** |

Casing: 8" CASING from 0' to 70'
8" SCREEN from 70' to 84'

Screen: 14' of 8" diameter 25 slot

Water from coarse sand at 69' to 84'.

Address of well: 120' NNE of WTP

**Permit Date:** **Permit #:**

**COMPANY** Elmer W. Franke/Calhoun Drlg.
**FARM** Meredosia, Village
**DATE DRILLED** September 1, 1973 **NO.** 3
**ELEVATION** 0 **COUNTY NO.** 21944
**LOCATION** SE NE NW
**LATITUDE** 39.830881 **LONGITUDE** -90.554188
**COUNTY** **Montgomery** **API** **121352194400** **22 - 16N - 13W**

# APPENDIX C

# BORING LOGS WITH WELL DIAGRAMS

Surface Elevation: 446.06

Datum msl

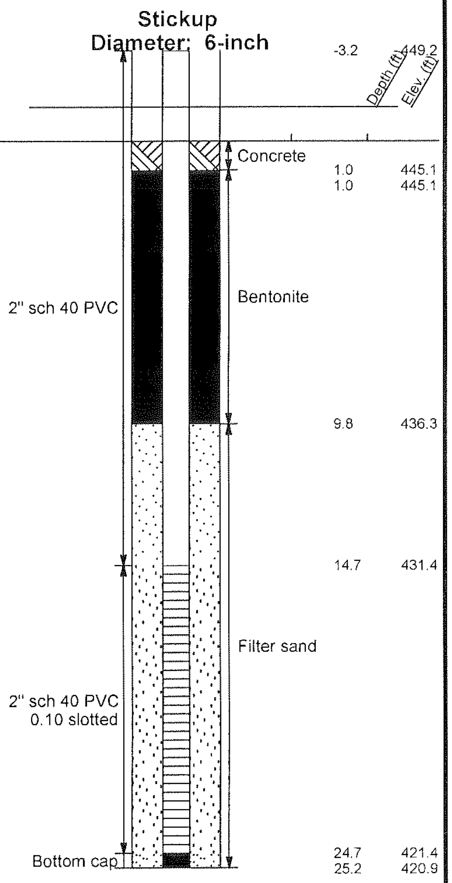
Completion Date: 10/26/10

Northing: 1147018.68

Easting: 2185605.2

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| 0 | Loose, brown, fine SAND - SP | | | |
| | | | 1-1-1 | SS1 |
| | | | 2-2-1 | SS2 |
| 5 | | | | |
| | | | 2-4-4 | SS3 |
| | | | 3-3-3 | SS4 |
| 10 | | | | |
| 12 | Loose, brown fine to coarse SAND, trace gravel - SP ▽ | | | |
| | | | 1-1-2 | SS5 |
| 15 | | | | |
| | | | 1-1-2 | SS6 |
| 20 | | | | |
| 22 | Loose, brown, fine SAND - SP | | | |
| | | | 0-1-2 | SS7 |
| 25 | Boring terminated at 25 feet. | | | |
| 30 | | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - MEREDOSIA.GPJ GTINC 0638301.GPJ 1/11/11

**GROUNDWATER DATA**

ENCOUNTERED AT 13 FEET ▽

**DRILLING DATA**

__ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM __ FEET
MB DRILLER LAH LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

REMARKS:

| | | |
|---|---|---|
| Drawn by: KA | Checked by: DTK | App'vd. by: KBP |
| Date: 11/3/10 | Date: 2-17-11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Ameren Power Generating Facility
Meredosia, Illinois**

LOG OF BORING: APW-1

**Project No. J017150.01**

Surface Elevation: 433.97
Datum msl

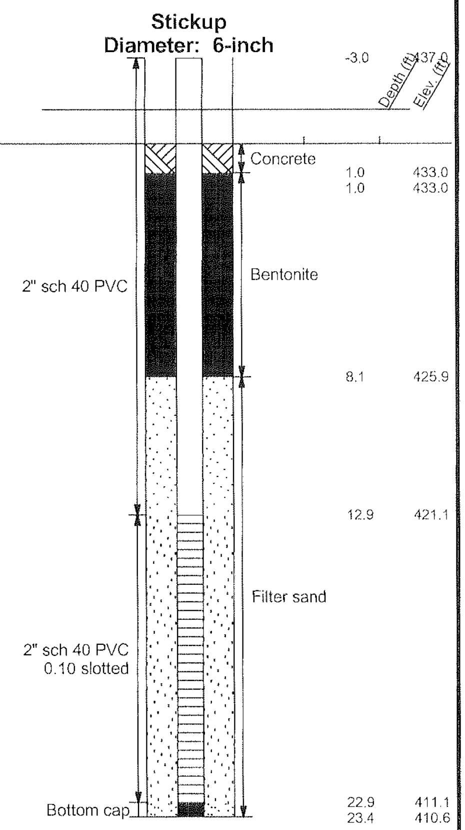
Completion Date: 10/25/10
Northing: 1148489.69
Easting: 2182485.19

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Soft to medium stiff, brown and gray CLAY, trace sand - CH | ▨ | | |
| | | ▨ | 2-2-2 | SS1 |
| 5 | | ▨ | 2-2-2 | SS2 |
| | | ▨ | 2-2-4 | SS3 |
| 10 | | ▨ | 0-2-3 | SS4 |
| 15 | | ▨ | 2-2-3 | SS5 |
| | Soft, gray, silty CLAY with shells, trace to some sand - CL | ▨ | | |
| 20 | | ▨ | 0-1-1 | SS6 |
| | Very loose, brown, fine to medium SAND - SP | ░ | | |
| 25 | | ░ | 0-0-1 | SS7 |
| | Boring terminated at 25 feet. | | | |
| 30 | | | | |
| 35 | | | | |

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - MEREDOSIA.GPJ GTINC 0638301.GPJ 12/22/10

**WELL DIAGRAM**



## GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

## DRILLING DATA

__ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM __ FEET
MB DRILLER LAH LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

REMARKS:

| Drawn by: KA | Checked by: DTK | App'vd. by: KJP |
|---|---|---|
| Date: 11/3/10 | Date: 2-17-11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren Power Generating Facility
Meredosia, Illinois

LOG OF BORING: APW-2/MW-2

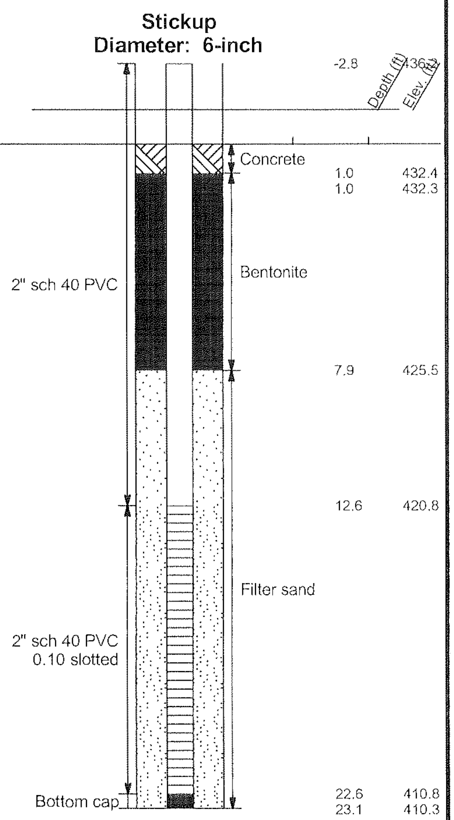
Project No. J017150.01

Surface Elevation: 433.35
Datum msl

Completion Date: 10/25/10
Northing: 1148118.6
Easting: 2181973.76

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Medium stiff, brown and gray CLAY, trace sand and wood - CH | | 2-3-3 | SS1 |
| 5 | | | 2-2-3 | SS2 |
| | | | 0-2-3 | SS3 |
| 10 | | | 0-1-2 | SS4 |
| | | ∇ | | |
| | Gray, silty CLAY, trace sand - CL | | | |
| | | | 95 | ST5 |
| 15 | | | | |
| | Soft, gray, silty SAND with shells and silty clay seams - SM | | | |
| | | | 0-1-1 | SS6 |
| 20 | | | | |
| | Wood | | 8-11-7 | SS7 |
| 25 | Boring terminated at 25 feet. | | | |
| 30 | | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

### GROUNDWATER DATA

ENCOUNTERED AT 12 FEET ∇

### DRILLING DATA

__ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM __ FEET
MB DRILLER LAH LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

REMARKS:

| | | |
|---|---|---|
| Drawn by: KA | Checked by: DTK | App'vd. by: RSP |
| Date: 11/3/10 | Date: 2-17-11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Ameren Power Generating Facility**
**Meredosia, Illinois**

LOG OF BORING: APW-3/B-10

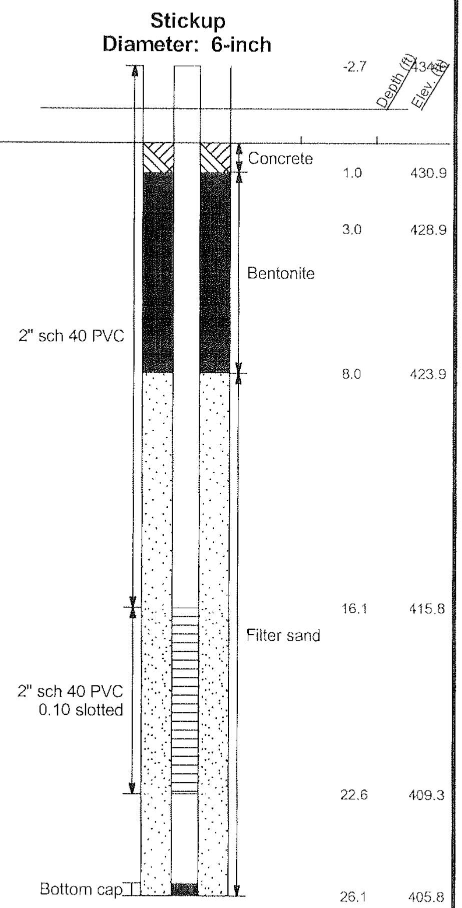
**Project No. J017150.01**

Surface Elevation: 431.90
Datum msl

Completion Date: 10/26/10
Northing: 1146935.94
Easting: 2181602.97

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Medium stiff to soft, brown and gray CLAY, trace sand and wood - CH | ▨ | 0-0-4 | SS1 |
| 5 | | ▨ | 2-4-4 | SS2 |
| | | ▨ | 1-1-1 | SS3 |
| 10 | | ▨ | 1-1-2 | SS4 |
| | Loose, brown, fine SAND - SP | ░ | | |
| 15 | | ░ | 3-6-7 | SS5 |
| 20 | | ░ | 0-2-2 | SS6 |
| | | ░ | 0-0-0 | SS7 |
| 25 | Boring terminated at 25 feet. | | | |
| 30 | | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

**GROUNDWATER DATA**

ENCOUNTERED AT 11.5 FEET ∇

**DRILLING DATA**

___ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM ___ FEET
MB DRILLER LAH LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

**REMARKS:**

| Drawn by: KA | Checked by: DTK | App'vd. by: ABP |
|---|---|---|
| Date: 11/3/10 | Date: 2-17-11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Ameren Power Generating Facility**
**Meredosia, Illinois**

**LOG OF BORING: APW-4**

**Project No. J017150.01**

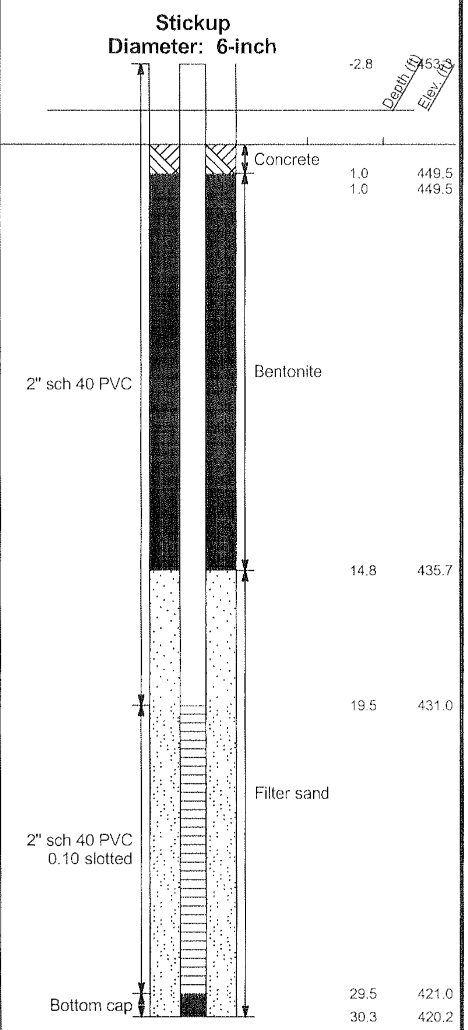
LOG OF BORING 2002 WL J017150.01 - MEREDOSIA.GPJ GTINC 0638301.GPJ 12/22/10

Surface Elevation: 450.48
Datum msl

Completion Date: 10/26/10
Northing: 1146922.64
Easting: 2183711.11

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Loose, brown, fine SAND - SP | | | |
| | | | 3-3-3 | SS1 |
| | | | 2-2-2 | SS2 |
| 5 | | | | |
| | | | 1-3-4 | SS3 |
| | | | 2-3-3 | SS4 |
| 10 | | | | |
| | | | 2-3-4 | SS5 |
| 15 | | | | |
| | | | 2-1-2 | SS6 |
| 20 | Loose, brown, fine to coarse SAND, trace to some gravel - SP | ∇ | | |
| | | | 3-3-3 | SS7 |
| 25 | | | | |
| | | | 1-1-1 | SS8 |
| 30 | Boring terminated at 30 feet. | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01 - MEREDOSIA.GPJ GTINC 0638301.GPJ 12/22/10

### GROUNDWATER DATA

ENCOUNTERED AT 19.5 FEET ∇

### DRILLING DATA

___ AUGER 4 1/4" HOLLOW STEM
WASHBORING FROM ___ FEET
MB DRILLER LAH LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

REMARKS:

| | | |
|---|---|---|
| Drawn by: KA | Checked by: DTK | App'vd. by: RBP |
| Date: 11/3/10 | Date: 2-17-11 | Date: 2/17/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Ameren Power Generating Facility**
**Meredosia, Illinois**

**LOG OF BORING: APW-5**

**Project No. J017150.01**

# APPENDIX D

# GROUNDWATER QUALITY DATA SUMMARY

January 4, 2013
8:51:07 AM

# Meredosia Power Station
## Water Quality Data: December 2010 through September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| Well Id | Date Sampled | Lab Id | Ag, diss, mg/L | As, diss, mg/L | B, diss, mg/L | Ba, diss, mg/L | Be, diss, mg/L | Cd, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 12/13/2010 | | <0.005 | <0.004 | 0.117 | <0.050 | <0.004 | <0.004 |
| | 03/24/2011 | 1032557-01 | <0.005 | <0.001 | 0.130 | 0.010 | <0.001 | <0.001 |
| | 06/24/2011 | 1062825-01 | <0.005 | <0.001 | 0.140 | 0.010 | <0.001 | <0.001 |
| | 09/15/2011 | 1092041-01 | <0.005 | <0.001 | 0.100 | 0.017 | <0.001 | <0.001 |
| | 10/28/2011 | 1110029-01 | <0.005 | <0.001 | 0.098 | 0.019 | <0.001 | <0.001 |
| | 03/26/2012 | 2032865-01 | <0.005 | <0.001 | 0.110 | 0.011 | <0.001 | <0.001 |
| | 06/18/2012 | 2062572-01 | <0.005 | <0.001 | 0.097 | 0.020 | <0.001 | <0.001 |
| | 09/17/2012 | 2092390-01 | <0.005 | <0.001 | 0.055 | 0.013 | <0.001 | <0.001 |
| APW-2 | 12/13/2010 | | <0.005 | 0.004 | 2.110 | <0.050 | <0.004 | <0.004 |
| | 03/24/2011 | 1032557-02 | <0.005 | 0.004 | 3.100 | 0.055 | <0.001 | <0.001 |
| | 09/15/2011 | 1092041-02 | <0.005 | 0.003 | 2.800 | 0.042 | <0.001 | <0.001 |
| | 10/28/2011 | 1110029-02 | <0.005 | 0.004 | 3.300 | 0.045 | <0.001 | <0.001 |
| | 03/26/2012 | 2032865-02 | <0.005 | 0.004 | 3.600 | 0.046 | <0.001 | <0.001 |
| | 06/18/2012 | 2062572-02 | <0.005 | 0.004 | 3.500 | 0.051 | <0.001 | <0.001 |
| | 09/17/2012 | 2092390-02 | <0.005 | 0.004 | 3.900 | 0.048 | <0.001 | <0.001 |
| APW-3 | 12/13/2010 | | <0.005 | 0.148 | 30.200 | <0.050 | <0.004 | <0.004 |
| | 03/24/2011 | 1032557-03 | <0.005 | 0.170 | 28.000 | 0.050 | <0.001 | 0.001 |
| | 09/15/2011 | 1092041-03 | <0.005 | 0.210 | 32.000 | 0.042 | <0.001 | <0.001 |
| | 10/28/2011 | 1110029-03 | <0.005 | 0.220 | 35.000 | 0.045 | 0.001 | <0.001 |
| | 03/26/2012 | 2032865-03 | <0.005 | 0.190 | 31.000 | 0.048 | <0.001 | 0.001 |
| | 06/18/2012 | 2062572-03 | <0.005 | 0.310 | 46.000 | 0.081 | <0.001 | 0.002 |
| | 09/17/2012 | 2092390-03 | <0.005 | 0.170 | 26.000 | 0.110 | <0.001 | 0.001 |
| APW-4 | 12/13/2010 | | <0.005 | 0.053 | 2.550 | 0.067 | <0.004 | <0.004 |
| | 09/15/2011 | 1092041-04 | <0.005 | 0.150 | 4.500 | 0.085 | 0.002 | <0.001 |
| | 10/28/2011 | 1110029-04 | <0.005 | 0.180 | 6.300 | 0.095 | 0.002 | <0.001 |
| | 03/26/2012 | 2032865-04 | <0.005 | 0.029 | 3.900 | 0.048 | <0.001 | <0.001 |
| | 06/18/2012 | 2062572-04 | <0.005 | 0.033 | 4.800 | 0.063 | <0.001 | <0.001 |
| | 09/17/2012 | 2092390-04 | <0.005 | 0.036 | 4.900 | 0.064 | <0.001 | <0.001 |
| APW-5 | 12/13/2010 | | <0.005 | <0.004 | 0.118 | <0.050 | <0.004 | <0.004 |
| | 03/24/2011 | 1032557-04 | <0.005 | <0.001 | 0.170 | 0.009 | <0.001 | <0.001 |
| | 06/24/2011 | 1062825-02 | <0.005 | <0.001 | 0.200 | 0.010 | <0.001 | <0.001 |
| | 09/15/2011 | 1092041-05 | <0.005 | <0.001 | 0.350 | 0.006 | <0.001 | <0.001 |
| | 10/28/2011 | 1110029-05 | <0.005 | <0.001 | 0.310 | 0.006 | <0.001 | <0.001 |
| | 03/26/2012 | 2032865-05 | <0.005 | 0.001 | 0.300 | 0.009 | <0.001 | <0.001 |
| | 06/18/2012 | 2062572-05 | <0.005 | 0.001 | 0.410 | 0.010 | <0.001 | <0.001 |
| | 09/17/2012 | 2092390-05 | <0.005 | <0.001 | 0.320 | 0.009 | <0.001 | <0.001 |

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## Meredosia Power Station
## Water Quality Data: December 2010 through September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| Well Id | Date Sampled | Lab Id | Cl, diss, mg/L | CN, total, mg/L | Co, diss, mg/L | Cr, diss, mg/L | Cu, diss, ug/L | F, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 12/13/2010 | | 1.000 | <0.010 | <0.050 | <0.010 | <0.025 | <0.100 |
| | 03/24/2011 | 1032557-01 | 11.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 06/24/2011 | 1062825-01 | 5.600 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 09/15/2011 | 1092041-01 | 13.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.260 |
| | 10/28/2011 | 1110029-01 | 6.800 | <0.005 | <0.002 | <0.004 | <0.003 | 0.320 |
| | 03/26/2012 | 2032865-01 | 20.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 06/18/2012 | 2062572-01 | 45.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 09/17/2012 | 2092390-01 | 39.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| APW-2 | 12/13/2010 | | 33.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.300 |
| | 03/24/2011 | 1032557-02 | 50.000 | <0.005 | 0.004 | <0.004 | <0.003 | <0.250 |
| | 09/15/2011 | 1092041-02 | 41.000 | <0.005 | 0.003 | <0.004 | <0.003 | 0.440 |
| | 10/28/2011 | 1110029-02 | 42.000 | <0.005 | 0.002 | <0.004 | <0.003 | 0.460 |
| | 03/26/2012 | 2032865-02 | 47.000 | <0.005 | 0.003 | <0.004 | <0.003 | 0.320 |
| | 06/18/2012 | 2062572-02 | 50.000 | <0.005 | 0.003 | <0.004 | <0.003 | 0.270 |
| | 09/17/2012 | 2092390-02 | 44.000 | <0.005 | 0.003 | <0.004 | <0.003 | 0.300 |
| APW-3 | 12/13/2010 | | 54.500 | <0.010 | <0.050 | <0.010 | <0.025 | 0.250 |
| | 03/24/2011 | 1032557-03 | 54.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.360 |
| | 09/15/2011 | 1092041-03 | 44.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.490 |
| | 10/28/2011 | 1110029-03 | 47.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.540 |
| | 03/26/2012 | 2032865-03 | 54.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.320 |
| | 06/18/2012 | 2062572-03 | 49.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.290 |
| | 09/17/2012 | 2092390-03 | 58.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.290 |
| APW-4 | 12/13/2010 | | 41.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.390 |
| | 09/15/2011 | 1092041-04 | 50.000 | <0.005 | <0.002 | 0.007 | <0.003 | 0.730 |
| | 10/28/2011 | 1110029-04 | 63.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.790 |
| | 03/26/2012 | 2032865-04 | 58.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.470 |
| | 06/18/2012 | 2062572-04 | 53.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.450 |
| | 09/17/2012 | 2092390-04 | 49.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.450 |
| APW-5 | 12/13/2010 | | 3.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.130 |
| | 03/24/2011 | 1032557-04 | 2.800 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 06/24/2011 | 1062825-02 | 2.600 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 09/15/2011 | 1092041-05 | <1.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.310 |
| | 10/28/2011 | 1110029-05 | 1.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.360 |
| | 03/26/2012 | 2032865-05 | 2.500 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 06/18/2012 | 2062572-05 | 4.600 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
| | 09/17/2012 | 2092390-05 | 2.900 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |

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## Meredosia Power Station
## Water Quality Data: December 2010 through September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| **Well Id** | **Date Sampled** | **Lab Id** | **Fe, diss, mg/L** | **GW Depth (TOC), ft** | **GW Elv, ft** | **Hg, diss, mg/L** | **Mn, diss, mg/L** | **Ni, diss, mg/L** |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 12/13/2010 | | 0.162 | 19.150 | 430.111 | <0.000 | <0.015 | <0.040 |
| | 03/24/2011 | 1032557-01 | 0.030 | 18.300 | 430.961 | <0.000 | 0.008 | <0.005 |
| | 06/24/2011 | 1062825-01 | <0.010 | 10.800 | 438.461 | <0.000 | <0.001 | 0.014 |
| | 09/15/2011 | 1092041-01 | <0.010 | 17.300 | 431.961 | <0.000 | 0.003 | <0.005 |
| | 10/28/2011 | 1110029-01 | <0.010 | 19.600 | 429.661 | <0.000 | 0.006 | 0.005 |
| | 03/26/2012 | 2032865-01 | <0.010 | 21.550 | 427.711 | <0.000 | <0.001 | <0.005 |
| | 06/18/2012 | 2062572-01 | <0.010 | 21.340 | 427.921 | <0.000 | 0.009 | <0.005 |
| | 09/17/2012 | 2092390-01 | <0.010 | 23.450 | 425.811 | <0.000 | <0.001 | <0.005 |
| APW-2 | 12/13/2010 | | <0.100 | 13.140 | 423.729 | <0.000 | 0.931 | <0.040 |
| | 03/24/2011 | 1032557-02 | 1.100 | 8.300 | 428.569 | <0.000 | 0.480 | 0.012 |
| | 09/15/2011 | 1092041-02 | 0.370 | 12.650 | 424.219 | <0.000 | 0.820 | 0.007 |
| | 10/28/2011 | 1110029-02 | 0.460 | 13.600 | 423.269 | <0.000 | 0.790 | 0.006 |
| | 03/26/2012 | 2032865-02 | 0.150 | 13.270 | 423.599 | <0.000 | 0.910 | 0.009 |
| | 06/18/2012 | 2062572-02 | 0.340 | 14.460 | 422.409 | <0.000 | 0.830 | 0.011 |
| | 09/17/2012 | 2092390-02 | 0.300 | 15.590 | 421.279 | <0.000 | 0.960 | 0.011 |
| APW-3 | 12/13/2010 | | <0.100 | 13.350 | 422.931 | <0.000 | 0.169 | <0.040 |
| | 03/24/2011 | 1032557-03 | 0.650 | 5.700 | 430.581 | <0.000 | 0.450 | 0.010 |
| | 09/15/2011 | 1092041-03 | 0.410 | 13.900 | 422.381 | <0.000 | 0.280 | <0.005 |
| | 10/28/2011 | 1110029-03 | 0.330 | 14.600 | 421.681 | <0.000 | 0.250 | 0.006 |
| | 03/26/2012 | 2032865-03 | 0.480 | 12.800 | 423.481 | <0.000 | 0.300 | 0.006 |
| | 06/18/2012 | 2062572-03 | 0.390 | 13.950 | 422.331 | <0.000 | 0.460 | 0.011 |
| | 09/17/2012 | 2092390-03 | 5.400 | 15.920 | 420.361 | <0.000 | 1.200 | 0.012 |
| APW-4 | 12/13/2010 | | <0.100 | 9.250 | 425.609 | <0.000 | 3.100 | <0.040 |
| | 09/15/2011 | 1092041-04 | 5.900 | 9.200 | 425.659 | <0.000 | 3.400 | 0.019 |
| | 10/28/2011 | 1110029-04 | 6.600 | 10.000 | 424.859 | <0.000 | 5.400 | 0.010 |
| | 03/26/2012 | 2032865-04 | 14.000 | 9.900 | 424.959 | <0.000 | 2.800 | 0.006 |
| | 06/18/2012 | 2062572-04 | 16.000 | 10.950 | 423.909 | <0.000 | 3.300 | 0.009 |
| | 09/17/2012 | 2092390-04 | 16.000 | 12.360 | 422.499 | <0.000 | 2.900 | 0.010 |
| APW-5 | 12/13/2010 | | <0.100 | 25.040 | 428.157 | <0.000 | <0.015 | <0.040 |
| | 03/24/2011 | 1032557-04 | <0.010 | 22.600 | 430.597 | <0.000 | 0.012 | 0.008 |
| | 06/24/2011 | 1062825-02 | 0.012 | 14.700 | 438.497 | <0.000 | 0.001 | 0.010 |
| | 09/15/2011 | 1092041-05 | <0.010 | 23.400 | 429.797 | <0.000 | <0.001 | <0.005 |
| | 10/28/2011 | 1110029-05 | <0.010 | 24.500 | 428.697 | <0.000 | <0.001 | <0.005 |
| | 03/26/2012 | 2032865-05 | <0.010 | 27.200 | 425.997 | <0.000 | 0.001 | <0.005 |
| | 06/18/2012 | 2062572-05 | <0.010 | 27.300 | 425.897 | <0.000 | 0.040 | <0.005 |
| | 09/17/2012 | 2092390-05 | <0.010 | 29.180 | 424.017 | <0.000 | 0.002 | 0.006 |

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## Meredosia Power Station
## Water Quality Data: December 2010 through September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| Well Id | Date Sampled | Lab Id | NO3, diss, mg/L | Pb, diss, mg/L | pH (field), std | Sb, diss, mg/L | Se, diss, mg/L | SO4, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-1 | 12/13/2010 | | 3.800 | <0.005 | 6.690 | <0.006 | <0.010 | 26.400 |
| | 03/24/2011 | 1032557-01 | 3.900 | <0.001 | 7.630 | <0.003 | 0.002 | 23.000 |
| | 06/24/2011 | 1062825-01 | 4.700 | <0.001 | 7.830 | <0.003 | 0.002 | 33.000 |
| | 09/15/2011 | 1092041-01 | 1.700 | <0.001 | | <0.003 | 0.002 | 20.000 |
| | 10/28/2011 | 1110029-01 | 2.800 | <0.001 | 7.250 | <0.003 | 0.002 | 24.000 |
| | 03/26/2012 | 2032865-01 | 5.700 | <0.001 | 7.250 | <0.003 | 0.001 | 15.000 |
| | 06/18/2012 | 2062572-01 | 2.100 | <0.001 | 6.840 | <0.003 | <0.001 | 13.000 |
| | 09/17/2012 | 2092390-01 | 1.600 | <0.001 | 7.210 | <0.003 | 0.002 | 12.000 |
| APW-2 | 12/13/2010 | | 0.400 | <0.005 | 5.980 | <0.006 | <0.010 | 28.200 |
| | 03/24/2011 | 1032557-02 | <0.020 | <0.001 | 7.050 | <0.003 | <0.001 | 41.000 |
| | 09/15/2011 | 1092041-02 | <0.020 | <0.001 | | <0.003 | <0.001 | <25.000 |
| | 10/28/2011 | 1110029-02 | 0.040 | <0.001 | 7.320 | <0.003 | 0.003 | 14.000 |
| | 03/26/2012 | 2032865-02 | 0.070 | <0.001 | 7.410 | <0.003 | 0.001 | 13.000 |
| | 06/18/2012 | 2062572-02 | <0.020 | 0.001 | 7.120 | <0.003 | 0.004 | 18.000 |
| | 09/17/2012 | 2092390-02 | <0.020 | <0.001 | 7.170 | <0.003 | 0.002 | 15.000 |
| APW-3 | 12/13/2010 | | 0.490 | <0.005 | 6.920 | <0.006 | <0.010 | 284.000 |
| | 03/24/2011 | 1032557-03 | <0.020 | <0.001 | 8.170 | <0.003 | 0.001 | 310.000 |
| | 09/15/2011 | 1092041-03 | <0.020 | <0.001 | | <0.003 | <0.001 | 260.000 |
| | 10/28/2011 | 1110029-03 | <0.020 | <0.001 | 8.240 | <0.003 | 0.002 | 290.000 |
| | 03/26/2012 | 2032865-03 | <0.020 | <0.001 | 8.360 | <0.003 | <0.001 | 270.000 |
| | 06/18/2012 | 2062572-03 | <0.020 | 0.001 | 8.270 | <0.003 | 0.002 | 300.000 |
| | 09/17/2012 | 2092390-03 | <0.020 | <0.001 | 7.470 | <0.003 | 0.003 | 300.000 |
| APW-4 | 12/13/2010 | | 0.310 | <0.005 | 5.880 | <0.006 | <0.010 | 49.300 |
| | 09/15/2011 | 1092041-04 | 0.040 | <0.001 | | <0.003 | 0.012 | 53.000 |
| | 10/28/2011 | 1110029-04 | 0.290 | <0.001 | 7.230 | <0.003 | 0.013 | 17.000 |
| | 03/26/2012 | 2032865-04 | <0.020 | <0.001 | 7.420 | <0.003 | 0.015 | 23.000 |
| | 06/18/2012 | 2062572-04 | <0.020 | <0.001 | 7.050 | <0.003 | 0.021 | 14.000 |
| | 09/17/2012 | 2092390-04 | <0.020 | <0.001 | 7.000 | <0.003 | 0.030 | 24.000 |
| APW-5 | 12/13/2010 | | 1.700 | <0.005 | 6.440 | <0.006 | <0.010 | 6.100 |
| | 03/24/2011 | 1032557-04 | 1.900 | <0.001 | 7.760 | <0.003 | <0.001 | 17.000 |
| | 06/24/2011 | 1062825-02 | 1.400 | <0.001 | 7.520 | <0.003 | 0.002 | 15.000 |
| | 09/15/2011 | 1092041-05 | 2.000 | <0.001 | | <0.003 | 0.001 | 9.500 |
| | 10/28/2011 | 1110029-05 | 1.900 | <0.001 | 7.730 | <0.003 | 0.004 | 6.700 |
| | 03/26/2012 | 2032865-05 | 2.000 | <0.001 | 7.910 | <0.003 | 0.002 | 14.000 |
| | 06/18/2012 | 2062572-05 | 4.100 | <0.001 | 7.580 | <0.003 | 0.003 | 15.000 |
| | 09/17/2012 | 2092390-05 | 2.600 | <0.001 | 7.540 | <0.003 | 0.002 | 33.000 |

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## Meredosia Power Station
## Water Quality Data: December 2010 through September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| Well Id | Date Sampled | Lab Id | TDS, mg/L | Tl, diss, mg/L | Zn, diss, mg/L |
|---|---|---|---|---|---|
| APW-1 | 12/13/2010 | | 132.000 | <0.002 | <0.020 |
| | 03/24/2011 | 1032557-01 | 190.000 | <0.001 | <0.006 |
| | 06/24/2011 | 1062825-01 | 140.000 | <0.001 | <0.006 |
| | 09/15/2011 | 1092041-01 | 190.000 | <0.001 | <0.006 |
| | 10/28/2011 | 1110029-01 | 150.000 | <0.001 | <0.006 |
| | 03/26/2012 | 2032865-01 | 180.000 | <0.001 | <0.006 |
| | 06/18/2012 | 2062572-01 | 270.000 | <0.001 | <0.006 |
| | 09/17/2012 | 2092390-01 | 280.000 | <0.001 | <0.006 |
| APW-2 | 12/13/2010 | | 368.000 | <0.002 | <0.020 |
| | 03/24/2011 | 1032557-02 | 630.000 | <0.001 | <0.006 |
| | 09/15/2011 | 1092041-02 | 430.000 | <0.001 | <0.006 |
| | 10/28/2011 | 1110029-02 | 440.000 | <0.001 | <0.006 |
| | 03/26/2012 | 2032865-02 | 460.000 | <0.001 | <0.006 |
| | 06/18/2012 | 2062572-02 | 510.000 | <0.001 | 0.006 |
| | 09/17/2012 | 2092390-02 | 520.000 | <0.001 | <0.006 |
| APW-3 | 12/13/2010 | | 660.000 | <0.002 | <0.020 |
| | 03/24/2011 | 1032557-03 | 750.000 | <0.001 | <0.006 |
| | 09/15/2011 | 1092041-03 | 680.000 | <0.001 | <0.006 |
| | 10/28/2011 | 1110029-03 | 650.000 | <0.001 | <0.006 |
| | 03/26/2012 | 2032865-03 | 710.000 | <0.001 | <0.006 |
| | 06/18/2012 | 2062572-03 | 770.000 | 0.001 | 0.012 |
| | 09/17/2012 | 2092390-03 | 970.000 | <0.001 | <0.006 |
| APW-4 | 12/13/2010 | | 418.000 | <0.002 | <0.020 |
| | 09/15/2011 | 1092041-04 | 470.000 | <0.001 | <0.006 |
| | 10/28/2011 | 1110029-04 | 520.000 | <0.001 | <0.006 |
| | 03/26/2012 | 2032865-04 | 300.000 | <0.001 | <0.006 |
| | 06/18/2012 | 2062572-04 | 690.000 | <0.001 | 0.007 |
| | 09/17/2012 | 2092390-04 | 360.000 | <0.001 | <0.006 |
| APW-5 | 12/13/2010 | | 138.000 | <0.002 | <0.020 |
| | 03/24/2011 | 1032557-04 | 230.000 | <0.001 | <0.006 |
| | 06/24/2011 | 1062825-02 | 290.000 | <0.001 | <0.006 |
| | 09/15/2011 | 1092041-05 | 180.000 | <0.001 | <0.006 |
| | 10/28/2011 | 1110029-05 | 160.000 | <0.001 | <0.006 |
| | 03/26/2012 | 2032865-05 | 250.000 | <0.001 | <0.006 |
| | 06/18/2012 | 2062572-05 | 280.000 | <0.001 | <0.006 |
| | 09/17/2012 | 2092390-05 | 290.000 | <0.001 | <0.006 |

# APPENDIX E

# EXCEEDANCES OF CLASS 1 GROUNDWATER STANDARDS

January 2, 2013
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# Exceedances of Class I Groundwater Standards: December 2010 - September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| LimitType | Parameter | Code | Units | Location | Sample Date | Analysis Result | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|---|
| State Std | As, diss | 01000 | mg/L | APW-3 | 12/13/2010 | 0.148 | | 0.050 |
| | | | | | 03/24/2011 | 0.170 | | 0.050 |
| | | | | | 09/15/2011 | 0.210 | | 0.050 |
| | | | | | 10/28/2011 | 0.220 | | 0.050 |
| | | | | | 03/26/2012 | 0.190 | | 0.050 |
| | | | | | 06/18/2012 | 0.310 | | 0.050 |
| | | | | | 09/17/2012 | 0.170 | | 0.050 |
| | | | | APW-4 | 12/13/2010 | 0.053 | | 0.050 |
| | | | | | 09/15/2011 | 0.150 | | 0.050 |
| | | | | | 10/28/2011 | 0.180 | | 0.050 |
| | B, diss | 01020 | | APW-2 | 12/13/2010 | 2.110 | | 2.000 |
| | | | | | 03/24/2011 | 3.100 | | 2.000 |
| | | | | | 09/15/2011 | 2.800 | | 2.000 |
| | | | | | 10/28/2011 | 3.300 | | 2.000 |
| | | | | | 03/26/2012 | 3.600 | | 2.000 |
| | | | | | 06/18/2012 | 3.500 | | 2.000 |
| | | | | | 09/17/2012 | 3.900 | | 2.000 |
| | | | | APW-3 | 12/13/2010 | 30.200 | | 2.000 |
| | | | | | 03/24/2011 | 28.000 | | 2.000 |
| | | | | | 09/15/2011 | 32.000 | | 2.000 |
| | | | | | 10/28/2011 | 35.000 | | 2.000 |
| | | | | | 03/26/2012 | 31.000 | | 2.000 |
| | | | | | 06/18/2012 | 46.000 | | 2.000 |
| | | | | | 09/17/2012 | 26.000 | | 2.000 |
| | | | | APW-4 | 12/13/2010 | 2.550 | | 2.000 |
| | | | | | 09/15/2011 | 4.500 | | 2.000 |
| | | | | | 10/28/2011 | 6.300 | | 2.000 |
| | | | | | 03/26/2012 | 3.900 | | 2.000 |
| | | | | | 06/18/2012 | 4.800 | | 2.000 |
| | | | | | 09/17/2012 | 4.900 | | 2.000 |
| | Fe, diss | 01046 | | APW-3 | 09/17/2012 | 5.400 | | 5.000 |
| | | | | APW-4 | 09/15/2011 | 5.900 | | 5.000 |
| | | | | | 10/28/2011 | 6.600 | | 5.000 |
| | | | | | 03/26/2012 | 14.000 | | 5.000 |
| | | | | | 06/18/2012 | 16.000 | | 5.000 |
| | | | | | 09/17/2012 | 16.000 | | 5.000 |
| | Mn, diss | 01056 | | APW-2 | 12/13/2010 | 0.931 | | 0.150 |

January 2, 2013
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# Exceedances of Class I Groundwater Standards: December 2010 - September 2012

