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CLOSURE PLAN, VENICE POWER PLANT ASH PONDS 2 & 3

VENICE POWER PLANT
VENICE, ILLINOIS

Project No. 1949

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TABLE OF CONTENTS

1 INTRODUCTION 1-1
- 1.1 Overview 1-1
- 1.2 Site Map 1-1
- 1.3 Site Description 1-2
- 1.4 Description of Closure Activities 1-2
  - 1.4.1 Final Cover 1-2
  - 1.4.2 Storm Water Management 1-3
- 1.5 Description of Groundwater Management Zone 1-3

2 HYDROGEOLOGIC INVESTIGATION 2-1
- 2.1 Background 2-1
- 2.2 Site Description 2-2
  - 2.2.1 Geology 2-2
  - 2.2.2 Mississippi River Characterization 2-2
  - 2.2.3 Groundwater Flow 2-2
- 2.3 Monitoring Well Network 2-4
  - 2.3.1 Existing Perched Groundwater Monitoring Wells 2-4
  - 2.3.2 Existing Zone of Saturation Monitoring Wells 2-4
  - 2.3.3 Proposed Monitoring Well Network 2-5
- 2.4 Groundwater Quality as of 2009 2-6
  - 2.4.1 Other Known and Potential Sources 2-7
  - 2.4.2 Boron Loading to the Mississippi River 2-7
- 2.5 Fate and Transport Modeling 2-8
  - 2.5.1 Conceptual Model 2-8
  - 2.5.2 Model Approach 2-8
  - 2.5.3 Percolation and Recharge Modeling Using HELP 2-9
    - 2.5.3.1 Help Model Approach 2-10
    - 2.5.3.2 HELP Input Data 2-10
    - 2.5.3.3 Help Model Results 2-10
  - 2.5.4 Flow and Transport Modeling 2-11
    - 2.5.4.1 Model Descriptions 2-11
    - 2.5.4.2 Model Sequence 2-11
    - 2.5.4.3 Flow and Transport Model Setup and Inputs 2-11
    - 2.5.4.4 Input Data Assumptions 2-12
  - 2.5.5 Modeling Results 2-12
    - 2.5.5.1 Calibration 2-12
    - 2.5.5.2 Prediction 2-13

3 GROUNDWATER MONITORING PLAN 3-1
- 3.1 Groundwater Monitoring System 3-1
- 3.2 Groundwater Monitoring Program 3-1

3.2.1 Monitoring Parameters 3-1
3.2.2 Sampling Schedule 3-2
3.2.3 Groundwater Sample Collection 3-3
3.2.4 Laboratory Analysis 3-3
3.2.5 Quality Assurance Program 3-3
3.2.6 Groundwater Monitoring System Maintenance Plan 3-4
3.2.7 Data Reporting 3-4
3.3 Groundwater Quality Standards 3-4
3.3.1 On-Site Applicable Groundwater Quality Standards 3-4
3.3.2 Off-Site Applicable Groundwater Quality Standards 3-5
3.4 Demonstration of Compliance 3-5
3.4.1 Compliance with On-Site Applicable Groundwater Quality Standards 3-5
3.4.2 Demonstration of Compliance 3-6
3.5 Proposed Mitigation Actions 3-7
4 FINAL COVER DESIGN 4-1
4.1 Overview 4-1
4.1.1 Profile 4-1
4.1.2 Areal Extent 4-2
4.2 Final Slope and Global Stability 4-2
4.3 Storm Water Management Plan 4-4
4.4 Construction Quality Assurance Program 4-5
4.4.1 Geosynthetics Installation 4-6
4.4.2 Protective Soil Layer 4-7
4.4.3 Storm Water Pump Stations 4-8
5 CLOSURE AND POST-CLOSURE ACTIVITIES 5-1
5.1 Final Cover Construction and Closure Report 5-1
5.2 Post-Closure Maintenance of Cover System 5-1
5.3 Post-Closure Care Plan 5-2
5.4 Annual Reporting 5-2
5.5 Post-Closure Report and Certification of Completion of Post-Closure Care Plan 5-3
6 SCHEDULE 6-1
7 REFERENCES 7-1

FIGURES

Figure 1-1	Site Location Map (1949-A01C)
Figure 1-2	Site Layout (1949-22-B01C)
Figure 1-3	Extent of Groundwater Management Zone
Figure 2-1	Cross-Section B-B'
Figure 2-2	Groundwater Elevation, June 2008 (1949-22-B05C)
Figure 2-3	Groundwater Elevation, September 2008 (1949-22-B04C)
Figure 2-4	Groundwater Elevation, December 2008 (1949-22-B02C)
Figure 2-5	Groundwater Elevation, March 2009 (1949-22-B03C)
Figure 2-6	Adjustments to Monitoring Well Network
Figure 2-7	Observed Boron Concentrations in 2009
Figure 2-8	Boron and Arsenic Concentrations in 2009
Figure 2-9	Scatter Plot Comparing Boron and Arsenic Concentrations in Groundwater Samples Collected in 2009
Figure 2-10	Flow Model Calibration Results
Figure 2-11	Transport Model Calibration Results
Figure 2-12	Prediction Model Results (No Action Scenario)
Figure 2-13	Prediction Model Results (Base Case Scenario)
Figure 2-14	Prediction Model Results (Base Case Sensitivity)
Figure 2-15	Prediction Model Results (Case 1 Scenario)
Figure 3-1	Groundwater Monitoring Program Well Locations

TABLES

Table 1-1	Comparison to 35 IAC Section 840.130 Closure Plan Contents
Table 2-1	Mississippi River Mean Monthly Stage
Table 2-2	Hydraulic Gradients and Groundwater Velocity
Table 2-3	Hydraulic Conductivity Values
Table 2-4	Existing Monitoring Well Network Summary
Table 2-5	Arsenic Concentrations in Leachate Wells and Upgradient Groundwater
Table 2-6	HELP Model Input / Output Parameters (Cap Alternative Evaluation)
Table 2-7	HELP Model Input / Output Parameters (Protective Soil Evaluation)
Table 2-8	HELP Model Input / Output Parameters (Final Grade Evaluation)
Table 3-1	Groundwater Monitoring System Monitoring Wells and Construction Details
Table 3-2	Groundwater Monitoring Program Parameters and Laboratory Analysis Methods
Table 3-3	Groundwater Monitoring Program Schedule
Table 4-1	Computed Stability Safety Factors for Final Slope Design
Table 4-2	Rainfall Depths Corresponding to Storm Event Recurrence Intervals
Table 4-3	Anticipated Duration of Ponding and Maximum Depth by Storm Event Recurrence Interval
Table 4-4	Proposed Seed Mixes and Application Rates for Final Cover

APPENDICES

Appendix A:	Hydrogeological Investigation, Former Ash Disposal Pond System, AmerenUE Venice Power plant, Venice, Illinois (Hanson, 2000) [on CD]
Appendix B:	Technical Memorandum No.1, Potable Well Survey, Hydrogeologic Assessment, and Modifications to the Groundwater Monitoring Program, Venice Ash Impoundment [on CD]
Appendix C:	Technical Memorandum No.2, Supplemental Hydrogeological Assessment, Venice Ash Ponds [on CD]
Appendix D:	Technical Memorandum No.3, Boron Loading to the Mississippi River from Venice Ponds 2 and 3 [on CD]
Appendix E:	Technical Memorandum No.4, Evaluation of Closure Alternatives, Venice Ash Ponds [on CD]
Appendix F:	Technical Memorandum No.5, Predicted Change in Percolation, Venice Ash Impoundment [on CD]
Appendix G:	Technical Memorandum No.6, Groundwater Modeling of Venice Former Ash Ponds [on CD]
Appendix H:	Groundwater Sampling Standard Operating Procedure
Appendix I:	Global Slope Stability Evaluation—Ash Pond Closures at Ameren Missouri's Venice, Illinois Power Plant
Appendix J:	Veneer Slope Stability Evaluation—Ash Pond Closures at Ameren Missouri's Venice, Illinois Power Plant
Appendix K:	Groundwater Model Input and Output Files [on CD]
Appendix L:	Proposed Groundwater Management Zone Map

DRAWINGS

Drwg No 7824-Y-502159: Title Sheet

Drwg No 7824-Y-502160: Existing Conditions

Drwg No 7824-Y-502161: Geomembrane Subgrade Grading Plan

Drwg No 7824-Y-502162: Final Cover Grading and Storm Water Management Plan

Drwg No 7824-Y-502163: Final Cover Sections

Drwg No 7824-Y-502164: Final Cover Sections and Details

Drwg No 7824-Y-502165: North Pump Station Plan View

Drwg No 7824-Y-5066: South Pump Station Plan View

Drwg No 7824-Y-5067: Pump Station Profiles

Drwg No 7824-Y-5068: Storm Water Pump Station Plan View Section and Details

1 INTRODUCTION

1.1 Overview

Union Electric Company d/b/a Ameren Missouri (hereafter referred to as Ameren) operated two on-site coal ash impoundments (Ponds 2 and 3) south of the Venice Power Plant in Venice, Illinois. Coal ash from the power plant was sluiced to the ponds from the 1950's until the late 1970's, when the last of the coal-burning units at the plant was converted to burn oil. Oil ash, process wastewater, and storm water continued to be pumped to the ponds from 1977 until 1999, and storm water and process wastewater were routed through the ponds until 2005. The ponds have not been used since 2005, when a new storm water and process wastewater treatment system was constructed immediately north of the ash ponds.

Ameren is proposing to close the Venice ponds in place, following an approach that will generally conform to regulatory provisions adopted by the Illinois Pollution Control Board concerning the closure of a coal ash impoundment in Hutsonville, Illinois (35 IAC 840 et seq.). Sections 1 through 4 of this closure plan follow the structure for a closure plan listed in those rules. Table 1-1 lists specific closure plan elements prescribed in 35 IAC 840.130 and sections within this closure plan where those elements are addressed.

This closure plan also includes elements from 35 IAC 840 that would not otherwise be included in the closure plan, in order to document Ameren's intent to close the Venice ponds consistent with the rule. Therefore, Section 5 of this closure plan describes post-closure maintenance of the cover system following an approach similar to 35 IAC 840.136, the elements required for a post-closure care plan (840.138 and 840.140), and descriptions of the elements that will be incorporated into the final cover construction and closure report (840.134), post-closure report (840.142).

A schedule for implementation and completion of these activities is provided in Section 6.

1.2 Site Map

The Venice ash impoundments (hereafter referred to as the Venice ponds) are located in St. Clair County (the power plant property straddles the border between Madison and St. Clair counties), Township 2 North, Range 10 West, Section 2 (Figure 1-1). The ash ponds are bounded to the north by the Venice power plant, to the east by property owned by Norfolk Southern Rail, to the south by property owned by Terminal Rail Road Association, and to the west by the Metro East Sanitary District's flood control levee for the Mississippi River. The property on which the levee exists and the adjacent Mississippi River bank are owned by Ameren. A map of the site layout is provided as Figure 1-2. This map identifies all pertinent features (e.g., the Mississippi River and levee), buildings, the ash impoundments, and all existing wells.

1.3 Site Description

Materials managed in the Venice ponds included coal fly and bottom ash, oil fly ash, and low-volume wastes associated with generation of electric power. All materials managed in the ponds were generated at the Venice Power Plant.

The ponds occupy a combined area of approximately 58 acres with each being roughly the same size. The estimated volume of material in the ponds is 1,425,000 cubic yards with an average depth of 30 feet in Pond 2 and 26 feet in Pond 3. Both ponds are unlined, consistent with industry practice of the time of their construction in the 1950's.

As part of closure planning, the structural integrity of the ponds was evaluated. This evaluation included the proposed final cover and related grading plan. The results of this evaluation demonstrate that the proposed topographic configuration of the ponds and final cover meet or exceed the relevant stability criteria specified in 35 IAC 811.304. Further details regarding this evaluation are provided in Section 4.2.

1.4 Description of Closure Activities

1.4.1 Final Cover

The Venice ponds are dewatered. They have been cleared of vegetation and re-graded in accordance with the proposed storm water management plan (Section 4.3). A geosynthetic cover will be placed over the re-graded ash, consisting of (from bottom up) a 40-mil polyvinyl chloride (PVC) geomembrane; a geocomposite drainage layer, consisting of a high-density polyethylene geonet with geotextile adhered to the top and bottom of the net, to drain infiltrated surface water; and a 3 foot thick protective soil layer. The protective layer will have 2.5 feet of rooting zone soil and 6 inches of topsoil to support the establishment of vegetation to minimize erosion and exposure of the geosynthetics. This cover design meets the requirements of 35 IAC 811.314, and provides a barrier to infiltration and subsequent generation and release of leachate. The cover system will extend to the levee on the west, with the exact extent subject to approval by the US Army Corps of Engineers, and will extend across the north berm. The cover system will extend to, but not cross, the east and south berms. The Illinois Department of Transportation (IDOT) is constructing an access road along the east side of the Venice ponds to their Mississippi River Bridge (I-70) project located just to the south of the ash ponds. The cover will be terminated along side of this access road, rather than crossing it, since it will be constructed after IDOT's access road is completed and while they are using the road to access the bridge project. The south berm will be left intact to prevent runoff of storm water off site to the south and avoid contributions to potential flooding within this area, which is a closed depression.

1.4.2 Storm Water Management

The south and east berms are located immediately adjacent to the property boundary, and there is no property outside of the ash ponds to the east and south for managing storm water runoff from the cover. Due to insufficient grade and concerns for erosion of the levee, Ameren is unable to direct storm water runoff from the cover to the west. Managing storm water runoff from the cover north of the ash ponds would result in an unacceptable impact to Ameren's operations. As a result, there is no feasible option for draining storm water off the cover. Therefore, storm water derived from precipitation falling onto the cover will be routed toward two low areas designed into the north and south ends of the cover and pumped from these locations over the levee to the Mississippi River. The cover will be graded such that there is no off-site contribution, or run-on, of storm water from areas outside of the ash ponds.

1.5 Description of Groundwater Management Zone

In March 2010, Ameren presented to IEPA for approval the establishment of a groundwater management zone (GMZ). Subsequent to the March 2010 presentation, Ameren attempted to negotiate an access agreement with the property owner to the south; however, the terms requested by the property owner were not practical for a long-term monitoring and compliance program. In February 2010, Ameren notified IEPA that an impasse had been reached and IEPA agreed that a GMZ confined to the property boundary could be an alternative approach. The revised GMZ is illustrated on Figure 1-3, and mapped in detail in Appendix L. The legal description for the GMZ is as follows:

> A tract of land situated partly in the County of Madison and party in the County of St. Clair, State of Illinois, located in Southwest Quarter (SW¼) of Section 36, Township 3 North Range 10 West and Section 1, Township 2 North Range 10 West of the Third Principal Meridian, more particularly described as follows: Starting at a point which is marked by an Old Iron Pin in the Northwest corner of U.S Survey 623 which has Illinois State Plane coordinates of N 52868.31 E 55930.60, is the Point of Beginning;
>
> Thence 1,342.7 ft. S 26°58'50"E to a point that is on the line between U.S. Survey 623 and 764, thence 1,980.7 ft. S 23°02'58"E to a point , thence 84.5 ft. S48°09'30"W to a point which is the intersection of the east line of Lot 100, as shown and described on a plat prepared by Julius Pitzman, City Surveyor of St. Louis, Missouri, and filed for record in Plat Book "H", Page 31 , of the records of St. Clair County, Illinois, and U.S. Survey 764, said point having an Illinois State Plane coordinate of N 49792.782 E 57252.320,, thence 290.84 ft. S48°24'34"W to a point which is the

> southwest corner of US Survey 764, thence 1,634.28 ft. S 77°11'49"W to the east shore line of the Mississippi River, thence following the east shore line of the Mississippi River in a northerly direction to a point that is 3,556.4 ft. N07°5'19"W of the last described point and 934.1 ft. S 83°45'07"W from the Northwest corner of U.S Survey 623 (point of beginning); thence 840.8 ft. N 68°00'47"E to a point, thence 259.98 ft. S 34°55'54"E back to the point of the Point of Beginning. Said parcel containing approximately 104 +/- acres at normal river stage.

Groundwater within the GMZ discharges to the Mississippi River. Ameren understands that none of the groundwater impairments associated with the Venice ponds significantly impact water quality within the Mississippi River as discussed below in Section 2.4.2.