**Date Range: 12/13/2010 to 09/17/2012**

| LimitType | Parameter | Code | Units | Location | Sample Date | Analysis Result | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|---|
| State Std | Mn, diss | 01056 | mg/L | APW-2 | 03/24/2011 | 0.480 | | 0.150 |
| | | | | | 09/15/2011 | 0.820 | | 0.150 |
| | | | | | 10/28/2011 | 0.790 | | 0.150 |
| | | | | | 03/26/2012 | 0.910 | | 0.150 |
| | | | | | 06/18/2012 | 0.830 | | 0.150 |
| | | | | | 09/17/2012 | 0.960 | | 0.150 |
| | | | | APW-3 | 12/13/2010 | 0.169 | | 0.150 |
| | | | | | 03/24/2011 | 0.450 | | 0.150 |
| | | | | | 09/15/2011 | 0.280 | | 0.150 |
| | | | | | 10/28/2011 | 0.250 | | 0.150 |
| | | | | | 03/26/2012 | 0.300 | | 0.150 |
| | | | | | 06/18/2012 | 0.460 | | 0.150 |
| | | | | | 09/17/2012 | 1.200 | | 0.150 |
| | | | | APW-4 | 12/13/2010 | 3.100 | | 0.150 |
| | | | | | 09/15/2011 | 3.400 | | 0.150 |
| | | | | | 10/28/2011 | 5.400 | | 0.150 |
| | | | | | 03/26/2012 | 2.800 | | 0.150 |
| | | | | | 06/18/2012 | 3.300 | | 0.150 |
| | | | | | 09/17/2012 | 2.900 | | 0.150 |
| | pH (field) | 00400 | STD | APW-2 | 12/13/2010 | 5.980 | 6.500 | |
| | | | | APW-4 | 12/13/2010 | 5.880 | 6.500 | |
| | | | | APW-5 | 12/13/2010 | 6.440 | 6.500 | |

# APPENDIX F

# HYDRAULIC GRADIENT AND ILLINOIS RIVER LOADING CALCULATIONS

## Appendix F
## Mixing Calculation Showing Effect of Boron Loading on Illinois River Quality at Low Flow

| | | | | |
|---|---|---|---|---|
| **7-day 10-year low flow at Meredosia Power Station** | | 3700 | cfs | Source: http://il.water.usgs.gov/drought/lowflow.html, 1988 data |
| | $Q_{7,10}$ = | 9.1E+09 | L/day | |
| | | | | |
| **Boron loading rate** | | | | |
| Maximum Boron Concentration in Groundwater (Cmax) | | 46 | mg/L | APW-3 |
| Maximum Hydraulic Conductivity | | 0.0570 | cm/s | Based on well 21.2c in Gibb et al., 1979 |
| Hydraulic Gradient | | 0.00295 | | Maximum observed gradient toward river |
| Aquifer Thickness | | 100 | ft | Assumed |
| Length of Impoundment + 500 feet (each way) north and south | | 2,600 | ft | Fly Ash Pond |
| | | | | |
| Q = KIA | | | | |
| K = Max Hydraulic Conductivity | | 1.9E-03 | ft/s | |
| I = Hydraulic Gradient | | 0.00295 | | |
| A = Cross-Sectional Area | | 260,000 | $ft^2$ | |
| Q (per second) | | 1.43435 | cfs | |
| Q (per day) | | 3,509,265.61 | L/day | |
| | | | | |
| Loading Rate (L) | | 1.6E+08 | mg/day | = Cmax * Q |
| | L = | 355.14 | lb/day | |
| | | | | |
| **Boron concentration increase in Illinois River at low flow due to loading CCP Impoundment** | | | | |
| | $d_B$ = | 0.0178 | mg/L | = $L/Q_{7,10}$ |
| | | | | |
| **Boron concentration increase near-shore in Illinois River at low flow due to loading from CCP Impoundment** | | | | |
| Assumes loading distributed within 50 feet of east bank | | 0.27 | mg/L | relative to a total river width of 750 feet |
| | | | | |
| Typical boron laboratory detection limit | | 0.0038 | mg/L | Source: USEPA SW-846 Method 6010c |

## Appendix F
## Mixing Calculation Showing Effect of Boron Loading on Illinois River Quality under Typical Conditions

| | | | |
|---|---|---|---|
| **Median of annual average flow at Meredosia Power Station** | 21200 | cfs | Source: http://waterdata.usgs.gov/site_no=05585500 |
| $Q_{7,10}$ = | 5.2E+10 | L/day | |
| **Boron loading rate** | | | |
| Median Boron Concentration in Groundwater (Cmed) | 4.7 | mg/L | Median of wells near river (APW-2, APW-3, APW-4) |
| Maximum Hydraulic Conductivity | 0.0570 | cm/s | Based on well 21.2c in Gibb et al., 1979 |
| Hydraulic Gradient | 0.002135 | | Median observed gradient toward river 2010-2012 |
| Aquifer Thickness | 100 | ft | Assumed |
| Length of Impoundment + 500 feet (each way) north and south | 2,600 | ft | Fly Ash Pond |
| Q = KIA | | | |
| K = Max Hydraulic Conductivity | 1.9E-03 | ft/s | |
| I = Hydraulic Gradient | 0.00214 | | |
| A = Cross-Sectional Area | 260,000 | ft$^2$ | |
| Q (per second) | 1.03808 | cfs | |
| Q (per day) | 2,539,756.64 | L/day | |
| Loading Rate (L) | 1.2E+07 | mg/day | = Cmax * Q |
| L = | 26.26 | lb/day | |
| **Boron concentration increase in Illinois River at low flow due to loading CCP Impoundment** | | | |
| $d_B$ = | 0.0002 | mg/L | = L/$Q_{7,10}$ |
| **Boron concentration increase near-shore in Illinois River at low flow due to loading from CCP Impoundment** | | | |
| Assumes loading distributed within 50 feet of east bank | 0.0035 | mg/L | relative to a total river width of 750 feet |
| Typical boron laboratory detection limit | 0.0038 | mg/L | Source: USEPA SW-846 Method 6010c |

# Appendix F
## Mixing Calculation Showing Effect of Arsenic Loading on Illinois River Quality at Low Flow

| | | | | |
|---|---|---|---|---|
| **7-day 10-year low flow at Meredosia Power Station** | | 3700 | cfs | Source: http://il.water.usgs.gov/drought/lowflow.html, 1988 data |
| | $Q_{7,10}$ = | 9.1E+09 | L/day | |
| | | | | |
| **Arsenic loading rate** | | | | |
| Maximum Arsenic Concentration in Groundwater (Cmax) | | 0.31 | mg/L | APW-3 |
| Maximum Hydraulic Conductivity | | 0.0570 | cm/s | Based on well 21.2c in Gibb et al., 1979 |
| Hydraulic Gradient | | 0.00295 | | Maximum observed gradient toward river |
| Aquifer Thickness | | 100 | ft | Assumed |
| Length of Impoundment + 500 feet (each way) north and south | | 2,600 | ft | Fly Ash Pond |
| | | | | |
| Q = KIA | | | | |
| K = Max Hydraulic Conductivity | | 1.9E-03 | ft/s | |
| I = Hydraulic Gradient | | 0.00295 | | |
| A = Cross-Sectional Area | | 260,000 | $ft^2$ | |
| Q (per second) | | 1.43435 | cfs | |
| Q (per day) | | 3,509,265.61 | L/day | |
| | | | | |
| Loading Rate (L) | | 1.1E+06 | mg/day | = Cmax * Q |
| | L = | 2.39 | lb/day | |
| | | | | |
| **Arsenic concentration increase in Illinois River at low flow due to loading CCP Impoundment** | | | | |
| | $d_B$ = | 0.00012 | mg/L | = $L/Q_{7,10}$ |
| | | | | |
| **Arsenic concentration increase near-shore in Illinois River at low flow due to loading from CCP Impoundment** | | | | |
| Assumes loading distributed within 50 feet of east bank | | 0.0018 | mg/L | relative to a total river width of 750 feet |
| | | | | |
| Typical arsenic quantitation limit (Atomic Adsorption method) | | 0.0010 | mg/L | Source: USEPA SW-846 Method 7010 |

## Appendix F
## Mixing Calculation Showing Effect of Arsenic Loading on Illinois River Quality under Typical Conditions

| | | | |
|---|---|---|---|
| **Median of annual average flow at Meredosia Power Station** | 21200 | cfs | Source: http://waterdata.usgs.gov/site_no=05585500 |
| $Q_{7,10}$ = | 5.2E+10 | L/day | |
| | | | |
| **Arsenic loading rate** | | | |
| Median Arsenic Concentration in Groundwater (Cmed) | 0.045 | mg/L | Median of wells near river (APW-2, APW-3, APW-4) |
| Maximum Hydraulic Conductivity | 0.0570 | cm/s | Based on well 21.2c in Gibb et al., 1979 |
| Hydraulic Gradient | 0.002135 | | Median observed gradient toward river 2010-2012 |
| Aquifer Thickness | 100 | ft | Assumed |
| Length of Impoundment + 500 feet (each way) north and south | 2,600 | ft | Fly Ash Pond |
| | | | |
| Q = KIA | | | |
| K = Max Hydraulic Conductivity | 1.9E-03 | ft/s | |
| I = Hydraulic Gradient | 0.00214 | | |
| A = Cross-Sectional Area | 260,000 | $ft^2$ | |
| Q (per second) | 1.03808 | cfs | |
| Q (per day) | 2,539,756.64 | L/day | |
| | | | |
| Loading Rate (L) | 1.1E+05 | mg/day | = Cmax * Q |
| L = | 0.25 | lb/day | |
| | | | |
| **Arsenic concentration increase in Illinois River at low flow due to loading CCP Impoundment** | | | |
| $d_B$ = | 2.2E-06 | mg/L | = $L/Q_{7,10}$ |
| | | | |
| **Arsenic concentration increase near-shore in Illinois River at low flow due to loading from CCP Impoundment** | | | |
| Assumes loading distributed within 50 feet of east bank | 3.3E-05 | mg/L | relative to a total river width of 750 feet |
| | | | |
| Typical arsenic quantitation limit (Atomic Adsorption method) | 0.0010 | mg/L | Source: USEPA SW-846 Method 7010 |

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient – Magnitude and Direction**

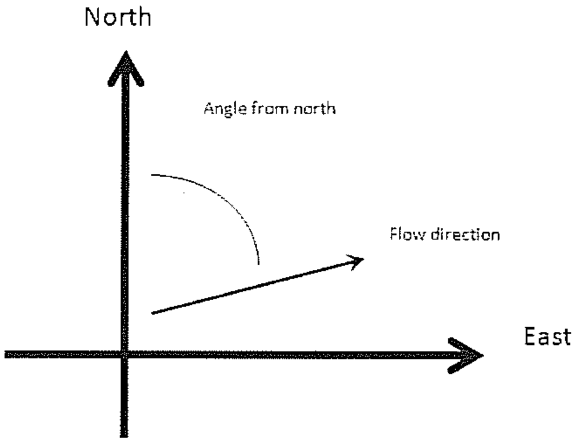
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\,x_1 + b\,y_1 + c = h_1$
$a\,x_2 + b\,y_2 + c = h_2$
$a\,x_3 + b\,y_3 + c = h_3$
. . .
$a\,x_{30} + b\,y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

$i = 1,2,3, \dots , 30$
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 Example Data Set 2 Calculate Clear
Save Data Recall Data Go Back

| | | | |
|---|---|---|---|
| Site Name | Meredosia | | |
| Date | 12/13/2010 | Current Date | |
| Calculation basis | Head ▾ | | |
| Coordinates ft ▾ | | | |
| I.D. | x-coordinate | y-coordinate | head ft ▾ |
| 1) APW-1 | 2185605.2 | 1147018.68 | 430.11 |
| 2) APW-2 | 2182485.2 | 1148489.69 | 423.73 |
| 3) APW-3 | 2181973.76 | 1148118.6 | 422.93 |
| 4) APW-4 | 2181602.97 | 1146935.94 | 425.61 |
| 5) APW-5 | 2183711.11 | 1146922.64 | 428.16 |
| 6) | | | |
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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 5 |
| Max. Difference Between Head Values | 2.188 |
| Gradient Magnitude (i) | 0.002417 |
| Flow direction as degrees from North (positive y axis) | 329.7 |
| Coefficient of Determination ($R^2$) | 0.987 |

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Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

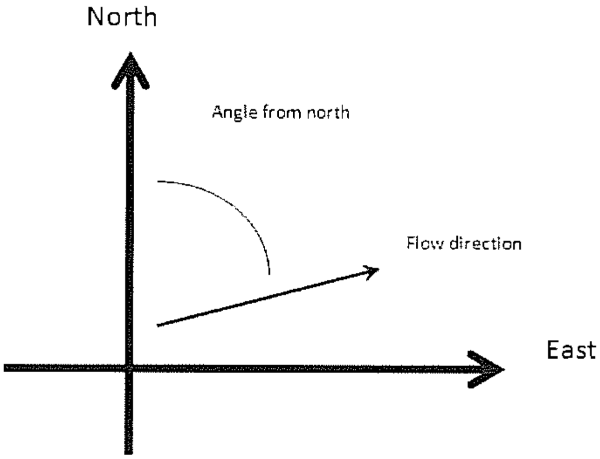
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\ x_1 + b\ y_1 + c = h_1$
$a\ x_2 + b\ y_2 + c = h_2$
$a\ x_3 + b\ y_3 + c = h_3$
. . .
$a\ x_{30} + b\ y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

$i = 1,2,3, \ldots, 30$
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

☐ Example Data Set 1 ☐ Example Data Set 2 ☐ Calculate ☐ Clear
☐ Save Data ☐ Recall Data ☐ Go Back

Site Name: Meredosia
Date: 9/15/11 ☐ Current Date
Calculation basis: Head ▾
Coordinates: ft ▾

| I.D. | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|
| 1) APW-1 | 2185605.2 | 1147016.68 | 431.96 |
| 2) APW-2 | 2182485.2 | 1148489.69 | 424.22 |
| 3) APW-3 | 2181973.76 | 1148118.6 | 422.38 |
| 4) APW-4 | 2181602.97 | 1146935.94 | 425.66 |
| 5) APW-5 | 2183711.11 | 1146922.64 | 429.80 |
| 6) | | | |
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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 5 |
| Max. Difference Between Head Values | 2.920 |
| Gradient Magnitude (i) | 0.002951 |
| Flow direction as degrees from North (positive y axis) | 324.2 |
| Coefficient of Determination ($R^2$) | 0.966 |

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Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

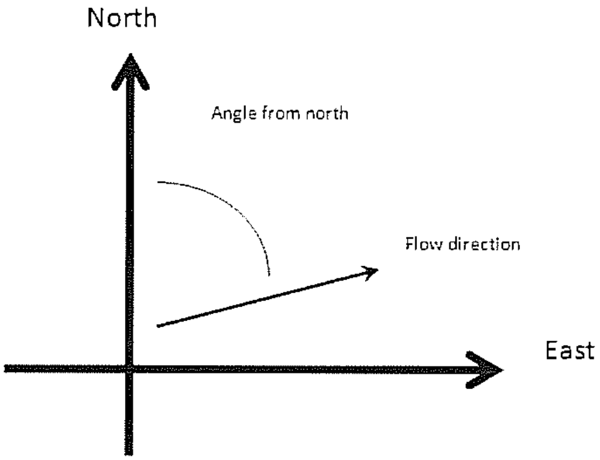
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\,x_1 + b\,y_1 + c = h_1$
$a\,x_2 + b\,y_2 + c = h_2$
$a\,x_3 + b\,y_3 + c = h_3$
...
$a\,x_{30} + b\,y_{30} + c = h_{30}$

where $(x_i, y_i)$ are the coordinates of the well and
$h_i$ is the head

$i = 1,2,3, \ldots, 30$
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name Meredosia
Date 10/28/11 Current Date
Calculation basis Head ▾
Coordinates ft ▾

| I.D. | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|
| 1) APW-1 | 2185605.2 | 1147018.68 | 429.66 |
| 2) APW-2 | 2182465.2 | 1148489.69 | 423.27 |
| 3) APW-3 | 2181973.76 | 1148118.6 | 421.68 |
| 4) APW-4 | 2181602.97 | 1146935.94 | 424.86 |
| 5) APW-5 | 2183711.11 | 1146922.64 | 428.70 |
| 6) | | | |
| 7) | | | |
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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 5 |
| Max. Difference Between Head Values | 2.432 |
| Gradient Magnitude (i) | 0.002731 |
| Flow direction as degrees from North (positive y axis) | 330.3 |
| Coefficient of Determination ($R^2$) | 0.945 |

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Last updated on Tuesday, December 11, 2012

EPA United States Environmental Protection Agency

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

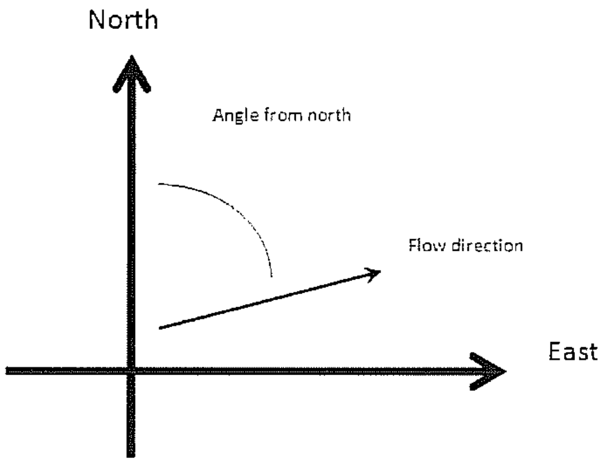
**Gradient Calculation** from fitting a plane to as many as thirty points

$a x_1 + b y_1 + c = h_1$
$a x_2 + b y_2 + c = h_2$
$a x_3 + b y_3 + c = h_3$
. . .
$a x_{30} + b y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

$i = 1,2,3, \ldots, 30$
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

Site Name Meredosia
Date 3/26/12 Current Date
Calculation basis Head ▾
Coordinates ft ▾

| I.D. | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|
| 1) APW-1 | 2185605.2 | 1147018.68 | 427.71 |
| 2) APW-2 | 2182485.2 | 1148489.69 | 423.60 |
| 3) APW-3 | 2181973.76 | 1148118.6 | 423.48 |
| 4) APW-4 | 2181602.97 | 1146935.94 | 424.96 |
| 5) APW-5 | 2183711.11 | 1146922.64 | 426.00 |
| 6) | | | |
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**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 5 |
| Max. Difference Between Head Values | 1.289 |
| Gradient Magnitude (i) | 0.001412 |
| Flow direction as degrees from North (positive y axis) | 329.3 |
| Coefficient of Determination ($R^2$) | 0.986 |

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Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient -- Magnitude and Direction**

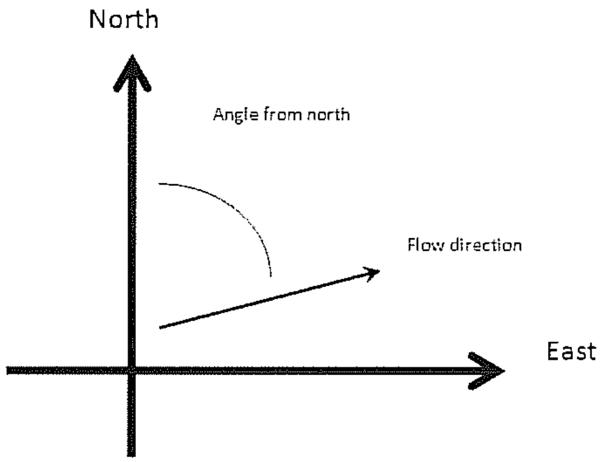
**Gradient Calculation** from fitting a plane to as many as thirty points

$a\,x_1 + b\,y_1 + c = h_1$
$a\,x_2 + b\,y_2 + c = h_2$
$a\,x_3 + b\,y_3 + c = h_3$
. . .
$a\,x_{30} + b\,y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

$i = 1,2,3, \ldots, 30$
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 | Example Data Set 2 | Calculate | Clear
Save Data | Recall Data | Go Back

| | | | |
|---|---|---|---|
| Site Name | Meredosia | | |
| Date | 6/18/12 | | Current Date |
| Calculation basis | Head ▾ | | |
| Coordinates | ft ▾ | | |
| I.D. | x-coordinate | y-coordinate | head ft ▾ |
| 1) APW-1 | 2185605.2 | 1147018.68 | 427.92 |
| 2) APW-2 | 2182485.2 | 1148489.69 | 422.41 |
| 3) APW-3 | 2181973.76 | 1148118.6 | 422.33 |
| 4) APW-4 | 2181602.97 | 1146935.94 | 423.91 |
| 5) APW-5 | 2183711.11 | 1146922.64 | 425.90 |
| 6) | | | |
| 7) | | | |
| 8) | | | |
| 9) | | | |
| 10) | | | |
| 11) | | | |
| 12) | | | |
| 13) | | | |
| 14) | | | |
| 15) | | | |
| 16) | | | |
| 17) | | | |

18)
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21)
22)
23)
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25)
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28)
29)
30)

**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 5 |
| Max. Difference Between Head Values | 1.704 |
| Gradient Magnitude (i) | 0.001849 |
| Flow direction as degrees from North (positive y axis) | 325.8 |
| Coefficient of Determination ($R^2$) | 0.998 |

WCMS

Last updated on Tuesday, December 11, 2012

# EPA On-line Tools for Site Assessment Calculation

**Hydraulic Gradient – Magnitude and Direction**

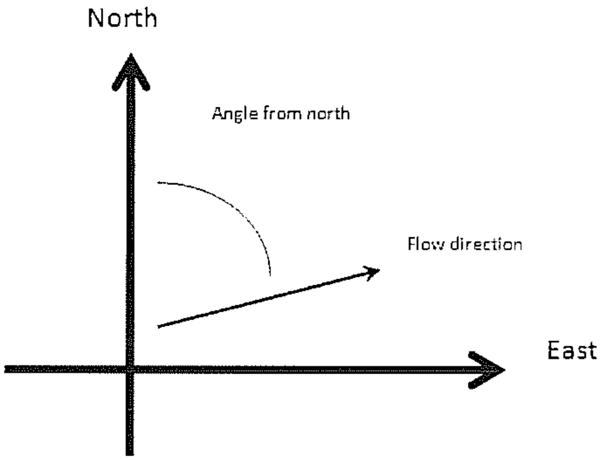
**Gradient Calculation** from fitting a plane to as many as thirty points

$a x_1 + b y_1 + c = h_1$
$a x_2 + b y_2 + c = h_2$
$a x_3 + b y_3 + c = h_3$
...
$a x_{30} + b y_{30} + c = h_{30}$

where $(x_i,y_i)$ are the coordinates of the well and
$h_i$ is the head

$i = 1,2,3, \ldots , 30$
The coefficients a, b, and c are calculated by a least-squares fitting of the the data to a plane

The gradient is calculated from the square root of $(a^2 + b^2)$ and the angle from the arctangent of a/b or b/a depending on the quadrant



**Inputs**

Example Data Set 1 Example Data Set 2 Calculate Clear
Save Data Recall Data Go Back

| | |
|---|---|
| Site Name | Meredosia |
| Date | 9/17/12 Current Date |
| Calculation basis | Head ▾ |
| Coordinates | ft ▾ |

| I.D. | x-coordinate | y-coordinate | head ft ▾ |
|---|---|---|---|
| 1) APW-1 | 2185605.2 | 1147018.68 | 425.81 |
| 2) APW-2 | 2182485.2 | 1148489.69 | 421.28 |
| 3) APW-3 | 2181973.76 | 1148118.6 | 420.36 |
| 4) APW-4 | 2181602.97 | 1146935.94 | 422.50 |
| 5) APW-5 | 2183711.11 | 1146922.64 | 424.02 |
| 6) | | | |
| 7) | | | |
| 8) | | | |
| 9) | | | |
| 10) | | | |
| 11) | | | |
| 12) | | | |
| 13) | | | |
| 14) | | | |
| 15) | | | |
| 16) | | | |
| 17) | | | |

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29)
30)

**Results**

| | |
|---|---|
| Number of Points Used in Calculation | 5 |
| Max. Difference Between Head Values | 1.661 |
| Gradient Magnitude (i) | 0.001676 |
| Flow direction as degrees from North (positive y axis) | 327.2 |
| Coefficient of Determination ($R^2$) | 0.969 |

WCMS

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# PHASE 1 HYDROGEOLOGICAL ASSESSMENT REPORT

## COAL COMBUSTION PRODUCT IMPOUNDMENT
## NEWTON ENERGY CENTER
## JASPER COUNTY, ILLINOIS

**Project No. 2125**

**Prepared For:**

**AMEREN ENERGY GENERATING COMPANY**

**Prepared By:**

**Natural Resource Technology, Inc.**
**23713 West Paul Road, Suite D**
**Pewaukee, WI  53072**

**March 19, 2013**

**Bruce R. Hensel, PG**
**Principal Hydrogeologist**

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# 1 INTRODUCTION

## 1.1 Purpose

Ameren Energy Generating Company owns and operates the Newton Energy Center in Jasper County, Illinois. The coal-fired power plant currently operates one impoundment for coal combustion product (CCP) management purposes (Figure 1). To assess the potential for constituent migration from this impoundment as requested by the Agency in their correspondence dated May 15, 2009, Ameren commissioned a hydrogeologic study, water well survey, development of a groundwater monitoring plan, and an initial groundwater quality assessment.

The objectives of this report are to:

- Summarize hydrogeologic information pertinent to the site.
- Evaluate groundwater quality data to determine whether or not operation of the impoundment has adversely affected groundwater.
- Determine the potential for off-site migration and whether or not there are potential groundwater receptors in the event of a release.

# 2 SETTING

Portions of the information in this section were previously presented and modified from in the site characterization and groundwater monitoring plan developed by Rapps Engineering & Applied Services (November 2009).

## 2.1 Power Plant and Ash Pond

The Newton Energy Center (NEC) is located in Jasper County in southeastern part of central Illinois approximately 7 miles southwest of the town of Newton (Figure 2). The plant is located on the north side of Newton Lake and has one CCP impoundment, which is active, located in Section 26 and the western half of Section 25, Township 6 North, Range 8 East.

The NEC's sole CCP impoundment, consisting of a Primary Ash Pond and Secondary Ash Pond, was constructed in 1977 and has a design capacity of approximately 9,715 acre-feet for the primary pond and 83.6 acre-feet for the secondary pond. The Primary Ash Pond has a surface area of 400 acres and a height of approximately 71 feet above grade. The Secondary Ash Pond has an area of 9.3 acres and a height of approximately 29 feet above grade. The CCP impoundment was not excavated during construction except for native materials used to build the containment berms. The impoundment receives bottom ash, fly ash, and low-volume wastewater (LVW) from the plant's two coal-fired boilers, and operates per NPDES Permit IL0049191, Outfall 001.

Other CCP management facilities at the NEC include a landfill with a closed Phase 1 cell and an inactive Phase 2 cell. The Phase 1 cell, built in 1977, was unlined, and accepted sodium-based flue gas desulfurization (FGD) wastes mixed with fly ash and lime (Poz-O-Tec). Phase 1 was closed in 1999 with a 40-millimeter thick geomembrane cap and currently has a Groundwater Management Zone (GMZ) established. Following a switch by the NEC to western coal in 1997, the Phase 2 cell began receiving coal ash that same year and continuing until 2011. The Phase 2 cell has a geomembrane liner with a leachate collection system.

## 2.2 Regional Geology

The Quaternary deposits in the Newton area are 100 to 120 feet thick and consist mainly of diamictons and intercalated outwash deposits that were deposited during Illinoian and Pre-Illinoian glaciations. The Quaternary deposits are underlain by Pennsylvanian age bedrock, primarily shale at the surface, of the Mattoon Formation. Additional detail is provided in Appendix A.

## 2.3 Water Resources

### 2.3.1 Surface Water

The major surface water body in the vicinity of the NEC is Newton Lake, an elongated body of water that borders the CCP impoundment on three sides (south, east, and west). The southern boundary of the CCP impoundment runs parallel to the north shore of the lake and is located approximately 250 to 700 feet from the water's edge. The primary drainage ways in the area are Big Muddy Creek and Wolf Creek, which lie approximately 2.3 miles west and 1.7 miles east of the site, respectively. In addition, minor streams and drainage channels cut across the drift plain in the area.

### 2.3.2 Groundwater

No surficial aquifers, i.e., aquifers that are present or exposed at the ground surface, are present in the study area. Berg, Kempton and Cartwright (1984) classified the area as G (relatively impermeable bedrock within 20 to 50 feet of ground surface, overlain by till or other fine grained materials) and B2 (sand and gravel within 20 feet of surface, overlain and underlain by relatively impermeable till, other fine-grained material, and/or bedrock). Aquifers in the area of the NEC generally fall into two broad categories: (1) unlithified sediments that are glacial or alluvial in origin and contain mostly sand and gravel deposits interbedded with clay and silt; and, (2) bedrock aquifers consisting of sandstone and fractured limestone, which vary widely in permeability. To the east of the NEC, water yielding sandstone formations occur at depths of 100 to 300 feet below ground surface (Selkregg et al., 1957). Groundwater available from local bedrock units is mostly mineralized and rarely used as a source for potable water. Glacial deposits generally provide enough water for rural and residential water supplies. Sand and gravel deposits within the Glasford Formation and the Pearl Formation have been developed locally for domestic water supplies. Locally occurring discontinuous sand and gravel deposits exist along the bottomlands of Big Muddy Creek, which can sustain domestic and farm groundwater supplies. The water bearing zones at the site are the sandy horizons that occur intermittently within the Glasford Formation and the Hagarstown Member of the Pearl Formation.

### 2.3.3 Private Water Wells

Public records were searched to identify water wells located within 2,500 feet of the CCP impoundment. The Newton property boundary is located in Township 6 North, Range 8 East, and the CCP impoundment is located within Sections 25 and 26. The 2,500 foot boundary spans across Sections 23, 24, 25, 26, 27, 34, 35, and 36. All wells within these sections are shown on Figure 3 and tabulated in Appendix B.

The following sources of information were queried to identify water well locations:

- Illinois State Geological Survey’s Illinois Water Well (ILWATER) Internet Map Service
- Illinois State Water Survey Domestic Well Database (ISWS)
- Illinois EPA’s web-based Geographic Information System (GIS) files
- Illinois Department of Public Health
- Jasper County Health Department

Eleven water well records were identified within the eight sections surrounding the unlined ash pond and are numbered 1 through 11 on Figure 3 and Appendix B, Table B-1. No water wells were identified within 2,500 feet of the CCP impoundment. Wells 2 through 6 list Ameren’s predecessor, Central Illinois Public Service (CIPS), as the well owner, and well 8 lists CIPS and the department of conservation as joint owners. These wells were drilled west of Newton Lake, in the Newton Lake State Fish and Wildlife Preserve, in 1978, shortly after construction of the power station was completed. The other five wells appear to be for farm/domestic use. Four wells (numbers 1, 9, 10, and 11) are located southeast of Newton Lake, and one well (number 7) is located more than 1 mile north of the.CCP impoundment, on land currently located by Ameren, but where aerial photographs indicate a domestic building was located prior to 2005.

Public water supply (PWS) wells within a ten mile radius of the CCP impoundment were identified via a search of the Illinois State Water Survey's Illinois Water Inventory Program (IWIP) database (not available on-line) by RAPPS (2009). Eight wells were identified within the search radius, including four belonging to the village of Dieterich and four belonging to the city of Newton. The closest PWS wells are the Newton wells, located approximately 8.25 miles northeast of the CCP impoundment. Given the clay soils prevalent in this area, these wells are beyond any zone of influence that could be reasonably attributed to the CCP impoundment.

# 3 MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

## 3.1 Monitoring Well Installation and Development

Three monitoring wells (APW-2, APW-3, and APW-4) were installed on July 18 and July 19, 2010 (Figure 1) by Geotechnology, Inc. At each well location, subsurface borings were advanced with a rotary drill rig equipped with hollow-stem augers to facilitate soil classification. Soil was continuously sampled through the center of the hollow stem auger. Monitoring wells, constructed of 2” inside diameter schedule 40 PVC riser and screen, with steel above-ground well covers, were installed at each location to monitor groundwater within the uppermost water-bearing unit adjacent to the impoundment. The wells were constructed consistent with monitoring well construction standards per IAC Title 35, Section 811.318. Drilling and sampling equipment was decontaminated before sampling and between sample locations to prevent cross contamination. The monitoring wells were surveyed by a licensed surveyor.

Monitoring well construction and survey data are summarized in Table 1. Boring logs and well diagrams are included in Appendix C. Boring depths were between 18 and 20 feet below ground surface (bgs). A cross-sectional view of the four monitoring wells showing ground surface and well screen elevations is provided in Figure 4.

Monitoring wells were developed on November 10, 2010, by surging and pumping a minimum of five well volumes and until specific conductivity stabilized or the wells were pumped dry. The depth to groundwater was measured in each monitoring well using an electronic water level indicator. Groundwater levels ranged from approximately 4.70 feet to 9.65 feet bgs at the time of well installation.

## 3.2 Groundwater Sampling and Chemical Analysis

The monitoring wells were sampled during eight consecutive quarterly monitoring events from November 2010 through July 2012 in order to establish a statistical baseline for groundwater quality. The monitoring wells were purged and sampled for the first quarterly sampling event on November 30, 2010 using disposable bailers. Each monitoring well was purged until three well volumes were removed. Water quality parameters including pH, specific conductivity, and temperature were monitored in the field. Groundwater levels ranged from 6.82 feet to 10.85 feet bgs in the three wells. Table 2 presents the groundwater levels and elevations.

Water samples were field filtered and preserved for all parameters (both general chemistry and metals) with the exception of cyanide. Sample containers were labeled, placed in an ice-filled cooler, and transported using standard chain-of-custody procedures. The first round of groundwater sampling was conducted by Geotechnology, Inc. and sample analyses conducted by Accutest Laboratories located in Marlborough, MA . The groundwater sampling information and laboratory analytical reports are provided in the Geotechnology, Inc. monitoring report dated February 8, 2011. The seven subsequent quarterly monitoring events were sampled by Ameren and analyzed by PDC, Inc. All eight rounds of groundwater samples were analyzed for the inorganic constituents listed under Title 35, 620.410 with the exception of radium 226 and 228. Table 3 lists the field, general chemistry, and metal parameters monitored during the eight quarters of baseline sampling along with the analytical methods.

In addition to the three new monitoring wells sampled to characterize groundwater quality at the CCP impoundment, an existing background monitoring well (G116) was sampled for five consecutive quarters from July 12, 2011 through July 17, 2012 for the same set of parameters as wells APW-2, APW-3, and APW-4. The background groundwater quality from well G116 has been included in the discussion of groundwater quality presented in Section 5.

# 4 SITE HYDROGEOLOGY

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## 4.1 Lithology

The information used to describe site hydrogeology is based on the local geology obtained from published sources as presented in Section 2.2 and Appendix A, hydrogeologic investigation data from the 1997 landfill application by RAPPS prepared for the Phase 2 cell permit, and boring data collected at the three CCP impoundment monitoring well locations APW-2 through APW-4. The three borings ranged from 18 to 20 feet bgs and were advanced through the following unlithified materials in descending order:

- 4 to 7 feet of soft, brown, silty clay
- 5 to 9 feet of stiff to hard, brown, sandy clay; borings APW-2 and APW-3 both had some gravel within the sandy clay
- 6 to 7 feet of stiff to hard, brown to brown-gray, sandy clay with gravel at borings APW-3 and APW-4; and 7 feet of hard dark gray clay and till at APW-2

The uppermost water-bearing unit intercepted in the area of the CCP impoundment is the silty to sandy clay of the “Upper Drift”, as identified in the 1997 landfill investigation, which consists of Peoria Silt, Sangamon Soil, and/or Hagarstown Member. The hydraulic conductivity of this unit was tested at the landfill monitoring wells and ranged from $2.4\text{x}10^{-6}$ to $6.1\text{x}10^{-5}$ cm/s. Monitoring wells APW-3 and APW-4 are screened entirely within this upper unit and well APW-2 is partially screened with this unit. Below the Upper Drift lies the Vandalia Member diamicton, a dark gray silty to sandy clay till. The lower portion of well APW-2 may be screened within the Vandalia Member. The contact between the Hagarstown Member of the Upper Drift and the Vandalia Member is reported as between 532 and 510 feet above mean sea level (amsl) in the vicinity of the NEC. Beneath the Vandalia Member lie the Mulberry Grove Member, Smithboro Member diamicton, and the undifferentiated Banner Formation. The Mulberry Grove Member consists of three to five feet of mostly gray sandy silt, and was defined as the uppermost aquifer at the landfill site. The Smithboro Member and Banner Formation consist of 30 to 50 feet of mostly silty clay with traces of sand and gravel. APW-2, APW-3, and APW-4 did not penetrate these units, and the existence of these units in the vicinity of the CCP impoundment is inferred from borings at the landfill.

## 4.2 Groundwater Flow

Groundwater elevation data (potentiometric levels) were collected for the three downgradient monitoring wells. Groundwater depths and elevations for the eight quarterly monitoring events are provided in Table 2 and graphically illustrated on time-series plots on Figure 5. Groundwater levels ranged from 0.2 to 7.0 feet bgs from November 2010 through July 2012. The shallowest groundwater depths in the three wells, ranging from 0.2 to 1.7 feet bgs, were observed from May to October 2011. The deepest groundwater depths, ranging from 1.3 to 7.0 feet bgs, were observed in November 2010 and July 2012. Comparing the ground surface and monitoring well screen elevations, as illustrated on Figure 4, with the groundwater level elevations, it is apparent that the shallow groundwater levels are a reflection of land surface topography.

Considering the potential for hydraulic head imposed on the groundwater flow system by the impoundment that lies between the three monitoring wells, groundwater flow between these three points cannot be contoured with confidence. Newton Lake is at an elevation between 500 and 510 feet msl, and the impoundment is maintained at an elevation between 530 and 540 feet. Groundwater elevations in the monitoring wells were between 520 and 530 feet, and these values are between the surface water elevations of the impoundment and the lake, suggesting that groundwater flow is from the ash pond toward Newton Lake. A conceptual flow map is presented as Figure 6.

Since groundwater near the CCP impoundment discharges to Newton Lake and the Lake is entirely on property owned by Ameren, there is no potential for off-site migration from the CCP impoundment.

## 4.3 Potential For Groundwater Receptors

A potential groundwater receptor is a water supply well located in a position that can be interpreted as downgradient from the CCP pond, and screened within a geologic formation that can reasonably be expected to be a groundwater migration pathway in the event of a release.

Figure 3 shows water wells located within the vicinity of the unlined impoundments. As described in Section 2.3.3, all except one of these wells are located on the other side of Newton Lake from the CCP impoundment, and the other well is more than one mile north of the CCP impoundment and associated with a house that no longer exists. As noted in Section 4.2, there is no potential for off-site migration from the CCP impoundment. Since there is no potential for off-site migration and no water wells between the CCP impoundment and Newton Lake, there is no potential for groundwater receptors downgradient of the CCP impoundment.

# 5 GROUNDWATER CHEMISTRY

## 5.1 Overview

The purpose of the sampling and inorganic analysis of groundwater from monitoring wells at the NEC was to assess background and downgradient groundwater quality, to evaluate elevated concentrations and those exceeding groundwater standards, and to identify primary factors potentially influencing groundwater quality changes spatially and temporally.

All of the groundwater quality data collected and analyzed for both field and laboratory parameters, including the full list of inorganic constituents listed in IAC 35 Part 620 Section 410 except for Radium 224/226, are provided in Appendix D for the eight quarters of monitoring conducted from November 2010 through July 2012 for the three new monitoring wells APW-2, APW-3, and APW-4. In addition, the groundwater quality data for background well G116, collected during five consecutive quarters from July 2011 through July 2012, are included for comparison to the CCP impoundment well data.

A statistical summary of all of the water quality data at each of the three monitoring wells and background well G116 is provided in Table 4, including the mean, median, maximum, minimum, standard deviation, and percent non-detects. Although shallow groundwater in the uppermost water-bearing unit may meet the classification criteria of a Class II (General Resource) groundwater, for the purposes of this report only the Class I groundwater standards are shown on Table 4 and constituents where concentration exceed Class I groundwater standards are highlighted on the table.

## 5.2 Comparison of Groundwater Quality to Class I Standards

A listing of all exceedances of Class I groundwater quality standards, sorted by constituent, well location, and sample date, is provided in Appendix E. Constituents with exceedances are also highlighted on Table 4. Constituents with groundwater quality exceedances were:

- pH: APW-2 (1 of 8 samples), APW-3 (1 of 8), APW-4 (1 of 8)
- Manganese: APW-2 (8 of 8), APW-4 (7 of 8)
- Sulfate: APW-2 (8 of 8), APW-4 (8 of 8)
- TDS: APW-2 (8 of 8), APW-4 (8 of 8)

The pH values that were lower than the 6.50 standard occurred only in the first quarter monitoring event and were most likely caused by systematic error due to instrument calibration or non-stabilized groundwater geochemistry at the time of sampling. Coal ash leachate tends to be alkaline and is therefore not a source of low pH.

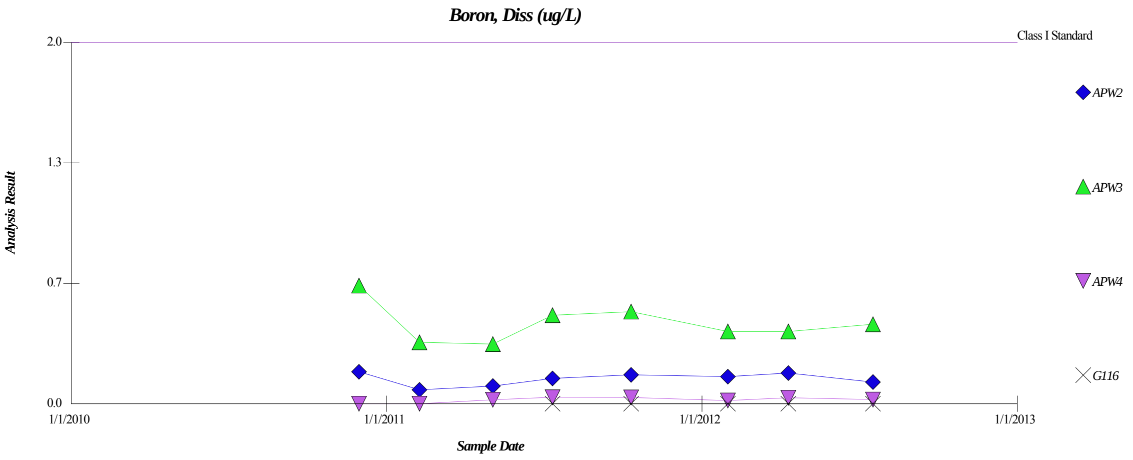
Sulfate, manganese, and TDS consistently exceeded their respective Class I groundwater standards at wells APW-2 and APW-4, located at the west and east ends of the CCP impoundment, respectively. Well APW-3, located between the midpoint of the impoundment and Newton Lake, did not have any exceedances for these constituents. As discussed in the next section, these exceedances are not attributed to a release from the CCP impoundment.

## 5.3 Groundwater Quality Analysis

### 5.3.1 Primary Coal Ash Leachate Indicators

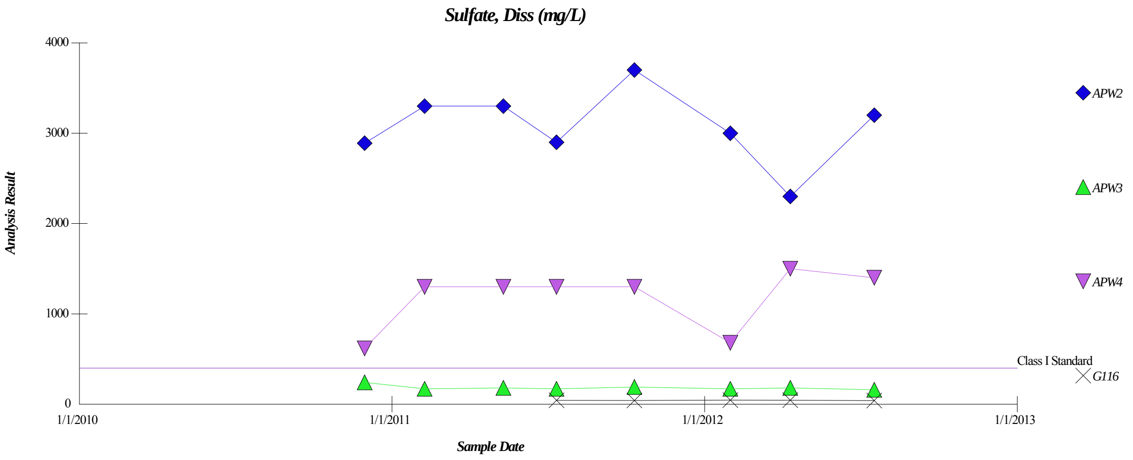
Boron and sulfate are the primary indicator constituents for coal ash leachate. Median boron concentrations in groundwater at the CCP impoundment range from 0.028 mg/L at well APW-4 to 0.42 mg/L at well APW-3. The maximum observed concentration at the three CCP impoundment wells was 0.65 mg/L at well APW-3, located between the midpoint of the southern edge of the CCP impoundment and Newton Lake. These concentrations are relatively low and are not necessarily indicative of a release from the impoundment. Boron concentrations in groundwater are greater than 1 mg/L at CCP impoundments in Illinois where releases have occurred (EPRI, 2001). Background monitoring well G116 had no detected concentrations of boron over this same monitoring period, suggesting that the concentrations in APW-1, APW-2, and APW-3 are higher than background. However, when compared to boron concentrations in other shallow monitoring wells on the property, the boron concentrations at APW-4 are low and the concentrations at APW-2 are typical, while boron concentrations at APW-3 are among the highest observed in groundwater on the power plant property (Figure 7). Boron concentrations were steady during the monitoring period.

| | **Median Concentration** | |
|---|---|---|
| **Well No.** | **Boron mg/L** | **Sulfate mg/L** |
| APW-2 | 0.15 | 3100 |
| APW-3 | 0.42 | 175 |
| APW-4 | 0.028 | 1300 |
| G116 (Background) | <0.010 | 43 |
| *IL Class I Standard* | *2.0* | *400* |



*Graph showing boron concentration versus time. Non-detects are plotted as zero values.*

In contrast to the low boron concentrations, median sulfate concentrations at the three wells ranged from 175 to 3,100 mg/L versus a background concentration at well G116 of 43 mg/L. The highest sulfate concentrations were observed at well APW-2, located west of the CCP impoundment. The lowest sulfate concentrations, excluding background well data, occurred at well APW-3. Sulfate concentrations were steady during the monitoring period.



*Graph showing sulfate concentration versus time.*

The two wells with the highest sulfate concentrations, APW-2 and APW-4, had the lowest boron concentrations (Figure 9). In contrast, well APW-3 had the highest boron concentrations and the lowest sulfate concentrations. These observations are one of several multiple lines of evidence suggesting that the sulfate concentrations higher than the Part 201 standard are not associated with the CCP impoundment:

- Boron concentrations are lower than encountered at other CCP impoundment in Illinois where releases have been observed.
- Sulfate has lower concentration in surface water of the CCP impoundment than in the monitoring wells, suggesting that the impoundment is not a significant source of sulfate.
- Sulfate in APW-2 has higher concentration than coal ash leachate from the Phase 2 landfill, suggesting that coal ash leachate is not the source of observed concentrations.
- Sulfate concentrations exceeding 1,000 mg/L are sporadically encountered in monitoring wells throughout the NEC property, in a distribution that does not necessarily implicate either the landfill or the CCP impoundment.
- The ratio of sulfate to boron in APW-2 and APW-4 is different than the ratio in CCP leachate, which suggests that groundwater in these monitoring wells is either not affected or minimally affected by coal ash leachate.

The first line of evidence was discussed at the beginning of this subsection. The other lines are discussed next.

*Sulfate has lower concentration in surface water of the CCP impoundment than in the monitoring wells*. CCP impoundment water was sampled for the Station's 2011 NPDES permit application. The sulfate concentration in this sample was 96 mg/L, which is more than an order of magnitude lower than the median concentrations of 3100 and 1300 mg/L in APW-2 and APW-4, respectively. Sulfate concentration may increase as water percolates through CCP at the bottom of the impoundment (see next point); however, this additional leaching would be most significant where thick ash has accumulated, such as the delta near APW-4 (see Figure 1). It does not necessarily explain the high sulfate concentrations observed at APW-2, which is at the far end of the 400-acre impoundment from the inlet and where a relatively thin layer of CCP is deposited at the base of the impoundment.

| Sample Point | Median Concentration | | Notes |
|---|---|---|---|
| | Boron mg/L | Sulfate mg/L | |
| CCP impoundment pond water | 0.88 | 96 | Per NPDES Permit Application IL0049191 7/21/11 |
| Newton Lake | 0.30 | 53 | As above |
| Leachate ( LF Phase 1) | 4.5 | 18,000 | Leachate piezometer L1, all sample dates through 2012 (boron data from 1998-2001) |
| Leachate ( LF Phase 2) | 35 | 1,100 | Leachate sump L301, all sample dates through 2012 |

*Sulfate in APW-2 has higher concentration than coal ash leachate from the Phase 2 landfill cell*. There are no porewater leachate data available for the CCP impoundment. However, porewater leachate in the impoundment is expected to be more similar to the Phase 2 landfill cell leachate than to the Phase 1 landfill cell leachate because the Phase 1 cell received a combination of bituminous coal ash and FGD waste, while the Phase 2 cell only received coal ash (as did the impoundment). FGD waste tends to leach higher concentrations of sulfate and chloride than coal ash (EPRI, 2006).[1] The Phase 2 cell is not completely comparable to the CCP impoundment because the impoundment received ash from bituminous and subbituminous coals while the Phase 2 cell only received ash from bituminous coals; however, the EPRI (2006) leachate data suggest that the difference between source coals is not as large as the difference between material types.[2]

APW-2 has higher sulfate concentrations than the coal ash leachate in the Phase 2 landfill cell, which suggests that coal ash leachate in the CCP impoundment is not the source of sulfate observed in APW-2. Conversely, APW-4 has similar sulfate concentrations as the Phase 2 cell, and if the CCP impoundment is the source of sulfate to APW-4 then leachate from the impoundment is not undergoing any dilution as it migrates to APW-4. This hypothesis concerning APW-4 seems plausible considering that the well is only 25 feet from the impoundment; however, boron concentrations in APW-4 are two orders of magnitude lower than in coal ash leachate and it does not seem plausible that sulfate can migrate 25 feet without undergoing a change in concentration while boron concentrations decrease by two orders of magnitude.

*Sulfate concentrations exceeding 1000 mg/L are sporadically encountered in monitoring wells throughout the NEC property*. A review of groundwater monitoring data collected for the Phase 1 and Phase 2 landfill cells shows that sulfate concentrations exceed 1000 mg/L in 18 monitoring wells on the property (Figure 10). Seven of these monitoring wells are more than 1,000 feet from the CCP impoundment, and one of these monitoring wells (G114) is 3,000 feet from the CCP impoundment and 1,300 feet from the closest landfill cell. Proceeding counterclockwise from north, these seven monitoring wells are:

- G110: 580 feet north of the Phase 1 cell, median sulfate concentration of 1000 mg/L.
- G120: 550 feet west of the Phase 1 cell, median sulfate concentration of 1700 mg/L; G139 lies between this monitoring well and the landfill and has a lower median sulfate concentration of 384 mg/L.

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[1] The EPRI data only included leachate from calcium based FGD systems; however, the leachate data collected from the Phase 1 landfill cell verify that this observation is also applicable to sodium based FGD systems.

[2] EPRI 2006 also compared landfill leachate to impoundment leachate and found landfill leachate to have higher concentrations for many constituents. However, EPRI's landfill leachate samples were all porewater, while the impoundment leachate samples were a mixture of porewater and pond water. Since concentrations may increase as water in the pond percolates through underlying coal ash (thus becoming porewater) in an impoundment, the EPRI landfill versus impoundment comparison is not directly applicable to this evaluation.

- G109: 240 feet west of the Phase 1 cell, median sulfate concentration of 4000 mg/L.
- G136: 15 feet west of the Phase 1 cell, median sulfate concentration of 1700 mg/L.
- G119: 180 feet west of the Phase 1 cell, median sulfate concentration of 1800 mg/L.
- G114: 1270 feet southwest of the Phase 1 cell, median sulfate concentration of 2100 mg/L; G108 (770 mg/L) and G133 (420 mg/L) lie between this monitoring well and the landfill.
- G107: 810 feet south of the Phase 1 cell, median sulfate concentration of 2900 mg/L.

Considering the large distance between these monitoring wells and the CCP impoundment, the presence of other monitoring wells with relatively low sulfate concentrations between these wells and the CCP management areas, the low hydraulic conductivity of the Upper Drift ($2.8 \times 10^{-5}$ cm/s), and the conceptual flow model of groundwater flow toward Newton Lake, it is unlikely that sulfate concentrations in the monitoring wells listed above are due to migration from the CCP impoundment. This suggests that there is another source for elevated sulfate concentrations at the site, one of which is the CCP landfill. However, for the same reasons as stated for the CCP impoundment, it may not be appropriate to attribute all of the high sulfate concentrations (particularly at G120 and G114) to the landfill either, suggesting a sulfate source at the site unrelated to the landfill or impoundment.

*The ratio of sulfate to boron in APW-2 and APW-4 is different than the ratio in leachate*. Groundwater impacted by CCP leachate should have a signature similar to leachate unless one of the constituents has a naturally high concentration in groundwater relative to the leachate or is preferentially attenuated along the flow path. The signature for CCP leachate can be defined using the ratio of primary indicator constituents boron and sulfate, both of which have higher concentration in leachate samples than background groundwater as represented by G116, and both of which undergo little, if any attenuation in groundwater other than mixing and dilution (which affects both constituents equally). Sulfate to boron ratios were calculated for all water samples at the CCP landfill and impoundment in which both constituents were monitored by dividing the sulfate concentration in mg/L by the boron concentration in mg/L (substituting one-half the detection limits for non-detects). The median ratios for each sample point are plotted in Figure 11. Based on all samples, CCP leachate (from the pond water sample, Phase 1 cell leachate, and Phase 2 cell leachate) had a ratio ranging from 11 to 6,600 (dimensionless). APW-3 plots within this range. However, if only the range for coal ash leachate is considered, because no FGD material was placed in the CCP impoundment, then APW-3 ($SO_4$:B ratio=399) is slightly higher than CCP pond water (109) and coal ash leachate as represented by the Phase 2 landfill leachate collection system (32).

Water samples from APW-2 and APW-4 have a significantly different $SO_4$:B signature (median ratio values greater than 21,000) than leachate (median ratio values lower than 3,800). These data suggest that there is another source of sulfate in groundwater other than leachate from the landfill or impoundment. However, it is also possible that the high ratios at APW-2 and APW-4 are a result of boron being preferentially attenuated from solution along the migration pathway—in which case CCP may still be considered a source.[3] Boron is mobile in typical hydrogeologic environments; although limited attenuation via sorption is possible in clays (EPRI, 2004).

A second ion ratio calculation was performed using sulfate and chloride. Chloride is not subject to any form of attenuation in groundwater. Median chloride concentrations are:

| Sample Point | Median Chloride (mg/L) |
|---|---|
| APW-2 | 105 |
| APW-3 | 13 |
| APW-4 | 27 |
| G116 (Background) | 38 |
| L1: Leachate ( LF Phase 1) | 8600 |
| L301: Leachate ( LF Phase 2) | 44 |

Median sulfate : chloride ratios are presented in Figure 12, and again show that the signature for APW-3 falls within the range of leachate ratios while APW-2 and APW-4 have higher ratios than coal ash leachate. In this case, the ratio for APW-2 is sufficiently close to the ratio of Phase 2 leachate that the ratios could be considered similar, but that similarity is a coincidence as indicated by absolute sulfate and chloride concentrations, which are both more than a factor of two higher in APW-2 than in Phase 2 leachate.

The table below summarizes this weight of evidence analysis. Answers of “yes” indicate that data support the CCP impoundment as a source, and answers of “no” indicate that data do not support the CCP impoundment as a source for the observed sulfate concentrations in groundwater. The only line of evidence supporting a CCP landfill or impoundment source for APW-2 and APW-4 is that concentrations are higher than background. Since there are other sources for sulfate in the environment, as discussed below, this single line of evidence is not sufficient to conclude that the CCP impoundment is the source of sulfate at these two wells, and the weight of evidence analysis indicates that the CCP impoundment is not the source for the observed concentrations. Conversely, the weight of evidence analysis suggests that the source of sulfate concentrations observed in APW-3, which are lower than the Class I groundwater quality standard, may be the CCP impoundment. This conclusion is not stated more definitely because

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[3] Since boron is used in the denominator of the ratio calculation the ratio would increase under this scenario.

the key line of evidence based on the sulfate : boron signature for this well is inconclusive when compared to the leachate signatures most applicable to the coal ash managed in the CCP impoundment.

| **Line of Evidence** | **APW-2** | **APW-3** | **APW-4** |
|---|---|---|---|
| Boron concentrations higher than background? (Figure 7) | Not conclusive | Yes | No |
| Sulfate concentrations higher than background? (Figure 10) | Yes | Not conclusive | Yes |
| Sulfate concentration similar to or lower than in CCP impoundment water? (Figure 10) | No | Not conclusive | No |
| Sulfate concentration similar to or lower than in coal ash leachate? (reference to Phase 2 cell in Figure 10) | No | Yes | Not conclusive |
| Elevated sulfate concentrations only found near CCP landfill or impoundment? | | No | |
| Sulfate : boron ratio falls within CCP leachate range? (Figure 11) | No | Yes | No |
| Sulfate : boron ratio falls within range defined by CCP pond and coal ash (Phase 2) leachate ? (Figure 11) | No | Not conclusive | No |
| Sulfate : chloride ratio falls within CCP leachate range? (Figure 12) | Not conclusive | Yes | No |

There are at least two alternative explanations for the high sulfate concentrations observed at APW-2 and APW-4, although neither can be verified with available data:

- High sulfate concentrations are generated when sulfide minerals in clay soils are oxidized. High sulfate concentrations, although not as high as monitored in APW-2 and APW-4, have been attributed to this source for at least one other clay soil site in Illinois (USGS, 1992). This phenomena can occur when oxygen is introduced to a subsurface environment by placement of a monitoring well.
- If FGD solids were placed as fill on other parts of the property, outside the limits of the landfill, they could explain the observed sulfate concentrations, although NRT is not aware of any records to support this alternative, and this hypothesis does not explain why sulfate concentrations are elevated disproportionately more than boron in APW-2 and APW-4.

Groundwater elevations in APW-2 and APW-4 are between 825 and 830 feet msl. The only feature in the surrounding landscape higher than these groundwater elevations in the CCP impoundment. If the CCP impoundment is not the source of water in these wells, then the water is originating as recharge very close to the monitoring well. This observation is consistent with the sulfide mineral oxidation hypothesis above, since that would be occurring in the soils and water surrounding the monitoring well screen. This observation is also consistent with the FGD fill hypothesis if that fill was placed very close to the monitoring well locations.

### 5.3.2 Other Constituents Potentially Impacted by Coal Ash Leachate

There is no evidence of any other constituents potentially impacted by leachate from the CCP impoundment.

### 5.3.3 Constituents with Elevated Concentrations Due to Causes Other than Coal Ash Leachate

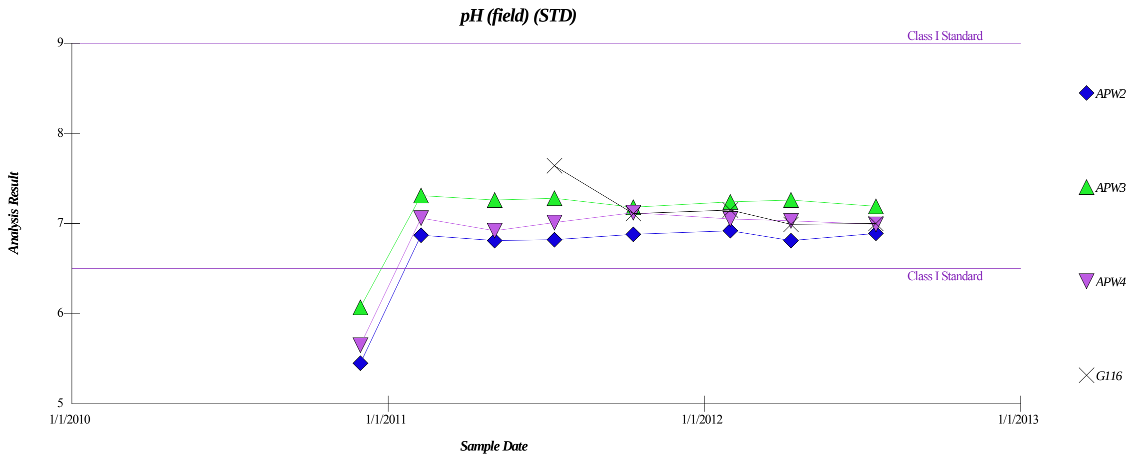
Nine constituents have concentrations in downgradient groundwater higher than in background groundwater as monitored at G116. In each case, the highest concentrations occur in APW-2. In addition, pH is slightly lower in APW-2 and APW-4 than background.

| | **Median Concentration** | | | | |
|---|---|---|---|---|---|
| **Well No.** | **pH SU** | **Arsenic mg/L** | **Chloride mg/L** | **Chromium mg/L** | **Copper mg/L** |
| APW-2 | 6.85 | 0.005 | 105 | 0.007 | 0.008 |
| APW-3 | 7.25 | 0.002 | 13 | <0.004 | <0.003 |
| APW-4 | 7.02 | 0.001 | 27 | <0.004 | <0.003 |
| G116 | 7.11 | <0.001 | 38 | <0.004 | <0.003 |
| *IL Class I Std.* | 6.5 / 9.0 | *0.01*** | *200* | *0.1* | *0.65* |

| **Well No.** | **Median Concentration** | | | | |
| --- | --- | --- | --- | --- | --- |
| | **Manganese mg/L** | **Nickel mg/L** | **Selenium mg/L** | **Zinc mg/L** | **TDS mg/L** |
| APW-2 | 0.64 | 0.039 | 0.017 | 0.043 | 5000 |
| APW-3 | 0.047 | 0.006 | 0.008 | 0.009 | 595 |
| APW-4 | 0.23 | 0.018 | 0.008 | 0.020 | 2300 |
| G116 | 0.009 | <0.005 | 0.004 | <0.006 | 590 |
| *IL Class I Std.* | *0.15* | *0.1* | *0.05* | 5 | *1200* |

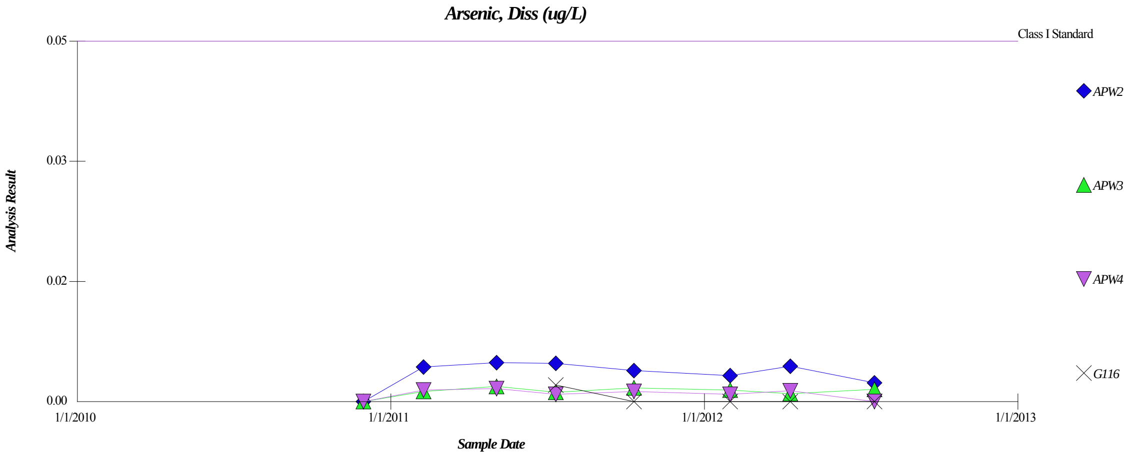
** Arsenic standard at time of sampling was 0.050 mg/L

Median pH values ranged from 6.85 to 7.25, with minimum values ranging from 5.45 to 6.07, and maximum values ranging from 6.92 to 7.31. It is important to note that all of the pH readings below 6.10 at the three impoundment monitoring wells occurred only in the first quarter sampling event. No similarly low pH readings were observed in the subsequent seven quarters of monitoring. Given this observation, it appears that the field instrumentation used to measure the pH was not calibrated accurately, leading to a systematic error of low pH readings in all of the groundwater samples in November 2010. An alternative explanation to account for the low pH readings is that the groundwater was not stabilized from the drilling and well installation. Since CCP leachate tends to be alkaline, the lower pH values at APW-2 and APW-4 are not indicative of a release from the impoundment.



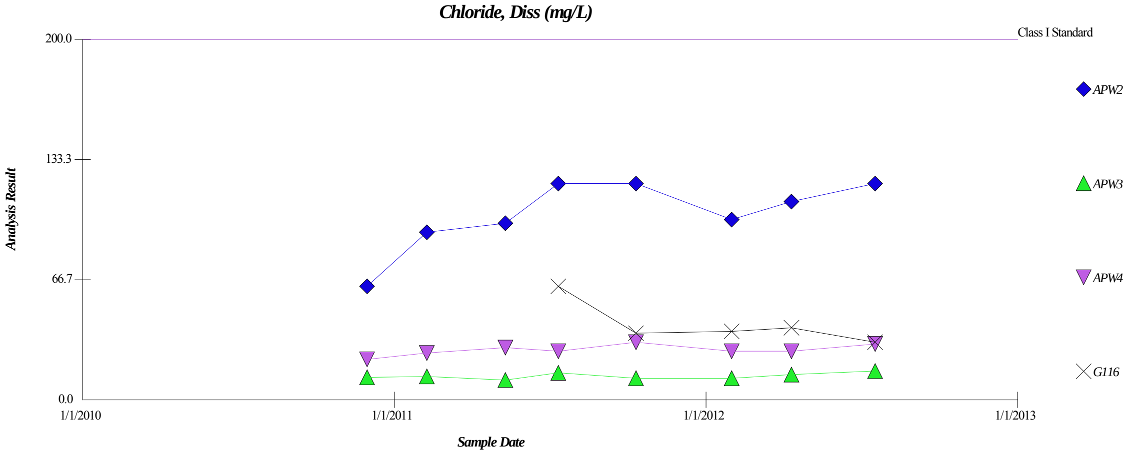
*Graph showing ph values versus time.*

As discussed next for chloride, arsenic concentrations were higher than background in APW-2, and similar to background in APW-3 and APW-4. Since the CCP impoundment is not the source of sulfate or chloride at APW-2, it is not likely the source of arsenic either. The maximum arsenic concentration of 0.005 mg/L was an order of magnitude lower than the Class I standard in effect at the time of sampling, and a factor of 2 lower than the current Class I standard.



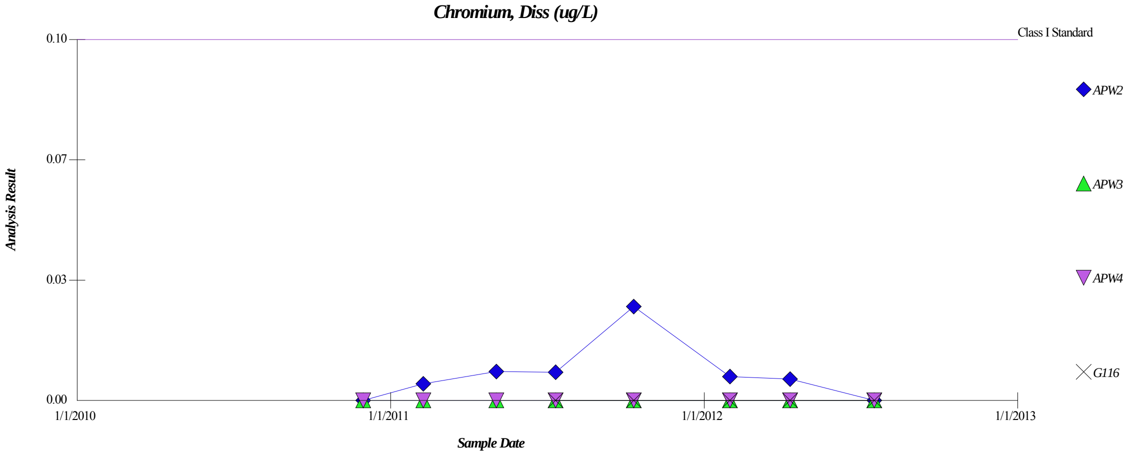
*Graph showing arsenic concentration versus time. Non-detects are plotted as zero values. The Class I standard illustrated on the plot was in effect at the time of sampling.*

Chloride concentrations were higher than background in APW-2, but lower than background in APW-3 and APW-4. The maximum chloride concentration in APW-2 was 120 mg/L. Chloride does not typically have high concentration in coal ash leachate, but can have high concentration in leachate from FGD waste. The median and maximum chloride concentration in APW-2 are higher than the pond water sample, higher than in coal ash leachate from the Phase 2 landfill, and higher than any of the field leachate samples analyzed by EPRI (2006). These observations indicate that the CCP impoundment, which only received coal ash, is not the source of chloride in APW-2.



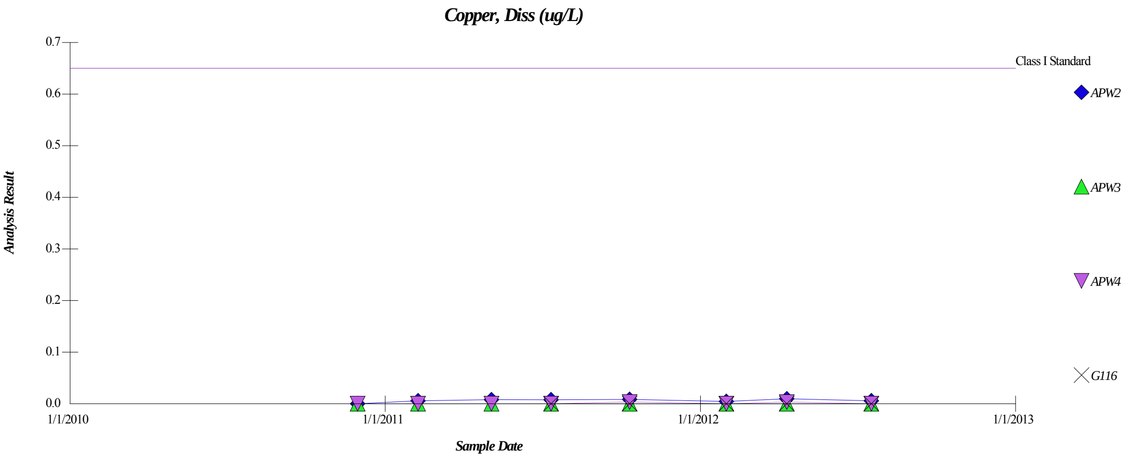
*Graph showing chloride concentration versus time.*

Like chloride, chromium concentrations were higher than background in APW-2, and chromium was not detected in any other CCP impoundment monitoring wells. Since the CCP impoundment is not the source of sulfate or chloride at APW-2, it is not likely the source of chromium either. The maximum chromium concentration of 0.026 mg/L was nearly a factor of 4 lower than the Class I standard.



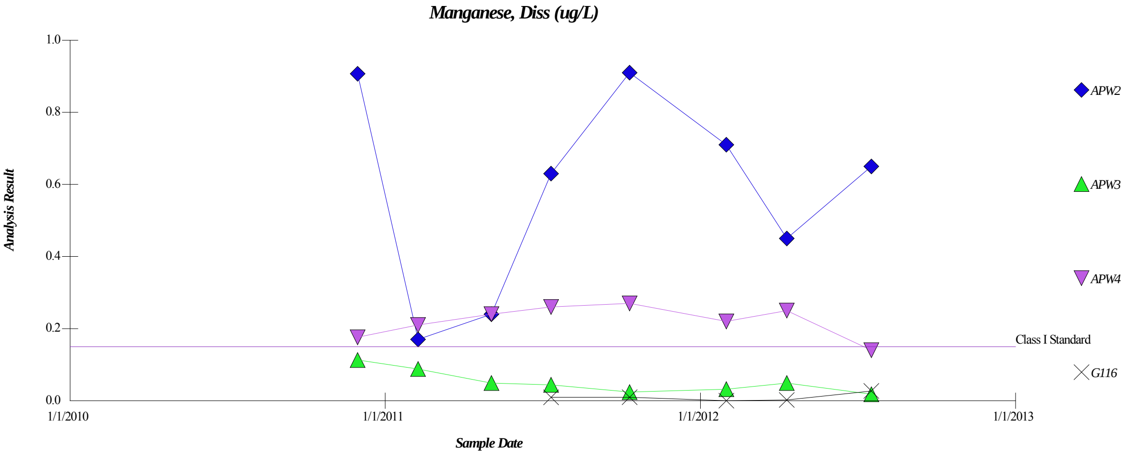
*Graph showing chromium concentration versus time. Non-detects are plotted as zero values.*

Copper was only detected in APW-2 and APW-4, the monitoring wells with elevated sulfate concentrations, although concentrations were low (a factor of 5 lower than the Class I standard). These wells also had slightly lower pH than APW-3 and G116, and copper, like most cations in water, tends to be more soluble at lower pH, which may explain the concentrations observed at these wells.



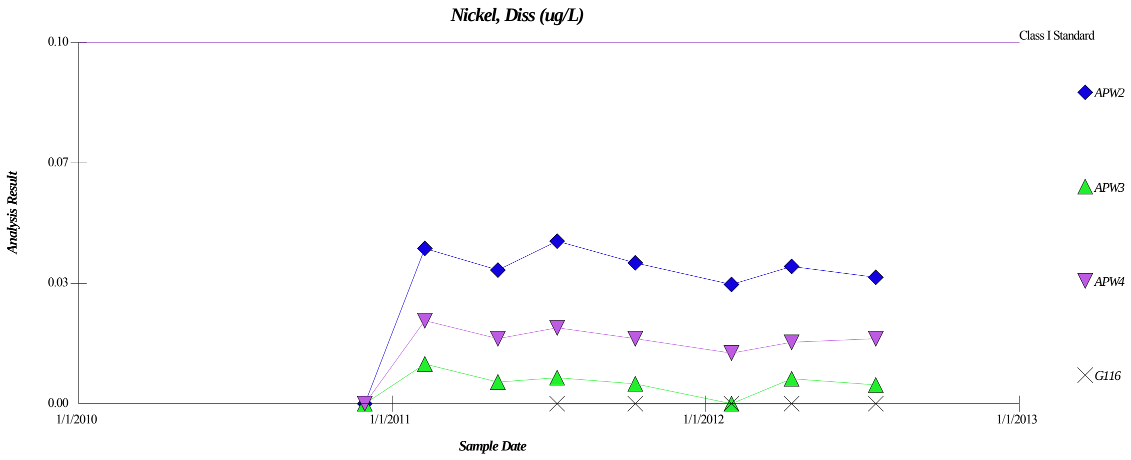
*Graph showing copper concentration versus time. Non-detects are plotted as zero values.*

Manganese concentrations were higher than the Class I standard and background in APW-2 and APW-4. Concentrations in APW-3 were similar to background. The manganese concentration in the impoundment water sample taken for the 2011 NPDES permit application was lower than observed in these monitoring wells at 0.011 mg/L, and manganese also has low concentration in coal ash leachate from the Phase 2 landfill (median of 0.021 mg/L), suggesting that coal ash leachate in the CCP impoundment is not the source of manganese.



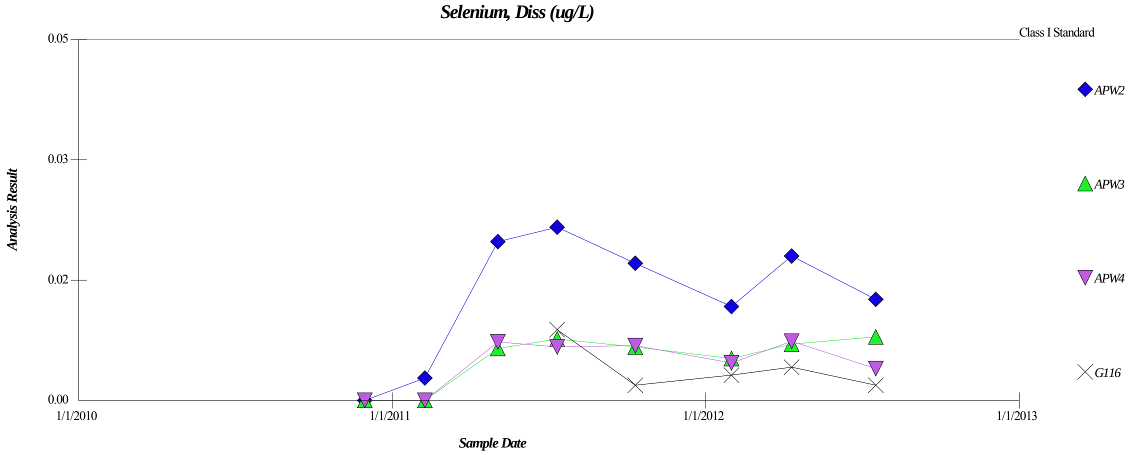
*Graph showing manganese concentration versus time. Non-detects are plotted as zero values.*

Nickel concentrations are distributed between the monitoring wells similarly to sulfate, with highest concentrations in APW-2 and next highest concentrations in APW-4. All concentrations were a factor of 2 or more lower than the Class I standard. The similar distribution suggests that the source of nickel is the same as the source of sulfate, which was established in Section 5.3.1 is not the CCP impoundment.



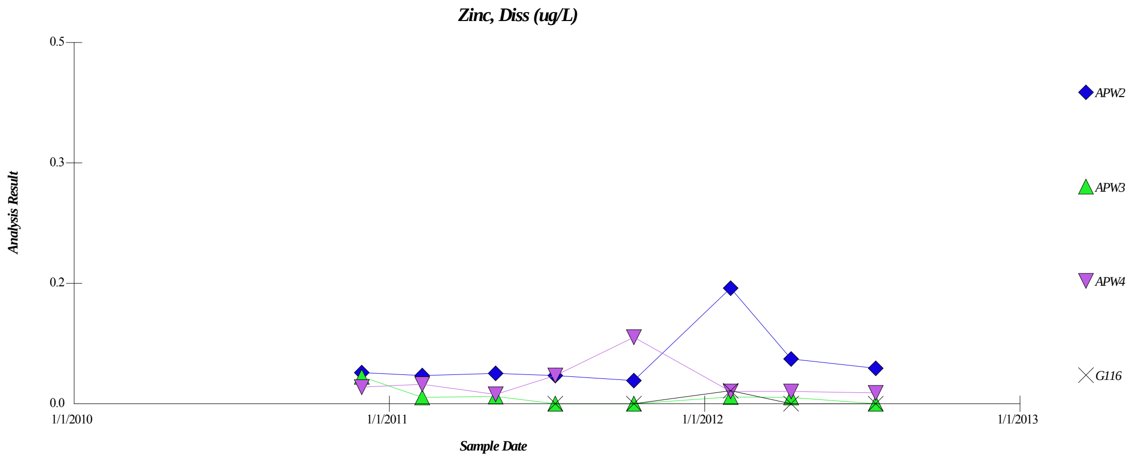
*Graph showing nickel concentration versus time. Non-detects are plotted as zero values.*

Like chloride, selenium concentrations were higher than background in APW-2, and similar to background in APW-3 and APW-4. Since the CCP impoundment is not the source of sulfate or chloride at APW-2, it is not likely the source of selenium either. The maximum selenium concentration of 0.024 mg/L was a factor of 2 lower than the Class I standard.