2 HYDROGEOLOGIC INVESTIGATION

2.1 Background

Hanson Engineers performed a hydrogeological assessment of Venice ponds 2 and 3 in 2000 (Appendix A). Activities included installation of groundwater monitoring wells, characterization of hydrogeology, and characterization of groundwater quality near the ponds. That assessment was performed while the ponds were active for storm water management at the power plant. The ponds were removed from service in 2005 and have received only precipitation since that time.

In 2009 a supplemental hydrogeologic assessment was performed by Natural Resource Technology, Inc. (NRT) to supplement the work of the Hanson report and to characterize groundwater quality near the ash ponds. Activities included collection of groundwater grab samples beyond the limits of the existing monitoring well network to define the vertical and horizontal extent of groundwater impacts associated with the ash ponds, a potable well survey, and fate and transport modeling. The results of the NRT investigations were presented in a series of Technical Memorandums:

- Technical Memorandum No.1 "Potable Well Survey, Hydrogeologic Assessment, and Modifications to the Groundwater Monitoring Program, Venice Ash Impoundment" (Appendix B);
- Technical Memorandum No.2 "Supplemental Hydrogeological Assessment, Venice Ash Ponds" (Appendix C);
- Technical Memorandum No.3 "Boron Loading to the Mississippi River from Venice Ponds 2 and 3" (Appendix D);
- Technical Memorandum No.4 "Evaluation of Closure Alternatives, Venice Ash Ponds" (Appendix E);
- Technical Memorandum No.5 "Predicted Change in Percolation, Venice Ash Impoundment" (Appendix F); and,
- Technical Memorandum No.6 "Groundwater Modeling of Venice Former Ash Ponds" (Appendix G).

The supplemental investigation performed by NRT conformed with the hydrogeological interpretations made in the Hanson, 2000 report. The text in the subsections below summarizes results of both hydrogeologic investigations with references to the attached reports as appropriate.

2.2 Site Description

2.2.1 Geology

The site is located in the Mississippi River valley floodplain, in an area referred to as the American Bottoms. Approximately 80 feet of alluvial deposits associated with the Mississippi River underlie the site. Those alluvial deposits are underlain by Mississippian-aged limestone bedrock. The natural undisturbed soil profile generally consists of clayey silt overlying sand and gravel. The upper 20 to 30 feet of the alluvial deposits contain alternating layers of silt, sand, and clay; while the lower 60 to 50 feet primarily consist of sand and gravel. During supplemental investigation activities, undisturbed soils were observed at ground surface in the floodplain west of the Mississippi River levee and in the field south of the ash ponds east of the levee.

Fill material greater than 10 feet thick, which contained coal ash, was observed in the berm that surrounds the ash ponds, the former coal pile storage area north of the ponds, and within the ash ponds themselves (Figure 2-1). Fill material less than 10 feet thick, and which did not contain coal ash, was observed east of the ash ponds.

2.2.2 Mississippi River Characterization

The nearest United States Army Corps of Engineers (USACE) gauging station is located approximately 2.5 river miles upstream of the site, in Granite City, Illinois (Lock and Dam 27 lower). From 1965 through 2008, the mean annual elevation of the Mississippi River was 393.55 feet MSL (mean sea level) at Lock and Dam 27.

Using the monthly mean elevation data provided by the USACE, it was determined that the Mississippi River stage regularly exceeds the mean annual stage during the months of March, April, May, and June (Table 2-1), and occasionally exceeds mean annual stage at other times of the year. During these periods, groundwater at the site may be flowing away from the river in an east or southeasterly direction (flow reversal). During the majority of the year, groundwater flows toward the river.

2.2.3 Groundwater Flow

Groundwater flow contours for four consecutive quarterly monitoring events are illustrated in Figures 2-2 through 2-5. Groundwater is typically encountered at a depth of 20 to 30 feet at the site. Groundwater flow in the region is controlled by the Mississippi River, and water levels within the monitoring wells rise and fall with river stage. The predominant groundwater flow direction is northeast to southwest (toward the Mississippi River) during most of the year. During periods of high river stage, usually the spring or early summer months, groundwater flow direction is northwest to southeast (away from the river).

Hydraulic gradients and groundwater velocity were calculated for the periods shown on Figures 2-2 through 2-5 (Table 2-2). Hydraulic gradients during these events ranged from 0.001 to 0.008 toward the river and 0.004 to 0.006 away from the river. The geometric mean hydraulic conductivity of the uppermost aquifer is 2.89 x 10^{-3} cm/s (Table 2-3). Assuming an effective porosity of 0.25, groundwater flow velocities ranged from 13 ft/yr to 90 ft/yr.

Using river elevation data collected near the Venice ponds during quarterly sampling events, the following generalizations can be made:

- Flow reversals are commonly observed on site when the Mississippi River elevation is above 400 feet MSL;
- The water table is nearly flat or exhibits variable flow patterns (normal and/or reversed) on site when the Mississippi River elevation is between 390 and 400 feet MSL; and,
- Normal flows are commonly observed on site when the Mississippi River elevation is below 390 feet MSL.

The direction of groundwater flow across the site is dependant both on Mississippi River level and the duration of such elevated river stage. Short periods of elevated river stage may cause flow reversals in the western monitoring wells near the riverbank. Sustained periods of elevated river stage are typically required to change the direction of groundwater flow across the entire site.

Elevated river stage may also have an impact on groundwater quality by raising groundwater levels across the site and saturating fly ash at the base of the former ponds. Subsurface profile B-B' (Figure 2-1) indicates the base of ash is approximately 400 feet MSL. In monitoring wells located near the central portions of the former ponds (MW-4 and MW-6) groundwater levels have been observed above 400 feet approximately 15% of the time (see Figure 9 in Tech Memo 2, Appendix C).

Groundwater elevations in excess of 400 feet have been coincident with the June quarterly sampling event. However, it is noteworthy that groundwater in these wells occurs episodically as the river level does not rise above 400 feet every year (there is a three year period from 2005 through 2007 where observed groundwater levels were below 400 feet in both wells). Review of USACE daily mean elevation data indicate that river elevations during 2005 and 2006 also rarely exceeded 400 feet. This suggests that to the extent groundwater comes into contact with ash, such communication occurs during the spring or early summer on an episodic and non-annual basis.

2.3 Monitoring Well Network

Construction details for the existing monitoring well network are summarized in Table 2-4.

2.3.1 Existing Perched Groundwater Monitoring Wells

The existing monitoring well network consists of nine separate sampling locations surrounding the former ponds (Figure 1-2). Some locations include a well to monitor perched groundwater (those wells have a "P" following the name, e.g. MW-2P). Since 2000, the perched zone wells have been typically dry. Boron concentrations in the perched zone wells are consistently lower than its Class I standard (Tech Memo 2, Appendix C), including wells MW-5P and MW-7P. The only exception was observed at MW-2P where two boron samples obtained prior to dewatering of the pond (one in 1999 and one in 2001) had concentrations higher than 2 mg/L. More recent observations (2008 and 2009) at MW-2P were below the Class I standard. The lack of apparent impacts at MW-5P and MW-7P demonstrates that the perched zone is not a migration pathway. The migration pathway is the saturated zone as indicated by elevated concentrations of boron, an indicator constituent for coal ash leachate, at wells MW-5 and MW-7.

The perched zone wells are screened in a sand and gravel lens that only contains significant amounts of water during extremely wet periods. Accordingly, sampling at these locations can occur only during periods of flood events. For example, the last time samples were collected from MW-8P and MW-9P was in June of 2008, during a period of record rainfall and flooding in portions of Iowa, Illinois, and Wisconsin that resulted in widespread flooding along the Mississippi River.

The lack of boron exceedances in the perched zone monitoring wells, combined with the observation that these wells are often dry, indicates that migration is not currently occurring via the perched zone. Rather, the perched zone reflects recharge during rainy periods. Because the perched wells do not monitor the contaminant migration pathway, they were not included in the groundwater quality discussions that follow. It is further recommended that these wells be removed from the proposed monitoring well network and permanently abandoned.

2.3.2 Existing Zone of Saturation Monitoring Wells

The existing monitoring well network consists of nine separate locations around the former ponds (Figure 1-2). The zone of saturation monitoring wells are typically screened between elevations 395 and 385 feet MSL with the exception MW-8 and MW-9 which are screened approximately 10 feet deeper. The monitoring wells are all 2-inch diameter wells with 10-foot screens, and were constructed between April 1996 and July 1999 (in this report, references to screen elevation describe the elevation of the bottom of the screen and/or sample interval). The September 2009 round of analytical data collected from the well network was used for comparison to groundwater grab samples to depict groundwater flow and quality as of 2009.

Given that flow is usually toward the river, monitoring wells MW-8 and MW-9 are sufficiently far from the site that water quality in these wells will not be affected during flow reversals. This observation is confirmed by the low concentrations of the primary ash indicator constituent, boron, observed in these wells (as described below). The remainder of this document therefore refers to MW-8 and MW-9 as upgradient wells.

2.3.3 Proposed Monitoring Well Network

Based on a review of the analytical data collected from the monitoring wells and direct-push samples, additional monitoring well locations are proposed to monitor compliance with site groundwater quality standards as defined in Section 3.3 and 3.4, while some existing wells are proposed for abandonment.

As discussed above, the perched zone monitoring wells do not provide useful information relative to the extent of the boron plume; therefore, it is recommended that the perched wells be removed from the monitoring well network and permanently abandoned.

The proposed monitoring well network will be used to monitor compliance in all directions from the Venice ponds. Monitoring wells MW-10 and MW-11 will monitor compliance to the north; MW-5 will monitor compliance to the east; MW-6 will monitor compliance to the south; and MW-2, MW-3, and MW-11 will monitor compliance to the west (Figure 2-6). Deep piezometers will be nested with the water table monitoring wells at MW-2, MW-3, MW-6, and MW-11.

All new monitoring wells will be constructed consistent with monitoring well construction standards described in Section 3.1. Proposed well construction details are summarized in Table 3-1. The final screen intervals for new monitoring wells will be determined in the field during installation.

Groundwater monitoring at MW-7 cannot continue because this well is off-site and the access agreement with the property owner has ended. Ameren intends to properly abandon MW-7. MW-4 was abandoned on July 23, 2010 to make way for an access roadway associated with construction of the new I-70 bridge. Documentation of MW-4 abandonment will be included with other construction documentation in the Final Cover Construction and Closure Report as outlined in Section 5.1. Both MW-1 and MW-4 were drilled through coal ash. Review of monitoring results from these wells indicates that coal ash indicator (boron) concentrations in these wells are similar to those in the leachate wells (Tech Memo 2, Appendix C). This observation suggests that coal ash may have been dragged down to the screened interval of the monitoring wells during installation. Therefore, it is recommended that MW-1 also be permanently abandoned. Replacement wells are not needed because groundwater is monitored upgradient of these locations at MW-8 and MW-9, and downgradient of these locations at the MW-2 and proposed MW-11 well nests. Furthermore, construction of a replacement well for MW-4 is not feasible due to usage of the east berm for I-70 bridge construction traffic, and replacement of MW-1 is not recommended because that area will be capped and a replacement well would result in a penetration through the synthetic cap material, potentially enabling seepage into the coal ash.

2.4 Groundwater Quality as of 2009

Groundwater quality was evaluated in 2009 as part of the supplemental investigation (Tech Memo 2, Appendix C); results of that investigation are summarized below:

- The boron plume has been defined through existing monitoring wells and groundwater grab samples, and extends approximately 500 feet south of the property line (Figure 2-7).
- Arsenic is present inside and outside of the boron plume at concentrations in excess of the Class I groundwater quality standard (Figure 2-8). The Venice ponds, however, are not a significant source of arsenic to groundwater. This conclusion is based upon the following: 1) arsenic concentrations in field leachate samples taken from the ash ponds were lower than the maximum concentrations observed in groundwater (Table 2-5), whereas higher concentrations would be expected in leachate if the Venice ponds were the source; 2) there is a weak inverse correlation between arsenic and boron concentrations in groundwater (Figure 2-9), rather than a positive correlation that should exist if the Venice ponds were the source; and 3) arsenic concentrations higher than the Class I standard were observed in a background sampling location (GP002) (Figure 2-8), Accordingly, arsenic concentrations higher than Class I groundwater quality standards emanate from a different source than the Venice ponds.
- Iron is present inside and outside of the plume in excess of the Class I standard. Similar to arsenic, the data suggest that the source of iron is not the ash ponds.
- Manganese is present inside and outside of the boron plume in excess of the Class I standard. The presence of manganese in upgradient wells outside of the plume indicates that there is another source in the area, in this case that source may be natural rather than anthropogenic. Unlike iron and arsenic, the data suggest that the ash ponds may contribute to elevated manganese concentrations in groundwater; although the mechanism of this impact is geochemical rather than as a direct contribution source, because manganese concentrations in the leachate were usually lower than detection limits. Furthermore, manganese is more reactive and less mobile in groundwater than boron, and the extent of manganese contributed to groundwater from the ash ponds will not be greater than the extent of boron. Therefore, boron is the primary indicator for coal ash impacts.
- Total dissolved solids concentrations reflect dissolved concentrations of major ions in groundwater that are not necessarily associated with coal ash leachate from the ash ponds.

2.4.1 Other Known and Potential Sources

Past land use was evaluated using Sanborn maps from 1907, 1950, and 1962 (Appendix A). A corn refining operation and a plaster mill were in the vicinity in 1907. Creosoting operations were reported in the northern vicinity of the site as of 1950. The Sanborn maps indicated the presence of numerous oil tanks and storage areas for treated and untreated railroad ties. The creosoting operations were active as of 1962. All of these facilities were upgradient of the Venice power plant site.

As the Sanborn maps indicate, this area has been used for industrial purposes for at least 100 years, supporting the conclusion that multiple potential sources of contamination are present. For example, the petroleum impacted material encountered at GP001 (described Appendix C) is an example of the type of industrial by-products that may affect groundwater quality in the area. The creosote operation is a potentially significant potential source in the context of the Venice ash pond groundwater monitoring program because it was a wood treatment facility, and arsenic compounds were also used to treat wood at many such facilities.

2.4.2 Boron Loading to the Mississippi River

Boron loading to the Mississippi River from the inactive and dewatered Venice ponds was calculated to estimate the effect that this loading has on concentrations in the river (Appendix D). The estimated low flow of the Mississippi River at the Site is 46,500 cubic feet per second (cfs) and is four million times greater than the estimated groundwater flow into that receiving body.

Boron was chosen because it is readily available and is a very mobile indicator constituent of coal ash leachate. NRT used conservative assumptions for hydraulic conductivity, water flow conditions, and the highest observed concentration value (of 41 mg/L boron at MW-4) to calculate an estimate of the resulting incremental increase in boron in the Mississippi River due to discharge from the Venice ash ponds. The result was 0.0019 mg/L boron and this highly conservative concentration is approximately an order of magnitude lower than typical detection limits for boron as listed by USEPA. This result can be applied to other constituents that may have been released to groundwater from the Venice ash ponds. However, because boron almost always has higher concentration in coal ash leachate than any other trace or minor element (i.e., excluding the major ions Ca, Mg, K, Na, Cl, HCO_3, and SO_4), it can be assumed that these constituents will have concentrations even lower than the 0.0019 mg/L conservatively calculated for boron. Accordingly, the loading calculations indicate that boron released from the Venice ponds, and by extension all other coal ash leachate constituents, are negligible and have no perceptible impact on water quality within the Mississippi River.

2.5 Fate and Transport Modeling

Groundwater fate and transport modeling was performed to assess the groundwater impacts associated with the Venice ponds, assist with the remedial alternative analysis, and assist with development of the groundwater monitoring system. Technical Memorandums 5 & 6 (Appendices F & G) describe the modeling in detail, and the following subsections summarize those memos. A disk containing model files is attached in Appendix K.

2.5.1 Conceptual Model

Groundwater in the vicinity of the Venice ponds originates as recharge from precipitation, flow from the east, and recharge from the Mississippi River when at high stage. The ultimate discharge point for groundwater is the Mississippi River since there are no known active water supply wells near the ash ponds (Appendix B). Groundwater elevation fluctuates in response to changes in river stage. Flow direction reversals are also common, resulting in a highly variable up and down, back and forth flow pathway.

The only source considered for this modeling is the Venice ponds. While other sources of contamination are present in the area, the Venice ponds are the only known significant source of boron, the primary ash indicator constituent. Boron mass enters groundwater via two mechanisms: year-round leaching as precipitation and snow melt water percolates vertically through the ash, and occasional leaching when groundwater elevation rises to a level higher than the base of ash and flows horizontally through the material. The groundwater that seeps into the ash when water table is high likely drains vertically for an unspecified period of time after the water table returns to normal elevation.

2.5.2 Model Approach

A three-dimensional transient groundwater flow and transport model was calibrated to represent the conceptual flow system described above. Modeling begins in the year 2000, and mass that entered the aquifer prior to 2000 was simulated by specifying initial concentrations in groundwater. The model was calibrated to match groundwater elevation fluctuations and concentration trends observed between 2000 and 2009 (Run 19). Prediction simulations were then performed to evaluate the effect of the cap, which was assumed to be present beginning in 2011. The following scenarios were simulated:

- No Action (Run 19pna): The calibrated model was extended 27 years into the future without simulating placement of the cap;
- Base Case (Run 19pbc): The calibrated model was extended to July 2011 (estimate of when the geomembrane portion of the cap will be constructed). Starting in August 2011 the cap was simulated 25 years into the future. The cap covers the former ponds and berms.

- Case 1 (Run 19pc1): Similar to the base case, the calibrated model was extended to July 2011, then the cap was simulated another 25 years in the future. This scenario differs from the base case in that the cap covers the former ponds but leaves the eastern and southern berms uncapped.

Transport of boron was modeled because it is an indicator parameter for coal ash leachate, it is mobile in groundwater, and its concentration in downgradient monitoring wells is higher than its Class I groundwater quality standard.

This model was complicated by the need to simulate the fluctuations in elevation, flow direction, and leachate generation caused by changes in Mississippi River stage. To accommodate these fluctuations, four stress periods were used for each calendar year in the model from the first year of calibration (2000) to the final year of prediction (2035), for a total of 144 stress periods. These four stress periods simulate the average long-term transient fluctuations of the Mississippi River and its effects on groundwater flow near the site.

Three model codes were used to simulate groundwater flow and contaminant transport:

- Leachate percolation from the ponds and aquifer recharge south of the ponds was modeled using the Hydrologic Evaluation of Landfill Performance (HELP) model;
- Groundwater flow was modeled in three dimensions using MODFLOW; and
- Contaminant transport was modeled in three dimensions using MT3DMS.

2.5.3 Percolation and Recharge Modeling Using HELP

The Hydrologic Evaluation of Landfill Performance (HELP) code was developed by the U.S. Environmental Protection Agency and is used extensively in waste facility assessments. HELP predicts one-dimensional vertical percolation from a landfill or soil column based on precipitation, evapotranspiration, runoff, and the geometry and hydrogeologic properties of a layered soil and waste profile.

HELP (Version 3.07; Schroeder et. al, 1994) was used to estimate percolation through the former ash ponds after construction of the synthetic cap. HELP was also used to estimate aquifer recharge in the field south of the former ash ponds. This field lies in a closed depression ringed by soil berms that form the levee, railroad tracks, and the south berm of the former ash ponds.

HELP input and output files are included on a CD included as Appendix K.

2.5.3.1 Help Model Approach

Three rounds of HELP modeling were completed in support of closure:

1. HELP was used to model current conditions and assist with selection of the type of cap for closure (Tech Memo 5, Appendix F).
2. Once the cap was selected, HELP was used to estimate recharge through the cap for transport modeling. Three configurations of synthetic cap placement were simulated based on the texture of the protective soil layer (Silty, Sandy, and Clayey). HELP was also used to model infiltration south of the ponds, a large field that is a closed depression bounded by the south berm of the ash ponds, the levee, and railroad embankments.
3. HELP was also used to evaluate the effect of changes to the final grade of the synthetic cap after the transport model was completed.

2.5.3.2 HELP Input Data

Refer to Table 2-6 and Technical Memorandum No 5 (Appendix F) for detailed descriptions of model setup and input values for the first round of HELP modeling. The second and third rounds of HELP modeling are modifications of the first round. Second and third round inputs that vary from the first round are discussed below. All scenarios were modeled for a period of 20 years. Since the ponds are already dewatered, that mitigation scenario was not considered.

The second round inputs are summarized in Table 2-7. As discussed above, three configurations of the protective soil layer were tested during this round. The protective soil texture parameter was the only input varied from the first round of modeling (Table 2-6). Infiltration and recharge in the field south of the former ash ponds were also simulated with HELP for a period of 20 years at this time (Table 2-6).

The third round of inputs are summarized in Table 2-8. The 58 acre ponds were divided into two areas. The larger area was 43.5 acres with a slope of 1% over 520 feet. The smaller area was 14.5 acres with a slope of 2% over 330 feet. All other inputs were left unchanged from the previous HELP model runs (Table 2-6).

2.5.3.3 Help Model Results

The first round of HELP modeling resulted in the selection of a synthetic cap rather than soil or compacted clay caps.

The second round of HELP modeling resulted in a maximum percolation rate of 0.0024 in/yr (5.48×10^{-7} ft/day). To be environmentally conservative, that infiltration rate was rounded up to 6.00×10^{-7} ft/day for input to the transport model to represent the recharge component of seepage from the Venice ponds.

The third round of HELP modeling resulted in a weighted average infiltration rate of 0.0019 in/yr ($4.34x10^{-7}$ ft/day). This result was less than the recharge rate of $6.00x10^{-7}$ ft/day used in the transport model; therefore, the new slope changes would result in slightly less percolation (source) through the capped impoundments. The small reduction in percolation through the cap meant that the transport modeling would still be environmentally conservative and running an updated transport model would be unnecessary.

2.5.4 Flow and Transport Modeling

2.5.4.1 Model Descriptions

MODFLOW uses a finite difference approximation to solve a three-dimensional head distribution in a transient, multi-layer, heterogeneous, anisotropic, variable-gradient, variable-thickness, confined or unconfined flow system—given user-supplied inputs of hydraulic conductivity, aquifer/layer thickness, recharge, wells, and boundary conditions. The program also calculates water balance at wells, rivers, and drains. MT3DMS (Zheng and Wang, 1998) is an update of MT3D. It calculates concentration distribution for a single dissolved solute as a function of time and space. Concentration is distributed over a three-dimensional, non-uniform, transient flow field. Refer to Appendix G for more detailed descriptions of the flow and transport models.

2.5.4.2 Model Sequence

MODFLOW was calibrated to approximate groundwater elevation data collected between March 2000 and February 2009 (nine years). This timeframe was chosen because it represents current conditions and there were adequate data for calibration of this transient groundwater flow system. Next, MT3DMS was run, and model-predicted concentrations were calibrated to observed boron concentration values at the monitoring wells. Multiple iterations of MODFLOW and MT3DMS calibration were performed to achieve an acceptable match to observed data.

Once calibrated, additional simulations were performed to evaluate the prediction scenarios. With the exception of the No Action scenario (which has no cap) the percolation rate and concentration value assigned to the cap was the same for all prediction scenarios (25 mg/L), only the distribution of the cap was varied between the Base Case and Case 1.

2.5.4.3 Flow and Transport Model Setup and Inputs

Refer to Appendix G for detailed descriptions of model setup and input values. A CD containing input files is attached in Appendix K.

2.5.4.4 Input Data Assumptions

Simplifying assumptions were made while developing this model, including:

- The cap has an instantaneous effect on percolation rate;
- Leachate is assumed to instantaneously reach groundwater (e.g., migrate through the unsaturated zone);
- The Mississippi River is assumed to behave in a consistent annual pattern;
- The general head boundary and natural recharge are assumed constant over time; and
- Leachate concentrations are assumed to remain constant over time.

2.5.5 Modeling Results

Results of the MODFLOW/MT3DMS modeling are presented below. A CD containing output files is attached in Appendix K.

2.5.5.1 Calibration

The model was calibrated to observed conditions from 2000 through 2009. The model was first calibrated to approximate observed groundwater elevation (head) data, and then to observed concentration data. MW-1 and MW-4 were not used for concentration calibration because those wells were installed through ash and groundwater quality results are anomalous.

Head calibration results show that the model successfully reproduces the range of observed seasonal fluctuations (Figure 2-10).[1] MW-2 and MW-7 represented downgradient calibration; MW-1 and MW-5 represented on-site calibration; and MW-8 and MW-9 represented upgradient calibration. In all three areas, modeled and observed heads were in good agreement considering that the stress periods used in the model represent river stage in concept, rather than a historical depiction.

Concentration calibration accurately simulated observed trends at most monitoring wells (Figure 2-11). MW-2, MW-3, MW-7, and GP-6 represented downgradient concentrations. GP-6 is a monitoring point placed in the model to compare to a groundwater grab sample collected in the fall of 2009. The largest

[1] Qualitative head matching (e.g., calculation of the sum of squared residuals) was not performed for this model because the average fluctuations in river stage modeled did not necessarily correlate with actual fluctuations, and given the large range in observed and modeled heads, calculations of head differential would not be meaningful. Instead, calibration was deemed successful when head fluctuations covered a similar range as observed groundwater levels, and—most importantly—when modeled long-term concentration trends closely matched observed trends.

discrepancy between modeled and observed concentrations was at MW-3, where observed concentrations appear to be anomalously low given its proximity to the site in the downgradient flow path.[2] The model also predicted a future concentration increase at MW-6 that would not be interpreted from the relatively flat trend in the observed data. Since one purpose of the model is to predict the amount of time needed for groundwater to recover to Class I standards, the higher than observed modeled concentrations at MW-3 and MW-6 are conservative because it increases predicted recovery time.

2.5.5.2 Prediction

The No Action scenario (Figure 2-12) reflects that concentrations in wells MW-2 and MW-3 (downgradient, on-site between the levee and the ponds) will stabilize around 4 to 5 mg/L boron, approximately twice the Class I standard. Concentrations in GP-6 (downgradient, off-site about 500 feet south of ponds) will stabilize just below the Class I standard of 2 mg/L. Concentrations in well MW-7 (downgradient, off-site about 100 feet south of the ponds) will stabilize around 3 mg/L, above the Class I standard. On-site concentrations at MW-6 will stabilize around 6 mg/L, while on-site concentrations at MW-5 will stabilize just below the Class I standard. This scenario was modeled for comparison with the two scenarios described next, and does not represent a closure alternative considered by Ameren.

The Base Case scenario, with a cap that covers the ponds and all berms, (Figure 2-13) suggests that concentrations in all monitoring wells will stabilize below the Class I standard within 13 to 20 years, with the exception of on-site well MW-6. Concentrations modeled at MW-6 were slowly decreasing at the end of the model period and a linear interpolation of the trend suggests that concentrations will be lower than the Class I standard 28 years after the cap is constructed. However, it is important to remember that the model conservatively predicts an increase in concentration in MW-6 that is not supported by observed data, and as a result this recovery period may also be conservatively long.

The sensitivity of the Base Case scenario to saturated ash extent was tested by increasing the area of saturated ash to include the entire footprint of the former ash ponds (Figure 2-14). The results are similar with the following exception: Concentrations in MW-2 and MW-3 (downgradient, between the levee and ponds) stabilize around 4 to 5 mg/L. This suggests that if ash extent is greater than that assumed for the base case, Class I exceedances may persist west of the ash ponds, but not to the south.

The Case 1 scenario, which most closely approximates the final closure plan because it assumes that the eastern and southern berms are not capped, reflects that concentration distribution will be similar to the

[2] The proposed monitoring program includes a deep well at this location to determine if concentrations are higher at depth in the aquifer.

Base Case scenario (Figure 2-15), with concentrations at most monitoring wells stabilizing at levels below the Class I standard within 14 to 20 years. The most notable difference is that the recovery period at on-site monitoring well MW-6 is 57 years, although, as stated above, the model appears to be over-predicting concentration in this well.

3 GROUNDWATER MONITORING PLAN

3.1 Groundwater Monitoring System

A groundwater monitoring system is proposed for the Venice ponds to monitor groundwater, evaluate post-closure groundwater quality and trends, and to demonstrate compliance with the groundwater quality standards as described in Section 3.3.

Standards for monitoring well design and construction include:

- All monitoring wells will be cased in a manner that maintains the integrity of the bore holes.
- Wells will be screened to allow sampling only at the specified interval.
- All wells will be covered with vented caps, unless located in flood-prone areas, and equipped with devices to protect against tampering and damage.

The proposed groundwater monitoring system will consist of 2 upgradient and 10 downgradient of wells, installed at the water table and at depth in the uppermost aquifer underlying the Venice ponds. These wells will yield groundwater samples that represent the quality of background water that has not been affected by contamination from the Venice ponds and represent the quality of downgradient groundwater at the property boundary and within the GMZ (Figure 3-1). Monitoring well depths and construction details are listed in Table 3-1.

3.2 Groundwater Monitoring Program

A groundwater monitoring program is proposed to monitor groundwater and evaluate post-closure groundwater quality within the GMZ. The groundwater monitoring program will begin upon approval of this closure plan by IEPA, and completion of the installation of the groundwater monitoring system.

3.2.1 Monitoring Parameters

Groundwater quality data will be monitored for constituents listed in 35 IAC 620.410(a) and (d) except radium-226 and radium-228. Any constituent that is not detectable at the reporting level or PQL in the downgradient wells for four consecutive quarters or has a concentration that does not differ to a statistically significant degree from the concentration detected in the upgradient wells for four consecutive quarters may be removed from the monitoring program in both the upgradient and downgradient wells with the exception of:

- boron,
- iron,
- manganese,
- field parameters including pH,
- sulfate, and
- TDS.

Field parameters will include pH, specific conductance, temperature, groundwater elevation, and monitoring well depth. Table 3-2 lists constituents to be monitored at the Venice ash ponds.

3.2.2 Sampling Schedule

Groundwater sampling will be performed according to the schedule provided in Table 3-3. Quarterly sampling will initially be performed. Five years after approval of the closure plan, a request may be made to modify the post-closure care plan to reduce the frequency of groundwater monitoring to semi-annual sampling by demonstrating all of the following:

- That monitoring effectiveness will not be compromised by the reduced frequency of monitoring;
- That sufficient data has been collected to characterize groundwater; and
- That concentrations of constituents monitored at the downgradient boundaries of the GMZ show no statistically significant increasing trends that can be attributed to the Venice ponds.

If concentrations of constituents at the downgradient boundaries of the GMZ show no statistically significant increasing trends that can be attributed to the Venice ash ponds for the five years after reducing the monitoring frequency to semi-annual, a request may be made to modify the post-closure care plan to reduce monitoring frequency to annual sampling by demonstrating the same items above as for the reduction to semi-annual monitoring.

Groundwater monitoring may be discontinued upon Agency approval of a certified post-closure care report. Specifically, when no statistically significant increase is detected in the concentration of any constituent above that measured and recorded during the immediately preceding scheduled sampling for three consecutive years after changing to an annual monitoring frequency; or, contaminated leachate is no longer generated by the Venice ash ponds.

3.2.3 Groundwater Sample Collection

Groundwater samples will be collected according to the draft standard operating procedure attached in Appendix H. The procedure is summarized below.

All groundwater elevations will be measured on a single day, in conjunction with sampling of the wells. River elevations as measured at the Venice plant will also be recorded at this time.

Monitoring wells will be sampled using a submersible pump. The well will be purged until specific conductance has stabilized within ±10 percent. Once stabilized, field parameters will be recorded in the log book. A 0.45 um filter will be attached to the discharge tube and the sample will be collected in pre-cleaned HDPE bottles. Samples for metals analysis will be preserved in the field using nitric acid (HNO_3). All samples will be placed in a cooler with ice to maintain a temperature of less than 4° Celsius during transport to the analytical laboratory.

In addition to groundwater well samples, quality assurance samples will be collected as listed in Section 3.2.5.

3.2.4 Laboratory Analysis

Laboratory analysis will be performed by Ameren's state-certified laboratory using the methods listed in Table 3-2. If alternative methods are used, they will be comparable to or better than the methods listed in Table 3-2. Concentrations lower than the reporting limit (RL) or practical quantitation limit (PQL) will be reported as less than the RL or less than the PQL.

3.2.5 Quality Assurance Program

One blind replicate and one equipment blank sample will be collected and analyzed for each day of sampling. In addition, one field blank sample will be analyzed for each sample trip.

Laboratory QA/QC programs may vary, but most laboratories use similar approaches, which include:

- Regular generation of instrument calibration curves to assure instrument reliability.
- Laboratory control samples and/or quality control check standards that have been spiked, and analyses to monitor the performance of the analytical method.
- Matrix spike/matrix spike duplicate analyses to determine percent recoveries and relative percent differences for each of the analytes detected.

- Analysis of replicate samples to check the precision of the instrumentation and/or methodology employed for all analytical methods.
- Analysis of daily or batch method blanks to assure that the system is free of contamination.