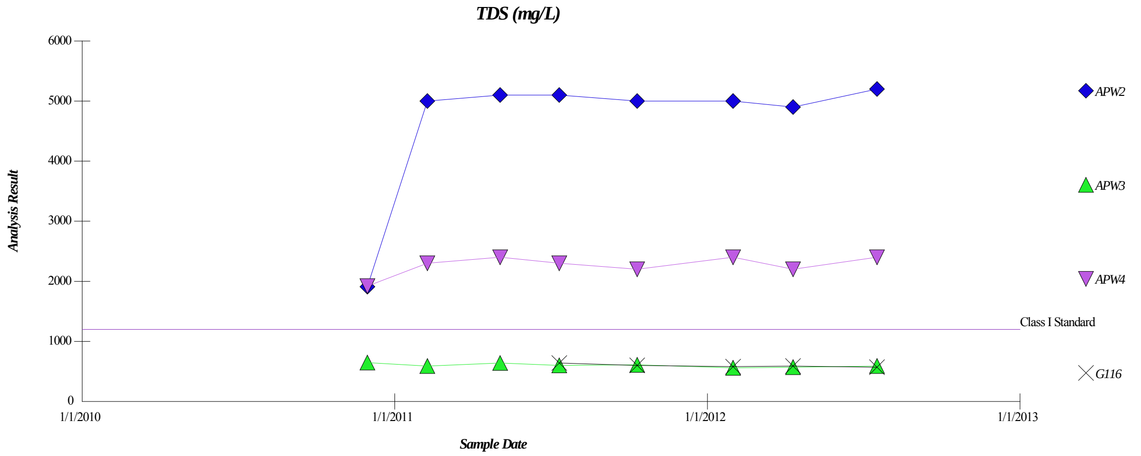
*Graph showing selenium concentration versus time. Non-detects are plotted as zero values.*

Zinc had highest concentrations in APW-2 and APW-4, although concentrations were low (two orders of magnitude lower than the Class I standard), and similar to background in APW-3. APW-2 and APW-4 had slightly lower pH than APW-3 and G116, and zinc, like most cations in water, tends to be more soluble at lower pH, which may explain the low observed concentrations at these wells.



*Graph showing zinc concentration versus time. Non-detects are plotted as zero values. The Y-axis is zoomed for clarity, and the Class I standard of 5 mg/L is not shown.*

Total dissolved solids (TDS) are the sum of dissolved constituents in groundwater, and in this case the exceedances at APW-2 and APW-4 reflect concentrations of sulfate and an unmonitored cation in the groundwater. The TDS exceedances are due to the same source as the sulfate exceedances, which is does not appear to be the CCP impoundment.



*Graph showing TDS concentration versus time.*

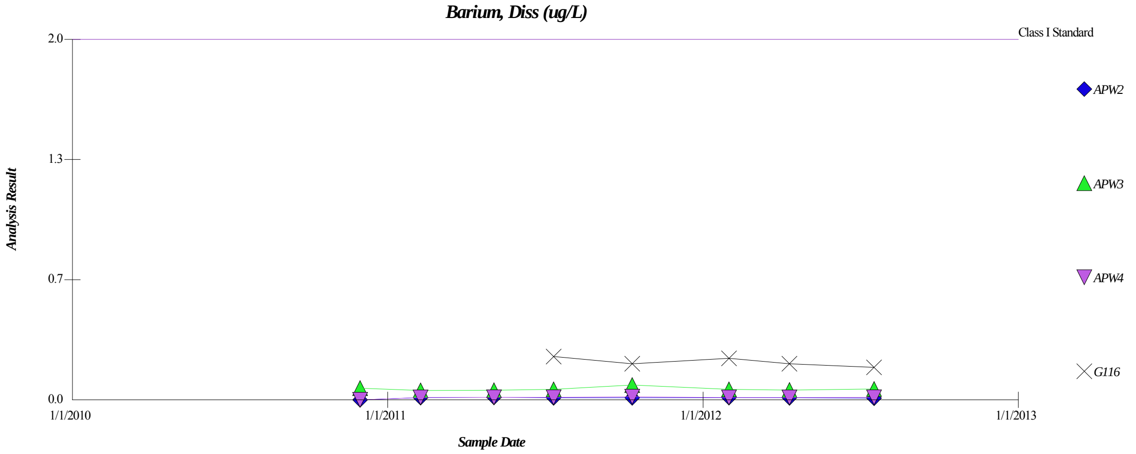
### 5.3.4 Constituents with Concentrations Near or Below Background

Barium and fluoride had concentrations lower than background groundwater, while cobalt, iron, and nitrate concentrations were all low and not significantly higher than background.

| | Median Concentration | | | | |
|---|---|---|---|---|---|
| **Well No.** | **Barium mg/L** | **Cobalt mg/L** | **Fluoride mg/L** | **Iron mg/L** | **Nitrate mg/L** |
| APW-2 | 0.012 | 0.002 | 0.25 | 0.017 | 0.07 |
| APW-3 | 0.058 | <0.002 | 0.27 | <0.010 | 0.05 |
| APW-4 | 0.014 | <0.002 | 0.25 | <0.010 | 0.03 |
| G116 | 0.20 | <0.002 | 0.43 | <0.010 | <0.02 |
| *IL Class I Std.* | *2.0* | *1.0* | *4.0* | *5.0* | *10* |

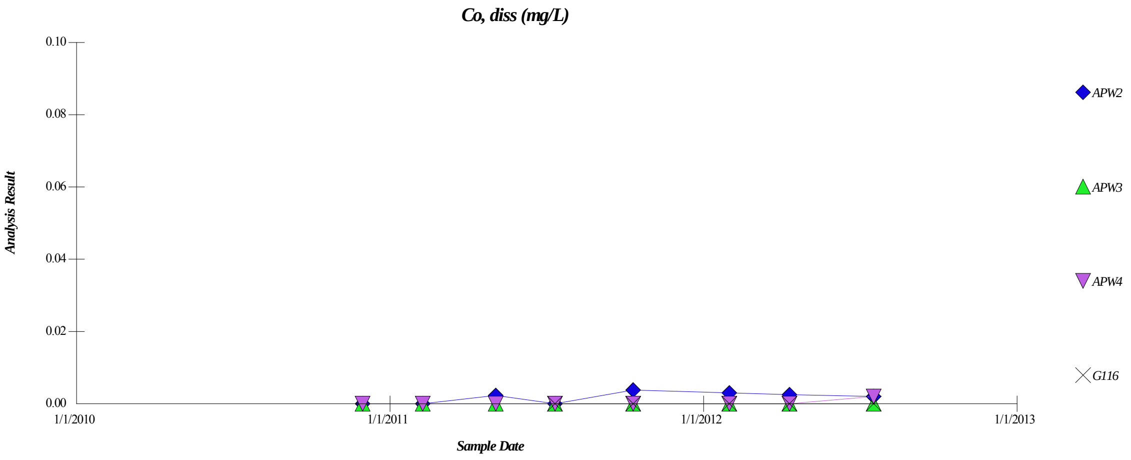
** Arsenic standard at time of sampling was 0.050 mg/L

Barium concentrations were lower than in background groundwater, with a maximum concentration of 0.24 mg/L in G116.



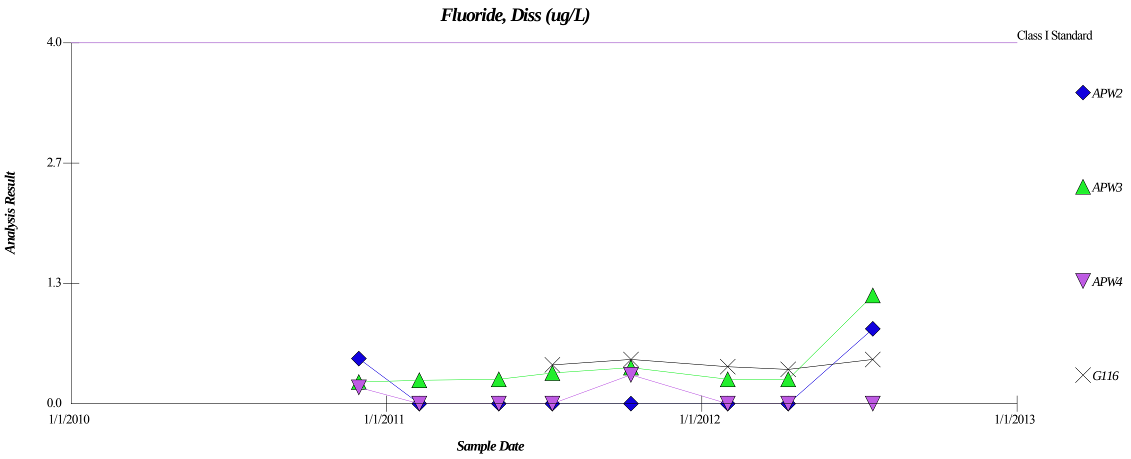
*Graph showing barium concentration versus time. Non-detects are plotted as zero values.*

Cobalt concentrations were low in all samples. The maximum concentration of 0.004 mg/L in APW-2 was two orders of magnitude lower than the Class I standard.



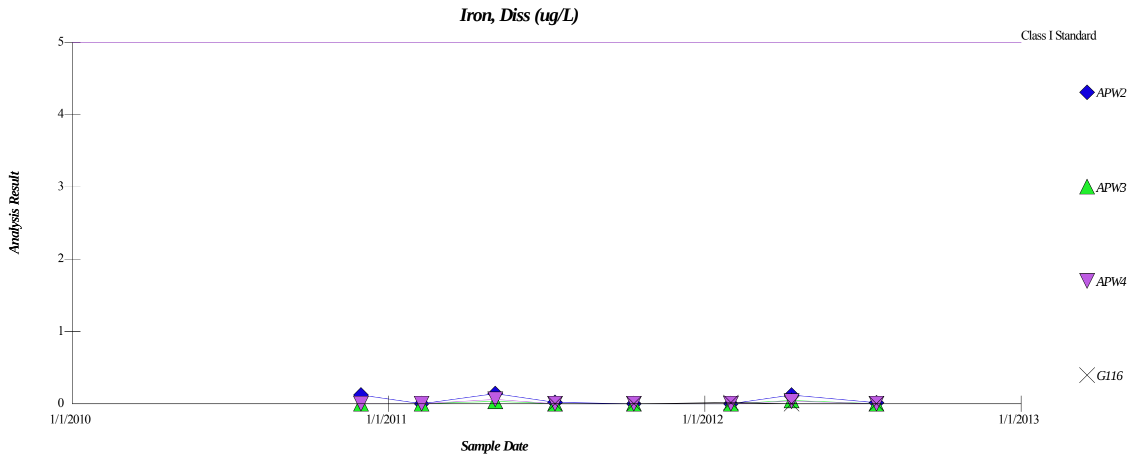
*Graph showing cobalt concentration versus time. Non-detects are plotted as zero values. The Y-axis is zoomed by a factor of 10 for clarity, and the Class I standard of 1 mg/L is not shown.*

Fluoride concentrations in the downgradient monitoring wells were lower than in background groundwater in all except the last sample. The highest concentration of 0.83 mg/L was observed in the last sample from APW-2.



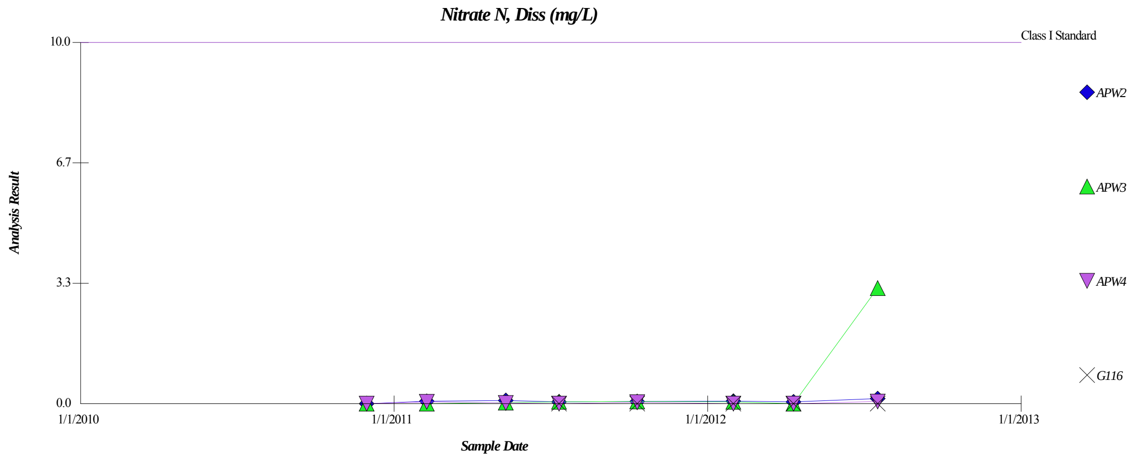
*Graph showing fluoride concentration versus time. Non-detects are plotted as zero values.*

Iron concentrations were usually below detection limits, except in APW-2. When detected, concentrations were very low. The highest concentration of 0.14 mg/L in APW-2 was more than an order of magnitude lower than the Class I standard.



*Graph showing iron concentration versus time. Non-detects are plotted as zero values.*

Nitrate was only detected in APW-2, APW-3, and APW-4. Except for the last, anomalous result at APW-3, nitrate concentrations were more than an order of magnitude lower than the Class I standard.



*Graph showing nitrate concentration versus time. Non-detects are plotted as zero values.*

### 5.3.5 Constituents That Were Infrequently or Not Detected

Antimony, beryllium, cadmium, cyanide, mercury, silver, and thallium were not detected in any groundwater samples associated with the CCP impoundment. Lead was only detected in two samples from APW-2 and one sample in G116, with a maximum concentration of 0.002 mg/L in G116.

# 6 CONCLUSIONS

## 6.1 Conclusions

The primary conclusion from voluntary monitoring of groundwater at the Newton CCP impoundment is that Class I groundwater quality standards are exceeded for sulfate, TDS and manganese; however, leachate from the coal ash managed in the impoundment would have a different signature in groundwater than observed at the two monitoring wells (APW-2 and APW-4) where Class I groundwater quality standards were exceeded. Two causes have been hypothesized for the sulfate and TDS exceedances: 1) oxidation of sulfide minerals caused by introduction of oxygen to the clay soils when the monitoring wells were installed, resulting in an increase in sulfate concentration near the well screen, which would cause a corresponding TDS increase; and/or 2) placement of FGD waste in the immediate vicinity of the monitoring wells. Concerning the second hypothesis, NRT understands that no FGD waste was placed in the impoundment. Groundwater quality in the monitoring wells may be attributed to leachate from FGD waste because it has higher sulfate concentration than coal ash leachate; however NRT is not aware of any documentation that it was placed anywhere on the NEC property outside the Phase I landfill cell. Furthermore:

- The CCP impoundment is underlain by clay-rich deposits that are more than 20 feet thick. These clays potentially restrict migration of leachate from the impoundment to surrounding groundwater.
- Groundwater elevations at the site mimic land surface topography and do not provide an indication of horizontal groundwater flow direction. However, groundwater elevations at the wells are higher than water elevation in Newton Lake and lower than water elevation in the impoundment, which suggests that groundwater flow is from the impoundment, past the monitoring wells, to Newton Lake.
- These groundwater elevation observations and the conceptual model of groundwater flow indicate that there is no potential for off-site migration from the CCP impoundment.
- There are no water wells between the CCP impoundment and Newton Lake, indicating that there are no potential groundwater receptors downgradient of the CCP impoundment.
- Boron concentrations in groundwater were all lower than 1 mg/L. CCP leachate typically contains high boron concentrations, and groundwater at other CCP management sites in Illinois where a release has occurred has had boron concentrations greater than 1 mg/L.
- APW-3, which did not have any exceedances of Class I groundwater quality standards, has boron and sulfate concentrations that are elevated compared to background at the site, and appear to be attributable to low-level coal ash leachate impacts from the CCP impoundment. The low boron and sulfate concentrations are stable and show no evidence of increasing; likely because the clay soils underlying the impoundment restrict leachate migration.

- The impoundment wells are screened in clay-rich soil which has hydraulic conductivity lower than 1 x $10^{-4}$ cm/s at other locations on the Newton property. These observations suggest that the groundwater monitored by these wells may be most-appropriately categorized as Class II groundwater. If classified as Class II, manganese concentrations do not exceed the groundwater quality standard; however, sulfate and TDS concentrations are higher than their respective Class II standards.

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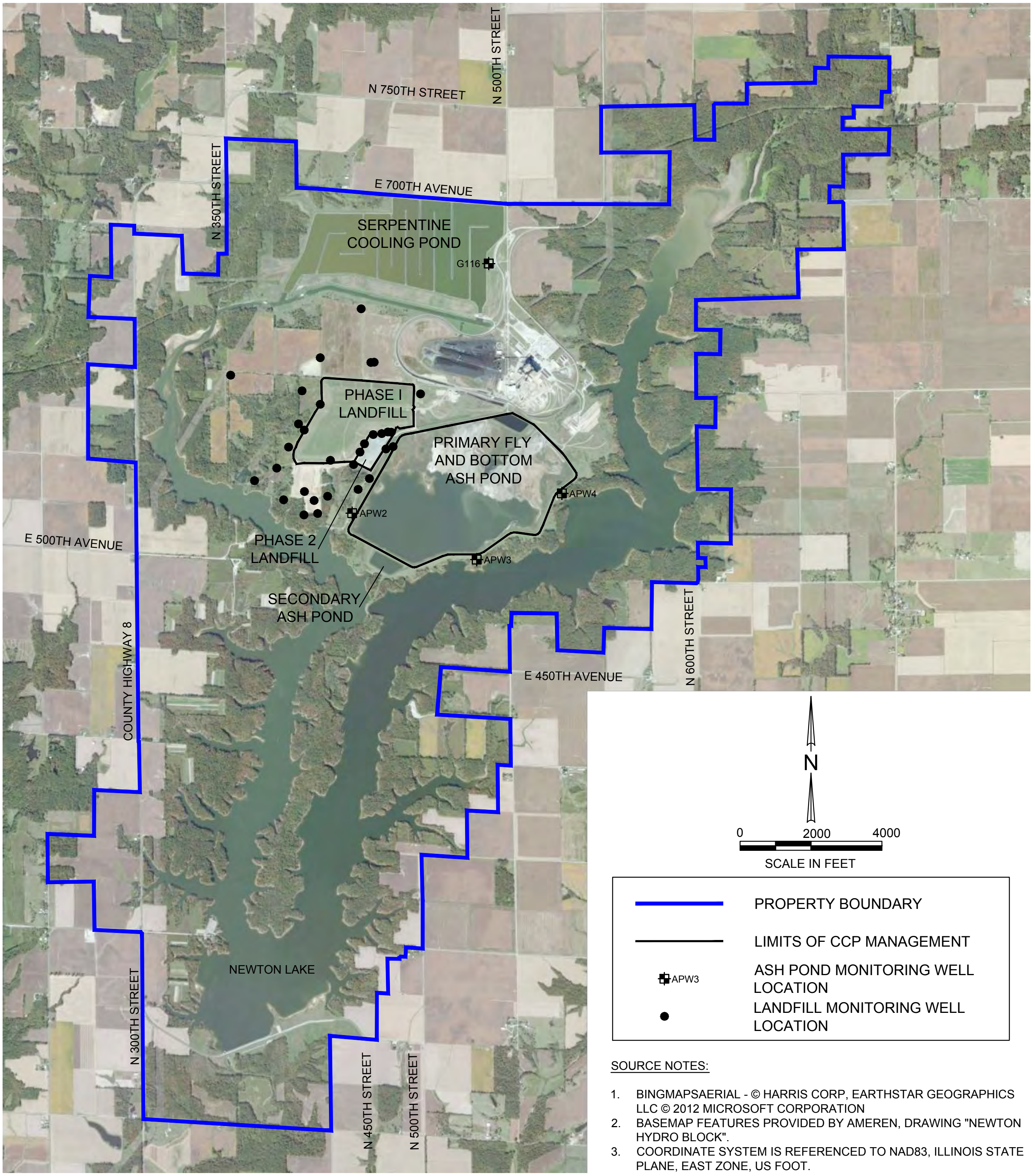
Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois Stratigraphy: Illinois State Geological Survey, Bulletin 95, 261 p.

# FIGURES



SOURCE NOTES:

1. BINGMAPSAERIAL - © HARRIS CORP, EARTHSTAR GEOGRAPHICS LLC © 2012 MICROSOFT CORPORATION
2. BASEMAP FEATURES PROVIDED BY AMEREN, DRAWING "NEWTON HYDRO BLOCK".
3. COORDINATE SYSTEM IS REFERENCED TO NAD83, ILLINOIS STATE PLANE, EAST ZONE, US FOOT.

# SITE OVERVIEW MAP

NATURAL
RESOURCE
TECHNOLOGY

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
NEWTON ENERGY CENTER
JASPER COUNTY, ILLINOIS

DRAWN: NWD DATE: 02/05/13 CHK'D: BRH DATE: 02/05/13 APP'D: BRH DATE: 03/05/13

PROJECT NO.
2125/2.0

DRAWING NO.
2125-2-A01C-SITE OVER

FIGURE NO.
1

Mar 05, 2013 11:37am PLOTTED BY: ndraskovich SAVED BY: ndraskovich
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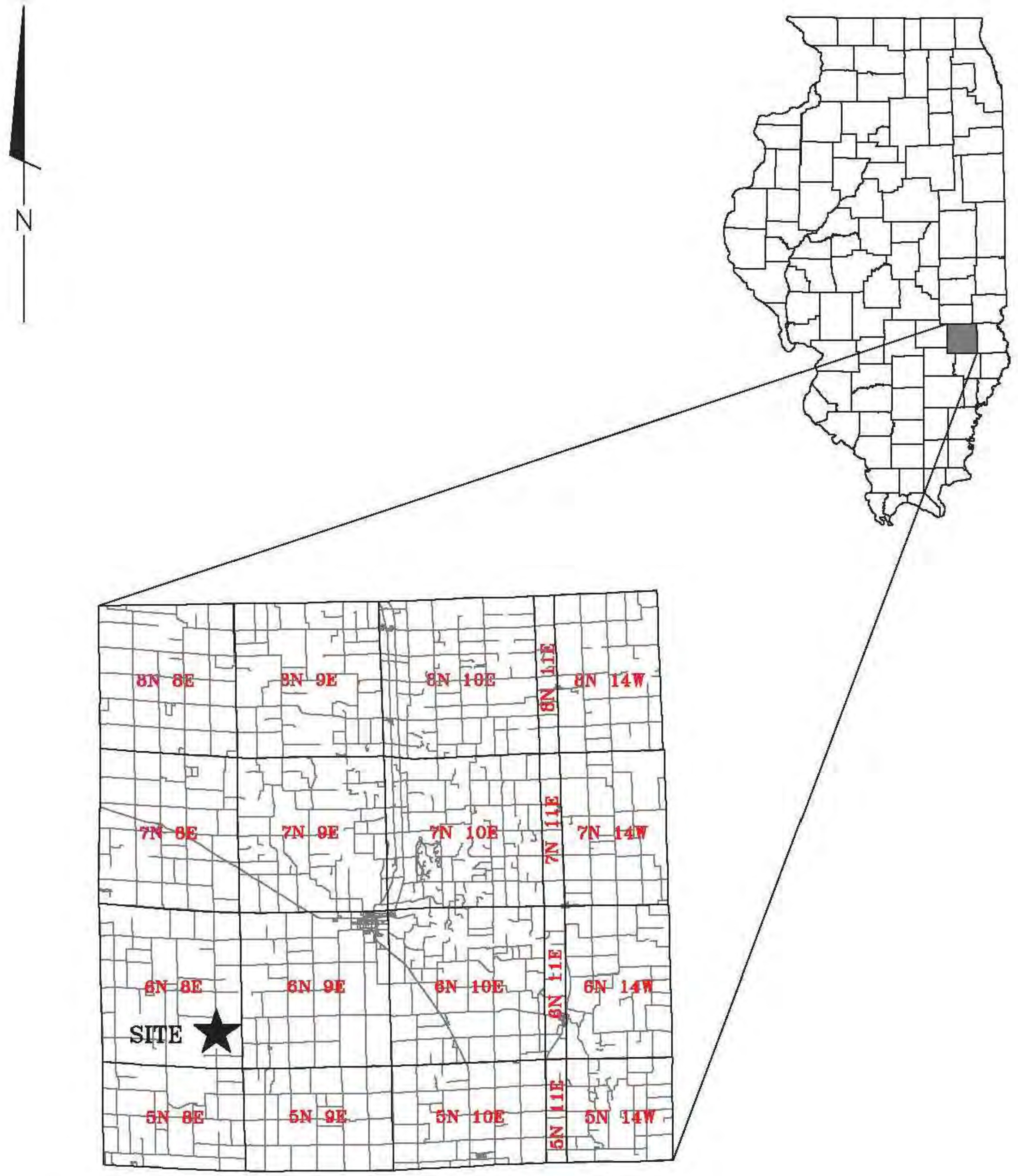


SOURCE NOTES:

1. FIGURE CONTENTS TAKEN FROM RAPPS ENGINEERING & APPLIED SCIENCE, INC. SITE LOCATION MAP, FIGURE 1 FROM PROJECT: SA09035, DRAWING: LOCMAP, DATED 11/09.

# SITE LOCATION MAP

NATURAL
RESOURCE
TECHNOLOGY

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
NEWTON ENERGY CENTER
JASPER COUNTY, ILLINOIS

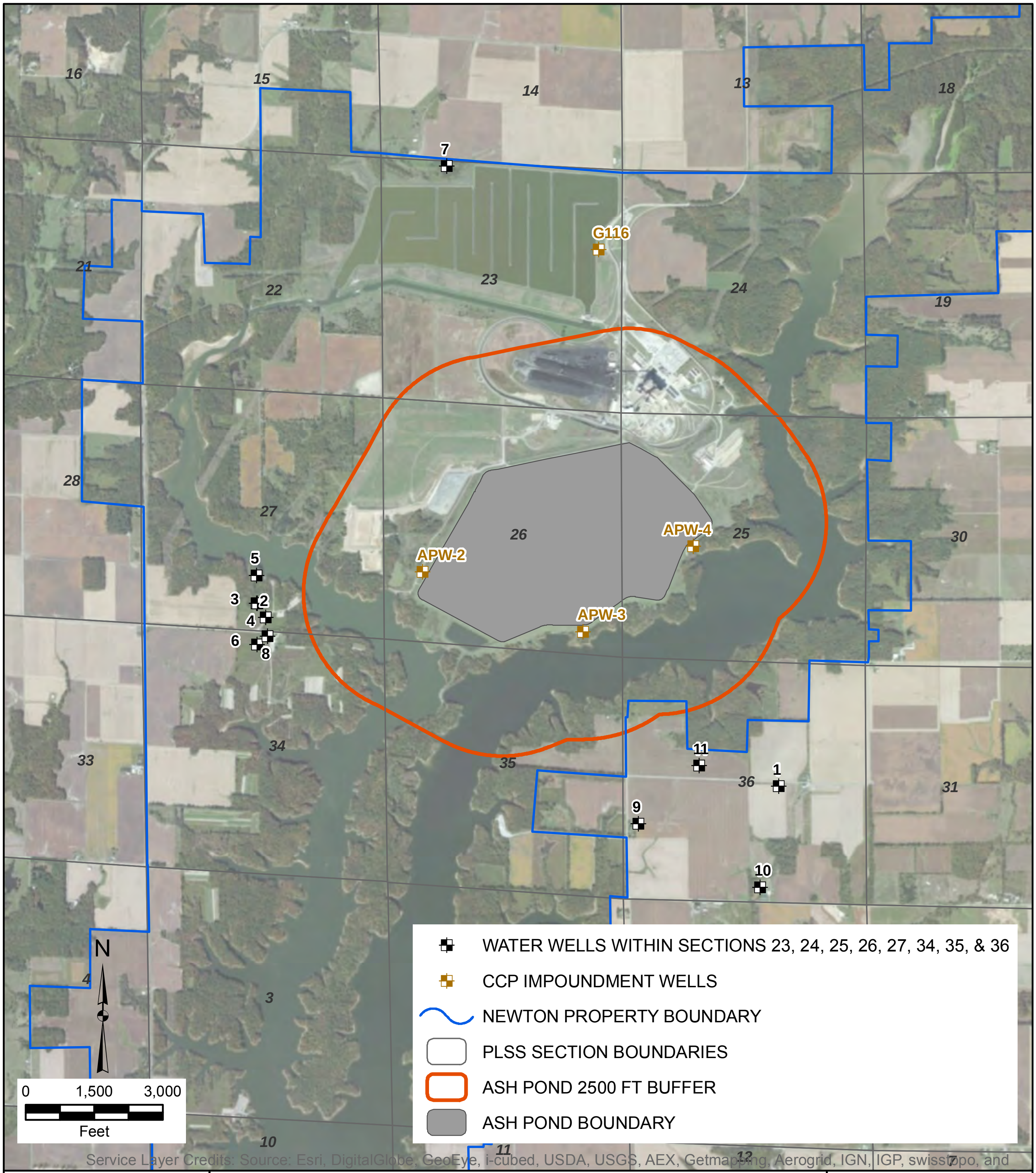
PROJECT NO.
2125/2.0

DRAWING NO.
2125-2-A02C-SITE LOC

FIGURE NO.
2

DRAWN: NWD DATE: 02/05/13 CHK'D: BRH DATE: 02/05/13 APP'D: BRH DATE: 03/05/13

Mar 05, 2013 11:36am PLOTTED BY: ndraskovich SAVED BY: ndraskovich
Y:\Mapping\Projects\21\2125\CAD\2\2125-2-A02C-SITE LOCATION.dwg Layout1
IMAGES: Y:\Mapping\Projects\21\2125\References\RAPP FIGURE1.jpg;
XREFS:



Y:\Mapping\Projects\21\2125\MXD\Fig. 3 Potable Well Search Results-Newton.mxd Author: nkron; Date/Time: 4/8/2013, 4:59:22 PM

DRAWN BY/DATE:
NDK 2/19/13
REVIEWED BY/DATE:
RLH 2/19/13
APPROVED BY/DATE:
BRH 2/20/13

# WELL SEARCH RESULTS

PHASE I HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
NEWTON ENERGY CENTER
JASPER COUNTY, ILLINOIS

PROJECT NO: 2125

FIGURE NO: 3

NATURAL RESOURCE TECHNOLOGY

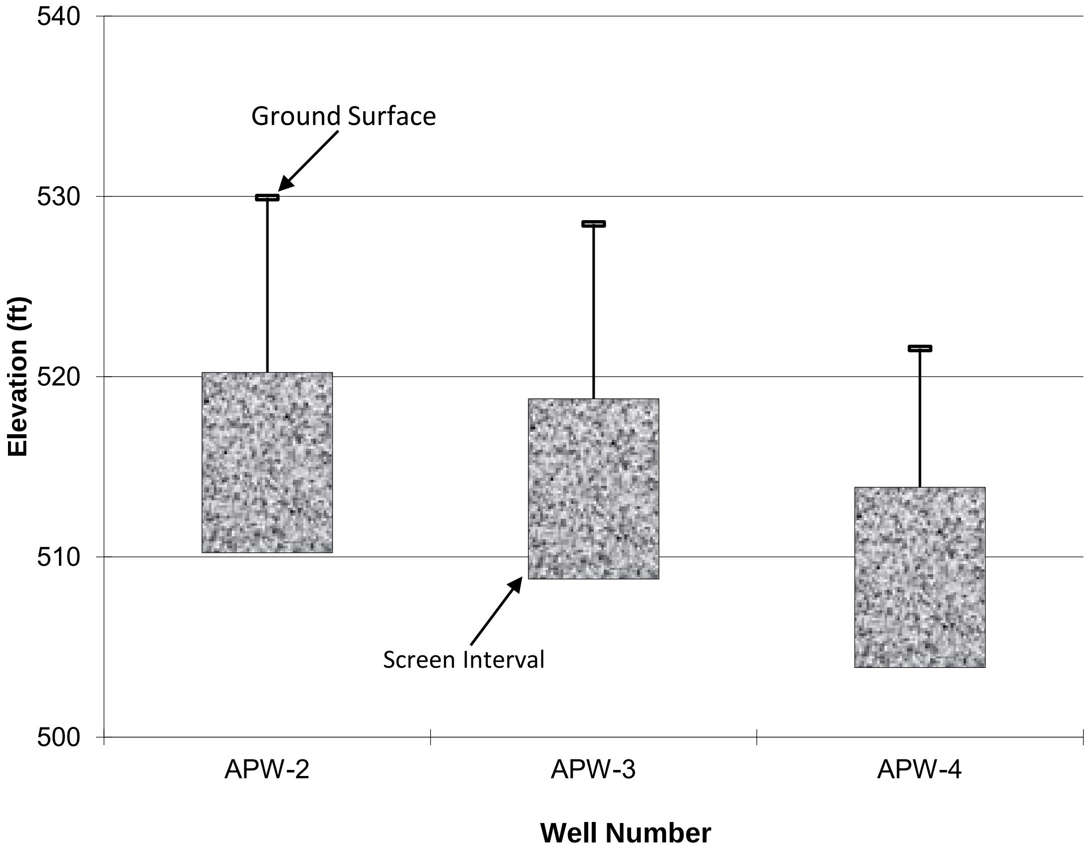


Figure 4. Monitoring Well Screen Elevations.

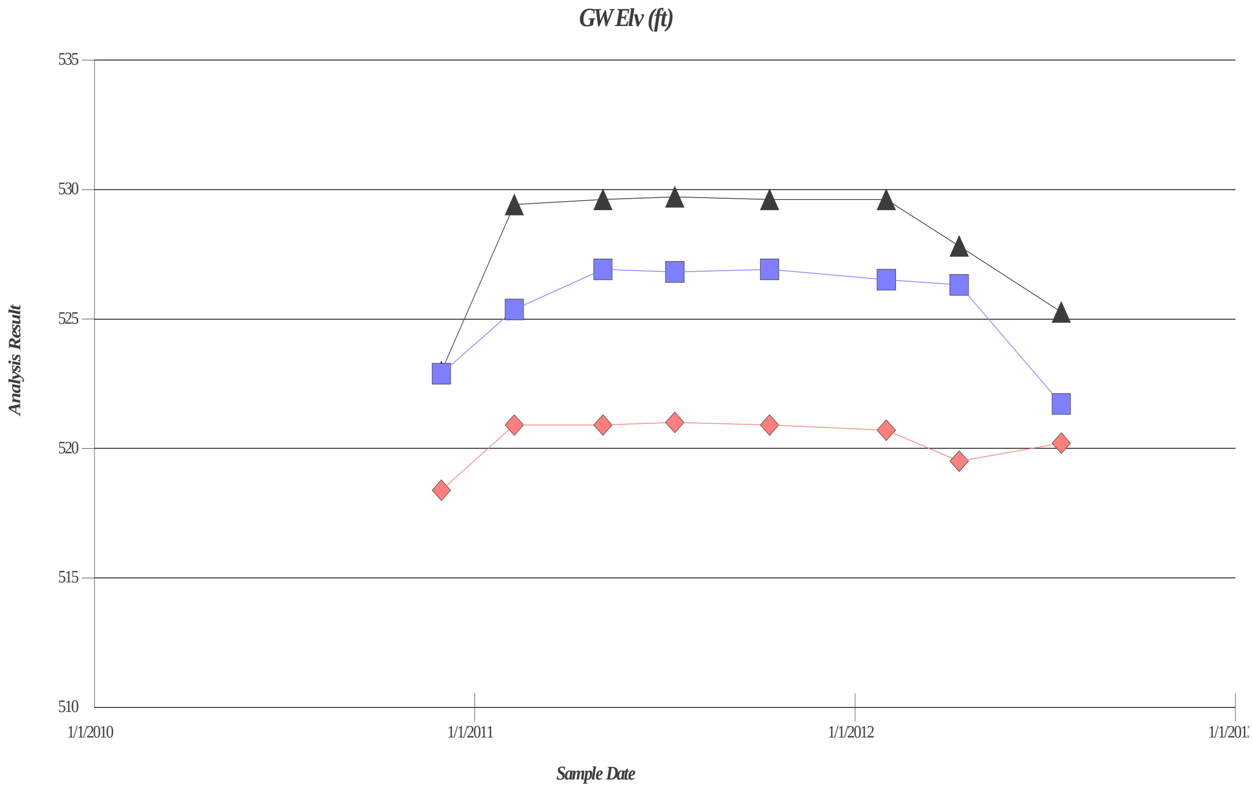
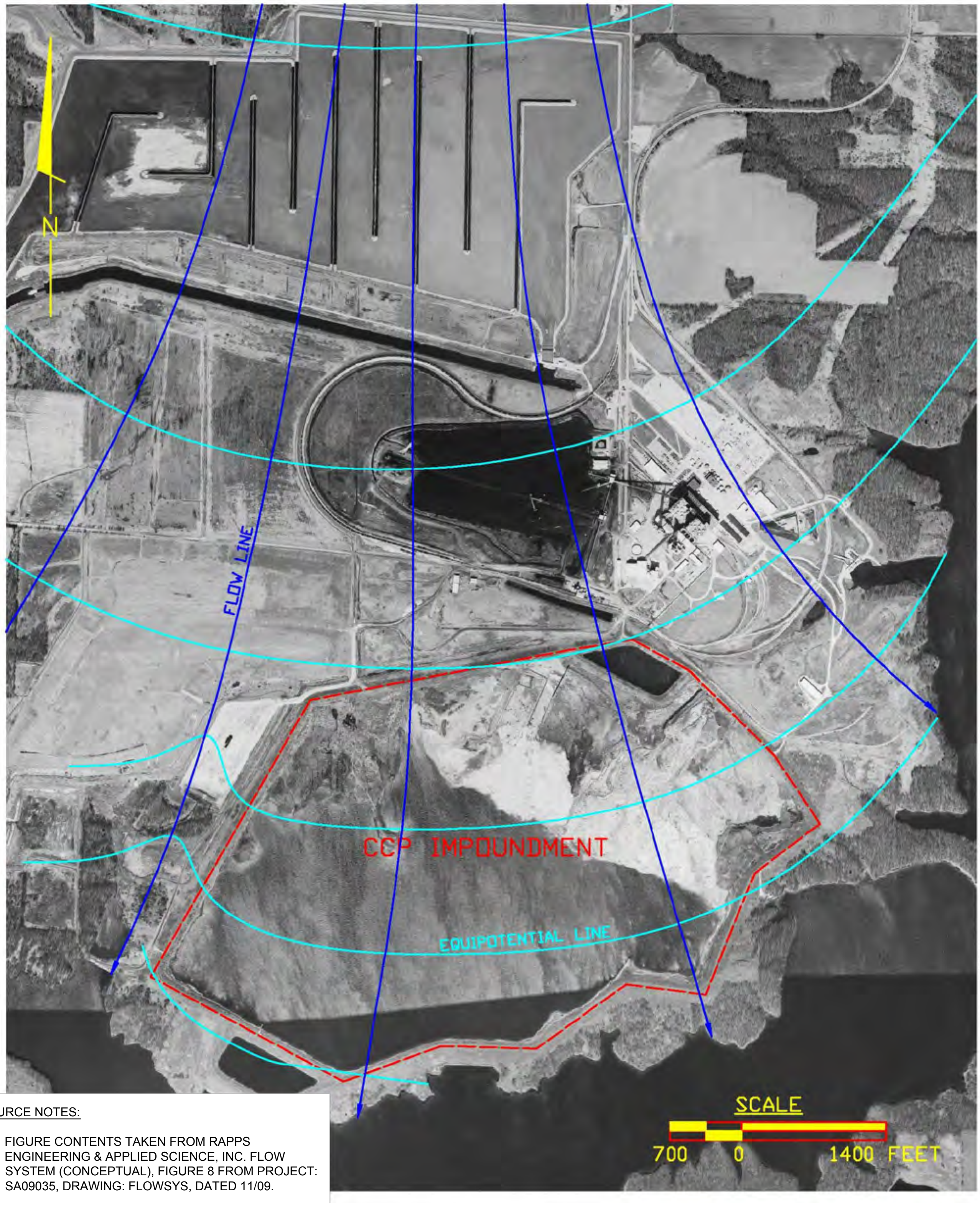


Figure 5. Groundwater Elevation Time Series.

NATURAL
RESOURCE
TECHNOLOGY



SOURCE NOTES:

1. FIGURE CONTENTS TAKEN FROM RAPPS ENGINEERING & APPLIED SCIENCE, INC. FLOW SYSTEM (CONCEPTUAL), FIGURE 8 FROM PROJECT: SA09035, DRAWING: FLOWSYS, DATED 11/09.