3.2.6 Groundwater Monitoring System Maintenance Plan

Monitoring wells will be inspected annually, and maintenance will be performed as needed to assure that the monitoring wells provide representative groundwater samples. Monitoring well inspections will consist of the following:

- Visual inspection, clearing of vegetation, replacement of markers, and painting of protective casings as needed to assure that monitoring wells are clearly marked and accessible.
- Visual inspection and repair or replacement of well aprons as needed to assure that they are intact, drain water away from the well, and have not heaved.
- Visual inspection and repair or replacement of protective casings as needed to assure that they are undamaged, and that locks are present and functional.
- Checks to assure that well caps are intact and vented, unless in flood-prone areas in which case caps will not be vented.
- Annual measurement of monitoring well depths to determine the degree of siltation within the wells. Wells will be redeveloped as needed to remove siltation from the screened interval if it impedes flow of water into the well.
- Checks that wells are clear of internal obstructions, and flow freely.

If maintenance of a monitoring well cannot address a deficiency, then a replacement well will be installed that meets the criteria outlined in Section 3.1.

3.2.7 Data Reporting

Sampling and analysis data from groundwater monitoring, and decisions to remove any constituent from the monitoring program, will be reported to the Agency no later than 30 days after the sampling and analysis have been completed.

3.3 Groundwater Quality Standards

3.3.1 On-Site Applicable Groundwater Quality Standards

On site, prior to the completion of the post-closure care period, the applicable groundwater quality standards at the Venice ponds are the concentrations as determined by groundwater monitoring, if such concentrations exceed the numeric standards for Class I: Potable Resource Groundwater set forth in 35 IAC 620.410.

After completion of the post-closure care period, the on-site concentrations of contaminants from the Venice ponds as determined by groundwater monitoring, if such concentrations exceed the numeric standards for Class I Potable Resource Groundwater set forth in 35 IAC 620.410, are the applicable groundwater standards if:

- To the extent practicable, the exceedance has been minimized and beneficial use, as appropriate for the class of groundwater, has been returned on-site;
- Any threat to public health or the environment on-site has been minimized; and
- An institutional control prohibiting potable uses of groundwater is placed on the Venice site in accordance with the Uniform Environmental Covenants Act (765 ILCS 122) or an alternative instrument authorized for environmental uses under Illinois law and approved by the Agency. Existing potable uses of groundwater may be preserved as long as such uses remain fit for human consumption in accordance with accepted water supply principles.

3.3.2 Off-Site Applicable Groundwater Quality Standards

Off-site applicable groundwater quality standards are not proposed and the Groundwater Management Zone (GMZ) will terminate at Ameren's southern property boundary. Groundwater modeling predictions suggest that concentrations will return to levels lower than Class I groundwater quality standards and approach background concentrations within 25 years (Section 2.5). Monitoring well nest 6 is located near the property boundary and is reflective of off-site impacts. Furthermore:

- To the extent practicable, the activities described in this closure plan are designed to minimize exceedances of groundwater quality standards; and
- Any threat to public health or the environment has been minimized. There are no groundwater receptors in this area (Appendix B), and in recognition of the industrial nature of the area and historical waste practices, the cities of Venice, East Saint Louis, Wood River, Granite City and the Villages of Brooklyn and Sauget – located in St. Clair and Madison counties – have all enacted groundwater use restriction ordinances.

3.4 Demonstration of Compliance

3.4.1 Compliance with On-Site Applicable Groundwater Quality Standards

Compliance with on-site groundwater quality standards will be achieved when no statistically significant increasing trend that can be attributed to the Venice ponds is detected in the concentrations of all constituents monitored at the downgradient boundaries of the Venice site for four consecutive years after changing to an annual monitoring frequency pursuant to Section 3.2. Monitoring wells to be used in this analysis are designated in Table 3-1 and Figure 3-1.

3.4.2 Demonstration of Compliance

An annual trend analysis will be performed for each compliance monitoring well designated in Table 3-1 and Figure 3-1 for all constituents monitored in accordance with Section 3.2 and listed in Table 3-2, based on a minimum of four consecutive samples, by applying Sen's Estimate of Slope. Compliance during closure and post-closure care periods will be demonstrated as described in Sections 3.4.1 and 3.4.2.

- If the results of sampling and analysis show an increasing trend at any compliance monitoring well located at the downgradient boundaries of the Venice site GMZ as specified in Table 3-1, a Mann-Kendall analysis will be performed at 95 percent confidence to determine whether or not the increasing trend is statistically significant. Ameren will investigate the cause of a statistically significant increasing trend as described below. If the statistically significant increasing trend occurs during post-closure care, the investigation will include more frequent inspection of the surface of the cover system and evaluation of background concentrations.
  - If the investigation attributes a statistically significant increasing trend to a superseding cause, Ameren will notify the Agency in writing, stating the cause of the increasing trend and providing the rationale used in such a determination.
  - If there is no superseding cause for the statistically significant increasing trend and sampling frequency has been reduced pursuant to semi-annual or annual sampling, a quarterly sampling schedule will be reestablished. After four consecutive quarterly samples show no statistically significant increasing trend, the frequency of groundwater monitoring will return to either semi-annual or annual, whichever frequency was utilized prior to the return to quarterly sampling.
  - Notifications concerning statistically significant increasing trends and revisions of the sampling frequency will be reported to the Agency in writing within 30 days after making the determinations.
- If a statistically significant increasing trend is observed to continue over a period of two or more consecutive years and there are no superseding causes for the trend, then Ameren will perform the following:
  - A hydrogeologic investigation; and
  - Additional site investigation, if necessary.

Based on the outcome of the investigation above, Ameren may take action to mitigate statistically significant increasing trends. Such actions will be proposed as a modification to the post-closure care plan within 180 days after completion of the investigation activities described above.

3.5 Proposed Mitigation Actions

If a statistically significant increasing trend is observed to continue over a period of two or more years, and a subsequent hydrogeologic and site investigation demonstrates that such exceedances are due to a release from the Venice Ash Ponds and corrective actions are appropriate to mitigate such releases, then Ameren will propose a corrective action plan as a modification to the post-closure care plan within 180 days after completion of the investigation activities. This plan will propose corrective actions to be undertaken to mitigate the groundwater quality exceedances.

4 FINAL COVER DESIGN

4.1 Overview

4.1.1 Profile

The final cover system proposed for the Venice ponds consists of the following profile (from bottom up), as depicted in Detail 3 on the enclosed Drawing 7824-Y-502164 entitled "Final Cover Sections and Details";

- 40-mil polyvinyl chloride (PVC) geomembrane infiltration barrier installed over a coal ash subgrade that will be prepared to be free of sharp objects or protrusions that may cause damage to the geomembrane when the overlying materials are placed;
- Geocomposite drainage layer, consisting of a high-density polyethylene geonet with geotextile adhered to the top and bottom of the geonet to provide a filter for the soils above the geocomposite and cushioning between the edges of the geonet and the geomembrane beneath; and
- 3-foot thick protective soil layer completely covering the geosynthetic layers with 2.5 feet of rooting zone soils and 6 inches of topsoil to support the establishment of vegetation on the cover system.

This cover design meets the requirements of 35 IAC 811.314, and provides a barrier to infiltration and subsequent generation and release of leachate.

PVC was selected for the geomembrane because of its greater flexibility relative to other types of geomembranes, making it better able to accommodate long-term settlement of ash within the ponds without compromising the infiltration barrier. PVC geomembrane is also available in larger panel sizes than that available for other types of geomembranes, which minimizes the amount of seams completed in the field. PVC is chemically compatible with the coal ash contained within the ponds. Vertical "boots" comprised of PVC geomembrane will be provided for penetrations in the cover for existing transmission tower foundations and poles for overhead electrical power distribution (Detail 4 on the enclosed Drawing 7824-Y-502164 entitled "Final Cover Sections and Details").

The geocomposite is provided to drain surface water that infiltrates the protective soil layer.

Vegetation will be established on the cover system to minimize erosion and exposure of the geosynthetics. Proposed seed mixes and related application rates are provided in Table 4-4.

4.1.2 Areal Extent

The approximate extent of the cover system is depicted on the enclosed Drawing 7824-Y-502161 entitled "Geomembrane Subgrade Grading Plan" and described herein.

The cover will extend to the Metro East Sanitary District's (MESD's) levee to the west, with the exact extent subject to approval by the US Army Corps of Engineers (USACE) and MESD. Details of the final cover system germane to USACE's / MESD's regulatory authority over the project, such as the proximity of the geosynthetics to the levee, were jointly submitted to MESD and the St. Louis District of USACE for review and approval around the same time as submittal of this closure plan to IEPA.

The cover system will extend across the north containment berm of Pond 2.

The east and south containment berm of Pond 3 will be left intact in accordance with the storm water management plan for the cover, which is described in Section 4.3 below.

The cover system will extend to, but not cross, the east containment berms of both ponds and south containment berm of Pond 3. The Illinois Department of Transportation (IDOT) has constructed an access road along the east side of the ponds to their Mississippi River Bridge (I-70) project located just to the south of the ponds. The anchor trench for the geosynthetics will be excavated along the west side of this access road since the cover system will be constructed after IDOT's access road is completed and while they are using the road to access the bridge project. Ameren learned through discussions with IDOT during planning of this access road in early 2010 that extending the cover across the access road would result in an impediment to construction of the bridge by limiting access to and use of the access road by IDOT and their contractor(s).

4.2 Final Slope and Global Stability

The Venice ponds will be graded to promote drainage of storm water runoff (Drawing 7824-Y-502162 entitled "Final Cover Grading and Storm Water Management Plan) prior to installation of the geosynthetics. Stability analyses were conducted on the proposed final slopes to verify and demonstrate compliance with relevant portions of 35 IAC 840.124, which cross-references 35 IAC 811.304 for foundation and mass stability requirements. Specifically, the following analyses were performed:

- Global stability under static and seismic conditions with consideration of a rapid decline or drawdown in the elevation of the adjacent Mississippi River;
- Surface deformation and liquefaction potential under seismic conditions; and
- Veneer stability of the geosynthetic cover under static and seismic conditions.

Two cross-sections representing the maximum slope from the crown in the middle of the cover to both the eastern berm and western levee were evaluated under static conditions at several different river and corresponding groundwater elevations. The cross-section exhibiting deep rotational failure under static conditions at the highest river and corresponding groundwater elevation (west slope) was carried forward for evaluation of static global stability under rapid drawdown conditions, seismic deformation, and global stability under pseudo-static (seismic) conditions. Liquefaction potential was also evaluated. Further details regarding the scope of these analyses and related assumptions / input parameters are summarized briefly below and in detail in Appendix I.

The proposed slopes exceed the minimum stability requirements in 35 IAC 811.304. Results are summarized below and in Table 4-1.

Computed Stability Safety Factors for Final Slope

Analysis	Static SF	Seismic SF
Global Stability	4.9	1.3
Rapid Drawdown	5.0	1.3
Veneer Stability	24.8	1.6
Required Minimum	1.5	1.3

Global stability was analyzed using the SLOPE/W computer software. A conceptual model of subsurface conditions at the site was constructed using data from historic site investigations. Geotechnical strength parameters for subsurface materials were conservatively estimated from literature sources due to a lack of site-specific data. The static analysis was performed for six river stages ranging from base conditions up to the approximate elevation of the top of the levee. Safety factors ranged from 4.86 to 6.50 under static conditions for the various river stages evaluated,

An additional static stability analysis was performed to evaluate the effects of a rapid drawdown condition where the river stage drops faster than the saturated slope material can drain. The analysis was performed for a rapid 8-ft drop in river stage resulting in a safety factor of 4.98. All static global stability analyses exceed the minimum safety factor of 1.5 required by 35 IAC 811.304.

The seismic stability analysis incorporated peak ground acceleration (PGA) of 0.23 for a 2% occurrence probability over 50 years based on a US Geologic Survey chart of seismic activity for the eastern US. The resulting factor of safety was 1.3 for a reasonable worst-case scenario with a river stage of 418 ft. An additional analysis evaluated the unlikely occurrence of simultaneous rapid drawdown and seismic events. The resulting safety factor was also 1.3. All seismic global stability analyses meet the minimum safety factor of 1.3 required by 35 IAC 811.304.

Due to the potential for earthquake-induced liquefaction, surface deformation and liquefaction analyses were conducted to satisfy the requirements of 35 IAC 811.304(f). Calculations were performed for NRT by Geo Engineering Consulting, LLC following methods published by the Tennessee Division of Solid Waste because the State of Illinois does not have specific technical guidance. The effects of both potential liquefaction and overall surface deformation on the final cover from seismic activity were determined to be negligible.

Lastly, the proposed geosynthetic cover was analyzed for veneer stability against sliding under static and seismic conditions (Appendix J). The critical interface was assumed to be between the geocomposite drainage layer and the PVC geomembrane. Material interface properties were conservatively estimated from published data for typical materials anticipated to be used in construction. The computed factor of safety against sliding was 24.78 and 1.56 for static and seismic conditions, respectively, which exceeds the corresponding minimum stability requirements of 1.5 and 1.3 in 35 IAC 811.304.

4.3 Storm Water Management Plan

Site constraints will not allow for the management of storm water outside of the limits of the final cover. The south and east containment berms of the ponds are located immediately adjacent to the property boundary, thus not providing any property outside of the ponds to the east and south for managing storm water runoff from the cover. The property to the south of the ponds is a closed depression to which the property east of the ponds already drains, and Ameren desires to avoid contributing to the potential for flooding within this area. Due to insufficient grade and concerns for erosion of the levee, Ameren is unable to direct storm water runoff from the cover to the west. Managing storm water runoff from the cover in the area north of the ponds would result in an unacceptable impact to Ameren's operations.

Consequently, storm water derived from precipitation falling onto and running off of the cover will be managed on the cover itself. The cover will be graded such that there is no off-site contribution, or run-on, of storm water from areas outside of the ponds, thus minimizing the amount of storm water that is managed on the cover. The cover grading plan was designed to collect storm water runoff in two topographically low areas located on the north and south ends of the cover (Drawing 7824-Y-502162, entitled "Final Cover Grading and Storm Water Management Plan"). Two low areas were necessary to minimize the amount of ash relocation / disturbance prior to installation of the cover. Storm water runoff collected in the low areas will be pumped from these locations over the levee to the Mississippi River.

The rate of inflow to the pump stations will be more variable than can be reasonably pumped to prevent ponding of storm water on the cover (most pumps operate at a static flow rate); therefore, the pump stations will be designed to minimize such ponding to the extent practical. A preliminary analysis of anticipated runoff and pumping rates suggests that ponding will be limited to approximately 0 to 3 feet in depth and 0.5 to 10 hours in duration depending upon the storm event. Recurrence intervals of 100% (1-yr), 50% (2-yr), 10% (10-yr), 4% (25-yr), 2% (50-yr), and 1% (100-yr), corresponding to the rainfall depths identified in Table 4-2, were evaluated. Runoff was quantified by the unit hydrograph method described in the Soil Conservation Service's (now referred to as the Natural Resource Conservation Service) Technical Release 55 (SCS, 1986). The shorter durations and lower depths of ponding were associated with the higher recurrence events (Table 4-3), while the longer durations and higher depths were associated with the lower recurrence events, indicating that the greatest extent of ponding anticipated will occur at a relatively low frequency.

Consequently, the cover design itself includes features to minimize infiltration while accommodating the management of storm water runoff on the cover. The geocomposite drainage layer component of the cover will drain directly into the pump stations so that infiltrated surface water is removed (Detail 1 of Drawing 7824-Y-502168, entitled "Storm Water Pump Station Sections and Details"). The geomembrane component of the cover will be placed beneath the subsurface wet wells associated with the pump stations. An additional flap of geomembrane will be placed directly beneath the geocomposite immediately surrounding the pump stations to minimize the infiltration of surface water into the topographically low spot in the main geomembrane layer. This flap will be fused to the main geomembrane layer and attached to the pump stations. A perforated pipe penetrating the geomembrane flap will be provided to facilitate monitoring for the presence of water within the topographically low spot in the main geomembrane layer and removal of this water via pumping. These details are depicted on Drawing 7824-Y-502168 entitled "Storm Water Pump Station Sections and Details".

During construction of the cover, coal ash contact water will be contained within the work area by the existing ash pond berms. Following installation of the geomembrane and construction of the storm water pump stations, accumulated storm water in the work area will be managed with the pump stations utilizing best management practices (BMPs), such as sediment traps and check dams, to minimize the amount of sediment discharged from the pump stations until vegetation is established on the cover.

4.4 Construction Quality Assurance Program

Construction of the proposed final cover system and storm water pumping stations will be subject to a quality assurance program similar to that required in 35 IAC 840.146. This program will be lead and supervised by a licensed professional engineer (PE) in the State of Illinois. Construction Quality Assurance (CQA) officers will execute the program on site through inspection and testing as described below. The CQA officers will communicate associated observations and testing results to the supervising PE, construction contractor (including relevant subcontractors), design engineer, and Ameren on a day-to-day basis, and prepare and maintain daily reports documenting construction activities and relevant CQA observations and/or test results. Observed construction quality deficiencies will be rectified by the contractor to the satisfaction of the CQA officers, supervising PE, design engineer, and Ameren.

4.4.1 Geosynthetics Installation

CQA officers will review quality control certificates issued by the geosynthetics manufacturers for each specific product used in the final cover prior to installation to verify that the products conform to relevant technical specifications. For geomembrane, this includes factory seam testing results to verify that the panels delivered to the site were fabricated in accordance with the relevant technical specifications. Nonconforming products will be rejected for use in the final cover.

The subgrade surface on which geosynthetics will be deployed / installed will be inspected and approved by the CQA officers and geosynthetics installer on a daily basis. This includes inspection of completed underlying geomembrane in the case of the geocomposite drainage layer. Additional inspections shall be performed if weather, vehicular traffic, or other factors may have changed the condition of the subgrade surface following approval. The following items shall be completed during subgrade inspections:

- Verification that the subgrade surface, including the anchor trench, has been prepared in accordance with the technical specifications and drawings;
- Visual inspection of the subgrade surface to verify that it is smooth and free of ruts, erosion rills, rocks or other protrusions which are greater in size than that allowed by the technical specifications; and
- Documentation of acceptance of the subgrade surface by the CQA officer and geosynthetics installer, including signatures by authorized representatives of each party.

If any portion of the subgrade surface is determined to be unacceptable, it will be repaired and subject to re-inspection and acceptance prior to deployment of geosynthetics.

The CQA officers will verify the following during deployment of geosynthetics:

- Geosynthetics panels are installed at the locations and positions indicated on the approved panel layout plan;
- Geosynthetics are deployed reasonably flat to minimize wrinkles and subsequent folds during placement of the protective soil layer above the geosynthetics;
- Removal or cut out and repair of wrinkles in the geosynthetics that are higher than wide;
- Sufficient slack is provided in the deployed geosynthetics to account for anticipated temperature fluctuations (excessive slack should be avoided);

- Deployed geosynthetics have not pulled away from the subgrade surface or anchor trench after a significant drop in temperature;
- Tensile stresses in the deployed geosynthetics are minimized to the extent practical;
- Stones or excessive dust that could damage the geomembrane or clog the geocomposite are not entrapped between layers of geosynthetics;
- Adequate ballast, such as sandbags, is provided to prevent uplift of the geosynthetics by wind and prevent damage of geosynthetics during temporary anchoring; and
- Geosynthetics are inspected for damage after placement any necessary repairs are made.

Seaming operations for all geosynthetics will be monitored by the CQA officers to verify that they are conducted in accordance with the relevant technical specifications and the geosynthetics installer's quality control program. For geomembrane, this includes both trial and production seams, and related non-destructive and destructive testing of each. Any seams that fail non-destructive testing will be repaired and re-tested by the geosynthetics installer. For seams that fail destructive tests, the installer will collect and test additional samples from the length of the affected seam as indicated in the relevant technical specifications until samples are obtained that yield satisfactory destructive testing results. For geocomposite, this includes verification that the composition of the geonet ties and geotextile seams meet the requirements of the relevant technical specifications, as well as the tie spacing and geonet / geotextile overlap. Geonet ties or geotextile seams that do not comply with the material specifications will be rejected from use in the final cover. Inadequate tie spacing and/or geotextile overlap will be corrected by the geosynthetic installer and subject to re-inspection and approval by the CQA officers.

4.4.2 Protective Soil Layer

The CQA officers will observe placement of the protective soil layer above the geosynthetics to verify that the installed geosynthetics are not damaged. The thickness of the first lift will be at least 12 inches and this material will be placed onto the geocomposite by a bulldozer that exerts a ground pressure of 5 pounds per square inch (psi) or less. Fill material will be free of sticks, rocks, roots or other debris that may puncture the geomembrane. If damage to geosynthetics is observed during fill placement, the filling operations will be suspended and not resumed in the damaged area until repairs to the geosynthetics can be made by the geosynthetics installer. The CQA officers will document any damage to the geosynthetics in their daily report as well as associated repairs and testing.

The fill material will be randomly sampled by the CQA officers. These samples will be analyzed by a geotechnical laboratory for documentation purposes.

The thickness of the completed protective soil layer will be verified through field survey and comparison of the geomembrane subgrade elevations and final elevations.

4.4.3 Storm Water Pump Stations

The CQA officers will inspect components of the storm water pump stations prior to installation to verify that they are in conformance with the relevant technical specifications. Surveying will be conducted during construction where appropriate to verify that these items are set at the elevations specified on the construction drawings. The CQA officers will observe construction of any piping and manhole connections and related backfill activities to verify that the materials and methods utilized conform to the relevant technical specifications and drawings for these items, and that leak testing is conducted where specified and that the results meet or exceed the requirements of the relevant technical specifications.

The CQA officers will observe nuclear density testing of structural backfill used in pump station foundations to verify compaction in accordance with the relevant technical specifications. CQA officers will also collect concrete delivery tickets and observe related quality control testing (e.g., slump, air entrainment, etc.) by the contractor to verify conformance with the relevant technical specifications. CQA officers will have authority to reject a load of concrete based upon the results of quality control testing. Cylindrical control samples of ready-mix concrete will be prepared by the contractor and tested for compressive strength to verify that cured compressive strengths meet or exceed the requirements of the relevant technical specifications. Compressive strength test results will be submitted to the CQA officers for review and approval prior to acceptance of the work.

5 CLOSURE AND POST-CLOSURE ACTIVITIES

5.1 Final Cover Construction and Closure Report

Ameren will prepare a final cover construction and closure report (closure report). This document will be submitted to IEPA within 90 days of completion of all closure activities described in Sections 3 and 4 of this closure plan. The closure report will include certification by a professional engineer that the Venice ponds have been closed in accordance with this closure plan, and will also contain supporting documentation including, but not limited to:

- Engineering and hydrogeology reports including, but not limited to, monitoring well completion reports and boring logs, monitoring well abandonment forms, all CQA reports, certifications, and designations of CQA officers-in-absentia;
- Photographs of the final cover system and any other photographs relied upon to document construction activities;
- A written summary of closure requirements and activities as set forth in the closure plan;
- Any other information relied upon by the professional engineer in making the closure certification; and
- The signature and seal of the professional engineer supervising the implementation of the closure plan, the preparation of the closure report, and making the certification of completion of closure.

5.2 Post-Closure Maintenance of Cover System

After closure and until completion of the post-closure report, Ameren will perform inspections of the cover system at the same time and frequency as the groundwater monitoring sampling schedule established in Table 3-3 and will take actions to mitigate the following conditions:

- Rills, gullies, and crevices six inches or deeper will be filled. Areas identified as particularly susceptible to erosion will be recontoured.
- Eroded and scoured drainage channels will be repaired, and lining material will be replaced if necessary.
- Holes and depressions created by settling will be filled and recontoured to prevent standing water.
- Areas in excess of 100 square feet, cumulative, with failed or eroded vegetation will be revegetated.

- Tears, rips, punctures, and other damage to the geosynthetic membrane will be repaired.
- Any woody species that take root on the protective cover will be removed.

5.3 Post-Closure Care Plan

A post-closure care plan will be submitted to IEPA within 90 days of completion of the cover.[3] The post closure care plan will include the following elements:

- Description of the post-closure care activities as listed in Section 5.2 of this closure plan;
- Description of the groundwater monitoring system as described in Section 3.1 of this closure plan, and a description of the maintenance plan for the groundwater monitoring system;
- Description of the groundwater monitoring program as described in Section 3.2 of this closure plan;
- Identification of the location of the monitoring wells used for trend analyses as listed in Section 3.4 of this closure plan;
- Description of the groundwater trend analysis methods as listed in Section 3.4 of this closure plan;
- A proposal for a groundwater management zone as listed in Section 1.5 of this closure plan;
- Description of actions proposed to mitigate statistically significant increasing trends in accordance with Section 3.4 of this closure plan, and the operation and maintenance of any structures or devices as listed in Section 3.5 of this closure plan; and
- The signature and seal of the professional engineer supervising the preparation of the post-closure care plan.

5.4 Annual Reporting

A report will be provided to IEPA annually during the post closure care period. The annual report will include the following items:

- Groundwater monitoring data;
- Annual trend analysis results per Section 3.4 of this Closure Plan, including a preliminary assessment of any statistically significant increasing trends;

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[3] In 35 IAC 840, the post-closure care plan is due 180 days after enactment of the rule. In this case, all of the elements of the post-closure care plan are included in this closure plan; however some items such as monitoring wells, are planned at this point in time. Therefore, we propose to submit the post-closure care plan after completion of the cover. This will allow inclusion of as-built details such as monitoring well construction.

- Groundwater monitoring system maintenance inspection forms, including a description of any maintenance or replacement activities performed; and
- Cover inspection reports and a description of any maintenance activities performed on the cover.

The annual report will be provided to IEPA by March 31 of the following year.

5.5 Post-Closure Report and Certification of Completion of Post-Closure Care Plan

Post-closure care will continue until a demonstration of compliance with the groundwater quality standards as set forth in Section 3.3 has been approved by the Agency. Ameren will prepare and submit to IEPA for review and approval a post-closure report within 60 days after satisfying the requirements of the approved post-closure care plan and achieving the applicable groundwater quality standards as set forth in the plan and Sections 3.3 and 3.4 of this closure plan. The post-closure report will include a certification(s) by a professional engineer that the objectives of this closure plan and post-closure care plan have been met. A professional geologist may supervise post-closure care activities as appropriate under the Professional Geologist Licensing Act (225 ILCS 745). The report will also contain supporting documentation including, but not limited to:

- Engineering and hydrogeology reports including, but not limited to, documentation of compliance with the groundwater quality standards of Section 3.3;
- Photographs of the final cover system and any other photographs relied upon to document construction activities ;
- A written summary of post-closure care requirements and activities as set forth in the post-closure care plan and their completion;
- Any other information relied upon by the professional engineer or professional geologist, as appropriate for the activity, in making the post-closure care certification(s); and
- The signature and seal of the professional engineer or professional geologist (if utilized) supervising the implementation of the post-closure care plan, and the signature and seal of the professional engineer supervising preparation of the post-closure report and making the certification of completion of the post-closure care plan.

6 SCHEDULE

Closure and post closure activities will be completed according to the schedule below. IEPA will be notified of any changes in schedule. Such notifications will include the reason(s) for the change and a new schedule.

- Installation of groundwater monitoring system: within 90 days of IEPA approval of this closure plan.
- Implementation of groundwater monitoring plan: the quarter immediately following installation of the groundwater monitoring system.
- Application for new, or modification of existing, storm water discharge permits: within 180 days of IEPA approval of this closure plan or US Army Corps of Engineers approval the levee alteration and 404 permitting for the outfalls, whichever is later.
- Construction of the cover: within 18 months of IEPA approval of this closure plan or US Army Corps of Engineers approval the levee alteration and 404 permitting for the outfalls, whichever is later.
- Submittal of closure report: 90 days after completion of closure activities as outlined in Section 4 of this closure plan.
- Submittal of post-closure care plan: 90 days after completion of closure activities as outlined in Section 4 of this closure plan.
- Post-closure report: 60 days after satisfying the requirements of the approved post-closure care plan and achieving the applicable groundwater quality standards as set forth in the plan and Sections 3.3 and 3.4 of this closure plan. Specifically, when no statistically significant increase is detected in the concentration of any constituent above that measured and recorded during the immediately preceding scheduled sampling for three consecutive years after changing to an annual monitoring frequency; or, when contaminated leachate is no longer generated by the Venice ash ponds.

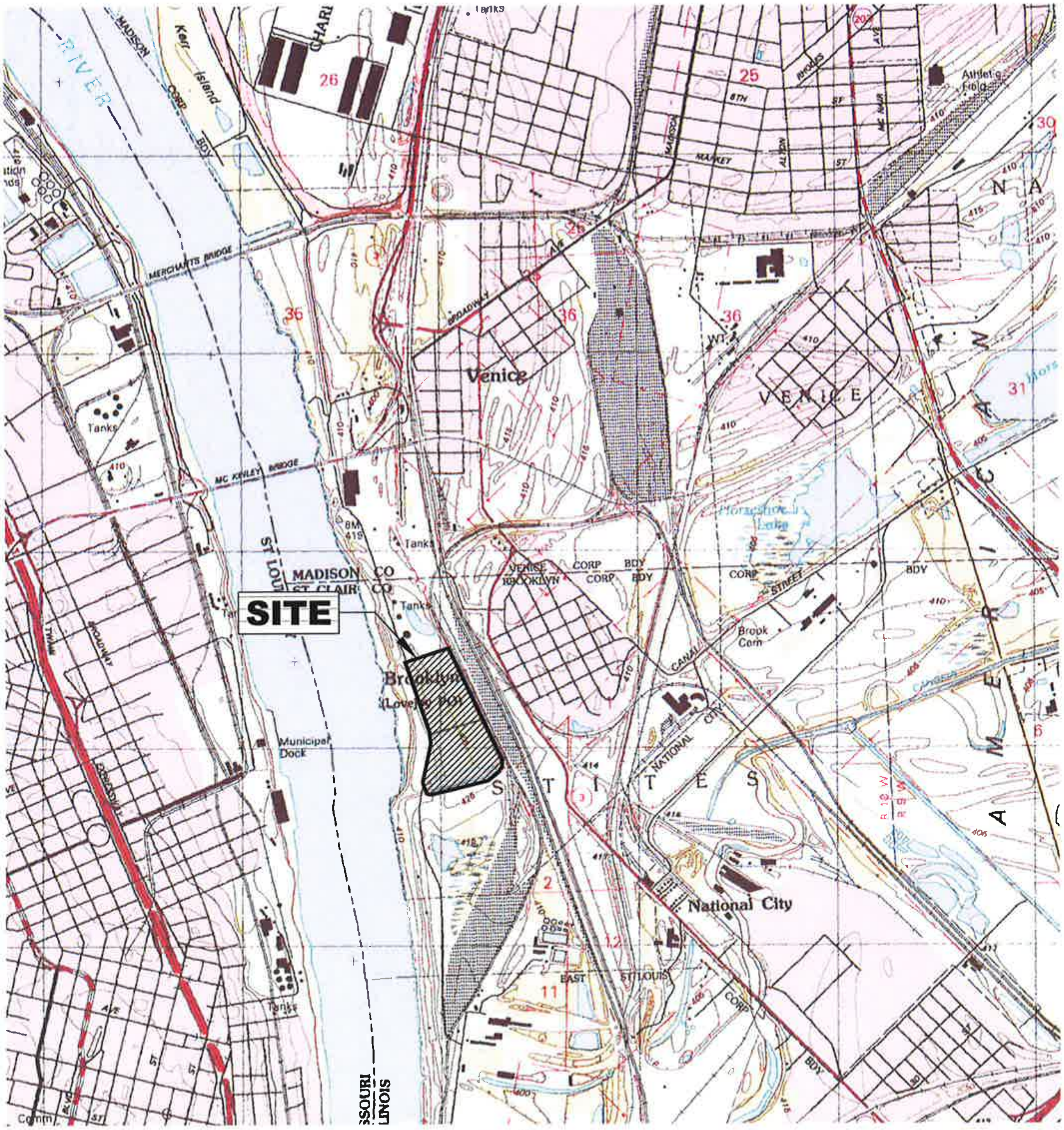
7 REFERENCES

Schroeder, P.R., T.S. Dozier, P.A. Zappi, B.M. McEnroe, J.W. Sjostrom, and R.L. Peyton, 1994, *The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3*, EPA/600/R-94/168b, U.S. Environmental Protection Agency Office of Research and Development, Washington, D.C.

Soil Conservation Service, 1986, *Urban hydrology for Small Watersheds.* Technical Release 55.

Zheng, Z., and P.P. Wang, 1998, *MT3DMS, A Modular Three-Dimensional Multispecies Transport Model*, Model documentation and user's guide prepared by the University of Alabama Hydrogeology Group for the US Army Corps of Engineers.