# FLOW SYSTEM (CONCEPTUAL)

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
NEWTON ENERGY CENTER
JASPER COUNTY, ILLINOIS

DRAWN: NWD DATE: 02/14/13 CHK'D: BRH DATE: 02/14/13 APP'D: BRH DATE: 03/05/13

NATURAL
RESOURCE
TECHNOLOGY

PROJECT NO.
2125/2.0

DRAWING NO.
2125-2-A06C-FLOW SYS

FIGURE NO.
6

Mar 05, 2013 11:36am PLOTTED BY: ndraskovich SAVED BY: ndraskovich
Y:\Mapping\Projects\21\2125\CAD\2\2125-2-A06C-FLOW SYSTEM.dwg Layout1
IMAGES: Y:\Mapping\Projects\21\2125\References\RAPP FIGURE8.jpg;
XREFS:

Figure 7. Median boron concentrations in Newton CCP impoundment and landfill shallow monitoring wells and leachate. Based on all data through 2012. Zero values indicate median concentrations below the detection limit. Landfill monitoring well locations are shown on Figure 8.

Natural Resource Technology

LIMITS OF CCP MANAGEMENT

APW2 ASH POND MONITORING WELL LOCATION

● LANDFILL MONITORING WELL LOCATION

SOURCE NOTES:

1. BINGMAPSAERIAL - © HARRIS CORP, EARTHSTAR GEOGRAPHICS LLC © 2012 MICROSOFT CORPORATION
2. BASEMAP FEATURES PROVIDED BY AMEREN, DRAWING "NEWTON HYDRO BLOCK".
3. COORDINATE SYSTEM IS REFERENCED TO NAD83, ILLINOIS STATE PLANE, EAST ZONE, US FOOT.

# LANDFILL AND CCP IMPOUNDMENT MONITORING WELL LOCATIONS

NATURAL
RESOURCE
TECHNOLOGY

PHASE 1 HYDROGEOLOGIC ASSESSMENT
AMEREN ENERGY GENERATING
NEWTON ENERGY CENTER
JASPER COUNTY, ILLINOIS

DRAWN: NWD DATE: 02/20/13 CHK'D: BRH DATE: 02/20/13 APP'D: BRH DATE: 03/05/13

PROJECT NO.
2125/2.0

DRAWING NO.
2125-2-A08C-MW LOCA

FIGURE NO.
8

Mar 05, 2013 11:38am PLOTTED BY: ndraskovich SAVED BY: ndraskovich
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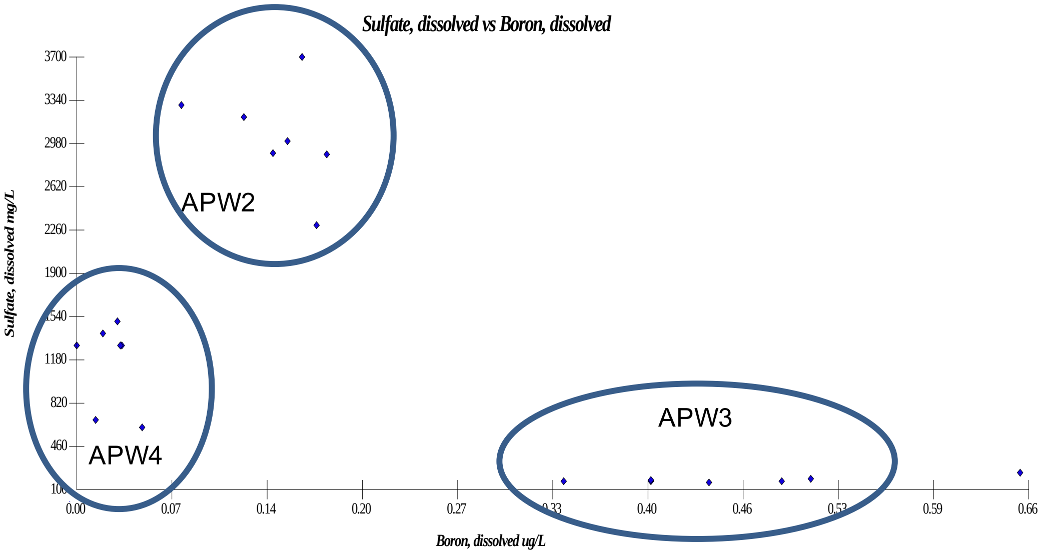


Figure 9. Sulfate versus boron concentrations.

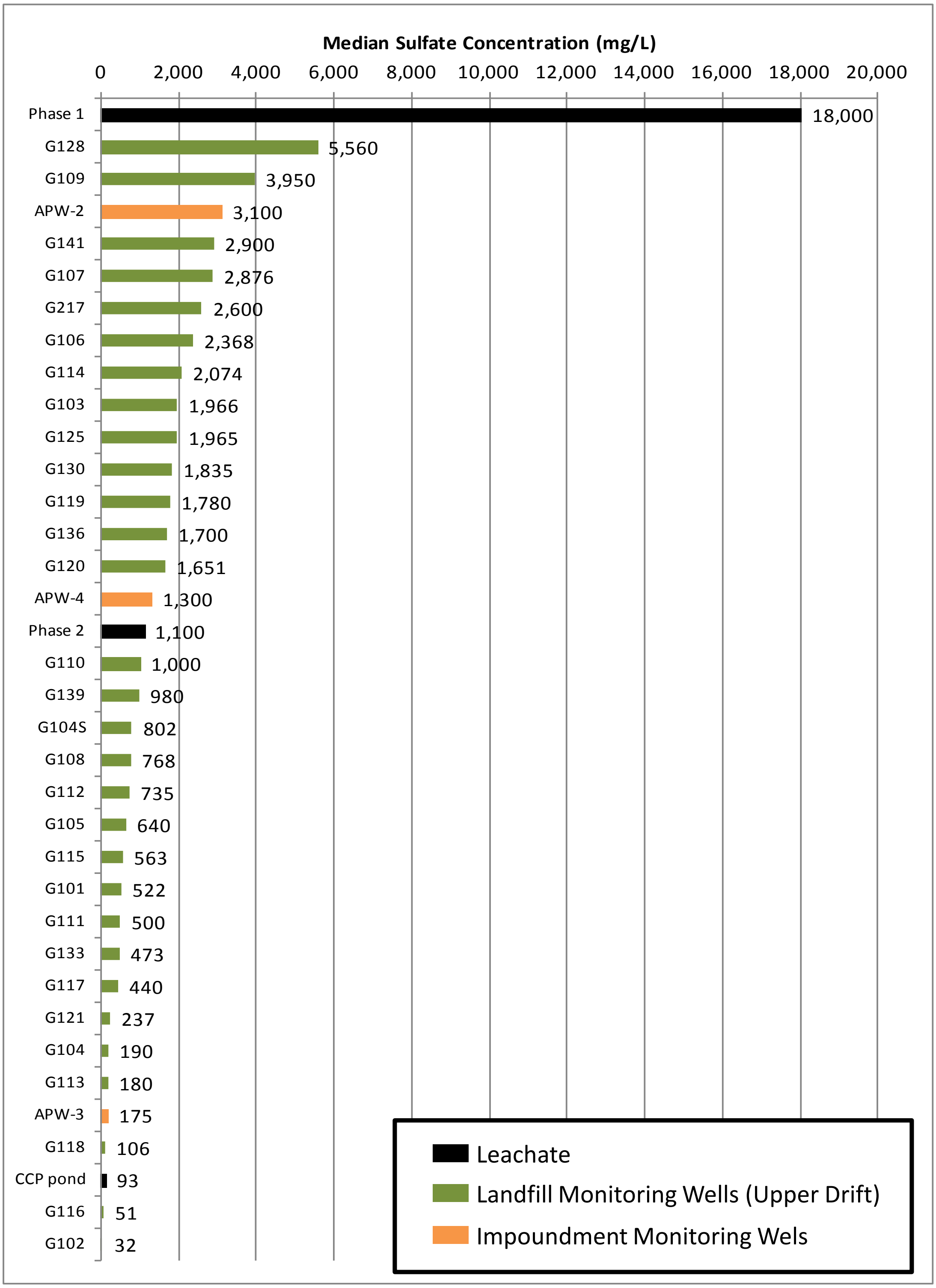


Figure 10. Median sulfate concentrations in Newton CCP impoundment and landfill shallow monitoring wells and leachate. Based on all data through 2012. Landfill monitoring well locations are shown on Figure 8.

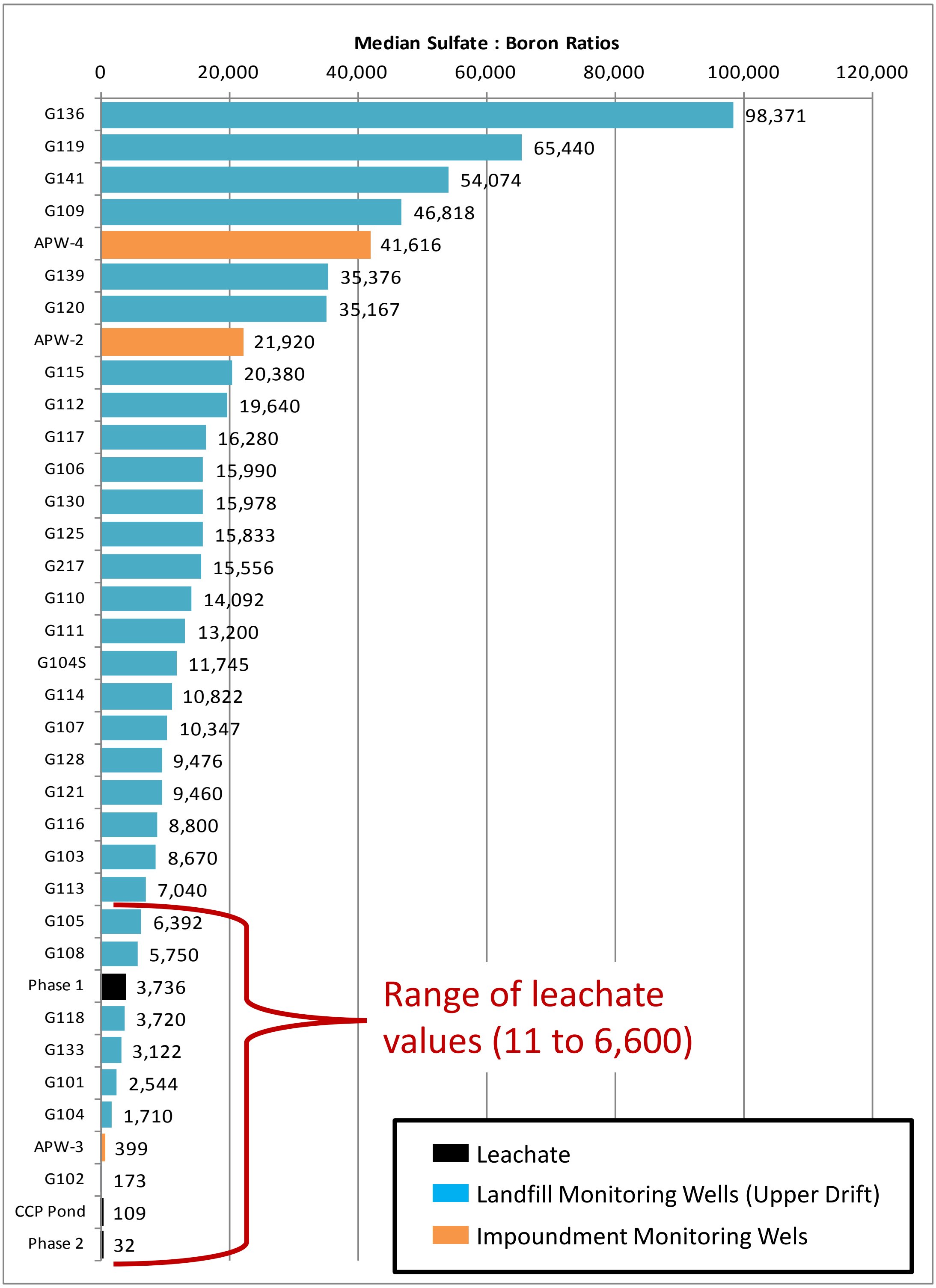


Figure 11. Median sulfate : boron ratios in Newton CCP impoundment and landfill shallow monitoring wells, and in leachate samples. Based on all data through 2012. Landfill monitoring well locations are shown on Figure 8.

Natural Resource Technology

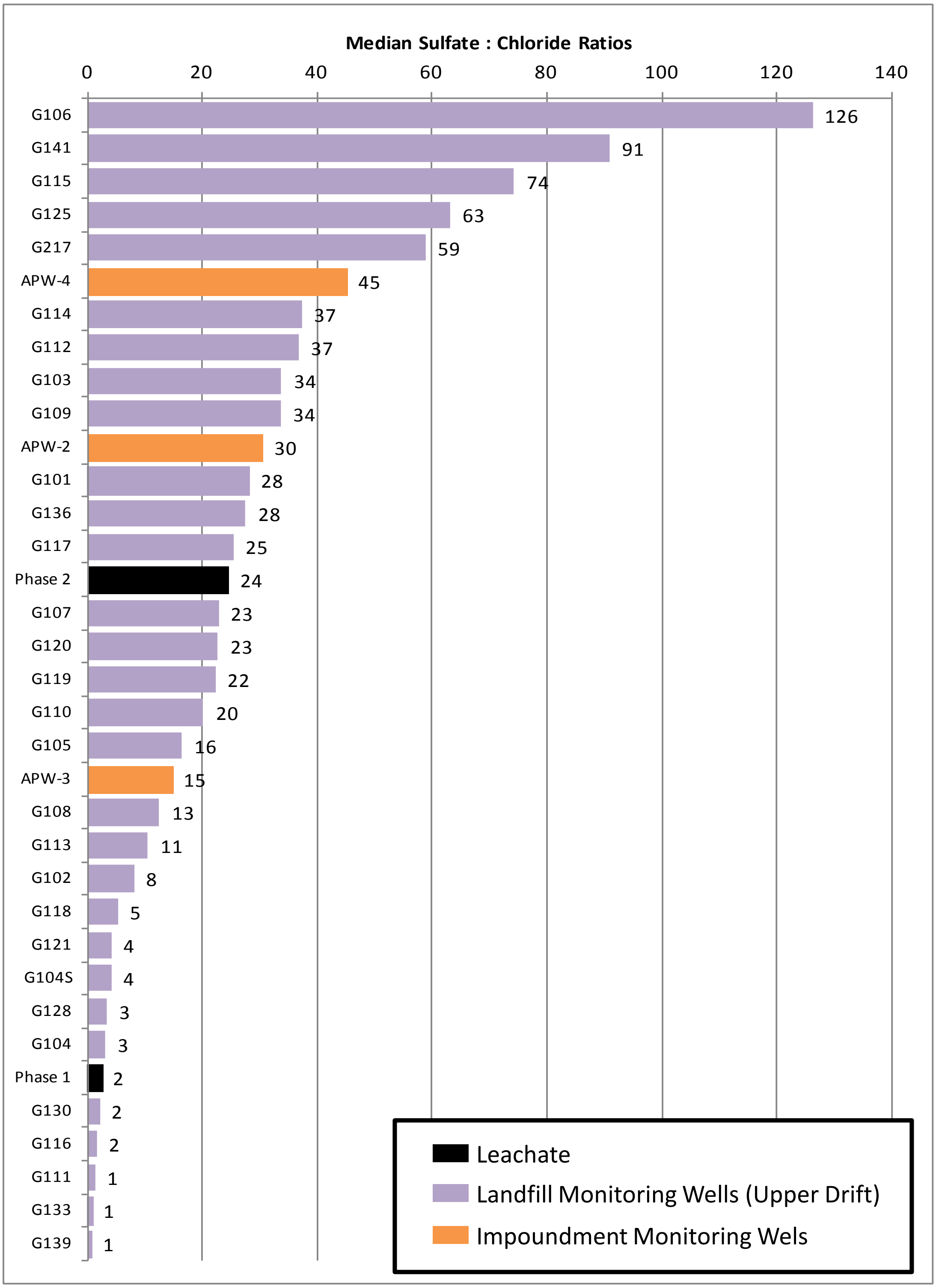


Figure 12. Median sulfate : chloride ratios in Newton CCP impoundment and landfill shallow monitoring wells, and in leachate samples. Based on all data through 2012. Landfill monitoring well locations are shown on Figure 8. CCP pond water is not plotted because chloride data were not available.

# TABLES

# Table 1. Monitoring Well Construction Details

## Groundwater Quality Assessment
## Newton Power Station; Newton, IL

| Monitoring Well Number | Installation Date[1,2] | Top of Well Riser Elevation | Ground Elevation | Screen Top Depth (BGS) | Screen Bottom Depth (BGS) | Screen Top Elevation | Screen Bottom Elevation | Bottom of Boring Elevation | Slotted Screen Length | Bottom Screen Depth from Ground Surface | Bottom Screen Depth from Top of Casing | Total Boring Depth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APW-2 | 06/19/10 | 533.82 | 529.93 | 9.70 | 19.70 | 520.23 | 510.23 | 509.9 | 10.00 | 19.70 | 23.59 | 20.0 |
| APW-3 | 06/18/10 | 532.52 | 528.47 | 9.70 | 19.70 | 518.77 | 508.77 | 508.5 | 10.00 | 19.70 | 23.75 | 20.0 |
| APW-4 | 06/19/10 | 525.21 | 521.56 | 7.70 | 17.70 | 513.86 | 503.86 | 503.6 | 10.00 | 17.70 | 21.35 | 18.0 |

| Monitoring Well Number | Northing[3] | Easting[3] |
|---|---|---|
| APW-2 | 822,688.0 | 995,465.3 |
| APW-3 | 821,379.8 | 998,975.7 |
| APW-4 | 823,246.5 | 1,001,379.6 |

Notes:

All depth and elevation measurements are in feet relative to NAVD 1988.

BGS = below ground surface.

[1] Drilling and well installation by Geotechnology, Inc.

[2] All wells constructed with 2-inch diametrer, 10-slot, Schedule 40 PVC screens.

[3] Coordinates are referenced to Illinois State Plane Coordinates, East Zone - NAD 1983.

# Table 2. Groundwater Levels and Elevations

## Groundwater Quality Assessment
## Newton Power Station; Newton, Illinois

| Monitoring Well Number | Ground Surface Elevation[1] (feet) | Measuring Point Elevation[1] (feet) | Groundwater Depth (feet below measuring point) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 11/30/10 | 2 02/08/11 | 3 05/04/11 | 4 07/12/11 | 5 10/11/11 | 6 01/31/12 | 7 04/10/12 | 8 07/17/12 |
| APW-2 | 529.93 | 533.82 | 10.85 | 4.40 | 4.20 | 4.10 | 4.20 | 4.20 | 6.00 | 8.55 |
| APW-3 | 528.47 | 532.52 | 9.63 | 7.15 | 5.60 | 5.70 | 5.60 | 6.00 | 6.20 | 10.80 |
| APW-4 | 521.56 | 525.21 | 6.82 | 4.30 | 4.30 | 4.20 | 4.30 | 4.50 | 5.70 | 5.00 |

| Monitoring Well Number | Groundwater Depth (feet below ground surface) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 11/30/10 | 2 02/08/11 | 3 05/04/11 | 4 07/12/11 | 5 10/11/11 | 6 01/31/12 | 7 04/10/12 | 8 07/17/12 |
| APW-2 | 6.96 | 0.51 | 0.31 | 0.21 | 0.31 | 0.31 | 2.11 | 4.66 |
| APW-3 | 5.58 | 3.10 | 1.55 | 1.65 | 1.55 | 1.95 | 2.15 | 6.75 |
| APW-4 | 3.17 | 0.65 | 0.65 | 0.55 | 0.65 | 0.85 | 2.05 | 1.35 |

| Monitoring Well Number | Groundwater Elevation (feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 11/30/10 | 2 02/08/11 | 3 05/04/11 | 4 07/12/11 | 5 10/11/11 | 6 01/31/12 | 7 04/10/12 | 8 07/17/12 |
| APW-2 | 522.97 | 529.42 | 529.62 | 529.72 | 529.62 | 529.62 | 527.82 | 525.27 |
| APW-3 | 522.89 | 525.37 | 526.92 | 526.82 | 526.92 | 526.52 | 526.32 | 521.72 |
| APW-4 | 518.39 | 520.91 | 520.91 | 521.01 | 520.91 | 520.71 | 519.51 | 520.21 |

Notes:

[1] All depth and elevation measurements are in feet relative to NAVD 1988.

# Table 3. Field and Laboratory Groundwater Monitoring Parameters

Groundwater Quality Assessment
Newton Power Station; Newton, Illinois

| **Field Parameters** | | | **Analysis Method** |
|---|---|---|---|
| Groundwater Elevation | | in-situ | |
| pH (field) | 1 | in-situ | SM 21st ed. 4500-$H^+$ |
| Specific Conductance | | in-situ | SM 21st ed. 2520-B |
| Temperature | | in-situ | SM 21st ed. 2550 |
| **General Chemistry Parameters**[2] | | | **Analysis Method** |
| Chloride | 1 | dissolved | SM21 4500CL C |
| Total Cyanide | 1 | total | EPA 335.4 |
| Fluoride | 1 | dissolved | SM4500 F-B-C |
| Nitrate as N | 1 | dissolved | EPA 353.2 |
| Sulfate | 1 | dissolved | ASTM516-90,02 |
| Total Dissolved Solids | 1 | dissolved | SM21 2540 C |
| **METALS**[2] | | | **Analysis Method**[3] |
| Antimony | 1,3 | dissolved | SW846 6010C |
| Arsenic | 1,3 | dissolved | SW846 6010C |
| Barium | 1,3 | dissolved | SW846 6010C |
| Beryllium | 1,3 | dissolved | SW846 6010C |
| Boron | 1,3 | dissolved | SW846 6010C |
| Cadmium | 1,3 | dissolved | SW846 6010C |
| Chromium | 1,3 | dissolved | SW846 6010C |
| Cobalt | 1,3 | dissolved | SW846 6010C |
| Copper | 1,3 | dissolved | SW846 6010C |
| Iron | 1,3 | dissolved | SW846 6010C |
| Lead | 1,3 | dissolved | SW846 6010C |
| Manganese | 1,3 | dissolved | SW846 6010C |
| Mercury | 1,3 | dissolved | SW846 7470A |
| Nickel | 1,3 | dissolved | SW846 6010C |
| Selenium | 1,3 | dissolved | SW846 6010C |
| Silver | 1,3 | dissolved | SW846 6010C |
| Thallium | 1,3 | dissolved | SW846 6010C |
| Zinc | 1,3 | dissolved | SW846 6010C |

Notes:

[1] Groundwater quality parameters for Class I: Potable Resource Groundwater (IAC 35 Part 620 Section 410).

[2] Samples preserved in field and filtered (except Cyanide) by laboratory.

[3] Sample prep method reference: SW846 3010A.

## Table 4. Statistical Summary of Groundwater Quality Data for Period of November 2010 - July 2012

Groundwater Quality Assessment
Newton Power Station; Newton, Illinois

| | | Monitoring Well APW-2[1] | | | | | | Monitoring Well APW-3[1] | | | | | | Monitoring Well APW-4[1] | | | | | | Background Monitoring Well G116[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter, Unit** | Class I GW Standard | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects | Mean | Median | Maximum | Minimum | Std Dev | % of Non-Detects |
| Field Parameters | | | | | | | | | | | | | | | | | | | | | | | | | |
| pH, Std Units | 6.5 / 9.0* | 6.68 | 6.85 | 6.92 | **5.45** | 0.50 | N/A | 7.10 | 7.25 | 7.31 | **6.07** | 0.42 | N/A | 6.85 | 7.02 | 7.12 | **5.65** | 0.49 | N/A | 7.18 | 7.11 | 7.64 | 6.99 | 0.27 | N/A |
| General Chemistry Parameters (totals) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chloride, mg/L | 200 | 103 | 105 | 120 | 63 | 20 | 0 | 13 | 13 | 16 | 11 | 1.7 | 0 | 28 | 27 | 32 | 23 | 3.0 | 0 | 42 | 38 | 63 | 32 | 12 | 0 |
| Cyanide, mg/L | 0.2 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Fluoride, mg/L | 4 | 0.37 | 0.25 | 0.83 | <0.25 | - - | 75 | 0.41 | 0.27 | 1.2 | 0.24 | 0.33 | 0 | 0.53 | 0.25 | 0.32 | <0.25 | - - | 75 | 0.44 | 0.43 | 0.49 | 0.38 | 0.049 | 0 |
| Nitrate, mg/L | 10 | 0.080 | 0.070 | 0.14 | <0.050 | 0.032 | 12.5 | 0.44 | 0.050 | 3.2 | <0.020 | 1.1 | 38 | 0.043 | 0.030 | 0.060 | <0.020 | 0.032 | 50 | nc | nc | nc | nc | nc | 100 |
| Sulfate, mg/L | 400 | **3,074** | **3,100** | **3,700** | **2,300** | 410 | 0 | 183 | 175 | 241 | 160 | 25 | 0 | **1,175** | **1,300** | **1,500** | **618** | 333 | 0 | 43 | 43 | 45 | 40 | 2.1 | 0 |
| Total Dissolved Solids, mg/L | 1,200 | **4,651** | **5,000** | **5,200** | **1,910** | 91 | 0 | 601 | 595 | 647 | 560 | 31 | 0 | **2,265** | **2,300** | **2,400** | **1,920** | 162 | 0 | 596 | 590 | 640 | 570 | 27 | 0 |
| Metals (dissolved) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Antimony, mg/L | 0.006 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Arsenic, mg/L | 0.01** | 0.004 | 0.005 | 0.005 | <0.003 | 0.001 | 0 | 0.002 | 0.002 | 0.002 | <0.004 | 0.001 | 12.5 | 0.002 | 0.001 | 0.002 | <0.001 | 0.001 | 25 | 0.001 | 0.001 | 0.002 | <0.001 | 0.001 | 80 |
| Barium, mg./L | 2 | 0.016 | 0.012 | 0.014 | <0.050 | 0.014 | 12.5 | 0.060 | 0.058 | 0.082 | 0.052 | 0.010 | 0 | 0.019 | 0.014 | 0.017 | <0.050 | 0.013 | 12.5 | 0.21 | 0.20 | 0.24 | 0.18 | 0.024 | 0 |
| Beryllium, mg/L | 0.004 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Boron, mg/L | 2 | 0.14 | 0.15 | 0.18 | 0.077 | 0.035 | 0 | 0.45 | 0.42 | 0.65 | 0.33 | 0.11 | 0 | 0.035 | 0.028 | 0.036 | <0.010 | 0.028 | 25 | nc | nc | nc | nc | nc | 100 |
| Cadmium, mg/L | 0.005 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Chromium, mg/L | 0.1 | 0.009 | 0.007 | 0.026 | <0.004 | 0.007 | 25 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Cobalt, mg/L | 1.0 | 0.008 | 0.002 | 0.004 | <0.002 | 0.017 | 37.5 | nc | nc | nc | nc | nc | 100 | 0.008 | 0.002 | 0.002 | <0.002 | 0.017 | 87.5 | nc | nc | nc | nc | nc | 100 |
| Copper, mg/L | 0.65 | 0.009 | 0.008 | 0.010 | <0.025 | 0.007 | 12.5 | nc | nc | nc | nc | nc | 100 | 0.006 | 0.003 | 0.003 | <0.003 | 0.008 | 75 | nc | nc | nc | nc | nc | 100 |
| Iron, mg/L | 5 | 0.056 | 0.017 | 0.14 | <0.010 | 0.060 | 37.5 | 0.029 | 0.010 | 0.046 | <0.010 | 0.032 | 75 | 0.031 | 0.010 | 0.010 | <0.004 | 0.002 | 75 | 0.011 | 0.010 | 0.017 | <0.010 | 0.003 | 80 |
| Lead, mg/L | 0.0075 | 0.002 | 0.001 | 0.001 | <0.001 | 0.001 | 75 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | 0.001 | 0.001 | 0.002 | <0.001 | 0.0006 | 80 |
| Manganese, mg/L | 0.15 | **0.58** | **0.64** | **0.91** | **0.17** | 0.28 | 0 | 0.052 | 0.047 | 0.11 | 0.018 | 0.033 | 0 | **0.22** | **0.23** | **0.27** | 0.14 | 0.044 | 0 | 0.010 | 0.009 | 0.027 | <0.001 | 0.010 | 20 |
| Mercury, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Nickel, mg/L | 0.1 | 0.039 | 0.039 | 0.045 | <0.040 | 0.004 | 12.5 | 0.011 | 0.006 | 0.011 | <0.005 | 0.012 | 25 | 0.021 | 0.018 | 0.023 | <0.040 | 0.008 | 12.5 | nc | nc | nc | nc | nc | 100 |
| Selenium, mg/L | 0.05 | 0.016 | 0.017 | 0.024 | <0.010 | 0.007 | 12.5 | 0.007 | 0.008 | 0.009 | <0.001 | 0.003 | 25 | 0.006 | 0.008 | 0.008 | <0.001 | 0.003 | 25 | 0.004 | 0.004 | 0.010 | 0.002 | 0.003 | 0 |
| Silver, mg/L | 0.05 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Thallium, mg/L | 0.002 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 | nc | nc | nc | nc | nc | 100 |
| Zinc, mg/L | 5 | 0.058 | 0.043 | 0.16 | 0.032 | 0.042 | 0 | 0.012 | 0.009 | 0.037 | <0.006 | 0.011 | 37.5 | 0.030 | 0.020 | 0.092 | 0.013 | 0.026 | 0 | 0.008 | 0.006 | 0.018 | <0.006 | 0.005 | 80 |

Notes:

[1] Eight quarterly samples collected for analysis on 11/30/10, 02/08/11, 05/04/11, 07/12/11, 10/11/12, 01/31/12, 04/10/12, and 07/17/12.

[2] Five quarterly samples collected for analysis on 07/12/11, 10/11/12, 01/31/12, 04/10/12, and 07/17/12.

Groundwater quality standards for Class I: Potable Resource Groundwater (IAC 35 Part 620 Section 410).

Statistics calculated with replacement of non-detect concentrations at 1X reported non-detect concentration. nc indicates that statistics were not calculated because all values were below detection limits.

| | |
|---|---|
| Exceeds Class I Groundwater Quality Standard. | Parameter is 100% Non-Detect in all 4 monitoring wells. |

N/A = not applicable.

< = Below method reporting limit.

* Lower and Upper limits for pH is the Class I groundwater quality standard of 6.5 and 9.0 Standard Units.

# APPENDIX A

# REGIONAL GEOLOGY

# A REGIONAL GEOLOGY

Regional geologic information was previously presented in the site characterization and groundwater monitoring plan developed by Rapps Engineering & Applied Services (November 2009), and is repeated here for completeness.

## A.1 Physiography

Illinois is situated in the south-central part of the great Central Lowland Province near the confluence of two major lines of drainage, the Mississippi and Ohio Rivers, making it the lowest of the north-central states with a mean elevation of about 600 feet above sea-level and a total relief of only 973 feet (Leighton et al., 1948). The NPS lies at the southeastern portion of the Springfield Plain of the Till Plains section, the largest physiographic division in Illinois, covering approximately four-fifths of the state (Appendix A [Figure 3]). It is characterized by its flatness and shallowly entrenched drainage. Drainage systems are well developed, and the district is in a late youthful stage of dissection.

## A.2 Unlithified

The Quaternary deposits in the area of the NPS consist mainly of diamictons and intercalated outwash that were deposited during Illinoian and pre-Illinoian glaciations (Appendix A [Figure 5]). A hydrogeologic investigation was conducted in 1997 by RAPPS Engineering & Applied Science (RAPPs) to characterize the geology at the NPS as part of an application for a Phase II CCP landfill permit (IEPA Bureau of Land Application Log No. 1997-233). The following geologic descriptions are based largely on the findings of that investigation. Approximately 100 to 120 feet of unlithified deposits overlie the bedrock at the site. The major Quaternary formations present include, from oldest to youngest:

Pre-Illinoian Stage: Pre-Illinoian deposits at the site consist of undifferentiated diamictons belonging to the Banner Formation which generally rest directly on bedrock and consist mostly of glacial diamictons and intercalated sand and gravel outwash. The Banner Formation is approximately 20 to 30 feet thick at the site and consists of greenish-gray moist silty clay with traces of sand.

Illinoian Stage: The Glasford Formation is the most widespread formation of glacial origin in Illinois and is largely the deposit of Illinoian glaciers of the Lake Michigan Lobe. It includes diamictons, intercalated outwash deposits, and overlying accretion-gley deposits. The three members of the Glasford Formation encountered at the site are, from oldest to youngest, the Smithboro Till Member, the

Mulberry Grove Member, and the Vandalia Till Member. The Hagarstown Member of the Pearl Formation was also encountered at the site. Each Illinoian Stage member is described below.

The Smithboro Member is the lowest member of the Glasford Formation in south-central Illinois. It is characterized as a gray, compact diamicton that is softer, more silty, and less friable than the overlying Vandalia Member, and was deposited by ice sheets moving northwest to southeast across the region (Jacobs and Lineback, 1969). At the site, the Smithboro Till Member consists of a gray, silty-clay diamicton with traces of sand and gravel, with a thickness ranging from 10 to 20 feet.

The Mulberry Grove Member typically consists of a thin, lenticular unit of gray sandy silt (Willman and Frye, 1970). It represents the interval between the retreat of the glacier that deposited the Smithboro Member and the advance of the glacier that deposited the Vandalia Member. At the site, the Mulberry Grove Member is approximately 3 to 5 feet thick and consists mostly of gray sandy silt.

The Vandalia Member, named for Vandalia, Fayette County, near the type locality, is a relatively sandy, gray, compacted diamicton commonly 25 to 50 feet thick with varying amounts of sand and gravel (Lineback, 1979; Willman and Frye, 1970). At the site, the Vandalia Member consists of a gray, silty to sandy clay diamicton with traces of sand and gravel and ranges in thickness from 20 to 60 feet.

The Hagarstown Member of the Pearl Formation consists of gravel, sand, and gravelly diamicton occurring as ice-contact deposits. It commonly occurs as ridged drift in a distinctive belt of linear to curved ridges and knolls. Outwash plains of poorly-sorted to well-sorted sand and gravel are present between the ridges in many places (Killey and Lineback, 1983). Where present, the Hagarstown Member sediments at the site vary in thickness from 3 to 24 feet, and consist of reddish-brown silty clay with some sand and gravel. It overlies the Vandalia Member diamicton and the elevation of the contact surface varies between approximately 510 feet to 532 feet MSL. It is generally found to be severely weathered at the site and is overlain in most places by the Sangamon Soil.

Sangamonian Stage: The Sangamon Soil formed during the interglacial period between the Illinoian and Wisconsinan Stages. It formed as a result of weathering of the upper portion of the Illinoian drift. The Sangamon Soil occurs throughout the site and consists of approximately 2.5 to 5.5 feet of light brown to light gray silty clay.

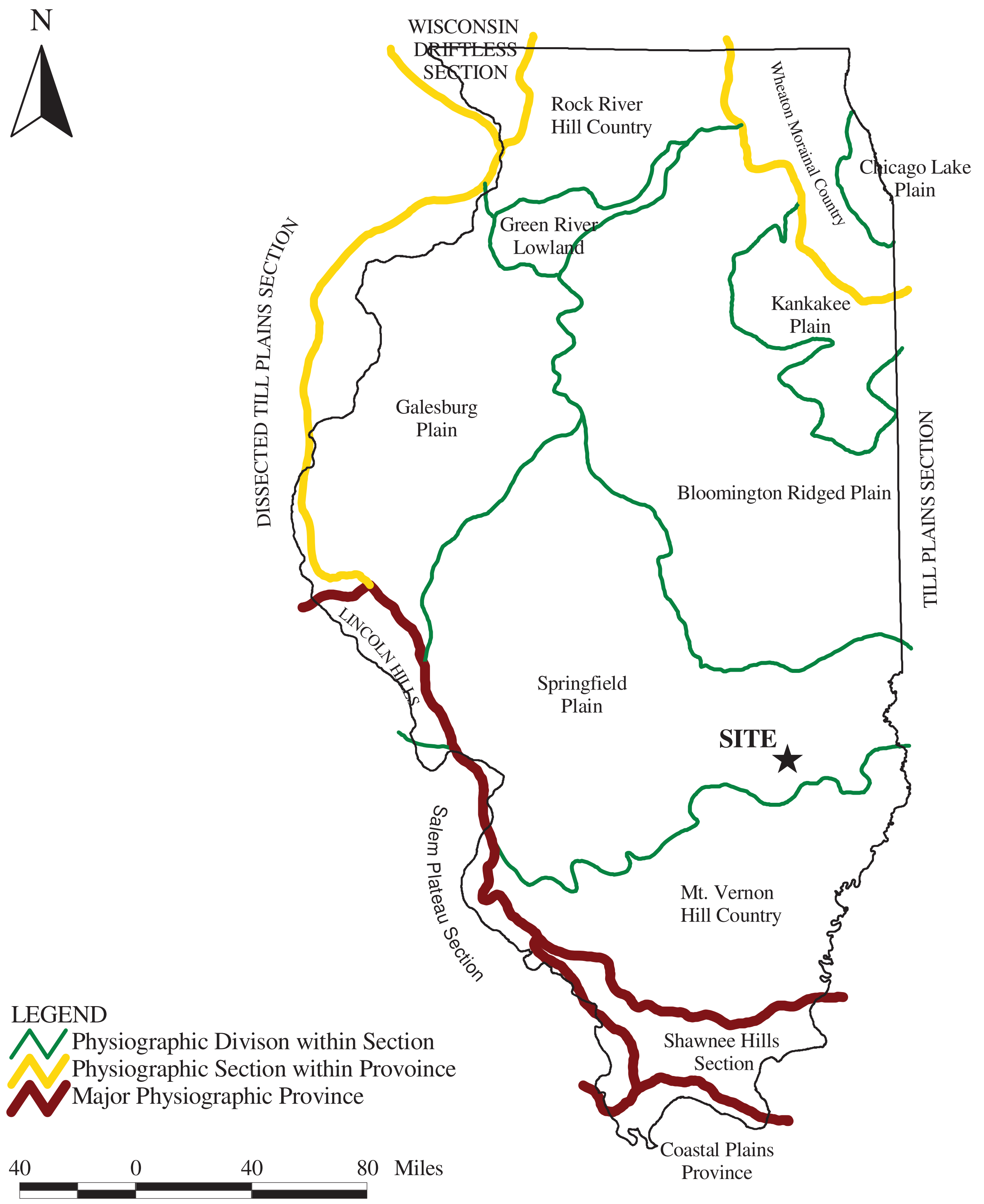
Wisconsinan Stage: Deposits belonging to the Wisconsinan Age Peoria Silt commonly occur in upland areas and along valley walls in Illinois. They generally grade from sandy silt in the bluffs of major source river valleys (like the Mississippi Valley) to clayey silt away from the bluffs, where it is commonly thinner and relatively weathered (Hansel and Johnson, 1996). They are typically massive and consist predominantly of windblown silt from the valley floor, with local lenses of well-sorted, fine- to medium-grained sand (Willman and Frye, 1970). Peoria Silt at the site consists of 3 to 9 feet of brown, mottled gray silty clay.

Holocene Stage: The Cahokia Formation consists of deposits in the floodplains and channels of modern rivers and streams, and is comprised of mostly poorly sorted sand, silt, and clay with wood and shell fragments, and local deposits of sandy gravel (Lineback, 1979). The upper part consists of overbank silts and clays, while the coarser-textured lower portion is mainly sandy channel and lateral accretion deposits. The Cahokia is present along all Illinois streams, although locally absent where active stream erosion is occurring (Willman and Frye, 1970). The Cahokia Formation is likely present in the Big Muddy Creek valley to the west of the site and along the bottom of Newton Lake to the east, which used to be the bottomland for Law Creek (Berg and Kempton, 1987).

## A.3 Bedrock

The NPS and surrounding areas are underlain by bedrock formations belonging to the Pennsylvanian Mattoon Formation (Appendix A [Figure 4]) (Kolata, 2005; Willman et al., 1967). Detailed descriptions of the Pennsylvanian strata of Illinois were published by Willman et al. (1975). The following geologic description is based on this report. The Mattoon Formation, named for Mattoon, Coles County, where exposures are prominent, is the youngest formation in the Pennsylvanian System in Illinois. It is underlain by the Bond Formation while the top is mostly an erosional surface overlain by Pleistocene glacial deposits. The Mattoon Formation has a maximum thickness of more than 600 feet in the central part of the Illinois Basin in Jasper County. It is characterized by a complex sequence of thin limestones, coals, black fissile shales, underclays, thick gray shales, and several well developed sandstones. The lateral extent of many of the named units has not been determined due to widely scattered outcrops and scarce subsurface data. However, coals and limestone units are considered to be as persistent as those in the underlying Bond and Modesto Formations.