FIGURES



SOURCE:
HTTP://STORE.USGS.GOV
USGS 7.5 MINUTE QUADRANGLE,
GRANITE CITY, IL-MO. DATED 1998.

N

0 2000 4000

SCALE IN FEET

CONTOUR INTERVAL 10 FEET

SITE LOCATION MAP

AMEREN
VENICE POWER STATION
VENICE, ILLINOIS

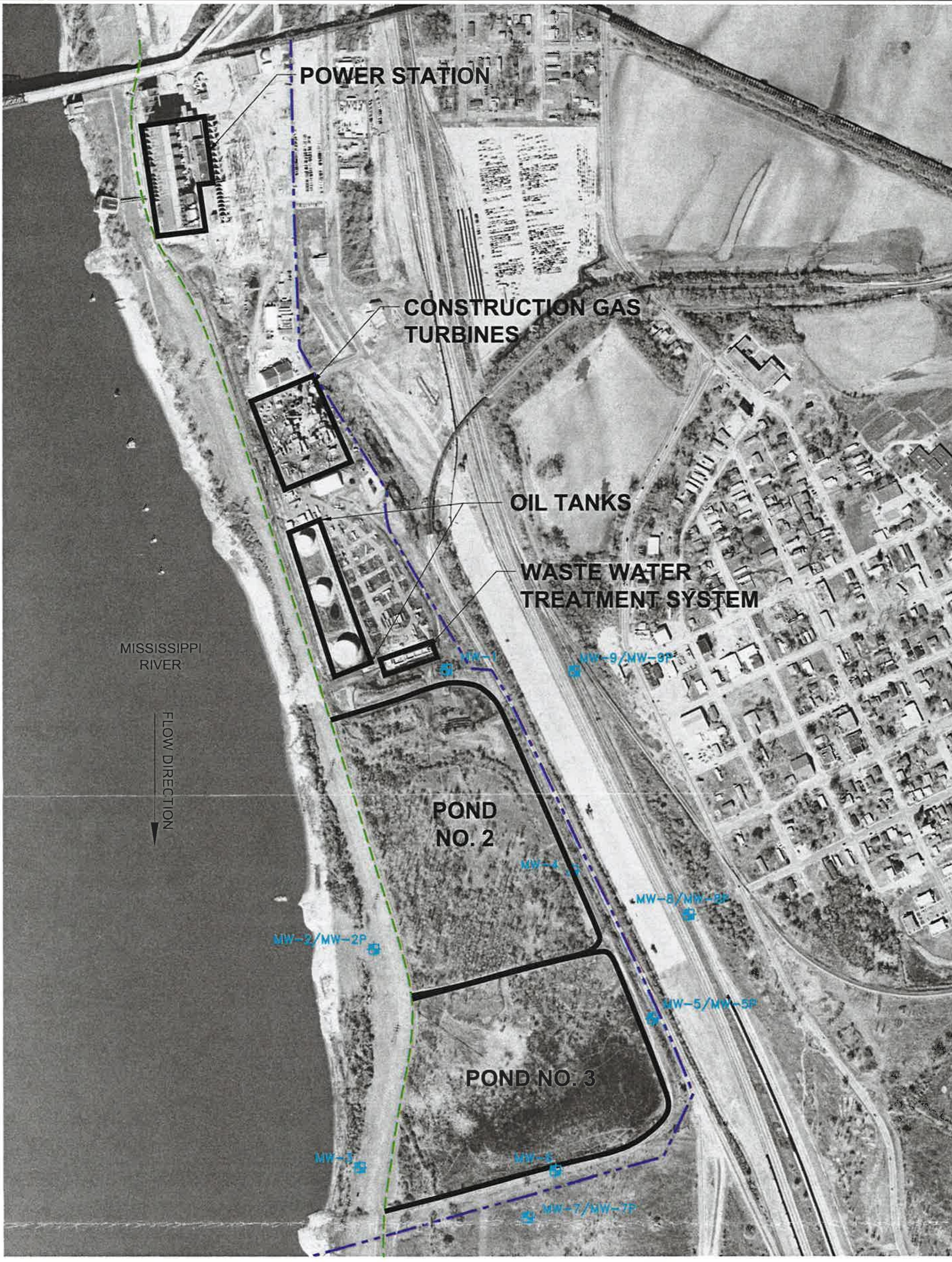
NATURAL
RESOURCE
TECHNOLOGY

DRAWN BY: RLH 11/22/10 APP'D BY: BRH DATE: 11/22/10

PROJECT NO.
1949

DRAWING NO.
1949–A01C

FIGURE NO.
1–1



LEGEND

MW-1	MONITORING WELL
— · —	APPROXIMATE PROPERTY BOUNDARY
— — —	TOP OF RIVER LEVEE

SOURCE:
2005 DIGITAL ORTHOPHOTO FROM ILLINOIS NATURAL RESOURCES GEOSPATIAL DATA CLEARINGHOUSE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY SOURCE WATER ASSESSMENT PROGRAM (SWAP) ArcIMS MAPPING TOOL (http://maps.epa.state.il.us/website/swap/intro.htm).

ILLINOIS STATE GEOLOGICAL SURVEY, DIGITAL WATER WELL RECORDS INTERACTIVE MAP (http://www.isgs.illinois.edu/maps-data-pub/wwdb/wwdb.shtml).

HANSON ENGINEERS, INC., UNDATED FIGURE "SITE PLAN, HYDROGEOLOGICAL INVESTIGATION, VENICE POWER PLANT", JOB NO. 9553085B.

N

0 250 500
SCALE IN FEET

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1949/2.2

FIGURE NO. 1-2

SITE LAYOUT MAP

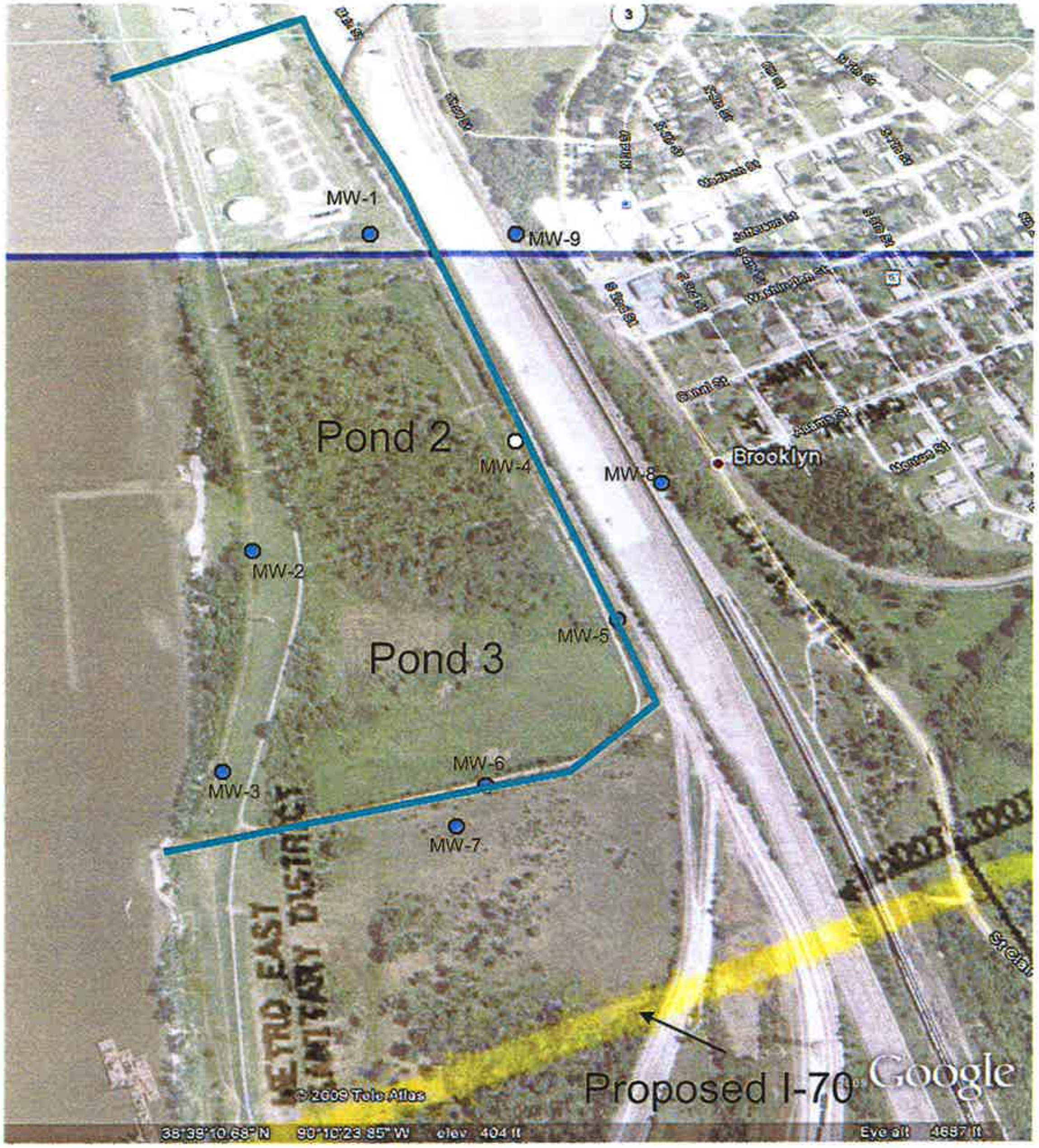
ASH POND CLOSURE PLAN
VENICE POWER STATION
VENICE, ILLINOIS

DRAWN BY: KNW/RLH	DATE: 02/04/11
CHECKED BY: BRH	DATE: 02/04/11
APPROVED BY: BRH	DATE: 02/04/11
DRAWING NO: 1949-22-B01C	
REFERENCE: 38090f23.sid	

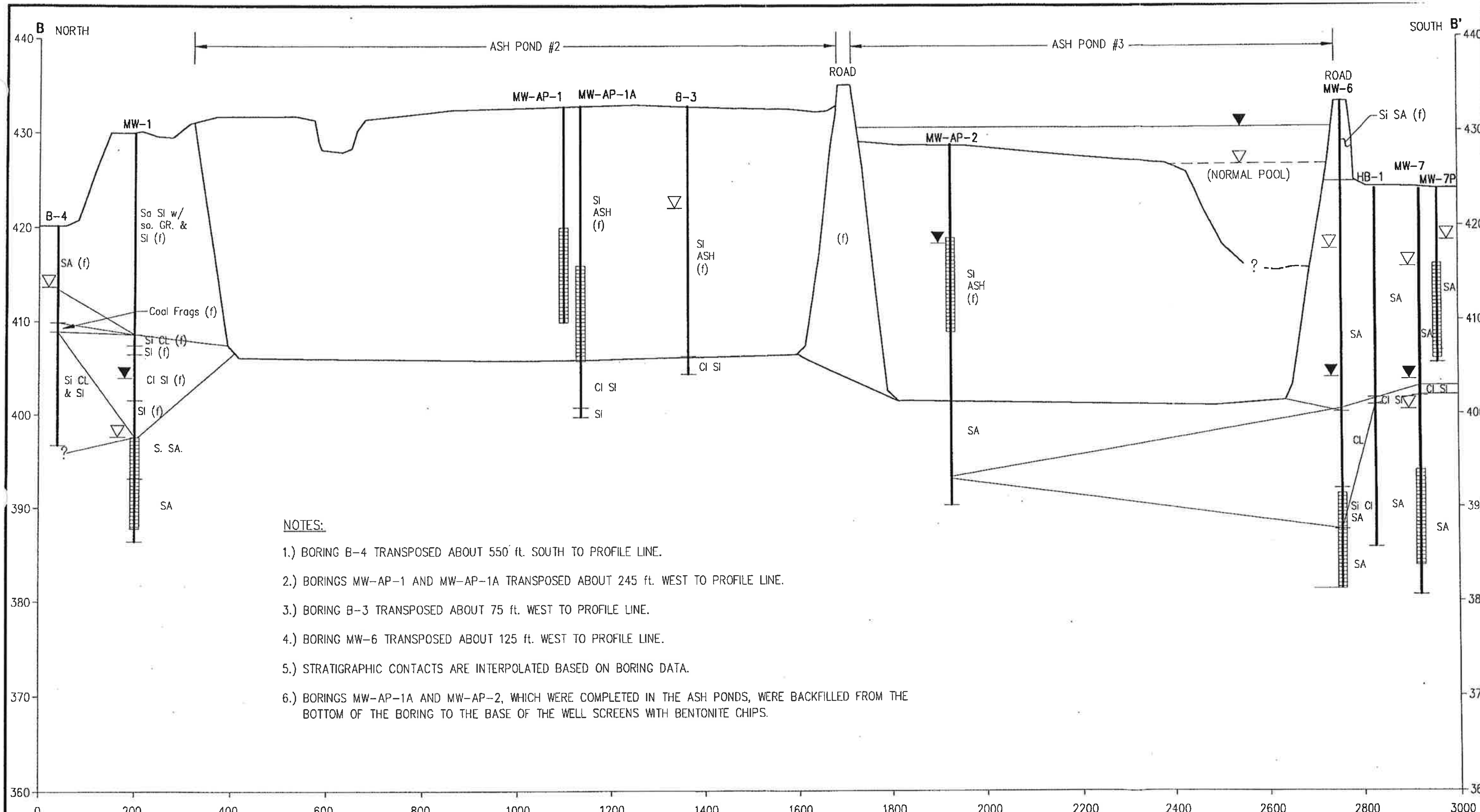
Figure 1-3 Approximate Extent of Groundwater Management Zone

- Existing MW Location
- Abandoned MW Location
- Proposed Groundwater Management Zone (approximate), see Appendix L for exact location

The dark blue line across the top of the page is an artifact of the I-70 overlay on the aerial photo



NATURAL RESOURCE TECHNOLOGY



NOTES:

1.) BORING B-4 TRANSPOSED ABOUT 550' ft. SOUTH TO PROFILE LINE.

2.) BORINGS MW-AP-1 AND MW-AP-1A TRANSPOSED ABOUT 245 ft. WEST TO PROFILE LINE.

3.) BORING B-3 TRANSPOSED ABOUT 75 ft. WEST TO PROFILE LINE.

4.) BORING MW-6 TRANSPOSED ABOUT 125 ft. WEST TO PROFILE LINE.

5.) STRATIGRAPHIC CONTACTS ARE INTERPOLATED BASED ON BORING DATA.

6.) BORINGS MW-AP-1A AND MW-AP-2, WHICH WERE COMPLETED IN THE ASH PONDS, WERE BACKFILLED FROM THE BOTTOM OF THE BORING TO THE BASE OF THE WELL SCREENS WITH BENTONITE CHIPS.

LEGEND

CL = CLAY
SI = SILT
SA = SAND
GR = GRAVEL
(f) = FILL
▽ = WATER LEVEL DURING DRILLING
▼ = WATER LEVEL ON JULY 8, 1999

SCALE

VERTICAL - 1 INCH = 10 FEET
HORIZONTAL - 1 INCH = 200 FEET

HANSON ENGINEERS INCORPORATED

SUBSURFACE PROFILE B-B"

HYDROGEOLOGICAL INVESTIGATION
VENICE POWER PLANT
AMEREN SERVICES
VENICE, ILLINOIS

JOB NO. 95S3085B Figure 2-1

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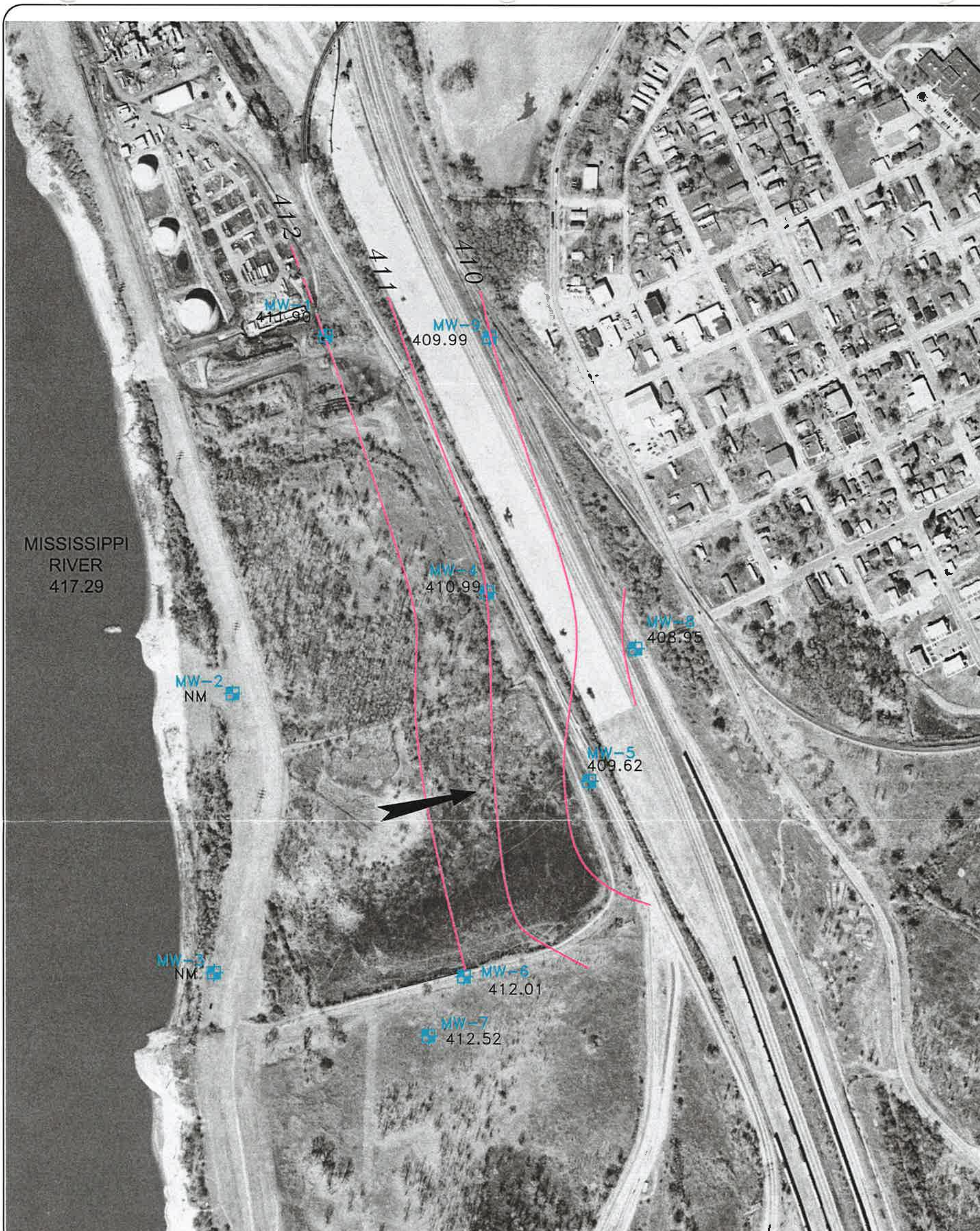


LEGEND

410	WATER TABLE ELEVATION CONTOUR, FT. (NGVD)
	GROUNDWATER FLOW DIRECTION
MW-1 400.50	MONITORING WELL AND WATER TABLE ELEVATION, FT. (NGVD)
NM	NOT MEASURED

SOURCE:
2005 DIGITAL ORTHOPHOTO FROM ILLINOIS NATURAL RESOURCES GEOSPATIAL DATA CLEARINGHOUSE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY SOURCE WATER ASSESSMENT PROGRAM (SWAP) ArcIMS MAPPING TOOL (http://maps.epa.state.il.us/website/swap/intro.htm).

ILLINOIS STATE GEOLOGOICAL SURVEY, DIGITAL WATER WELL RECORDS INTERACTIVE MAP (http://www.isgs.illinois.edu/maps-data-pub/wwdb/wwdb.shtml).

HANSON ENGINEERS, INC., UNDATED FIGURE "SITE PLAN, HYDROGEOLOGICAL INVESTIGATION, VENICE POWER PLANT", JOB NO. 95530858.

N

0 200 400
SCALE IN FEET

FIGURE NO. 2-2

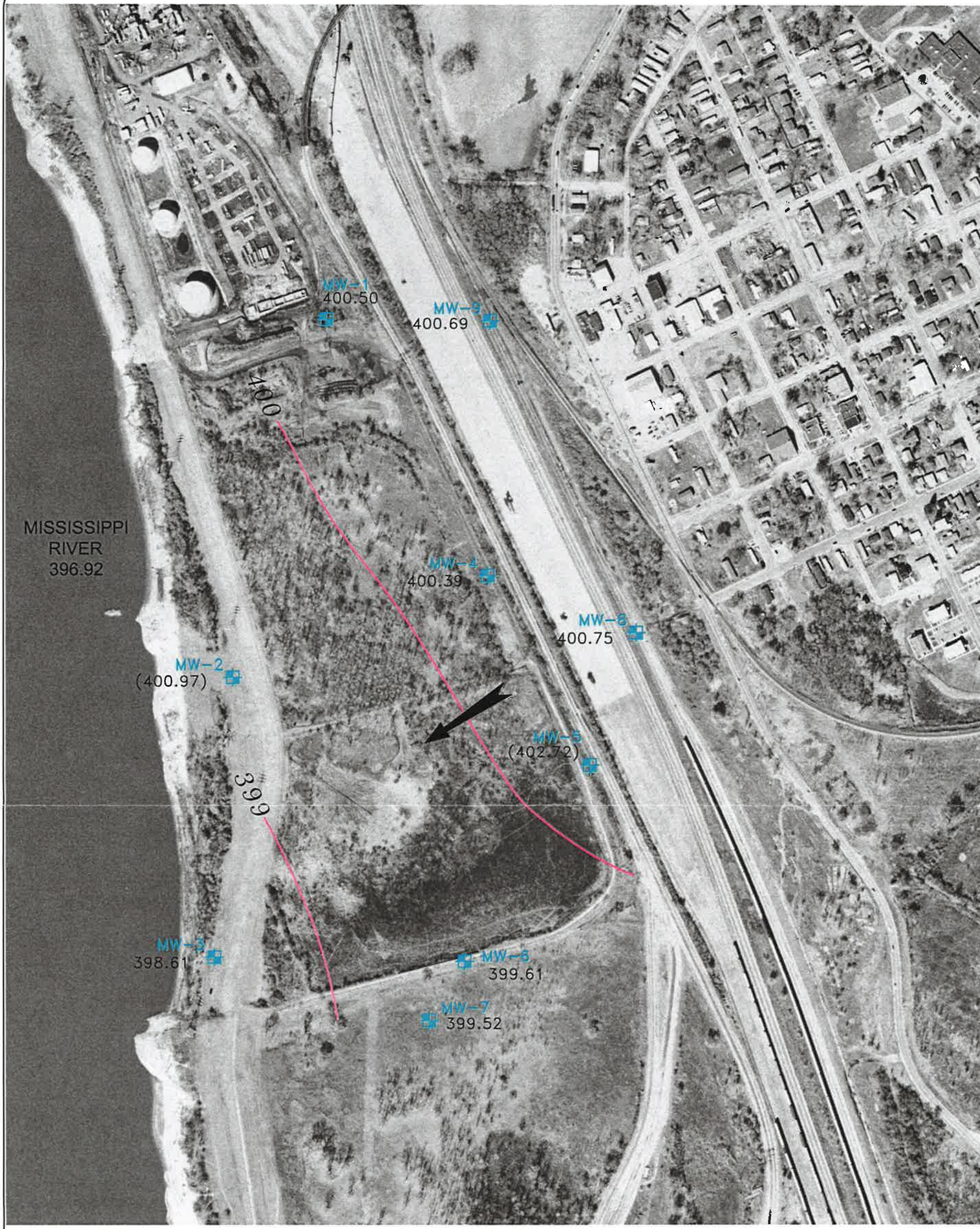
PROJECT NO. 1949/2.2

NATURAL RESOURCE TECHNOLOGY

GROUNDWATER ELEVATION
JUNE 26, 2008

ASH POND CLOSURE PLAN
VENICE POWER STATION
VENICE, ILLINOIS

DRAWN BY: KNW/RLH	DATE: 02/04/11
CHECKED BY: BRH	DATE: 02/04/11
APPROVED BY: BRH	DATE: 02/04/11
DRAWING NO: 1949-22-B05C	
REFERENCE: 38090f23.sid	



LEGEND

400 — WATER TABLE ELEVATION CONTOUR, FT. (NGVD)

GROUNDWATER FLOW DIRECTION

MW-1 400.50 — MONITORING WELL AND WATER TABLE ELEVATION, FT. (NGVD) ELEVATIONS IN PARANTHESIS NOT USED FOR CONTOURING

SOURCE:
2005 DIGITAL ORTHOPHOTO FROM ILLINOIS NATURAL RESOURCES GEOSPATIAL DATA CLEARINGHOUSE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY SOURCE WATER ASSESSMENT PROGRAM (SWAP) ArcIMS MAPPING TOOL (http://maps.epa.state.il.us/website/swap/intro.htm).

ILLINOIS STATE GEOLOGOICAL SURVEY, DIGITAL WATER WELL RECORDS INTERACTIVE MAP (http://www.isgs.illinois.edu/maps-data-pub/wwdb/wwdb.shtml).

HANSON ENGINEERS, INC., UNDATED FIGURE "SITE PLAN, HYDROGEOLOGICAL INVESTIGATION, VENICE POWER PLANT", JOB NO. 9553085B.

N

0 200 400
SCALE IN FEET

FIGURE NO. 2-3

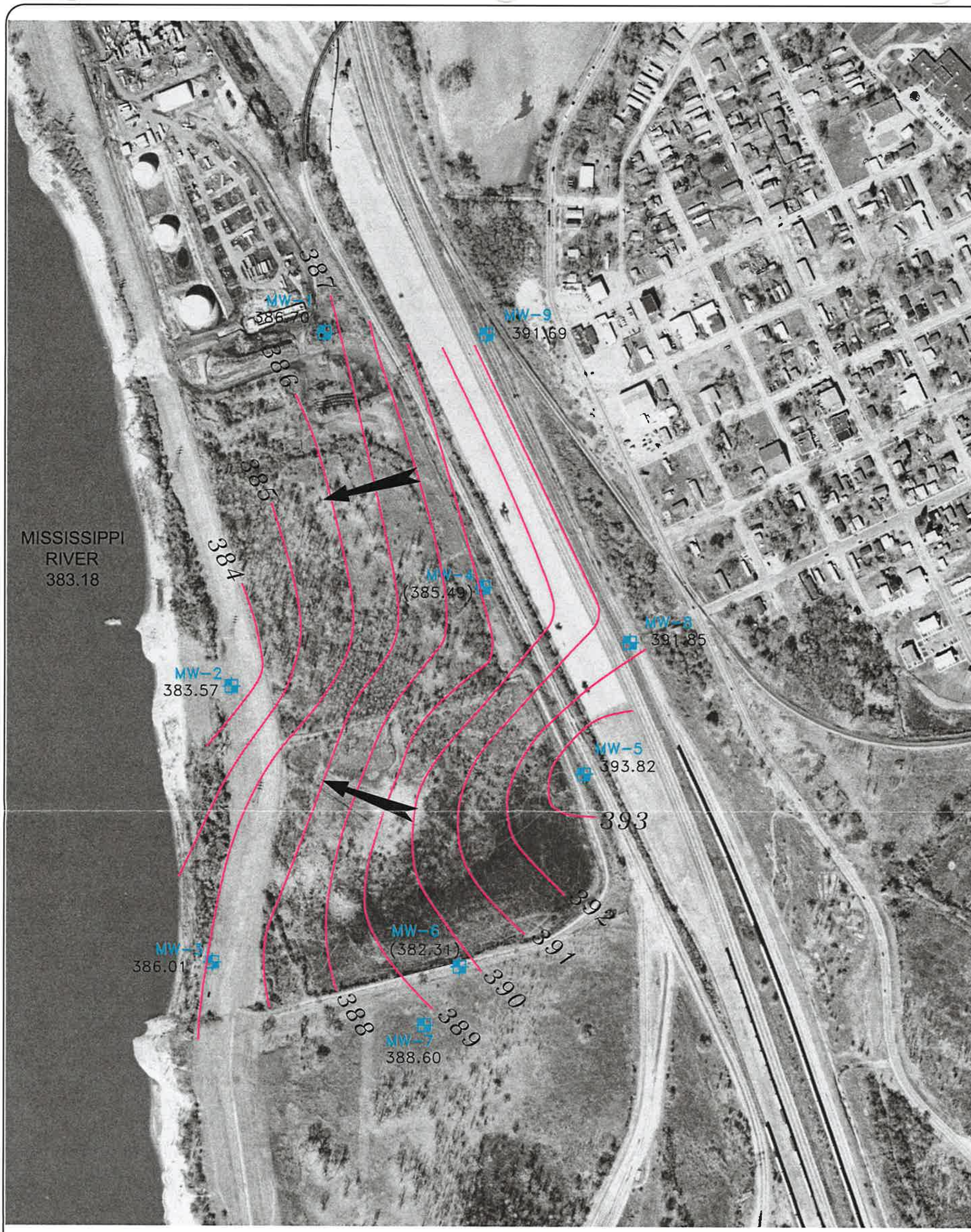
PROJECT NO. 1949/2.2

NATURAL RESOURCE TECHNOLOGY

GROUNDWATER ELEVATION SEPTEMBER 26, 2008

ASH POND CLOSURE PLAN
VENICE POWER STATION
VENICE, ILLINOIS

DRAWN BY:	KNW/RLH	DATE:	02/04/11
CHECKED BY:	BRH	DATE:	02/04/11
APPROVED BY:	BRH	DATE:	02/04/11
DRAWING NO: 1949-22-B04C			
REFERENCE: 38090f23.sid			



LEGEND

388 WATER TABLE ELEVATION CONTOUR, FT. (NGVD)

GROUNDWATER FLOW DIRECTION

MW-1 386.70 MONITORING WELL AND WATER TABLE ELEVATION, FT. (NGVD) ELEVATIONS IN PARANTHESIS NOT USED FOR CONTOURING

SOURCE:
2005 DIGITAL ORTHOPHOTO FROM ILLINOIS NATURAL RESOURCES GEOSPATIAL DATA CLEARINGHOUSE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY SOURCE WATER ASSESSMENT PROGRAM (SWAP) ArcIMS MAPPING TOOL (http://maps.epa.state.il.us/website/swap/intro.htm).

ILLINOIS STATE GEOLOGOICAL SURVEY, DIGITAL WATER WELL RECORDS INTERACTIVE MAP (http://www.isgs.illinois.edu/maps-data-pub/wwdb/wwdb.shtml).

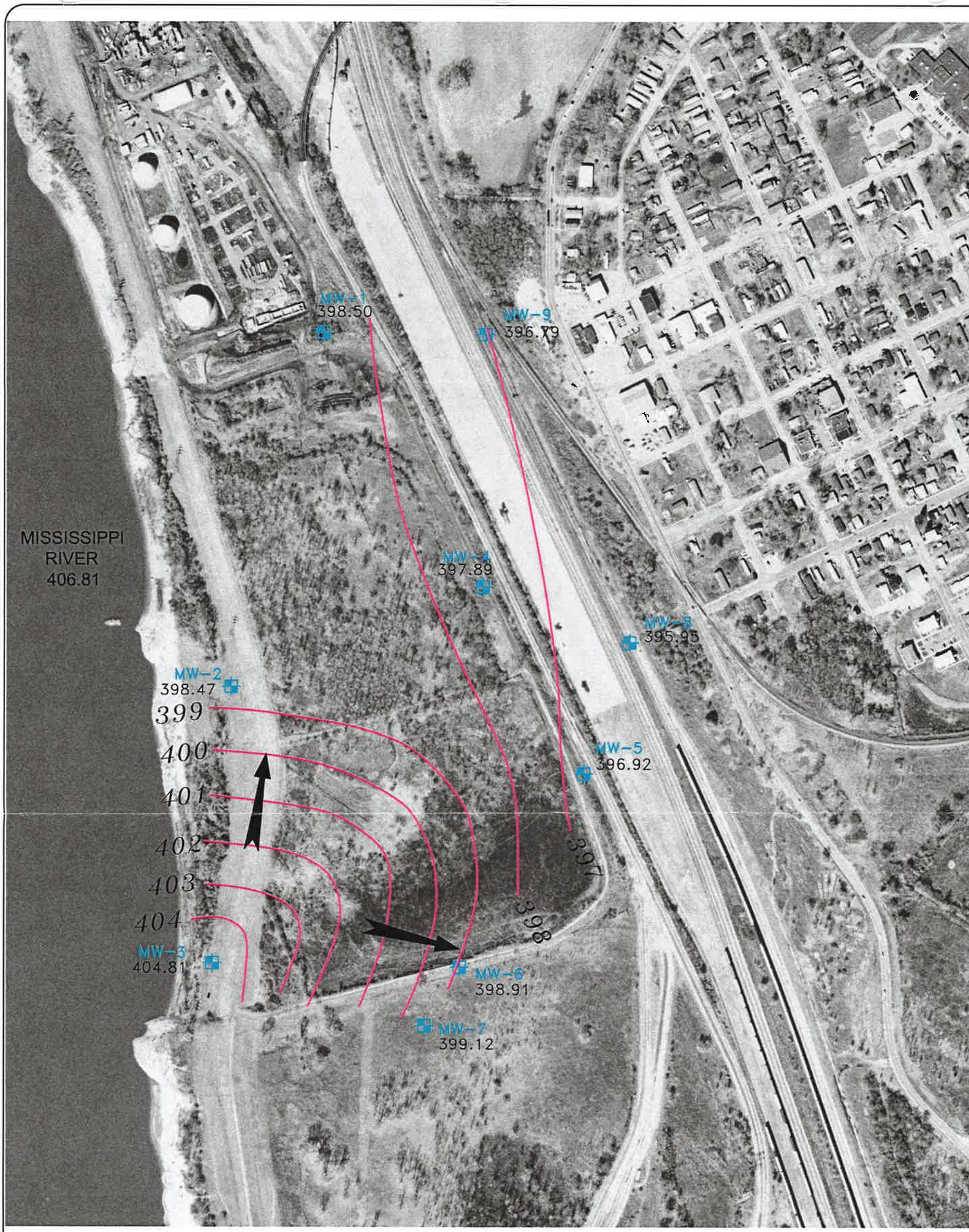
HANSON ENGINEERS, INC., UNDATED FIGURE "SITE PLAN, HYDROGEOLOGICAL INVESTIGATION, VENICE POWER PLANT", JOB NO. 9553085B.