Borings advanced at the NPS as part of a hydrogeologic site investigation for a CCP landfill indicate that the elevation of the top of the bedrock surface at the site is approximately 400 to 450 feet MSL. The depth to bedrock varies widely in the area owing to the undulatory nature of the eroded upper bedrock surface and ranges from approximately 90 to 120 feet. Logs indicate that the lithology of the uppermost bedrock is mostly shale.



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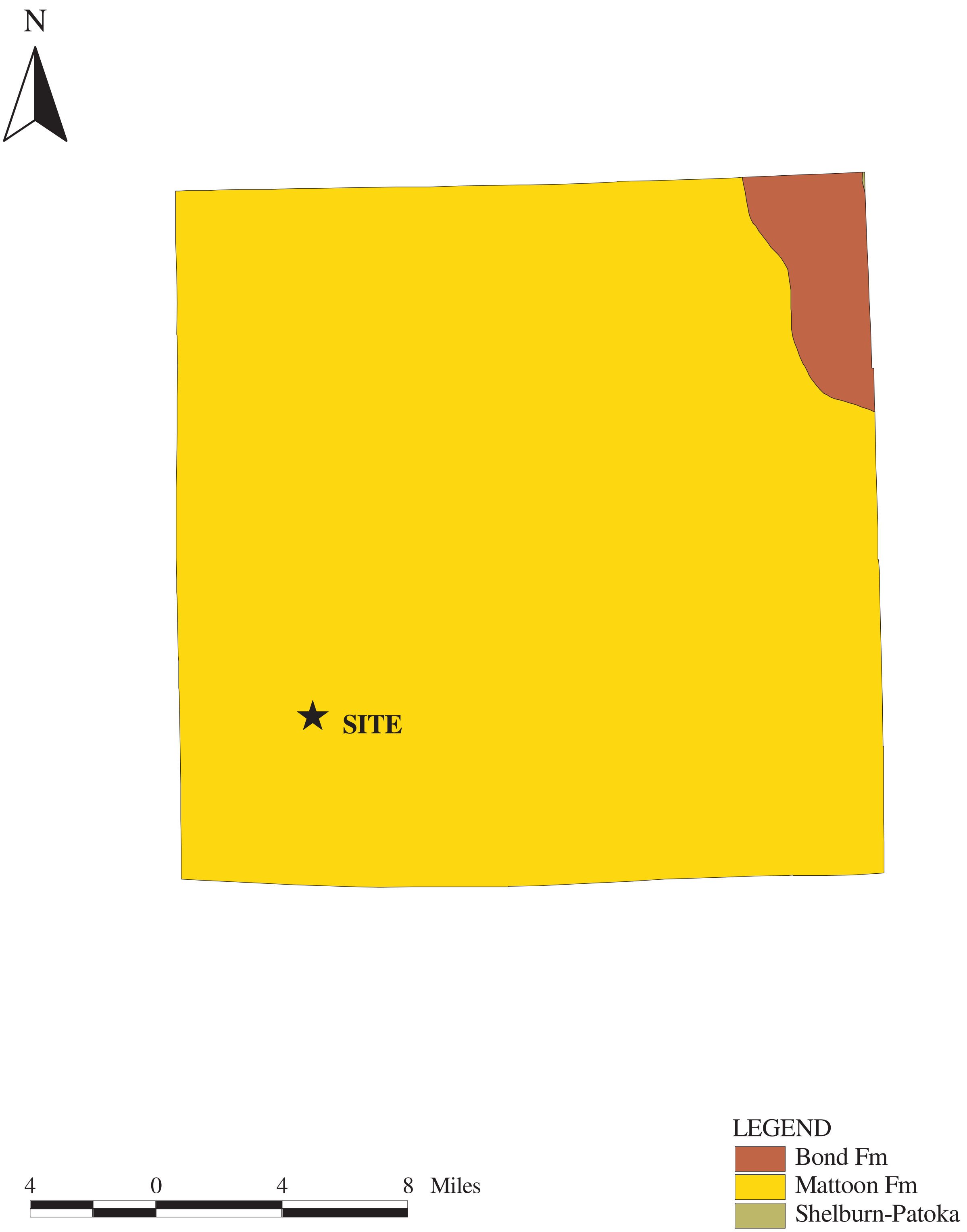
ILLINOIS PROFESSIONAL DESIGN FIRM No. 184-001130

# FIGURE 3
## PHYSIOGRAPHIC DIVISIONS OF ILLINOIS (LEIGHTON ET AL, 1948)

AMERENENERGY GENERATING COMPANY
NEWTON POWER STATION
JASPER COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Physio DATE: 11/09



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# FIGURE 4
## BEDROCK GEOLOGY
(HORBERG, 1950)

AMERENENERGY GENERATING COMPANY
NEWTON POWER STATION
JASPER COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Bedgeo DATE: 11/09

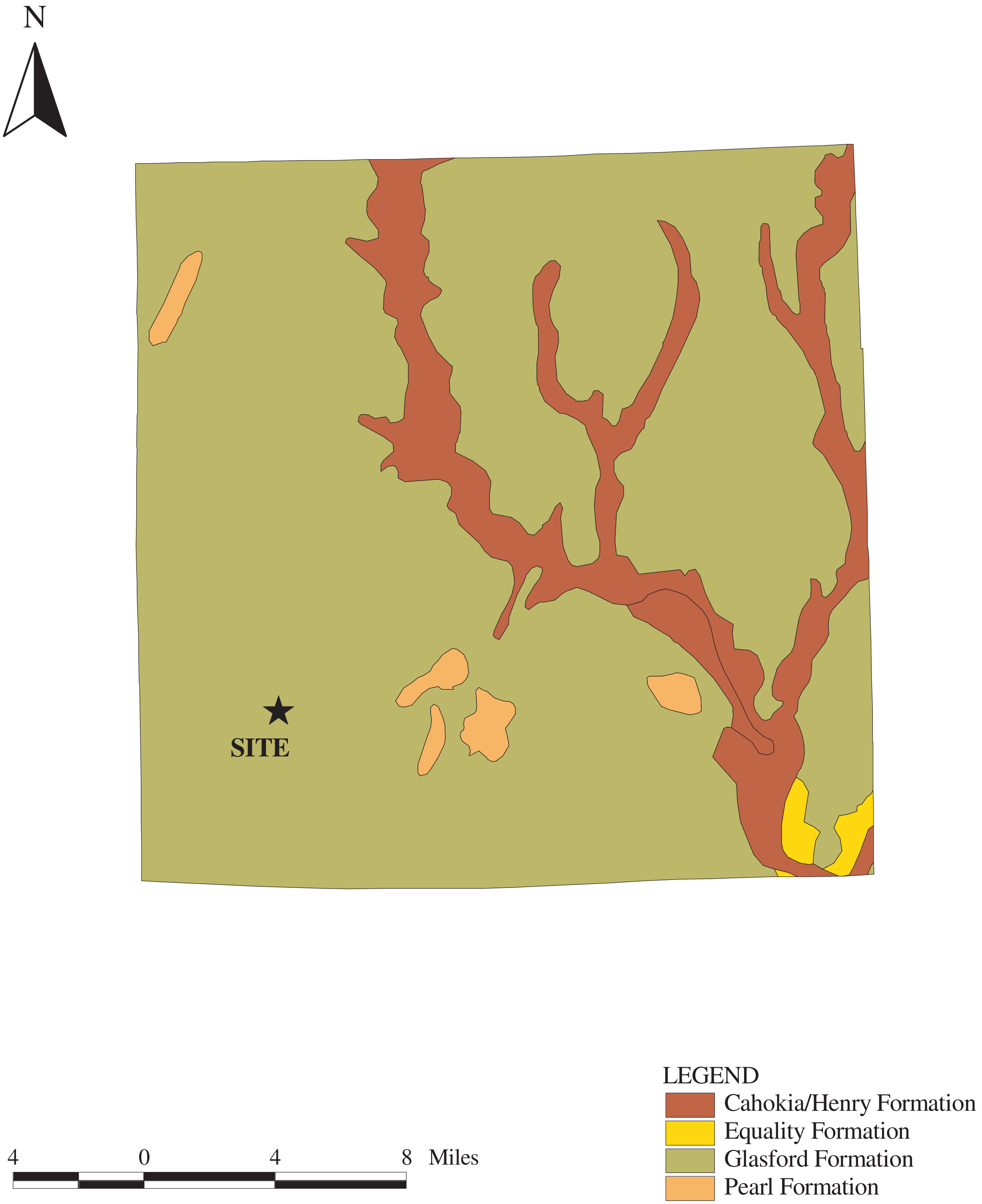

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**FIGURE 5**

QUATERNARY GEOLOGY
(HANSEL AND JOHNSON, 1996)

AMERENENERGY GENERATING COMPANY
NEWTON POWER STATION
JASPER COUNTY, ILLINOIS

PROJECT: SA09035 DRAWING: Quat DATE: 11/09

# APPENDIX B

# WELL SURVEY RESULTS

# B WELL SEARCH

## B.1 Well Search Overview

The following sources of information were utilized in order to determine community water source and water well locations:

- Illinois State Geological Survey's Illinois Water Well (ILWATER) Internet Map Service
- Illinois State Water Survey Domestic Well Database
- Illinois EPA web-based Geographic Information System (GIS) files
- Illinois Department of Public Health
- Jasper County Health Department.

## B.2 Illinois State Geological Survey (ISGS)

The ISGS website provided an ArcIMS View Map as well as a database query for water wells. ISGS database information including any boring logs and well construction information is provided in this Appendix.

## B.3 Illinois State Water Survey (ISWS)

All of the wells found through the ISWS database, also known as the Domestic Well Database, were previously identified on the ISGS website. Records contained within the ISWS database, consisting of public, industrial, and commercial water wells, were not all received as of the date of this report. Since the ISWS database generally contains the same well information as the ISGS and Illinois EPA databases, some ISWS well entries on the Appendix B-1 Table were marked as pending. Should any new information be acquired from the ISWS including additional water wells not previously identified from the other sources of the well information, it will be provided as an addendum to this report. Table B-2 lists wells located by RAPPS Engineering & Applied Science, Inc. that were not located and identified in the current well search for this report.

## B.4 Illinois Environmental Protection Agency (IEPA)

The Illinois EPA database website provided ArcIMS Viewer Maps showing information on community, non-community, and public water supply wells as defined on the Illinois EPA website:

- Community Water Supply (CWS): a public water supply that serves or is intended to serve at least 15 service connections used by residents or regularly serves at least 25 residents.
- Non-Community Water Supply (NCWS): a public water supply that is not a community water supply.
- Public Water Supply: all mains, pipes and structures through which water is obtained and distributed to the public, including wells and well structures, intakes and cribs, pumping stations, treatment plants, reservoirs, storage tanks and appurtenances, collectively or severally, actually used or intended for use for the purpose of furnishing water for drinking or general domestic use and which serve at least 15 service connections or which regularly serve at least 25 persons at least 60 days per year. A public water supply is either a community water supply or a non-community water supply.

No CWS, NCWS, or public water supply locations were identified in the designated sections. Well 11 on Figure 7, was identified on the IEPA database but was not present on the ISGS database. No boring log is present for well 11.

## B.5 Peoria County Health Department

Personnel from the Jasper County Health Department confirmed that there are no CWS, NCWS, or public water supply systems within the designated sections. No additional information was provided about the area.

## Table B-1. Other Water Wells, Precise Location Not Available

### Phase I Hydrogeologic Assessment

### Newton Power Station

| Map | Source of Well Information | | | | Location Name | Well | | Location | | | | Year | Aquifer | | Well |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well # | ISGS | ISWS*** | IEPA | Other | at Time of Well Completion | Depth | County | Township | Range | Section | Subsection | Drilled | Type | Formation | Use |
| 1 | 120792250300 | *** | 22503 | -- | Crouse, Ernest E | 30 | Morgan | 6N | 8E | 36 | NE,NW,SE | 1974 | unconsolidated | sandy clay | FD |
| 2 | 120792274700 | *** | 22747 | -- | CIPS | 65 | Morgan | 6N | 8E | 27 | SW | 1978 | unconsolidated | clay | IC |
| 3 | 120792274800 | *** | 22748 | -- | CIPS | 23 | Morgan | 6N | 8E | 27 | SW | 1978 | unconsolidated | clay | IC |
| 4 | 120792274900 | *** | 22749 | -- | CIPS | 35 | Morgan | 6N | 8E | 27 | SW | 1978 | unconsolidated | sandy clay | IC |
| 5 | 120792275000 | *** | 22750 | -- | CIPS | 63 | Morgan | 6N | 8E | 27 | SW | 1978 | unconsolidated | clay and gravel | IC |
| 6 | 120792275100 | *** | 22751 | -- | CIPS | 65 | Morgan | 6N | 8E | 34 | SW | 1978 | unconsolidated | clay | IC |
| 7 | 120792290300 | *** | 22903 | -- | Marshall, Bernard | 40 | Morgan | 6N | 8E | 23 | NE,NW | 1977 | unconsolidated | sandy clay | IC |
| 8 | 120792290600 | *** | 22906 | -- | CIPS & Dept of Conservation | 78 | Morgan | 6N | 8E | 34 | NE | 1978 | unconsolidated | sand and gravel | IC |
| 9 | 120792532600 | 338975 | 25326 | -- | Kirk, Pauline | 148 | Morgan | 6N | 8E | 36 | SW,NW,SW | 2001 | bedrock | shale and sandstone | FD |
| 10 | 120792537800 | 362604 | 25378 | -- | Sparks, Lawerence | 45 | Morgan | 6N | 8E | 36 | SW,SW,SE | 2004 | unconsolidated | sand and clay | FD |
| 11 | 120792392900 | *** | 23929 | -- | Lancaster, Jesse | -- | Morgan | 6N | 8E | 36 | -- | -- | -- | | -- |

ces of Information

| | |
|---|---|
| IEPA | Illinois Environmental Protection Agency |
| ISGS | Illinois State Geological Survey |
| ISWS | Illinois State Water Survey |
| SWA | IEPA Source Water Assessment |

Well Use

| | |
|---|---|
| FD | Farm and/or Domestic Water Well |
| IC | Industrial/Commercial Water Well |
| CWS | Community Water Supply |
| NCWS | Non-Community Water Supply |

Notes

| | |
|---|---|
| - - | Not applicable or no information available |
| ** | ISWS data pending |
| A | Well is mislocated in ISGS and/or IEPA databases |

# Table B-2. Other Water Wells, Precise Location Not Available

## Phase I Hydrogeologic Assessment

## Newton Power Station

| | | Location | | | Well | | Date |
|---|---|---|---|---|---|---|---|
| Well ID | Depth | Township | Range | Section | Use | Driller | Drilled |
| 62365 | 37 | 6N | 8E | 25 | IC | LAYNE-WESTERN | 2/22/1974 |
| 372029 | 69 | 6N | 8E | 26 | MO | SKS ENGINEERS | 1997 |
| 372030 | 83 | 6N | 8E | 26 | MO | SKS ENGINEERS | 1997 |
| 272031 | 70 | 6N | 8E | 26 | MO | SKS ENGINEERS | |
| 401840 | | 6N | 8E | 26 | IC | | // |
| 62366 | 63 | 6N | 8E | 27 | IC | BAKER AND SONS | 1978 |
| 62367 | 65 | 6N | 8E | 27 | IC | BAKER AND SONS | 1978 |
| 62368 | 23 | 6N | 8E | 27 | IC | BAKER AND SONS | 1978 |
| 62369 | 65 | 6N | 8E | 27 | IC | BAKER AND SONS | 1978 |
| 246087 | 25 | 6N | 8E | 27 | DO | GREEN | 5/9/1991 |
| 62377 | 65 | 6N | 8E | 34 | IC | BAKER AND SONS | 1978 |
| 62378 | 78 | 6N | 8E | 34 | CO | BAKER AND SONS | 9/27/1978 |
| 401842 | | 6N | 8E | 34 | | | // |

Notes:

| | |
|---|---|
| IC | not specified |
| MO | not specified |
| DO | Domestic |
| CO | not specified |

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Private Water Well** | **Top** | **Bottom** |
|---|---|---|
| clay brown | 0 | 10 |
| clay brown sandy | 10 | 22 |
| clay brown & sand | 22 | 23 |
| clay gray hard | 23 | 30 |
| sand & gravel gray | 30 | 31 |
| clay gray hard | 31 | 36 |
| wood & clay gray | 36 | 37 |
| sand & gravel gray | 37 | 38 |
| wood & clay brown | 38 | 39 |
| clay gray | 39 | 45 |
| **Total Depth** | | **45** |

Casing: 6" PVC from -1' to 10'
36" CONCRETE from 10' to 45'

Grout: NATURAL from 0 to 9.

Grout: BENTONITE from 9 to 10.

Grout: PEA GRAVEL from 10 to 45.

Water from sand & gravel at 22' to 38'.

Remarks: driller's est. well yield 1 gpm

Address of well: 400th Ave & 550th St.

Location source: Location from permit

**Permit Date:** July 27, 2004 **Permit #:**

**COMPANY** Kohnen, Clarence

**FARM** Sparks, Lawrence

**DATE DRILLED** August 6, 2004 **NO.**

**ELEVATION** 0 **COUNTY NO.** 25378

**LOCATION** SW SW SE

**LATITUDE** 38.906984 **LONGITUDE** -88.267991

**COUNTY** **Jasper** **API** **120792537800** **36 - 6N - 8E**

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# ILLINOIS STATE GEOLOGICAL SURVEY

| **Private Water Well** | **Top** | **Bottom** |
|---|---|---|
| clay with sand streaks | 0 | 24 |
| sandy gravelly shale | 24 | 41 |
| sticky gravelly shale | 41 | 68 |
| soft shale | 68 | 72 |
| soft sandy gravelly shale | 72 | 83 |
| sandy gravelly shale | 83 | 90 |
| sandrock | 90 | 100 |
| sticky shale | 100 | 103 |
| sandy shale | 103 | 120 |
| sand shale with streaks lime & coal | 120 | 127 |
| sand shale with sandrock streaks | 127 | 148 |
| **Total Depth** | | **148** |

Casing: 8" PVC from 4' to 24'
5" PVC from 0' to 90'
5" PVC SCREEN from 90' to 148'

Screen: 58' of 5" diameter .12 slot

Grout: CEMENT/BENT. from 20 to 84.

Grout: SAND from 84 to 86.

Grout: PEA GRAVEL from 86 to 88.

Water from sandrock at 100' to 148'.
Static level 18' below casing top which is 2' above GL
Pumping level 143' when pumping at 0 gpm for 0 hours

Permanent pump installed at 143' on December 26, 2001, with a capacity of 10 gpm

Remarks: driller's est. well yield 5 gpm

Address of well: 4274 N 500th
Newton, IL

Location source: Location from permit

**Permit Date:** September 18, 2001 **Permit #:**

**COMPANY** Jones, Gerald K.
**FARM** Kirk, Pauline
**DATE DRILLED** September 21, 2001 **NO.**
**ELEVATION** 0 **COUNTY NO.** 25326
**LOCATION** SW NW SW
**LATITUDE** 38.910802 **LONGITUDE** -88.277353
**COUNTY Jasper** **API 120792532600** **36 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Private Water Well** | **Top** | **Bottom** |
|---|---|---|
| clay top soil | 0 | 4 |
| sandy lcay | 4 | 16 |
| soft brown sandstone | 16 | 22 |
| hard gray clay | 22 | 49 |
| muddy sand & gravel | 49 | 55 |
| hard gray clay | 55 | 75 |
| muddy sand & gravel | 75 | 78 |
| hard gray clay | 78 | 92 |
| shale | 92 | 103 |
| black shale | 103 | 104 |
| shale | 104 | 118 |
| coal | 118 | 119 |
| shale | 119 | 140 |
| **Total Depth** | | **140** |

Grout: BENT & CUTTINGS from 0 to 140.

Location source: Location from permit

**Permit Date:** March 6, 1992 **Permit #:** 021586

**COMPANY** Hacker, Tim

**FARM** Johnson, Mike

**DATE DRILLED** March 16, 1992 **NO.**

**ELEVATION** 0 **COUNTY NO.** 24855

**LOCATION** SE SE SW

**LATITUDE** 38.937733 **LONGITUDE** -88.30746

**COUNTY Jasper** **API 120792485500** **22 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| soil | 0 | 3 |
| yellow clay | 3 | 12 |
| yellow sandy clay (water) | 12 | 13 |
| yellow hardpan | 13 | 20 |
| glacial drit | 20 | 52 |
| gray sand (water) | 52 | 58 |
| glacial drift | 58 | 72 |
| sand (water) | 72 | 75 |
| glacial drift | 75 | 78 |
| **Total Depth** | | **78** |

Casing: 6" SCH.40 19#,BLK STEEL from -3' to 21'
36" CONCRETE PIPE from 21' to 78'

Water from drift at 21' to 78'.

Remarks: 750 1000 GPD estimated

Sample set # 61749 (0' - 80') Received: November 16, 1978

Location source: Location from permit

**Permit Date:** September 6, 1978 **Permit #:** 79078

**COMPANY** Baker, Earl Jr.

**FARM** CIPS & Dept.of Conservation

**DATE DRILLED** September 27, 1978 **NO.** 1

**ELEVATION** 0 **COUNTY NO.** 22906

**LOCATION** 100'N line, 2540'E line of NE

**LATITUDE** 38.922073 **LONGITUDE** -88.30585

**COUNTY** **Jasper** **API** **120792290600** **34 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| top soil | 0 | 1 |
| yellow clay | 1 | 9 |
| yellow sandy clay | 9 | 32 |
| gray sandy clay | 32 | 40 |
| **Total Depth** | | **40** |

Casing: 36" CONCRETE PIPE from -1' to 40'

Water from sandy clay at 30' to 31'.

Location source: Platbook verified

**Permit Date:** June 7, 1977 **Permit #:** 61756

**COMPANY** Kohnen, Clarence

**FARM** Marshall, Bernard

**DATE DRILLED** July 18, 1977 **NO.**

**ELEVATION** 0 **COUNTY NO.** 22903

**LOCATION** 110'N line, 121'W line of NE NW

**LATITUDE** 38.950274 **LONGITUDE** -88.292049

**COUNTY Jasper** **API 120792290300** **23 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| S.S. #61750 (0 - 65') | 0 | 0 |
| yellow clay showing water | 0 | 20 |
| brown sandy clay hard | 20 | 30 |
| blue silty clay | 30 | 63 |
| hard blue clay(possible shale no sample) | 63 | 65 |
| **Total Depth** | | **65** |

Driller's Log filed
Sample set # 61750 (0' - 65') Received: November 16, 1978

**Permit Date:**

**Permit #:**

**COMPANY** owner
**FARM** C. I. P. S.
**DATE DRILLED** January 1, 1978
**NO.** 1
**ELEVATION** 0
**COUNTY NO.** 22751
**LOCATION** 300'S 2500'E NW/c
**LATITUDE** 38.921562
**LONGITUDE** -88.306654
**COUNTY** **Jasper**
**API** **120792275100**
**34 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| S.S. #61754 (0 - 63') | 0 | 0 |
| yellow clay | 0 | 5 |
| blue clay | 5 | 30 |
| green sandy clay | 30 | 40 |
| blue gravelly clay | 40 | 53 |
| greenish blue sand | 53 | 55 |
| hard green clay x/ gravel | 55 | 62 |
| shale hard | 62 | 63 |
| **Total Depth** | | **63** |

Remarks: on road by lake 60' S. of high water
Driller's Log filed
Sample set # 61754 (0' - 63') Received: November 16, 1978

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** C. I. P. S.
**DATE DRILLED** January 1, 1978 **NO.** 5
**ELEVATION** 0 **COUNTY NO.** 22750
**LOCATION** 1200'N 2500'E SW/c
**LATITUDE** 38.92571 **LONGITUDE** -88.306701
**COUNTY Jasper** **API 120792275000** **27 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| S.S. #61753 (0 - 60') | 0 | 0 |
| gray clay | 0 | 10 |
| yellow clay | 10 | 25 |
| green dirty sand | 25 | 30 |
| hard blue sandy clay | 30 | 65 |
| **Total Depth** | | **65** |

Remarks: 20' E. of #3 30' S. 25' E. of STA 5200

Driller's Log filed

Sample set # 61753 (0' - 60') Received: November 16, 1978

**Permit Date:**

**Permit #:**

**COMPANY** owner

**FARM** C. I. P. S.

**DATE DRILLED** January 1, 1978

**NO.** 4

**ELEVATION** 0

**COUNTY NO.** 22749

**LOCATION** 600'N 2525'E SW/c

**LATITUDE** 38.924046

**LONGITUDE** -88.306602

**COUNTY Jasper**

**API 120792274900**

**27 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| S.S. #61752 (0 - 28') | 0 | 0 |
| gray clay | 0 | 5 |
| yellow clay | 5 | 15 |
| blue clay | 15 | 23 |
| rock (boulder) at | 23 | 23 |
| **Total Depth** | | **23** |

Driller's Log filed
Sample set # 61752 (0' - 28') Received: November 16, 1978

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** C. I. P. S.
**DATE DRILLED** January 1, 1978 **NO.** 3
**ELEVATION** 0 **COUNTY NO.** 22748
**LOCATION** 600'N 2500'E SW/c
**LATITUDE** 38.92405 **LONGITUDE** -88.30669
**COUNTY Jasper** **API 120792274800** **27 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| S.S. #61751 (0 - 65') | 0 | 0 |
| yellow clay hard | 0 | 20 |
| yellow & blue clay hard | 20 | 30 |
| hard blue clay sign of water | 30 | 55 |
| soft gravelly clay | 55 | 62 |
| hard blue clay | 62 | 65 |
| **Total Depth** | | **65** |

Remarks: 300' N. of Trailer St.
Driller's Log filed
Sample set # 61751 (0' - 65') Received: November 16, 1978

**Permit Date:** **Permit #:**

**COMPANY** owner
**FARM** C. I. P. S.
**DATE DRILLED** January 1, 1978 **NO.** 2
**ELEVATION** 0 **COUNTY NO.** 22747
**LOCATION** 300'N 2700'E SW/c
**LATITUDE** 38.923184 **LONGITUDE** -88.305977
**COUNTY Jasper** **API 120792274700** **27 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| top soil | 0 | 2 |
| yellow sandy clay | 2 | 14 |
| yellow sand | 14 | 15 |
| yellow clay | 15 | 32 |
| **Total Depth** | | **32** |

Casing: 36" CONCRETE PIPE from 32' to -1'

Water from yellow sand at 14' to 15'.

Driller's Log filed

Location source: Location from permit

**Permit Date:** August 14, 1975 **Permit #:** 40189

**COMPANY** Kohnen, Clarence

**FARM** Elmore, Paul

**DATE DRILLED** December 8, 1975 **NO.**

**ELEVATION** 0 **COUNTY NO.** 22595

**LOCATION** 109'N line, 117'E line of NE NE NW

**LATITUDE** 38.950928 **LONGITUDE** -88.306705

**COUNTY** **Jasper** **API** **120792259500** **22 - 6N - 8E**

**Page** 1

# ILLINOIS STATE GEOLOGICAL SURVEY

| **Water Well** | **Top** | **Bottom** |
|---|---|---|
| top soil brown | 0 | 1 |
| yellow clay | 1 | 15 |
| yellow sandy clay | 15 | 18 |
| blue clay | 18 | 30 |
| **Total Depth** | | **30** |

Casing: 36" CONCRETE from 30' to -1'

Water from yellow sandy clay at 15' to 18'.

Driller's Log filed

Location source: Location from permit

**Permit Date:** November 5, 1973 **Permit #:**

**COMPANY** Kohnen, Clarence

**FARM** Crouse, Ernest E

**DATE DRILLED** May 4, 1974 **NO.**

**ELEVATION** 0 **COUNTY NO.** 22503

**LOCATION** 79'N line, 87'W line of NE NW SE

**LATITUDE** 38.913043 **LONGITUDE** -88.266554

**COUNTY Jasper** **API 120792250300** **36 - 6N - 8E**

# APPENDIX C

# BORING LOGS WITH WELL DIAGRAMS

Surface Elevation: 529.93

Datum: msl

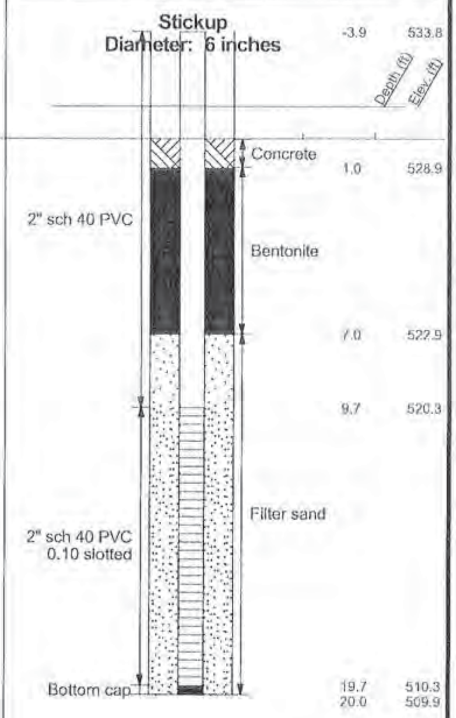
Completion Date: 6/19/10

Northing: 822688.04

Easting: 995465.25

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Soft, brown, silty CLAY - CL | ▨ | | |
| 5 | Stiff, brown, sandy CLAY - CL | ▨ | | |
| | Hard, brown, sandy CLAY with gravel - CL ∇ | ▨ | | |
| 10 | | | | |
| | Hard, dark gray CLAY and glacial till - CH | ▨ | | |
| 15 | | | | |
| 20 | Boring terminated at 20 feet. | | | |
| 25 | | | | |
| 30 | | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01ENV - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 2/22/11

**GROUNDWATER DATA**

ENCOUNTERED AT 8.5 FEET ∇

**DRILLING DATA**

4 1/4" AUGER ___ HOLLOW STEM

WASHBORING FROM ___ FEET

MVU DRILLER KCR LOGGER

CME 750X DRILL RIG

HAMMER TYPE Auto

**REMARKS:**

| | | |
|---|---|---|
| Drawn by: KA | Checked by: RBP | App'vd. by: DTK |
| Date: 6/29/10 | Date: 2-7-11 | Date: 2-7-11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren Power Plant
Newton, Illinois

LOG OF BORING: APW-2

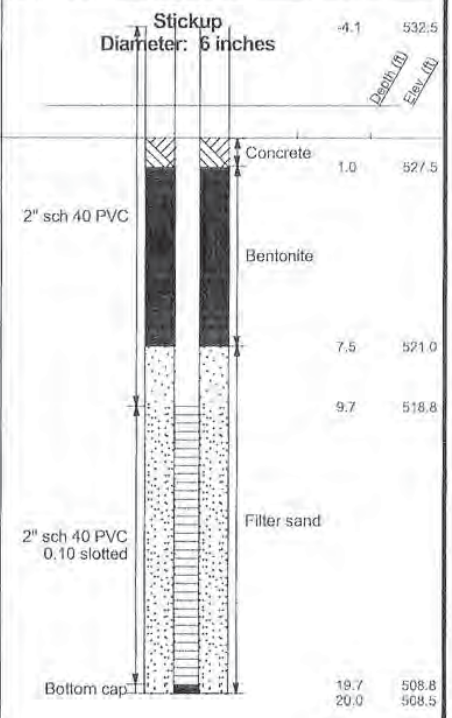
Project No. J017150.01

Surface Elevation: 528.47
Datum msl

Completion Date: 6/18/10
Northing: 821379.76
Easting: 998975.74

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Soft, brown, silty CLAY - CL | ▨ | | |
| 5 | | ▨ | | |
| | Soft, brown, sandy CLAY with gravel - CL | ▨ | | |
| | Hard, brown, sandy CLAY with gravel - CL | ▨ | | |
| 10 | | ▨ | | |
| | Hard, brownish-gray, sandy CLAY with gravel - CL | ▨ | | |
| 15 | | ▨ | | |
| 20 | Boring terminated at 20 feet. | | | |
| 25 | | | | |
| 30 | | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01ENV - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 2/22/11

**GROUNDWATER DATA**

X FREE WATER NOT ENCOUNTERED DURING DRILLING

**DRILLING DATA**

4 1/4" AUGER __ HOLLOW STEM
WASHBORING FROM __ FEET
MVU DRILLER KCR LOGGER
CME 750X DRILL RIG
HAMMER TYPE Auto

**REMARKS:**

| | | |
|---|---|---|
| Drawn by: KA | Checked by: RSJ | App'vd. by: DTK |
| Date: 6/29/10 | Date: 2/7/11 | Date: 2-7-11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren Power Plant
Newton, Illinois

LOG OF BORING: APW-3

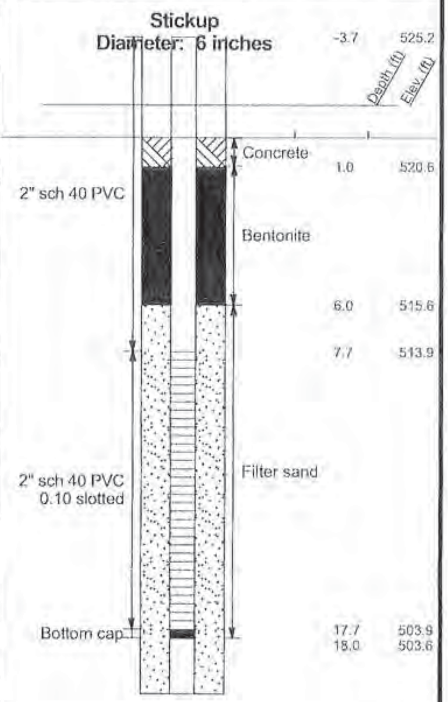
Project No. J017150.01

Surface Elevation: 521.56
Datum msl

Completion Date: 6/19/10
Northing: 823246.45
Easting: 1001379.56

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf)<br>SPT BLOW COUNTS<br>CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Soft, brown, silty CLAY - CL | ▨ | | |
| 5 | | ▨ | | |
| | Soft, brown, sandy CLAY - CL ∇ | ▨ | | |
| 10 | | ▨ | | |
| | Stiff, brown, sandy CLAY with gravel - CL | ▨ | | |
| 15 | | ▨ | | |
| | Boring terminated at 18 feet. | | | |
| 20 | | | | |
| 25 | | | | |
| 30 | | | | |
| 35 | | | | |

## WELL DIAGRAM



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

LOG OF BORING 2002 WL J017150.01ENV - AMEREN-NEWTON.GPJ GTINC 0638301.GPJ 2/7/2011

**GROUNDWATER DATA**

ENCOUNTERED AT 8 FEET ∇

**DRILLING DATA**

4 1/4" AUGER __ HOLLOW STEM
WASHBORING FROM __ FEET
MVU DRILLER KCR LOGGER
CME 750X DRILL RIG
HAMMER TYPE Auto

**REMARKS:**

| | | |
|---|---|---|
| Drawn by: KA | Checked by: RJS | App'vd. by: DRK |
| Date: 6/29/10 | Date: 2-7-11 | Date: 2-7-11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

Ameren Power Plant
Newton, Illinois

LOG OF BORING: APW-4

Project No. J017150.01

# APPENDIX D

# GROUNDWATER QUALITY DATA SUMMARY

## Groundwater Monitoring Data: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| Well Id | Date Sampled | Lab Id | Ag, diss, mg/L | As, diss, mg/L | B, diss, mg/L | Ba, diss, mg/L | Be, diss, mg/L | Cd, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-2 | 11/30/2010 | | <0.005 | <0.004 | 0.177 | <0.050 | <0.004 | <0.004 |
| | 02/08/2011 | 11021675-1 | <0.005 | 0.005 | 0.077 | 0.012 | <0.001 | <0.001 |
| | 05/04/2011 | 1050662-01 | <0.005 | 0.005 | 0.098 | 0.014 | <0.001 | <0.001 |
| | 07/12/2011 | 1071269-01 | <0.005 | 0.005 | 0.140 | 0.011 | <0.001 | <0.001 |
| | 10/11/2011 | 1101050-01 | <0.005 | 0.004 | 0.160 | 0.011 | <0.001 | <0.001 |
| | 01/31/2012 | 2020003-01 | <0.005 | 0.004 | 0.150 | 0.012 | <0.001 | <0.001 |
| | 04/10/2012 | 2041295-01 | <0.005 | 0.005 | 0.170 | 0.011 | <0.001 | <0.001 |
| | 07/17/2012 | 2072218-01 | <0.005 | 0.003 | 0.120 | 0.009 | <0.001 | <0.001 |
| APW-3 | 11/30/2010 | | <0.005 | <0.004 | 0.654 | 0.065 | <0.004 | <0.004 |
| | 02/08/2011 | 11021675-2 | <0.005 | 0.001 | 0.340 | 0.052 | <0.001 | <0.001 |
| | 05/04/2011 | 1050662-02 | <0.005 | 0.002 | 0.330 | 0.053 | <0.001 | <0.001 |
| | 07/12/2011 | 1071269-02 | <0.005 | 0.001 | 0.490 | 0.058 | <0.001 | <0.001 |
| | 10/11/2011 | 1101050-02 | <0.005 | 0.002 | 0.510 | 0.082 | <0.001 | <0.001 |
| | 01/31/2012 | 2020003-02 | <0.005 | 0.002 | 0.400 | 0.058 | <0.001 | <0.001 |
| | 04/10/2012 | 2041295-02 | <0.005 | 0.001 | 0.400 | 0.054 | <0.001 | <0.001 |
| | 07/17/2012 | 2072218-02 | <0.005 | 0.002 | 0.440 | 0.060 | <0.001 | <0.001 |
| APW-4 | 11/30/2010 | | <0.005 | <0.004 | <0.100 | <0.050 | <0.004 | <0.004 |
| | 02/08/2011 | 11021675-3 | <0.005 | 0.002 | <0.010 | 0.013 | <0.001 | <0.001 |
| | 05/04/2011 | 1050662-03 | <0.005 | 0.002 | 0.022 | 0.014 | <0.001 | <0.001 |
| | 07/12/2011 | 1071269-03 | <0.005 | 0.001 | 0.036 | 0.014 | <0.001 | <0.001 |
| | 10/11/2011 | 1101050-03 | <0.005 | 0.001 | 0.035 | 0.017 | <0.001 | <0.001 |
| | 01/31/2012 | 2020003-03 | <0.005 | 0.001 | 0.018 | 0.013 | <0.001 | <0.001 |
| | 04/10/2012 | 2041295-03 | <0.005 | 0.002 | 0.033 | 0.013 | <0.001 | <0.001 |
| | 07/17/2012 | 2072218-03 | <0.005 | <0.001 | 0.023 | 0.014 | <0.001 | <0.001 |
| G116 | 07/12/2011 | 1071268-04 | <0.005 | 0.002 | <0.010 | 0.240 | <0.001 | <0.001 |
| | 10/11/2011 | 1101046-04 | <0.005 | <0.001 | <0.010 | 0.200 | <0.001 | <0.001 |
| | 01/31/2012 | 2020002-05 | <0.005 | <0.001 | <0.010 | 0.230 | <0.001 | <0.001 |
| | 04/10/2012 | 2041298-05 | <0.005 | <0.001 | <0.010 | 0.200 | <0.001 | <0.001 |
| | 07/17/2012 | 2072216-04 | <0.005 | <0.001 | <0.010 | 0.180 | <0.001 | <0.001 |

## Groundwater Monitoring Data: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| Well Id | Date Sampled | Lab Id | Cl, diss, mg/L | CN, total, mg/L | Co, diss, mg/L | Cr, diss, mg/L | Cu, diss, mg/L | F, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-2 | 11/30/2010 |  | 63.000 | <0.010 | <0.050 | <0.010 | <0.025 | 0.500 |
|  | 02/08/2011 | 11021675-1 | 93.000 | <0.005 | <0.002 | 0.005 | 0.006 | <0.250 |
|  | 05/04/2011 | 1050662-01 |  | <0.005 | 0.002 | 0.008 | 0.008 |  |
|  | 05/11/2011 | 1051461-01 | 98.000 |  |  |  |  | <0.250 |
|  | 07/12/2011 | 1071269-01 | 120.000 | <0.005 | <0.002 | 0.008 | 0.008 | <0.250 |
|  | 10/11/2011 | 1101050-01 | 120.000 | <0.005 | 0.004 | 0.026 | 0.009 | <620.000 |
|  | 01/31/2012 | 2020003-01 | 100.000 | <0.005 | 0.003 | 0.007 | 0.005 | <0.250 |
|  | 04/10/2012 | 2041295-01 | 110.000 | <0.005 | 0.003 | 0.006 | 0.010 | <0.250 |
|  | 07/17/2012 | 2072218-01 | 120.000 | <0.005 | 0.002 | <0.004 | 0.006 | 0.830 |
| APW-3 | 11/30/2010 |  | 12.500 | <0.010 | <0.050 | <0.010 | <0.025 | 0.240 |
|  | 02/08/2011 | 11021675-2 | 13.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.260 |
|  | 05/04/2011 | 1050662-02 |  | <0.005 | <0.002 | <0.004 | <0.003 |  |
|  | 05/11/2011 | 1051461-02 | 11.000 |  |  |  |  | 0.270 |
|  | 07/12/2011 | 1071269-02 | 15.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.340 |
|  | 10/11/2011 | 1101050-02 | 12.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.400 |
|  | 01/31/2012 | 2020003-02 | 12.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.270 |
|  | 04/10/2012 | 2041295-02 | 14.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.270 |
|  | 07/17/2012 | 2072218-02 | 16.000 | <0.005 | <0.002 | <0.004 | <0.003 | 1.200 |
| APW-4 | 11/30/2010 |  | 22.500 | <0.010 | <0.050 | <0.010 | <0.025 | 0.180 |
|  | 02/08/2011 | 11021675-3 | 26.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
|  | 05/04/2011 | 1050662-03 |  | <0.005 | <0.002 | <0.004 | <0.003 |  |
|  | 05/11/2011 | 1051461-03 | 29.000 |  |  |  |  | <0.250 |
|  | 07/12/2011 | 1071269-03 | 27.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
|  | 10/11/2011 | 1101050-03 | 32.000 | <0.005 | <0.002 | <0.004 | 0.003 | 0.320 |
|  | 01/31/2012 | 2020003-03 | 27.000 | <0.005 | <0.002 | <0.004 | <0.003 | <0.250 |
|  | 04/10/2012 | 2041295-03 | 27.000 | <0.005 | <0.002 | <0.004 | 0.003 | <0.250 |
|  | 07/17/2012 | 2072218-03 | 31.000 | <0.005 | 0.002 | <0.004 | <0.003 | <2.500 |
| G116 | 07/12/2011 | 1071268-04 | 63.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.430 |
|  | 10/11/2011 | 1101046-04 | 37.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.490 |
|  | 01/31/2012 | 2020002-05 | 38.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.410 |
|  | 04/10/2012 | 2041298-05 | 40.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.380 |
|  | 07/17/2012 | 2072216-04 | 32.000 | <0.005 | <0.002 | <0.004 | <0.003 | 0.490 |

## Groundwater Monitoring Data: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| Well Id | Date Sampled | Lab Id | Fe, diss, mg/L | GW Depth (TOC), ft | Hg, diss, mg/L | Mn, diss, mg/L | Ni, diss, mg/L | NO3, diss, mg/L |
|---|---|---|---|---|---|---|---|---|
| APW-2 | 11/30/2010 |  | 0.121 | 10.850 | <0.0002 | 0.907 | <0.040 | <0.110 |
|  | 02/08/2011 | 11021675-1 | <0.010 | 4.400 | <0.0002 | 0.170 | 0.043 | 0.067 |
|  | 05/04/2011 | 1050662-01 | 0.140 | 4.200 | <0.0002 | 0.240 | 0.037 |  |
|  | 05/11/2011 | 1051461-01 |  |  |  |  |  | 0.090 |
|  | 07/12/2011 | 1071269-01 | 0.019 | 4.100 | <0.0002 | 0.630 | 0.045 | 0.050 |
|  | 10/11/2011 | 1101050-01 | <0.010 | 4.200 | <0.0002 | 0.910 | 0.039 | 0.060 |
|  | 01/31/2012 | 2020003-01 | <0.010 | 4.200 | <0.0002 | 0.710 | 0.033 | 0.070 |
|  | 04/10/2012 | 2041295-01 | 0.120 | 6.000 | <0.0002 | 0.450 | 0.038 | 0.050 |
|  | 07/17/2012 | 2072218-01 | 0.014 | 8.550 | <0.0002 | 0.650 | 0.035 | 0.140 |
| APW-3 | 11/30/2010 |  | <0.100 | 9.630 | <0.0002 | 0.113 | <0.040 | <0.110 |
|  | 02/08/2011 | 11021675-2 | <0.010 | 7.150 | <0.0002 | 0.088 | 0.011 | <0.020 |
|  | 05/04/2011 | 1050662-02 | 0.034 | 5.600 | <0.0002 | 0.049 | 0.006 |  |
|  | 05/11/2011 | 1051461-02 |  |  |  |  |  | 0.030 |
|  | 07/12/2011 | 1071269-02 | <0.010 | 5.700 | <0.0002 | 0.044 | 0.007 | 0.050 |
|  | 10/11/2011 | 1101050-02 | <0.010 | 5.600 | <0.0002 | 0.024 | 0.006 | 0.060 |
|  | 01/31/2012 | 2020003-02 | <0.010 | 6.000 | <0.0002 | 0.032 | <0.005 | 0.050 |
|  | 04/10/2012 | 2041295-02 | 0.046 | 6.200 | <0.0002 | 0.049 | 0.007 | <0.020 |
|  | 07/17/2012 | 2072218-02 | <0.010 | 10.800 | <0.0002 | 0.018 | 0.005 | 3.200 |
| APW-4 | 11/30/2010 |  | <0.100 | 6.820 | <0.0002 | 0.176 | <0.040 | <0.110 |
|  | 02/08/2011 | 11021675-3 | <0.010 | 4.300 | <0.0002 | 0.210 | 0.023 | 0.051 |
|  | 05/04/2011 | 1050662-03 | 0.061 | 4.300 | <0.0002 | 0.240 | 0.018 |  |
|  | 05/11/2011 | 1051461-03 |  |  |  |  |  | 0.020 |
|  | 07/12/2011 | 1071269-03 | <0.010 | 4.200 | <0.0002 | 0.260 | 0.021 | <0.020 |
|  | 10/11/2011 | 1101050-03 | <0.010 | 4.300 | <0.0002 | 0.270 | 0.018 | 0.040 |
|  | 01/31/2012 | 2020003-03 | <0.010 | 4.500 | <0.0002 | 0.220 | 0.014 | <0.020 |
|  | 04/10/2012 | 2041295-03 | 0.036 | 5.700 | <0.0002 | 0.250 | 0.017 | <0.020 |
|  | 07/17/2012 | 2072218-03 | <0.010 | 5.000 | <0.0002 | 0.140 | 0.018 | 0.060 |
| G116 | 07/12/2011 | 1071268-04 | <0.010 | 4.600 | <0.0002 | 0.009 | <0.005 | <0.020 |
|  | 10/11/2011 | 1101046-04 | <0.010 | 7.410 | <0.0002 | 0.010 | <0.005 | <0.020 |
|  | 01/31/2012 | 2020002-05 | 0.017 | 7.550 | <0.0002 | <0.001 | <0.005 | <0.020 |
|  | 04/10/2012 | 2041298-05 | <0.010 | 6.300 | <0.0002 | 0.002 | <0.005 | <0.020 |
|  | 07/17/2012 | 2072216-04 | <0.010 | 6.660 | <0.0002 | 0.027 | <0.005 | <0.020 |

December 12, 2012
1:00:52 PM

## Groundwater Monitoring Data: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| Well Id | Date Sampled | Lab Id | Pb, diss, mg/L | pH (field), STD | Sb, diss, mg/L | Se, diss, mg/L | SO4, diss, mg/L | Spec. Cond. (field), |
|---|---|---|---|---|---|---|---|---|
| APW-2 | 11/30/2010 | | <0.0050 | 5.450 | <0.006 | <0.010 | 2,890.000 | 4,410.000 |
| | 02/08/2011 | 11021675-1 | 0.0011 | 6.870 | <0.003 | 0.003 | 3,300.000 | 6,020.000 |
| | 05/04/2011 | 1050662-01 | <0.0010 | 6.810 | <0.003 | 0.022 | | 5,770.000 |
| | 05/11/2011 | 1051461-01 | | | | | 3,300.000 | |
| | 07/12/2011 | 1071269-01 | <0.0010 | 6.820 | <0.003 | 0.024 | 2,900.000 | 5,960.000 |
| | 10/11/2011 | 1101050-01 | <0.0010 | 6.880 | <0.003 | 0.019 | 3,700.000 | 5,950.000 |
| | 01/31/2012 | 2020003-01 | <0.0010 | 6.920 | <0.003 | 0.013 | 3,000.000 | 5,000.000 |
| | 04/10/2012 | 2041295-01 | 0.0013 | 6.810 | <0.003 | 0.020 | 2,300.000 | 5,150.000 |
| | 07/17/2012 | 2072218-01 | <0.0010 | 6.890 | <0.003 | 0.014 | 3,200.000 | 5,160.000 |
| APW-3 | 11/30/2010 | | <0.0050 | 6.070 | <0.006 | <0.010 | 241.000 | 906.000 |
| | 02/08/2011 | 11021675-2 | <0.0010 | 7.310 | <0.003 | <0.001 | 170.000 | 1,048.000 |
| | 05/04/2011 | 1050662-02 | <0.0010 | 7.260 | <0.003 | 0.007 | | 1,019.000 |
| | 05/11/2011 | 1051461-02 | | | | | 180.000 | |
| | 07/12/2011 | 1071269-02 | <0.0010 | 7.280 | <0.003 | 0.009 | 170.000 | 1,051.000 |
| | 10/11/2011 | 1101050-02 | <0.0010 | 7.180 | <0.003 | 0.007 | 190.000 | 1,030.000 |
| | 01/31/2012 | 2020003-02 | <0.0010 | 7.240 | <0.003 | 0.006 | 170.000 | 917.000 |
| | 04/10/2012 | 2041295-02 | <0.0010 | 7.260 | <0.003 | 0.008 | 180.000 | 901.000 |
| | 07/17/2012 | 2072218-02 | <0.0010 | 7.190 | <0.003 | 0.009 | 160.000 | 906.000 |
| APW-4 | 11/30/2010 | | <0.0050 | 5.650 | <0.006 | <0.010 | 618.000 | 2,490.000 |
| | 02/08/2011 | 11021675-3 | <0.0010 | 7.060 | <0.003 | <0.001 | 1,300.000 | 3,050.000 |
| | 05/04/2011 | 1050662-03 | <0.0010 | 6.920 | <0.003 | 0.008 | | 3,010.000 |
| | 05/11/2011 | 1051461-03 | | | | | 1,300.000 | |
| | 07/12/2011 | 1071269-03 | <0.0010 | 7.010 | <0.003 | 0.007 | 1,300.000 | 3,060.000 |
| | 10/11/2011 | 1101050-03 | <0.0010 | 7.120 | <0.003 | 0.008 | 1,300.000 | 3,080.000 |
| | 01/31/2012 | 2020003-03 | <0.0010 | 7.050 | <0.003 | 0.005 | 680.000 | 2,674.000 |
| | 04/10/2012 | 2041295-03 | <0.0010 | 7.030 | <0.003 | 0.008 | 1,500.000 | 2,645.000 |
| | 07/17/2012 | 2072218-03 | <0.0010 | 6.990 | <0.003 | 0.004 | 1,400.000 | 2,660.000 |
| G116 | 07/12/2011 | 1071268-04 | <0.0010 | 7.640 | <0.003 | 0.010 | 43.000 | 1,163.000 |
| | 10/11/2011 | 1101046-04 | <0.0010 | 7.110 | <0.003 | 0.002 | 41.000 | 1,140.000 |
| | 01/31/2012 | 2020002-05 | <0.0010 | 7.150 | <0.003 | 0.004 | 45.000 | 1,014.000 |
| | 04/10/2012 | 2041298-05 | 0.0023 | 6.990 | <0.003 | 0.005 | 44.000 | 977.000 |
| | 07/17/2012 | 2072216-04 | <0.0010 | 7.000 | <0.003 | 0.002 | 40.000 | 1,000.000 |

December 12, 2012
1:00:52 PM

## Groundwater Monitoring Data: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| Well Id | Date Sampled | Lab Id | TDS, mg/L | Temp (Fahrenheit), | Tl, diss, mg/L | Zn, diss, mg/L |
|---|---|---|---|---|---|---|
| APW-2 | 11/30/2010 | | 1,910.000 | 59.800 | <0.002 | 0.043 |
| | 02/08/2011 | 11021675-1 | 5,000.000 | 50.000 | <0.001 | 0.039 |
| | 05/04/2011 | 1050662-01 | 5,100.000 | 53.000 | <0.001 | 0.042 |
| | 07/12/2011 | 1071269-01 | 5,100.000 | 65.000 | <0.001 | 0.039 |
| | 10/11/2011 | 1101050-01 | 5,000.000 | 62.000 | <0.001 | 0.032 |
| | 01/31/2012 | 2020003-01 | 5,000.000 | 55.000 | <0.001 | 0.160 |
| | 04/10/2012 | 2041295-01 | 4,900.000 | 57.000 | <0.001 | 0.062 |
| | 07/17/2012 | 2072218-01 | 5,200.000 | 62.000 | <0.001 | 0.049 |
| APW-3 | 11/30/2010 | | 647.000 | 58.820 | <0.002 | 0.037 |
| | 02/08/2011 | 11021675-2 | 590.000 | 48.000 | <0.001 | 0.009 |
| | 05/04/2011 | 1050662-02 | 640.000 | 54.000 | <0.001 | 0.010 |
| | 07/12/2011 | 1071269-02 | 600.000 | 64.000 | <0.001 | <0.006 |
| | 10/11/2011 | 1101050-02 | 610.000 | 63.000 | <0.001 | <0.006 |
| | 01/31/2012 | 2020003-02 | 560.000 | 57.000 | <0.001 | 0.009 |
| | 04/10/2012 | 2041295-02 | 570.000 | 56.000 | <0.001 | 0.009 |
| | 07/17/2012 | 2072218-02 | 590.000 | 64.000 | <0.001 | <0.006 |
| APW-4 | 11/30/2010 | | 1,920.000 | 58.640 | <0.002 | 0.023 |
| | 02/08/2011 | 11021675-3 | 2,300.000 | 46.000 | <0.001 | 0.027 |
| | 05/04/2011 | 1050662-03 | 2,400.000 | 53.000 | <0.001 | 0.013 |
| | 07/12/2011 | 1071269-03 | 2,300.000 | 65.000 | <0.001 | 0.039 |
| | 10/11/2011 | 1101050-03 | 2,200.000 | 62.000 | <0.001 | 0.092 |
| | 01/31/2012 | 2020003-03 | 2,400.000 | 56.000 | <0.001 | 0.017 |
| | 04/10/2012 | 2041295-03 | 2,200.000 | 56.000 | <0.001 | 0.017 |
| | 07/17/2012 | 2072218-03 | 2,400.000 | 65.000 | <0.001 | 0.015 |
| G116 | 07/12/2011 | 1071268-04 | 640.000 | 64.000 | <0.001 | <0.006 |
| | 10/11/2011 | 1101046-04 | 600.000 | 63.000 | <0.001 | <0.006 |
| | 01/31/2012 | 2020002-05 | 580.000 | 56.000 | <0.001 | 0.018 |
| | 04/10/2012 | 2041298-05 | 590.000 | 60.000 | <0.001 | <0.006 |
| | 07/17/2012 | 2072216-04 | 570.000 | 67.000 | <0.001 | <0.006 |

# APPENDIX E

# EXCEEDANCES OF CLASS I GROUNDWATER STANDARDS

December 12, 2012
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# Exceedances of Class I Groundwater Standards: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| LimitType | Parameter | Code | Units | Location | Sample Date | Analysis Result | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|---|
| State Std | Mn, diss | 01056 | mg/L | APW-2 | 11/30/2010 | 0.907 | | 0.150 |
| | | | | | 02/08/2011 | 0.170 | | 0.150 |
| | | | | | 05/04/2011 | 0.240 | | 0.150 |
| | | | | | 07/12/2011 | 0.630 | | 0.150 |
| | | | | | 10/11/2011 | 0.910 | | 0.150 |
| | | | | | 01/31/2012 | 0.710 | | 0.150 |
| | | | | | 04/10/2012 | 0.450 | | 0.150 |
| | | | | | 07/17/2012 | 0.650 | | 0.150 |
| | | | | APW-4 | 11/30/2010 | 0.176 | | 0.150 |
| | | | | | 02/08/2011 | 0.210 | | 0.150 |
| | | | | | 05/04/2011 | 0.240 | | 0.150 |
| | | | | | 07/12/2011 | 0.260 | | 0.150 |
| | | | | | 10/11/2011 | 0.270 | | 0.150 |
| | | | | | 01/31/2012 | 0.220 | | 0.150 |
| | | | | | 04/10/2012 | 0.250 | | 0.150 |
| | pH (field) | 00400 | STD | APW-2 | 11/30/2010 | 5.450 | 6.500 | |
| | | | | APW-3 | 11/30/2010 | 6.070 | 6.500 | |
| | | | | APW-4 | 11/30/2010 | 5.650 | 6.500 | |
| | SO4, diss | 00946 | mg/L | APW-2 | 11/30/2010 | 2,890.000 | | 400.000 |
| | | | | | 02/08/2011 | 3,300.000 | | 400.000 |
| | | | | | 05/11/2011 | 3,300.000 | | 400.000 |
| | | | | | 07/12/2011 | 2,900.000 | | 400.000 |
| | | | | | 10/11/2011 | 3,700.000 | | 400.000 |
| | | | | | 01/31/2012 | 3,000.000 | | 400.000 |
| | | | | | 04/10/2012 | 2,300.000 | | 400.000 |
| | | | | | 07/17/2012 | 3,200.000 | | 400.000 |
| | | | | APW-4 | 11/30/2010 | 618.000 | | 400.000 |
| | | | | | 02/08/2011 | 1,300.000 | | 400.000 |
| | | | | | 05/11/2011 | 1,300.000 | | 400.000 |
| | | | | | 07/12/2011 | 1,300.000 | | 400.000 |
| | | | | | 10/11/2011 | 1,300.000 | | 400.000 |
| | | | | | 01/31/2012 | 680.000 | | 400.000 |
| | | | | | 04/10/2012 | 1,500.000 | | 400.000 |
| | | | | | 07/17/2012 | 1,400.000 | | 400.000 |
| | TDS | 00515 | | APW-2 | 11/30/2010 | 1,910.000 | | 1,200.000 |
| | | | | | 02/08/2011 | 5,000.000 | | 1,200.000 |
| | | | | | 05/04/2011 | 5,100.000 | | 1,200.000 |

December 12, 2012
1:05:46 PM

# Exceedances of Class I Groundwater Standards: November 2010 - July 2012

**Date Range: 11/01/2010 to 08/01/2012**

| LimitType | Parameter | Code | Units | Location | Sample Date | Analysis Result | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|---|
| State Std | TDS | 00515 | mg/L | APW-2 | 07/12/2011 | 5,100.000 | | 1,200.000 |
| | | | | | 10/11/2011 | 5,000.000 | | 1,200.000 |
| | | | | | 01/31/2012 | 5,000.000 | | 1,200.000 |
| | | | | | 04/10/2012 | 4,900.000 | | 1,200.000 |
| | | | | | 07/17/2012 | 5,200.000 | | 1,200.000 |
| | | | | APW-4 | 11/30/2010 | 1,920.000 | | 1,200.000 |
| | | | | | 02/08/2011 | 2,300.000 | | 1,200.000 |
| | | | | | 05/04/2011 | 2,400.000 | | 1,200.000 |
| | | | | | 07/12/2011 | 2,300.000 | | 1,200.000 |
| | | | | | 10/11/2011 | 2,200.000 | | 1,200.000 |
| | | | | | 01/31/2012 | 2,400.000 | | 1,200.000 |
| | | | | | 04/10/2012 | 2,200.000 | | 1,200.000 |
| | | | | | 07/17/2012 | 2,400.000 | | 1,200.000 |

# CHAPTER 4

# AFFIDAVIT OF DUANE HARLEY

# AFFIDAVIT OF DUANE E. HARLEY

My name is Duane E. Harley and I am the Senior Director of Engineering for Ameren Energy Resources ("AER"). Through its subsidiary companies Ameren Energy Generating, Ameren Energy Resources Generating Company, and Electric Energy Inc. (collectively, the "AER Companies"), AER owns and operates the following coal fired generating stations: Duck Creek, E.D. Edwards, Coffeen, Newton, Meredosia, Hutsonville and Joppa. We also own and operate Grand Tower Power Station, which was a coal-fired plant prior to conversion to gas in 2001. Should the Board enact the proposed rulemaking, there are ash ponds at every facility and across the AER system that would be subject to the proposed regulations.

The rulemaking proposal sponsored by the AER Companies describes the process by which ash ponds across the AER system would be evaluated to determine whether the existing ash pond systems are resulting in exceedances of groundwater quality standards and whether such exceedances, if they do exist, pose a risk to human health. In this regard, and as described more fully in the affidavit of Gary King, the proposed rulemaking is similar to the regulatory approach and concepts adopted by the Illinois Pollution Control Board and embodied in the Site Remediation Program (SRP). If adopted by the Board here, such an approach would allow the AER Companies to address and ultimately to close ash ponds across its system in an orderly and cost effective manner that is both protective of human health and the environment and aligns with federal regulations under consideration by the United States Environmental Protection Agency (USEPA).[1] While other witnesses will address the environmental aspects of the proposed rule, I will describe the purpose and function of ash ponds. I will address the costs associated with closure, as well as the various engineering and construction activities attendant to closure.

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[1] *Hazardous and Solid Waste Management Systems; Identification and Listing of Special Wastes; Disposal of Coal Combustion Residuals from Electric Utilities*, 75 Fed. Reg. 335128 (Jun. 21, 2010).

AER's energy centers are all located near large water bodies either on rivers (Illinois, Wabash, Mississippi, and Ohio) or cooling reservoirs (Coffeen, Newton, Duck Creek). Coal is the primary boiler fuel source and as a consequence the plants generate large quantities of ash as a byproduct of the combustion process. Coal combustion by-product (CCB material) is managed on-site by removing the material from the hoppers or emission control equipment and then conveying such material to surface impoundments. While some of our facilities now manage ash in a dry state, historically ash is transported via sluice waters from hoppers located underneath the boiler to the ash impoundments. So that excess solids are not released into river or lake systems, the ash impoundments are constructed so as to allow CCBs to settle into the basins. Sluice waters can then be recycled back through the plant process or discharged into an adjacent river or receiving lake. The impoundments are operated in accordance with permits issued by the Illinois Environmental Protection Agency (IEPA) - Bureau of Water and are regulated as water treatment devices.

These impoundments are decades old and were designed and constructed in accordance with then existing practices utilizing clay or native soil materials. As a consequence of the construction methods and the deposition of materials of the bottom of the impoundment, over the years, sluice water can come in contact with groundwater. As the Pollution Control Board noted in *In the matter of: Ameren Ashpond Closure Rules (Hutsonville Power Station): Proposed 35 Ill. Adm. Code 840.101 through 840.152*, R09-21 (Jan. 20, 2011) ("*Hutsonville Rule*"), the removal of CCB material and the retrofitting of these ponds with liners and leachate control systems, while standard engineering design requirements today, is not technologically and economically feasible.[2]

AER has evaluated the excavation and landfill disposal costs associated with the removal of ponded ash material and such costs are simply exorbitant. Disposal of ash from an

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[2] *Hutsonville Rule*, R09-21, slip op. at 69 (Oct. 7, 2010).

impoundment includes multiple steps: excavation; stacking of the ash to allow for decanting to lower the moisture content prior to hauling; loading decanted ash; and hauling to a landfill. Due to moisture in the ash, we estimate the unit weight will be approximately 135 pounds per cubic foot, or 1.8 tons per cubic yard. AER estimates the total volume of ponded CCB to be approximately 48 million tons. If this material was hauled off-site to a special waste landfill for disposal, such costs could total nearly $2.1 billion. The construction of on-site landfills would reduce such costs to approximately $481 million. Appended hereto as Exhibit 1 is a chart that reflects the estimated cost associated with such disposal options.

Set forth below is a table that identifies the impoundments within the AER system that could ultimately be subject to closure by the proposed rulemaking. The estimated capital cost of capping the impoundments is based upon the costs recently incurred at Hutsonville Ash Pond D pursuant to the *Hutsonville Rule* and scaled based on existing acreage of the individual ponds. While such figures will undergo considerable refinement as part of the engineering process, they represent the best figures currently available.

**Ameren Energy Generating**

| Plant | Ash Pond Status | In Service | Acreage | Retirement Cost |
|---|---|---|---|---|
| Coffeen | Inactive | 1972 | 60 | $1.9M |
|  | Active | 1979 | 23 | $6.4M |
| Newton | Active | 1977 | 400 | $28.9M |
|  | Active | 1977 | 10 | $0.5M |
| Meredosia | Inactive | 1968 | 34 | $6.5M |
|  | Inactive | 1972 | 11 | $1.9M |
| Hutsonville[3] | Active (Four Ponds) | 1968/1984/2000 | 20 | $5.0M |
| Grand Tower | Active | 1951 | 23 | $4.3M |

**Ameren Energy Resources Generating**

| Plant | Ash Pond Status | In Service | Acreage | Retirement Cost |
|---|---|---|---|---|
| Duck Creek | Inactive | 1976 | 85 | $10.0M |
|  | Inactive | 1985 | 58 | $12.8M |
| Edwards | Active | 1970 | 89 | $16.7M |

**Electric Energy Inc.**

| Plant | Ash Pond Status | In Service | Acreage | Retirement Cost |
|---|---|---|---|---|
| Joppa | Active | 1973/1985 | 107 | $12.6M |
|  | Inactive | 1955 | 84 | $10.8M |

**Total $118.3M**

Ash pond closures are site specific and these large, multi-acre projects that must be tailored to each facility and individually designed. The closure of an ash pond requires the stabilizing, grading, and capping of CCB materials that have been deposited in ponds over the course of decades. Engineering design elements include the following: stacking and dewatering of CCB materials; compaction to prevent subsidence; and sloping. Protection of the groundwater

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[3] AEG recently completed the closure of a 22-acre impoundment known as Ash Pond D at its Hutsonville Energy Center. Costs associated with that impoundment total nearly $7 million. Of the remaining impoundments, the bottom ash pond is unlined. However, the most cost effective alternative for closure of the remaining ash pond system (including lined ponds) entails the "clean closure" of the bottom ash pond by relocating CCB materials into one of the lined impoundments and capping.

is accomplished by installing a geomembrane liner[4] on top of the CCB materials. The cap is designed to prevent precipitation from infiltrating the ash thereby mitigating the mechanism through which the coal constituents can be released. Under drainage and storm water systems are designed and built to prevent standing water and to minimize erosion.

As mentioned, in 2012 AEG completed the closure of an ash pond at its Hustonville generating station. Appended to my affidavit as Exhibit 2 is a high level schedule which delineates the various project milestones including the following: development and submission of closure plan to IEPA; internal work order approval procedures and cash flow estimates; establish purchase order for engineering services; preparation of construction bid package; selection of contractor and establishment of purchase order and commercial terms; and site construction activities. Also attached as Exhibit 3 are photographs from the Hutsonville ash pond closure project which depict the pond prior to closure; the compacted ash materials; the geomembrane liner and the site with a vegetative cover.

It is important to note that the above figures represent only the cost to cap the ash ponds and not costs associated with other capital projects that may occur in conjunction with closure. For example, in addition to CCB materials, some of the ash ponds are used to manage the following low volume waste streams: storm water and coal pile runoff; demineralizer waste from water treatment purification processes; and plant sumps, drains and boiler blow down. Those waste streams would need to be routed into treatment basins which must be engineered and constructed prior to removal of the ash pond from service. Such costs would vary from station to station but current estimates range in magnitude from $1 million - $2 million depending upon the size of the basin. More significantly, the majority of the power stations would require modifications to transition to a dry bottom ash handling process. Detailed engineering would need to be performed to specifically quantify the costs associated with these

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[4] Geomembrane liners cost approximately $0.85 per square foot, installed.

modifications to enable bottom ash to be removed, stacked and conveyed to dry disposal facilities. Costs associated with bottom ash conversions are considerable (ranging from approximately $12 to $31 million depending upon the facility). Current estimates on a fleet wide basis total $105 million. This would be in addition to the estimated ash pond capping/closure costs of $118 million.

Further, Affiant sayeth not.

Duane E. Harley

Duane E. Harley

Subscribed and sworn to before me

this 9 day of April, 2013

Sherry Radae

Notary Public

OFFICIAL SEAL
SHERRY RADAE
Notary Public - State of Illinois
My Commission Expires Aug 15, 2016

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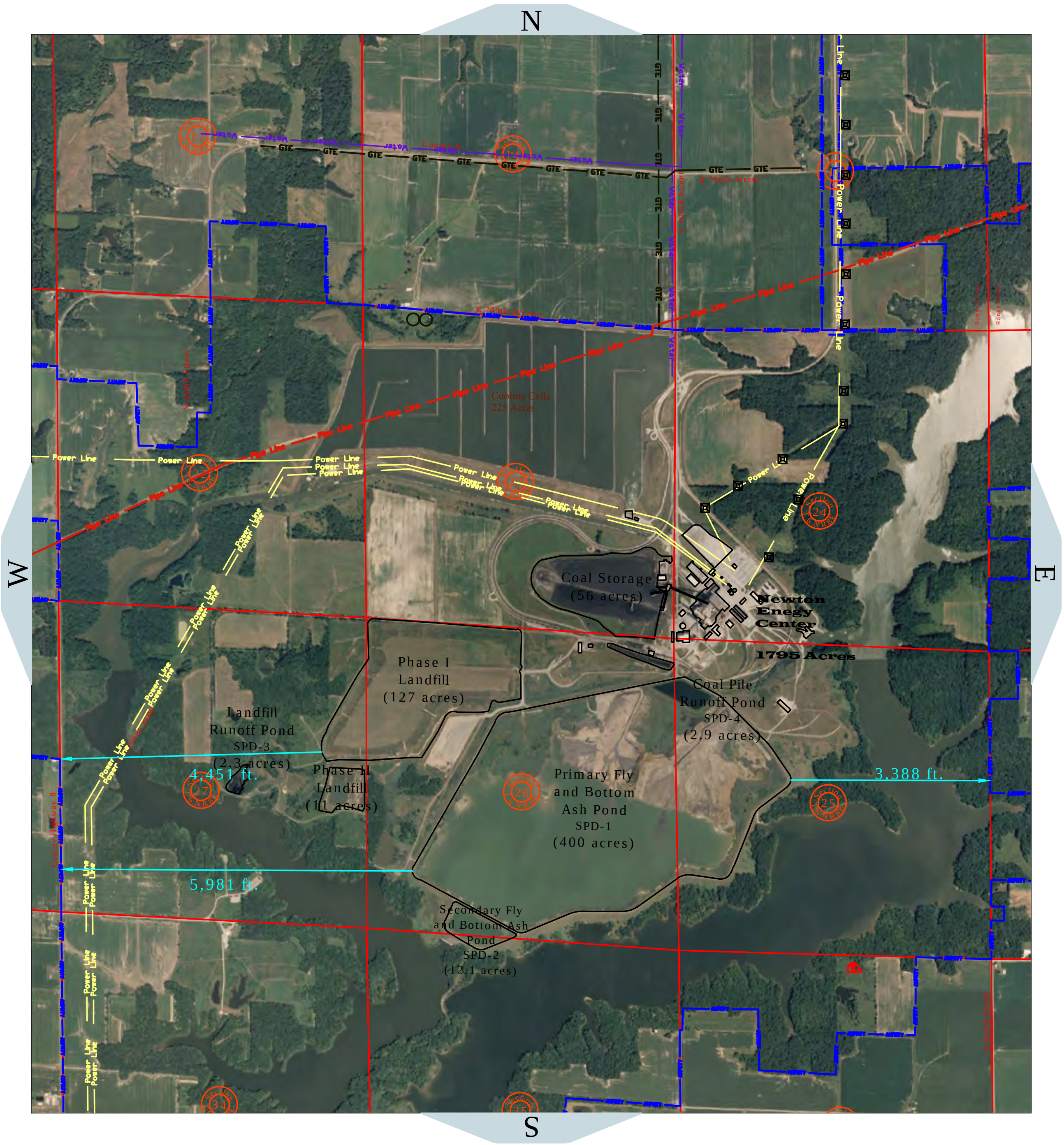
DRAFT



Real Estate

## LEGEND

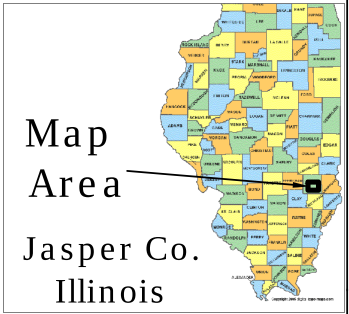
▭ Ameren Property

GTE Cable

High Pressure Gas Pipeline

## Ash Pond Distance to Property Boundary

## KEY MAP



N

| | |
|---|---|
| SCALE | |
| 1/2500 | Newton Energy Center |
| PLOT DATE | |
| 1/14/2013 | |
| FILE NAME | |
| g:/pcm/newton | |

Ameren ENERGY RESOURCES

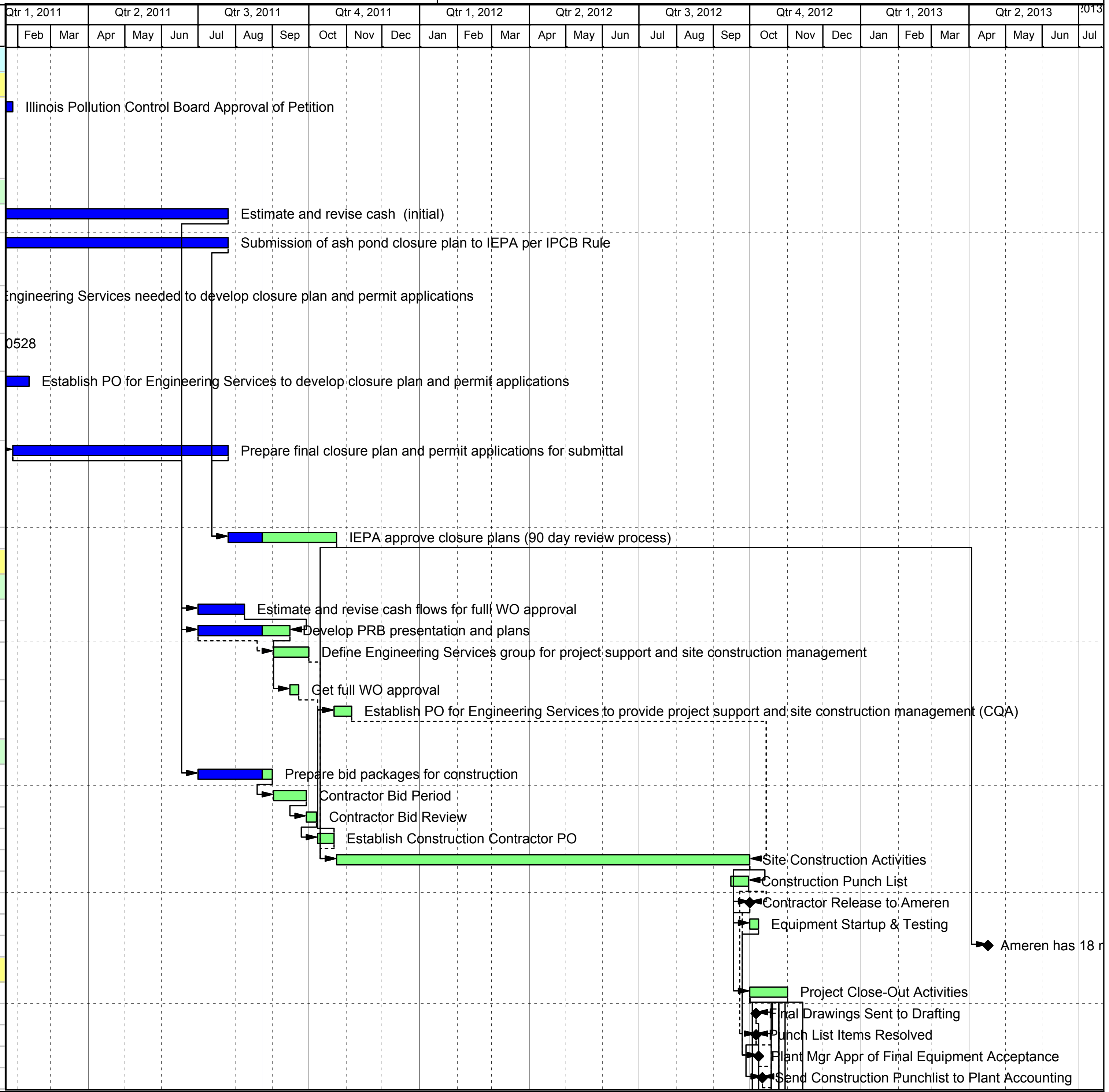
EXHIBIT 2

# W0528 - Hutsonville - Ash Pond D Closure

## Level 1/2 Schedule

Current Date: 08-22-2011

| Activity Name | Remaining Duration | Start | Finish |
|---|---|---|---|
| **W0528 - Hutsonville - Ash Pond D Closure** | 1807d | 02-22-2009 A | 04-16-2013 |
| **Planning** | 187d | 02-22-2009 A | 10-24-2011 |
| Illinois Pollution Control Board Approval of Petition | 0d | 02-22-2009 A | 01-28-2011 A |
| **Submission of Ash Pond Closure Plan to IEPA per IPCB Rule** | 187d | 02-22-2010 A | 10-24-2011 |
| Estimate and revise cash (initial) | 0d | 02-22-2010 A | 07-26-2011 A |
| Submission of ash pond closure plan to IEPA per IPCB Rule | 0d | 05-01-2010 A | 07-26-2011 A |
| Define Engineering Services needed to develop closure plan and permit applications | 0d | 05-01-2010 A | 12-01-2010 A |
| Open preliminary W0528 | 0d | 09-01-2010 A | 10-01-2010 A |
| Establish PO for Engineering Services to develop closure plan and permit applications | 0d | 01-21-2011 A | 02-10-2011 A |
| Prepare final closure plan and permit applications for submittal | 0d | 01-28-2011 A | 07-26-2011 A |
| IEPA approve closure plans (90 day review process) | 63d | 07-26-2011 A | 10-24-2011 |
| **Engineering and Construction** | 1807d | 07-01-2011 A | 04-16-2013 |
| **Engineering** | 223d | 07-01-2011 A | 11-05-2011 |
| Estimate and revise cash flows for fulll WO approval | 0d | 07-01-2011 A | 08-08-2011 A |
| Develop PRB presentation and plans | 24d | 07-01-2011 A | 09-15-2011 |
| Define Engineering Services group for project support and site construction management | 31d | 09-01-2011* | 10-01-2011 |
| Get full WO approval | 7d | 09-15-2011 | 09-22-2011 |
| Establish PO for Engineering Services to provide project support and site construction management (CQA) | 15d | 10-22-2011 | 11-05-2011 |
| **Construction** | 1807d | 07-01-2011 A | 04-16-2013 |
| Prepare bid packages for construction | 9d | 07-01-2011 A | 08-31-2011 |
| Contractor Bid Period | 28d | 09-01-2011 | 09-28-2011 |
| Contractor Bid Review | 9d | 09-29-2011 | 10-07-2011 |
| Establish Construction Contractor PO | 14d | 10-08-2011 | 10-21-2011 |
| Site Construction Activities | 343d | 10-24-2011* | 10-01-2012 |
| Construction Punch List | 15d | 09-15-2012 | 09-30-2012 |
| Contractor Release to Ameren | 0d | | 10-01-2012 |
| Equipment Startup & Testing | 7d | 10-01-2012 | 10-08-2012 |
| Ameren has 18 months from IEPA approval to complete construction | 0d | | 04-16-2013 |
| **Close Out** | 93d | 10-01-2012 | 11-01-2012 |
| Project Close-Out Activities | 31d | 10-01-2012 | 11-01-2012 |
| Final Drawings Sent to Drafting | 0d | | 10-06-2012 |
| Punch List Items Resolved | 0d | | 10-06-2012 |
| Plant Mgr Appr of Final Equipment Acceptance | 0d | | 10-08-2012 |
| Send Construction Punchlist to Plant Accounting | 0d | | 10-11-2012 |



| | | |
|---|---|---|
| ▭ Remaining Level of Effort | ▬ Actual Work | 🟥 Critical Remaining Work |
| ▬ Actual Level of Effort | 🟩 Remaining Work | ◆ Milestone |

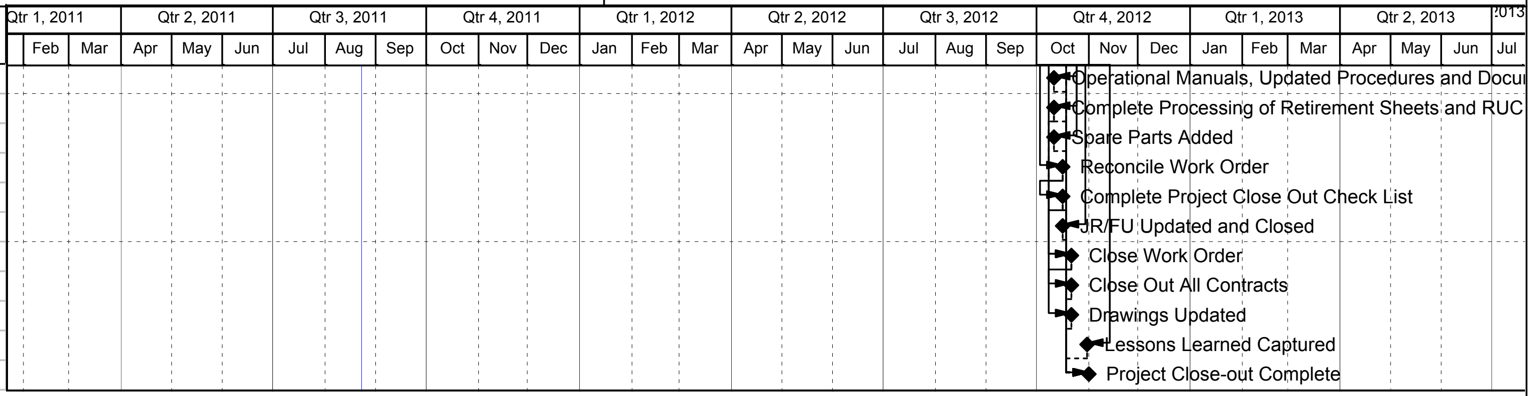
Ameren
ENERGY RESOURCES

# W0528 - Hutsonville - Ash Pond D Closure

## Level 1/2 Schedule

Current Date: 08-22-2011

| Activity Name | Remaining Duration | Start | Finish |
|---|---|---|---|
| Operational Manuals, Updated Procedures and Documents Stored | 0d | | 10-11-2012 |
| Complete Processing of Retirement Sheets and RUC | 0d | | 10-11-2012 |
| Spare Parts Added | 0d | | 10-11-2012 |
| Reconcile Work Order | 0d | | 10-16-2012 |
| Complete Project Close Out Check List | 0d | | 10-16-2012 |
| JR/FU Updated and Closed | 0d | | 10-16-2012 |
| Close Work Order | 0d | | 10-21-2012 |
| Close Out All Contracts | 0d | | 10-21-2012 |
| Drawings Updated | 0d | | 10-21-2012 |
| Lessons Learned Captured | 0d | | 10-31-2012 |
| Project Close-out Complete | 0d | | 11-01-2012 |



▭ Remaining Level of Effort
▬ Actual Level of Effort
🟦 Actual Work
🟩 Remaining Work
🟥 Critical Remaining Work
◆ Milestone

EXHIBIT 3


07.10.2012


11.14.2012

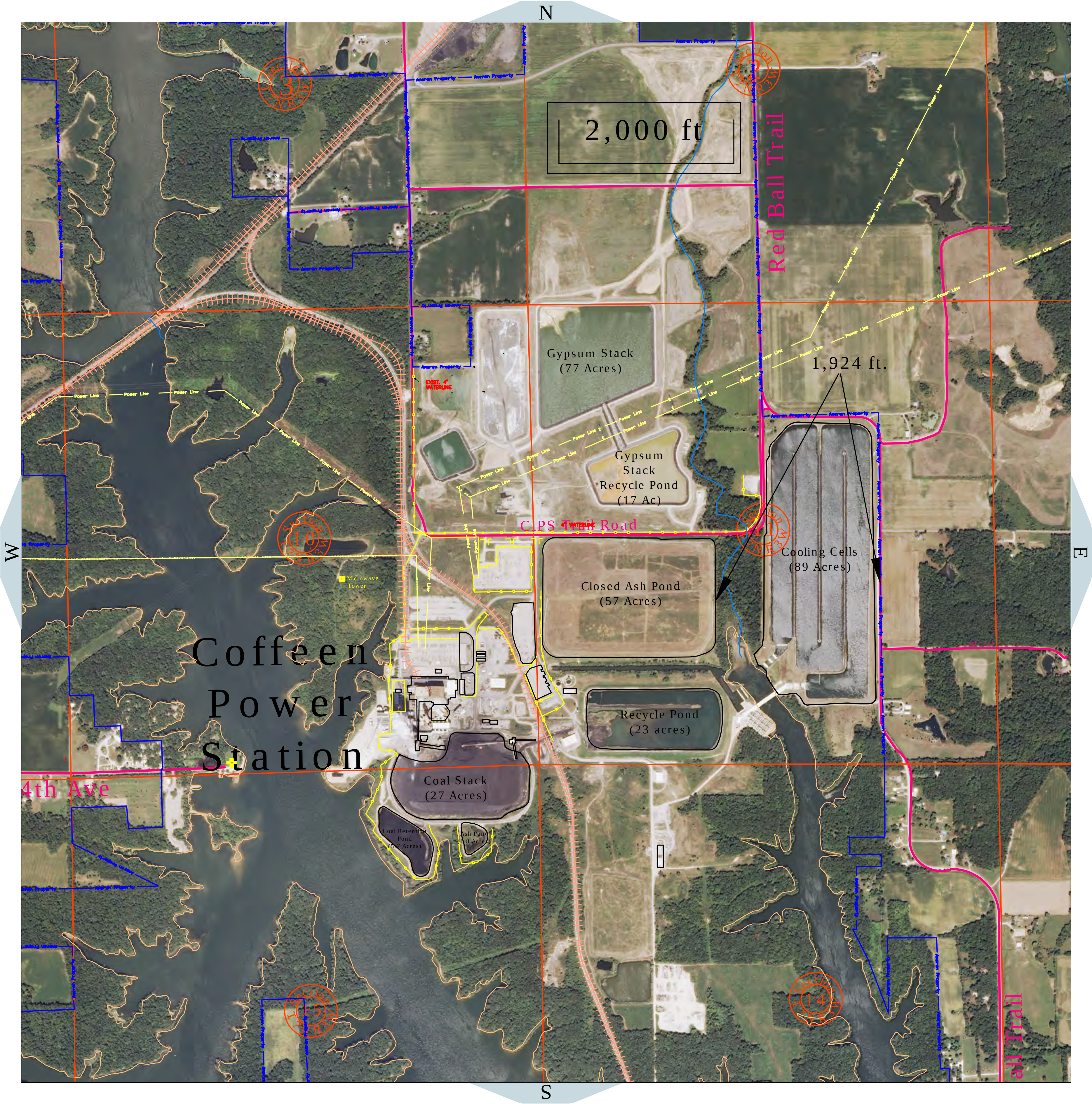
08.21.2012

08.21.2012


05.08.2012

# CHAPTER 5

# ASH POND LOCATION MAPS

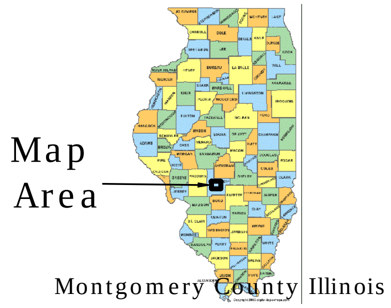


Ameren
Real Estate

## LEGEND

- Ameren Property Boundary
- Power Lines
- Railroad
- Security Fence

## Ash Pond Location to property Boundary

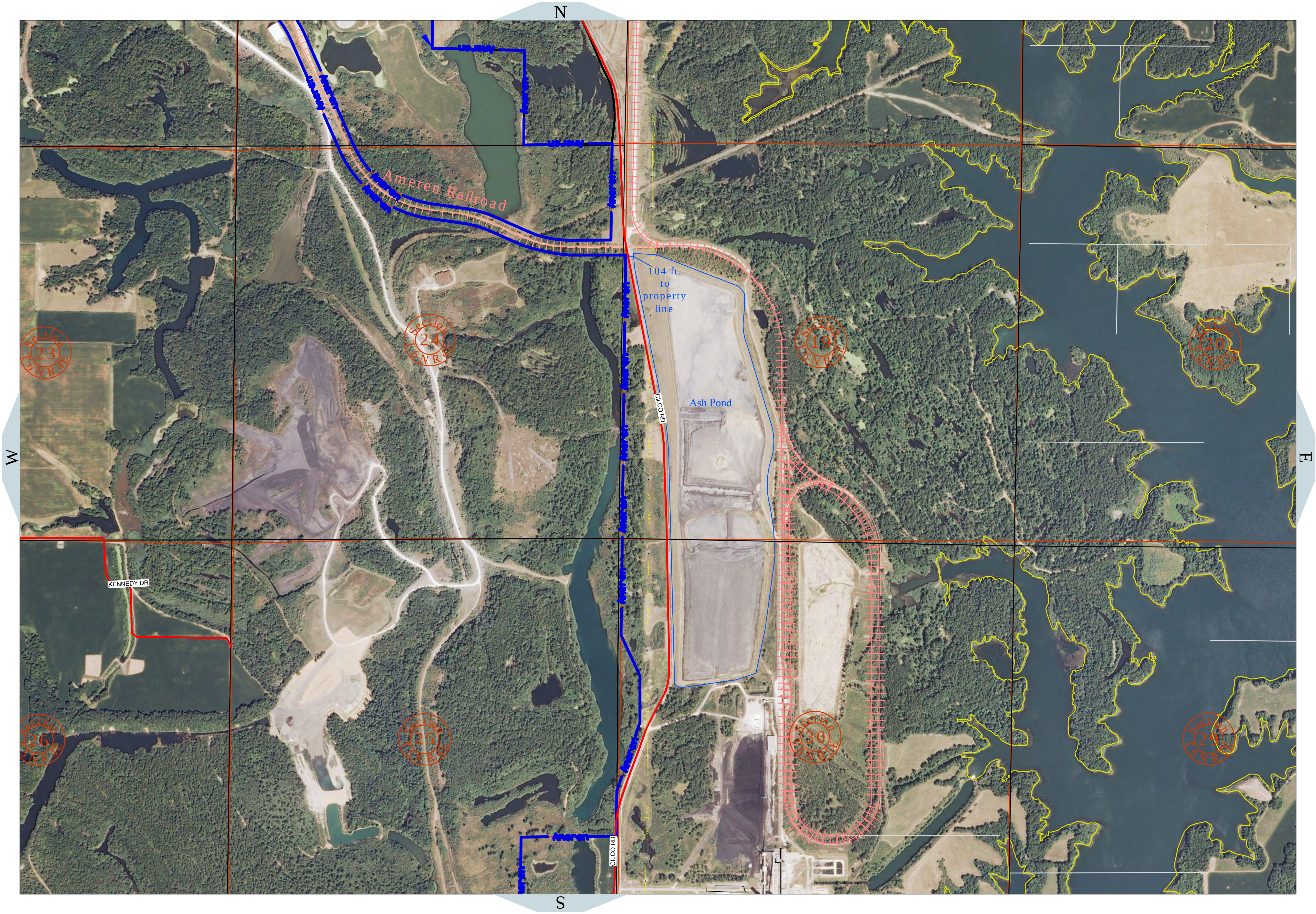


N

| SCALE | |
|---|---|
| 1/1000 | Coffeen Energy Center |
| PLOT DATE | |
| 2/2013 | |

FILE NAME

g: propertycontrolmaps/Montgomery Co.



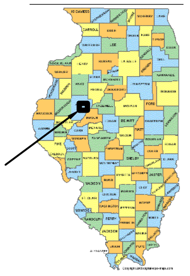
Ameren
Real Estate

LEGEND

Ameren Property

Railroad Bed

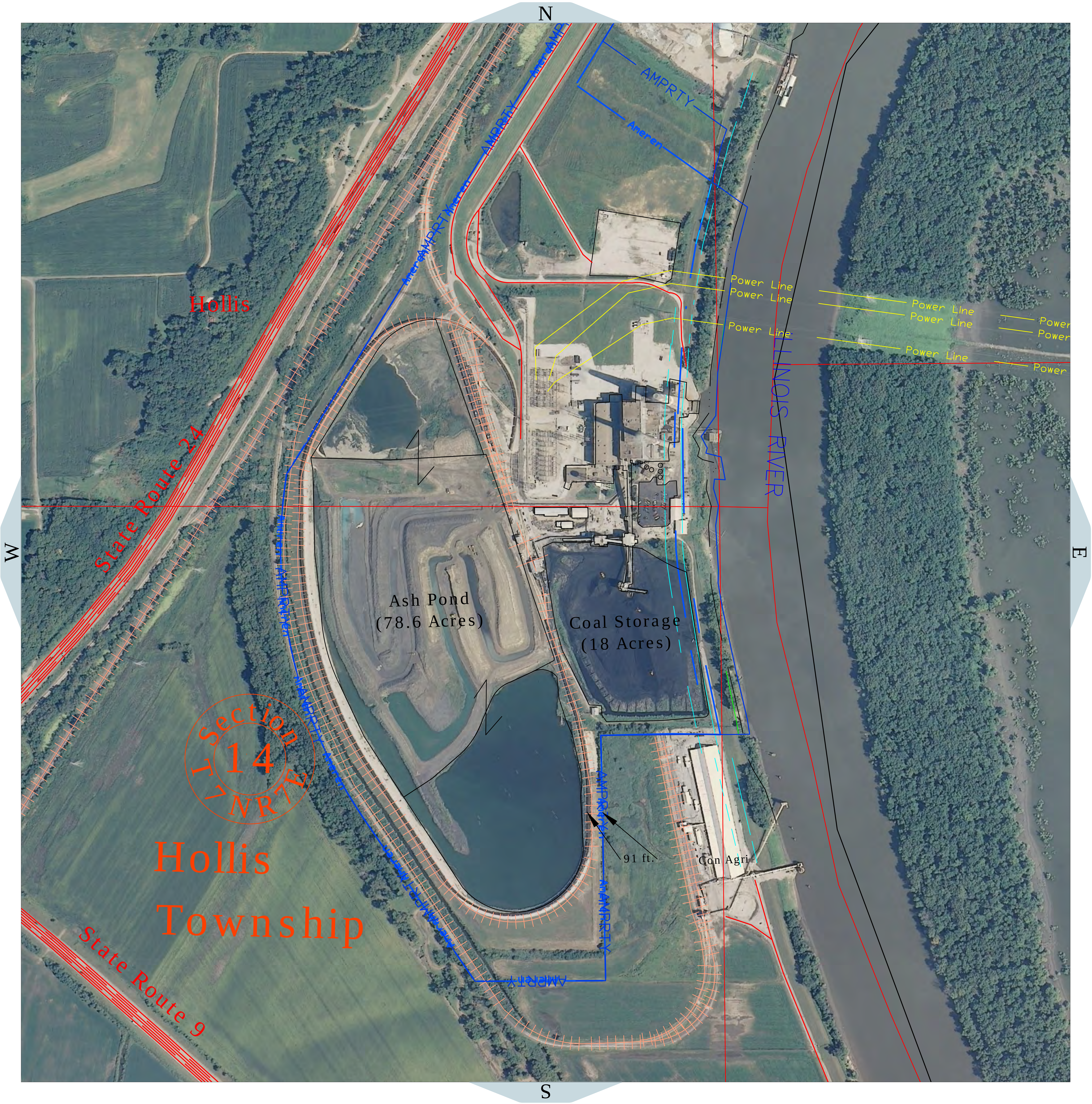
## Ash Pond Location to Property Boundary



Fulton County
Illinois

N

| SCALE | Duck Creek Energy Center |
|---|---|
| 1/1,200 | |
| PLOT DATE | |
| 1/2013 | |
| FILE NAME | |
| g: FultonCoIL/DuckCreek | |



Ameren

Real Estate

## LEGEND

Ameren Property Line

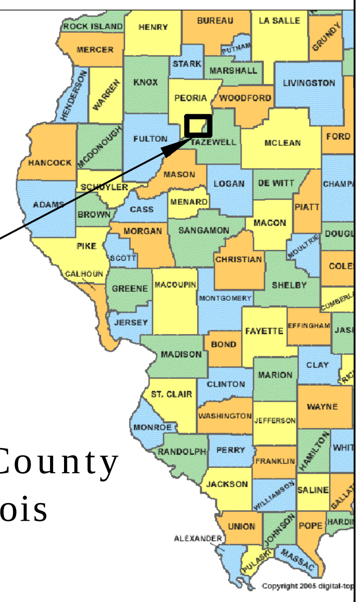
Railroad Bed

Section Line

Power Line

### Ash Pond Location to Property Boundary

Map Area



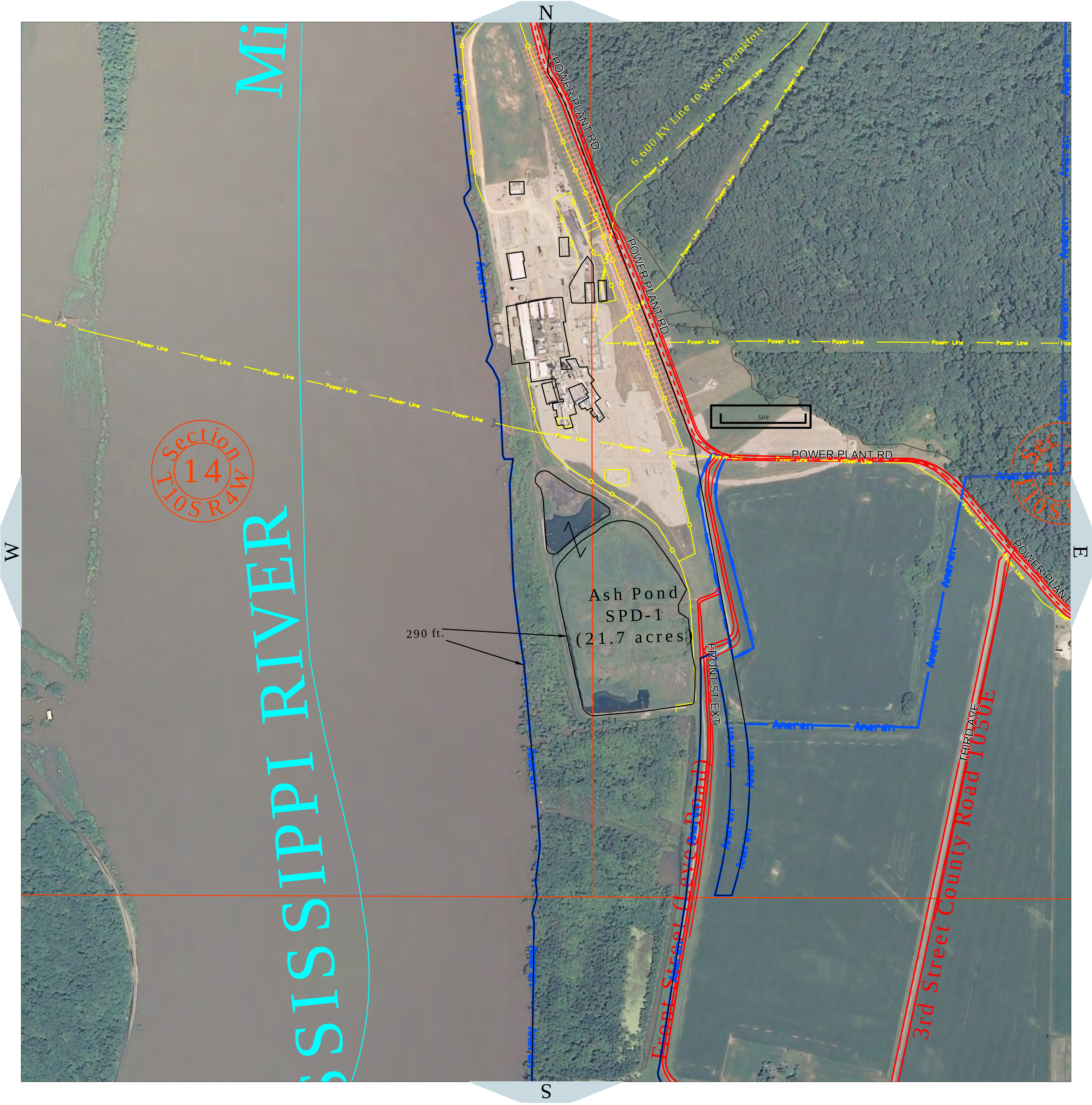
Peoria County
Illinois

N

| | |
|---|---|
| SCALE | |
| 1/400 | Edwards Station Energy Center |
| PLOT DATE | |
| 1/2013 | |

FILE NAME

g: propertycontrolmaps/Peoria Co.

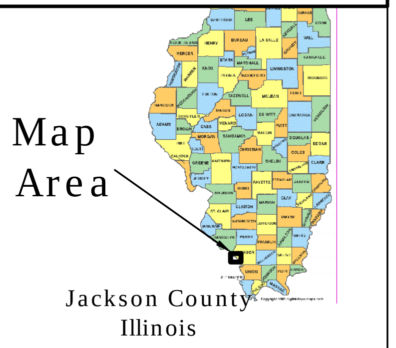


Ameren
Real Estate

LEGEND

Ameren Property Line
Railroad
Power Line
Section, Twn, Rng

# Ash Pond Location to Property Boundary



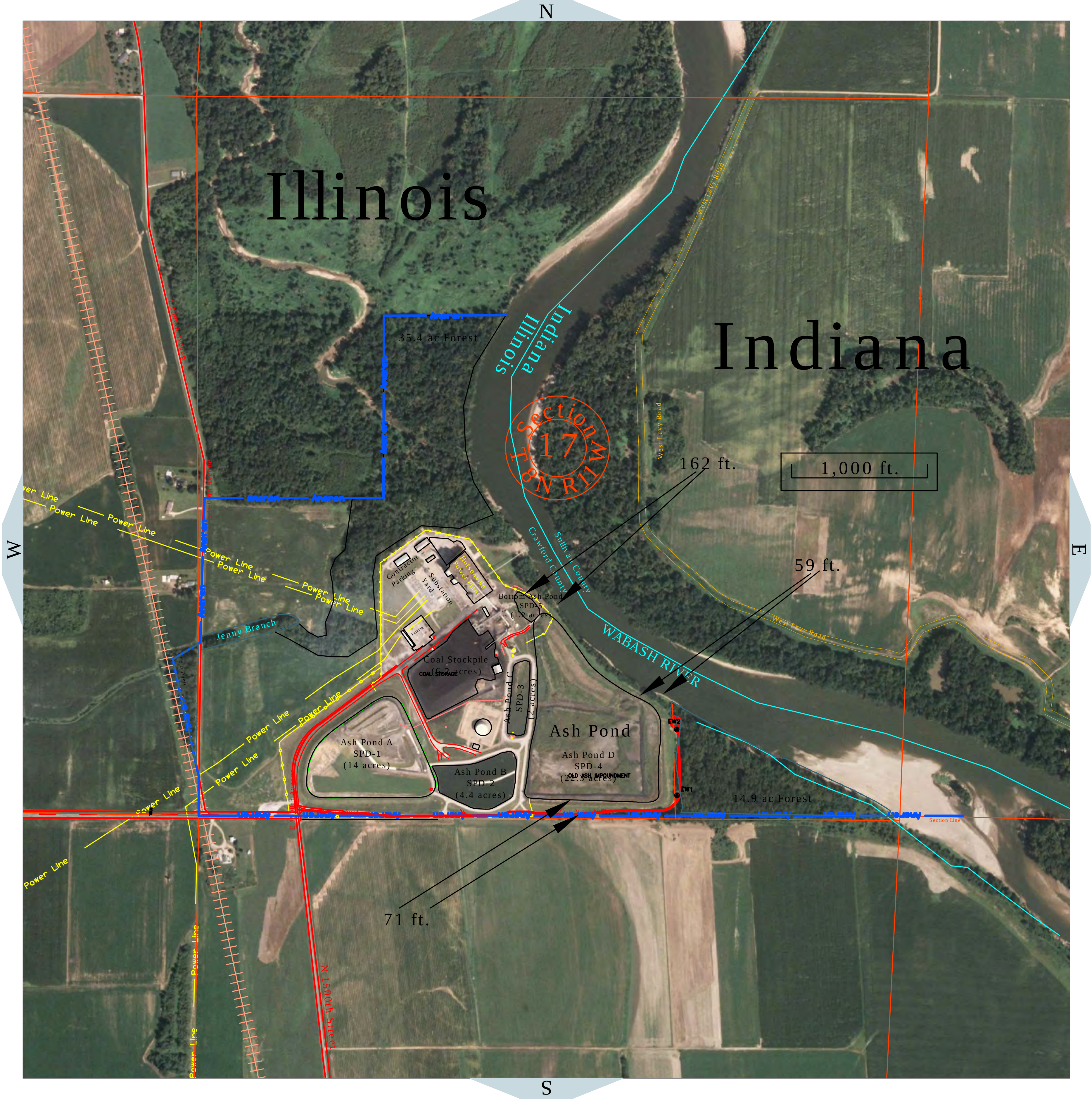
N

SCALE
1/400

PLOT DATE
2/2013

Grand Tower
Energy Center

FILE NAME
g: propertycontrolmaps/jackson
Co



Ameren
Real Estate

## LEGEND

Scale 1" = 500 ft

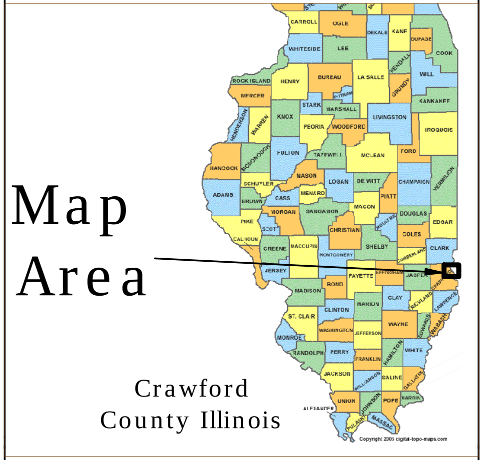
Ameren Property Line

Section, Twn, Rng

Security Fence

Railroad

## Ash Pond Distance to Property Boundary



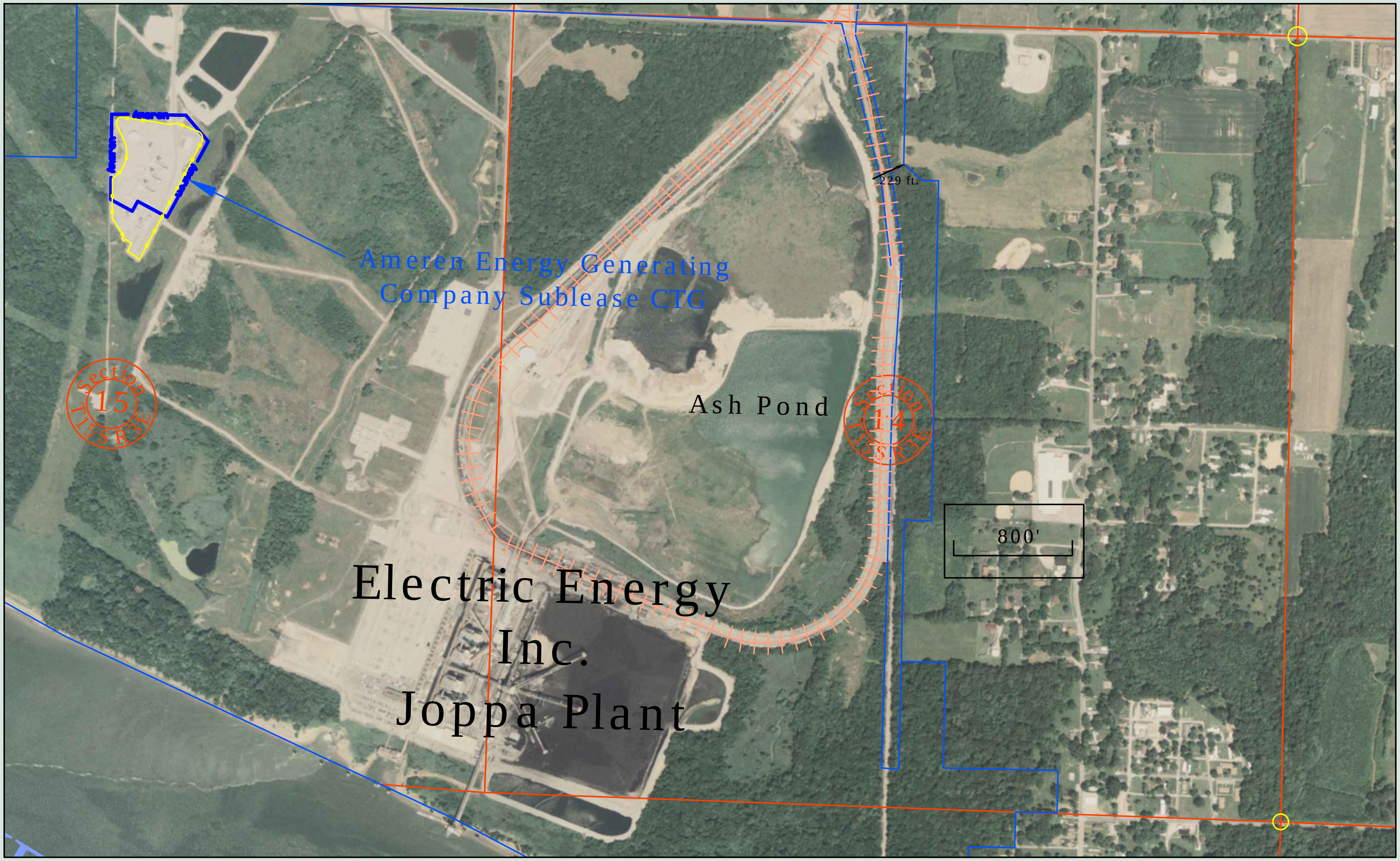
N

SCALE
1/500

PLOT DATE
2/2013

Hutsonville Power Station

FILE NAME
g: Property Control Maps/Hutsonville



Ameren Property Line

Railroad

Section, Twn, Rng

Security Fence

N

# Electric Energy Inc.
# Joppa Energy Center

## Massac Co. Ill

0 1,000 2,000

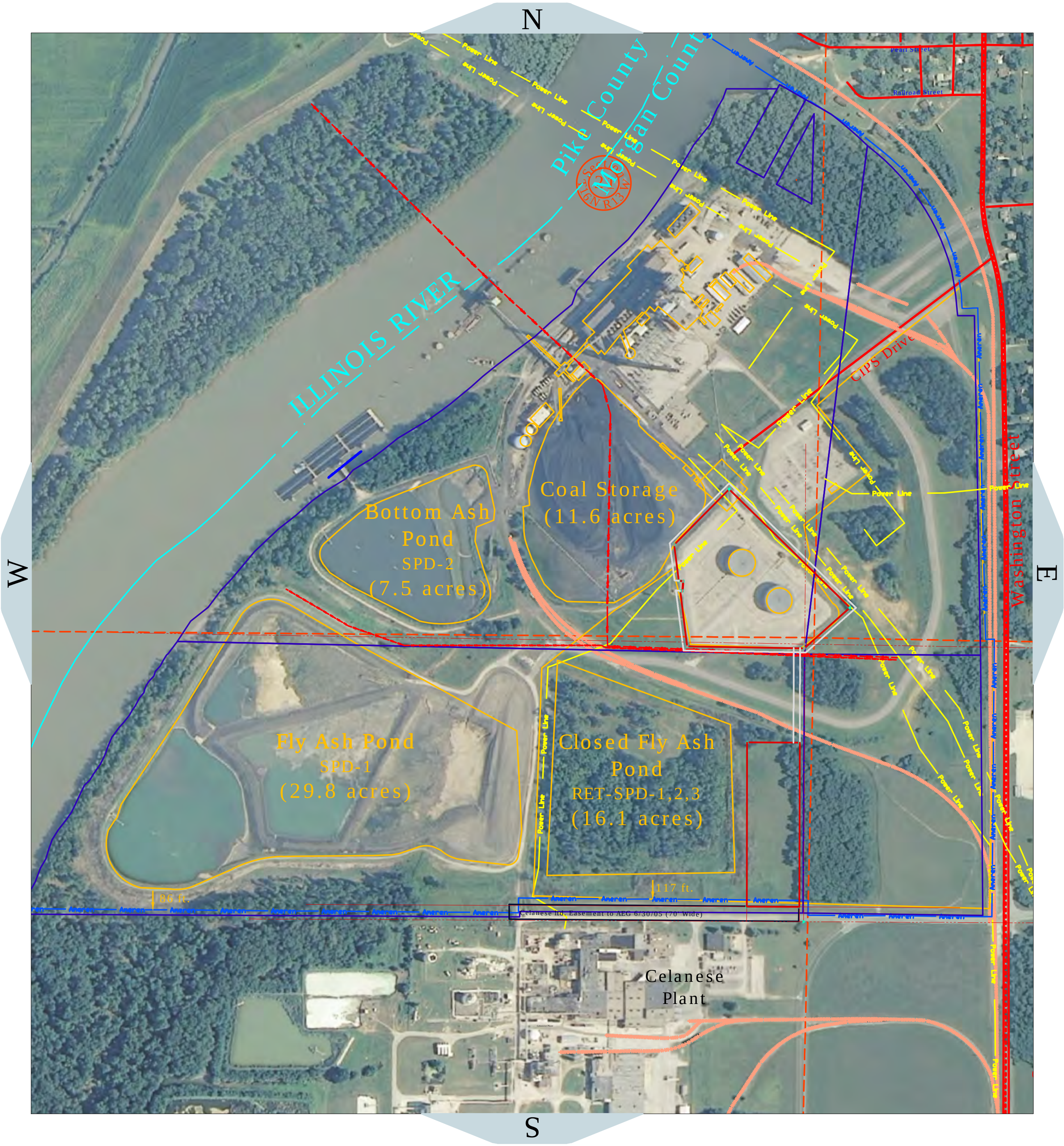
REVISIONS

| NO. | BY | DATE | DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Ash Pond Dist. to Property Bdry**

Contact: William Phelps
Phone: 314-206-1841
Email: wphelps@ameren.com

Ameren Real Estate



Ameren

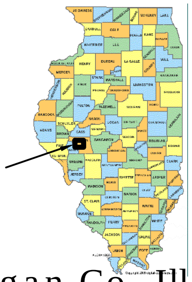
Real Estate

LEGEND

Ameren Property Line
Section, Twn, Rng
Security Fence

## Ash Pond Location to Property Boundary

KEY MAP



Map Area

Morgan Co. Ill

N

SCALE

1/500

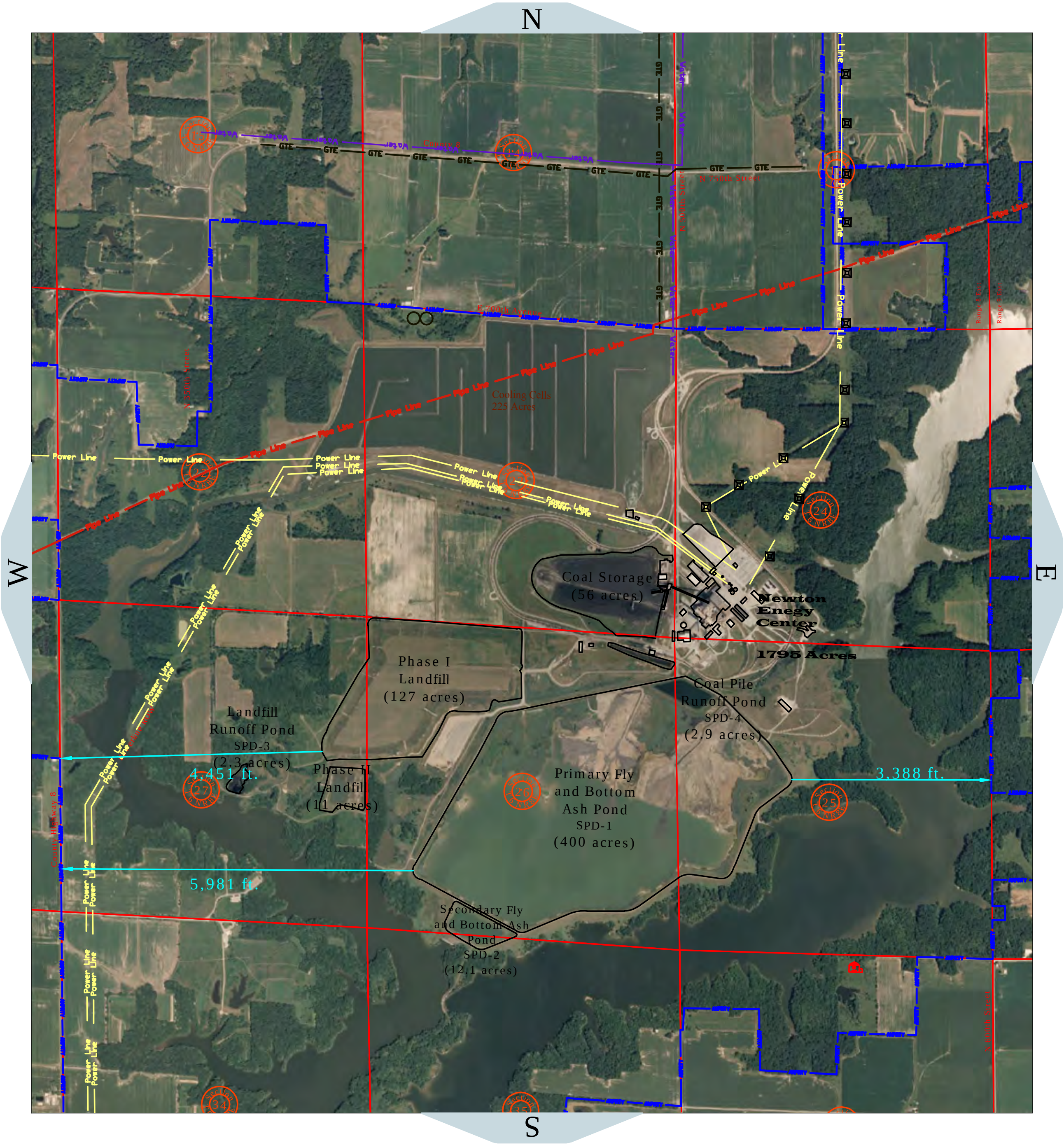
PLOT DATE

1/2013

Meredosia Energy Center

FILE NAME

g:PropCnt/Morganco



Ameren

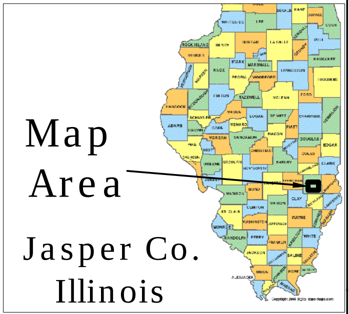
Real Estate

## LEGEND

| | |
|---|---|
| ▭ | Ameren Property |
| ▬ | GTE Cable |
| ▬ | High Pressure Gas Pipeline |

# Ash Pond Distance to Property Boundary

## KEY MAP



N

| SCALE | |
|---|---|
| 1/2500 | Newton Energy Center |
| PLOT DATE | |
| 1/14/2013 | |
| FILE NAME | |
| g:/pcm/newton | |