N

0 200 400
SCALE IN FEET

FIGURE NO. 2-4	PROJECT NO. 1949/2.2	NATURAL RESOURCE TECHNOLOGY	GROUNDWATER ELEVATION DECEMBER 2, 2008 ASH POND CLOSURE PLAN VENICE POWER STATION VENICE, ILLINOIS

DRAWN BY: KNW/RLH	DATE: 02/04/11
CHECKED BY: BRH	DATE: 02/04/11
APPROVED BY: BRH	DATE: 02/04/11
DRAWING NO: 1949-22-B02C	
REFERENCE: 38090f23.sid	



LEGEND

400 — WATER TABLE ELEVATION CONTOUR, FT. (NGVD)

GROUNDWATER FLOW DIRECTION

MW-1 398.50 — MONITORING WELL AND WATER TABLE ELEVATION, FT. (NGVD) ELEVATIONS IN PARANTHESIS NOT USED FOR CONTOURING

SOURCE:
2005 DIGITAL ORTHOPHOTO FROM ILLINOIS NATURAL RESOURCES GEOSPATIAL DATA CLEARINGHOUSE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY SOURCE WATER ASSESSMENT PROGRAM (SWAP) ArcIMS MAPPING TOOL (http://maps.epa.state.il.us/website/swap/intro.htm).

ILLINOIS STATE GEOLOGOICAL SURVEY, DIGITAL WATER WELL RECORDS INTERACTIVE MAP (http://www.isgs.illinois.edu/maps-data-pub/wwdb/wwdb.shtml).

HANSON ENGINEERS, INC., UNDATED FIGURE "SITE PLAN, HYDROGEOLOGICAL INVESTIGATION, VENICE POWER PLANT", JOB NO. 9553085B.

N

0 200 400
SCALE IN FEET

FIGURE NO. 2-5

PROJECT NO. 1949/2.2

NATURAL RESOURCE TECHNOLOGY

GROUNDWATER ELEVATION MARCH 14, 2009

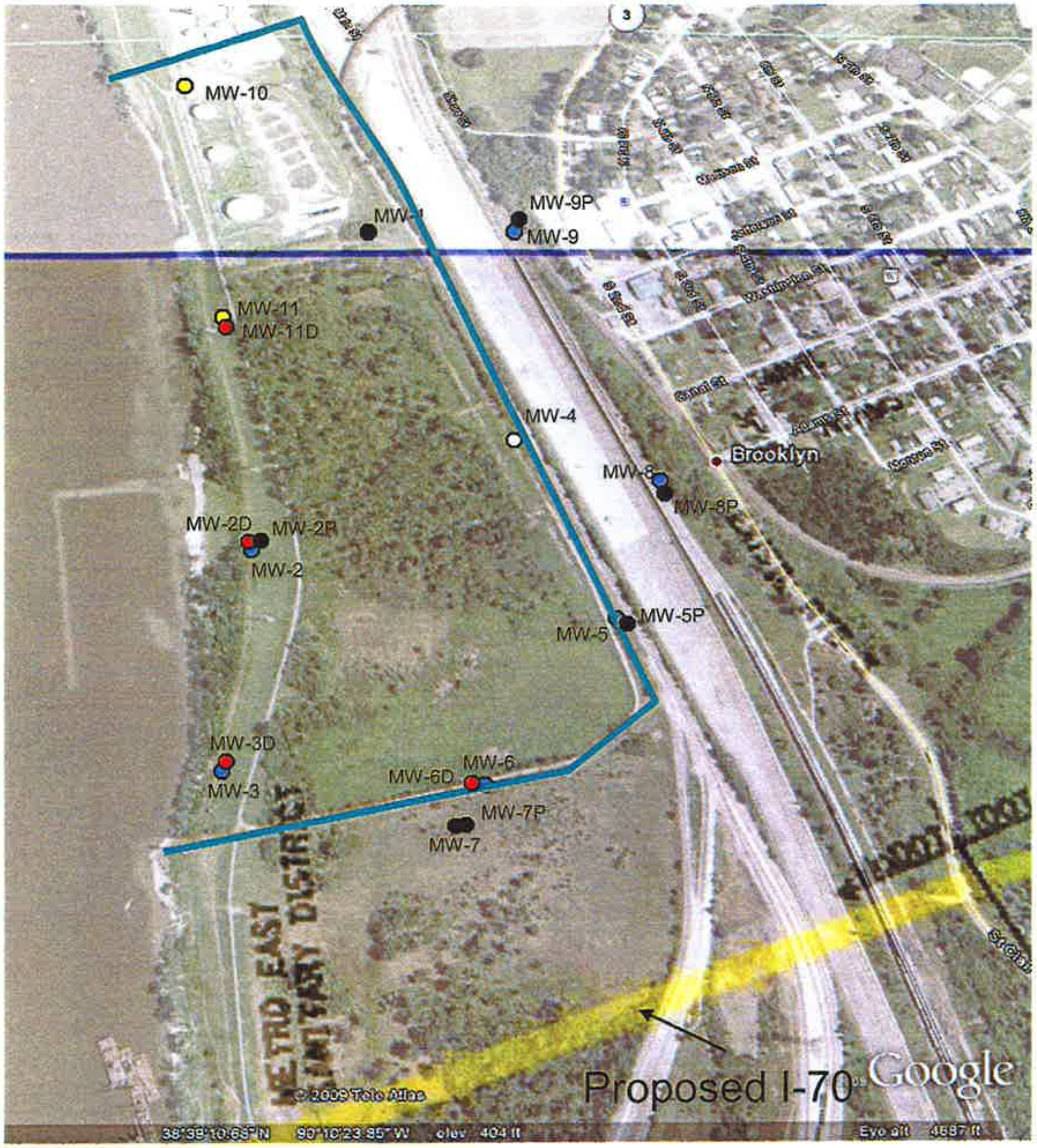
ASH POND CLOSURE PLAN VENICE POWER STATION VENICE, ILLINOIS

DRAWN BY:	KNW/RLH	DATE:	02/04/11
CHECKED BY:	BRH	DATE:	02/04/11
APPROVED BY:	BRH	DATE:	02/04/11
DRAWING NO: 1949-22-B03C			
REFERENCE: 38090f23.sid			

Figure 2-6 Adjustments to Monitoring Well Network

- Existing MW Location
- Abandoned MW Location
- Proposed Deep Well
- Proposed Water Table Well
- Existing MW Location Proposed for Abandonment
- Proposed Groundwater Management Zone (approximate), see Appendix L for exact location

The dark blue line across the top of the page is an artifact of the I-70 overlay on the aerial photo



NATURAL RESOURCE TECHNOLOGY

Figure 2-7 Observed Boron Concentrations in 2009

- Existing MW Location
- Abandoned MW Location
- Geoprobe Locations

Geoprobe data (October 2009)

MW data (June 2009)

1.6 Dissolved Boron concentration (mg/L)

Boron 2.0 mg/L concentration contour (Class I standard)

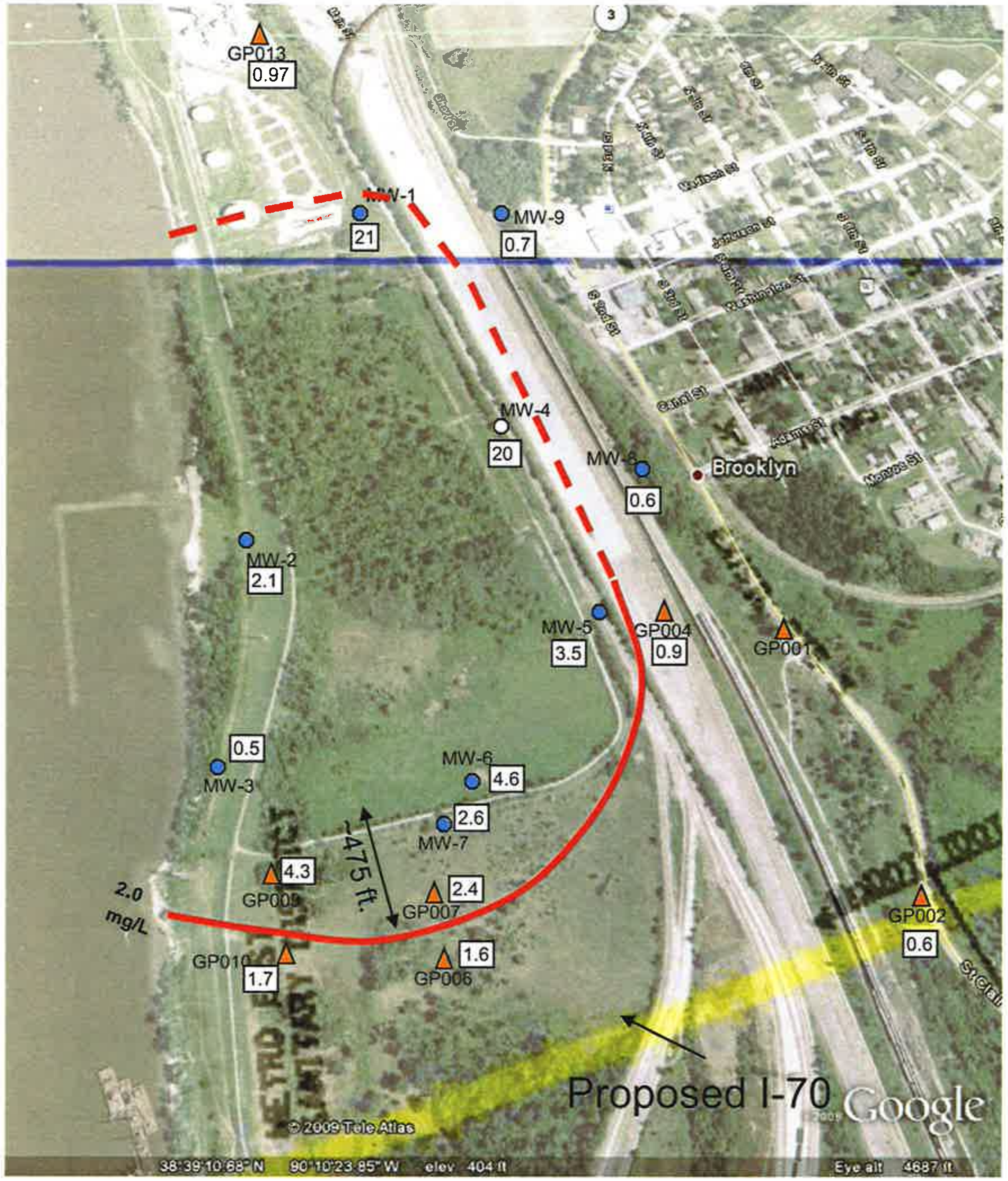


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Figure 2-8 Boron and Arsenic Concentrations in 2009

● Existing MW Location

○ Abandoned MW Location

▲ Geoprobe Locations

Geoprobe data (October 2009)

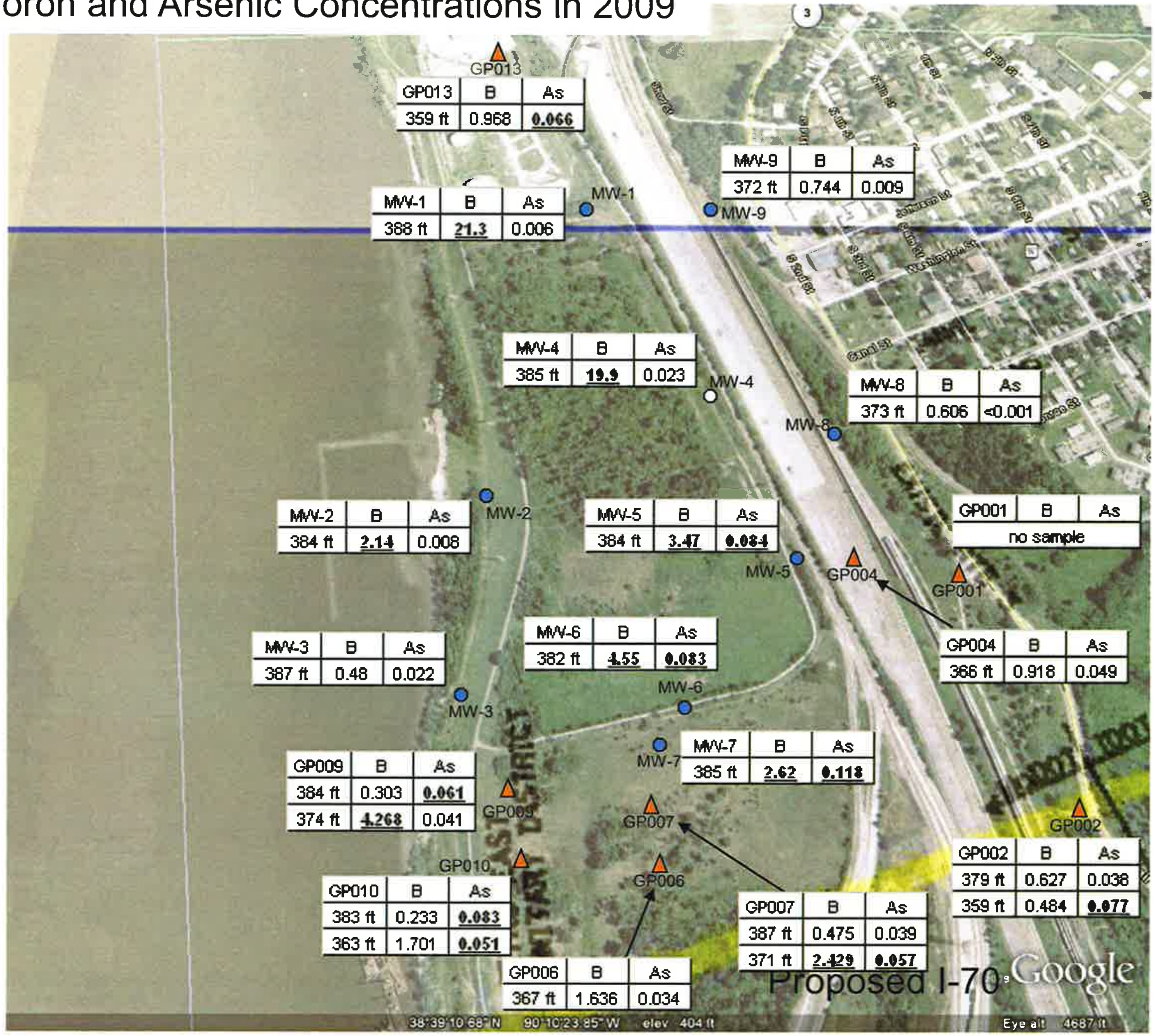
MW 3 data (March 2009)

Other MW data (June 2009)

Sample depths are elevations, in feet

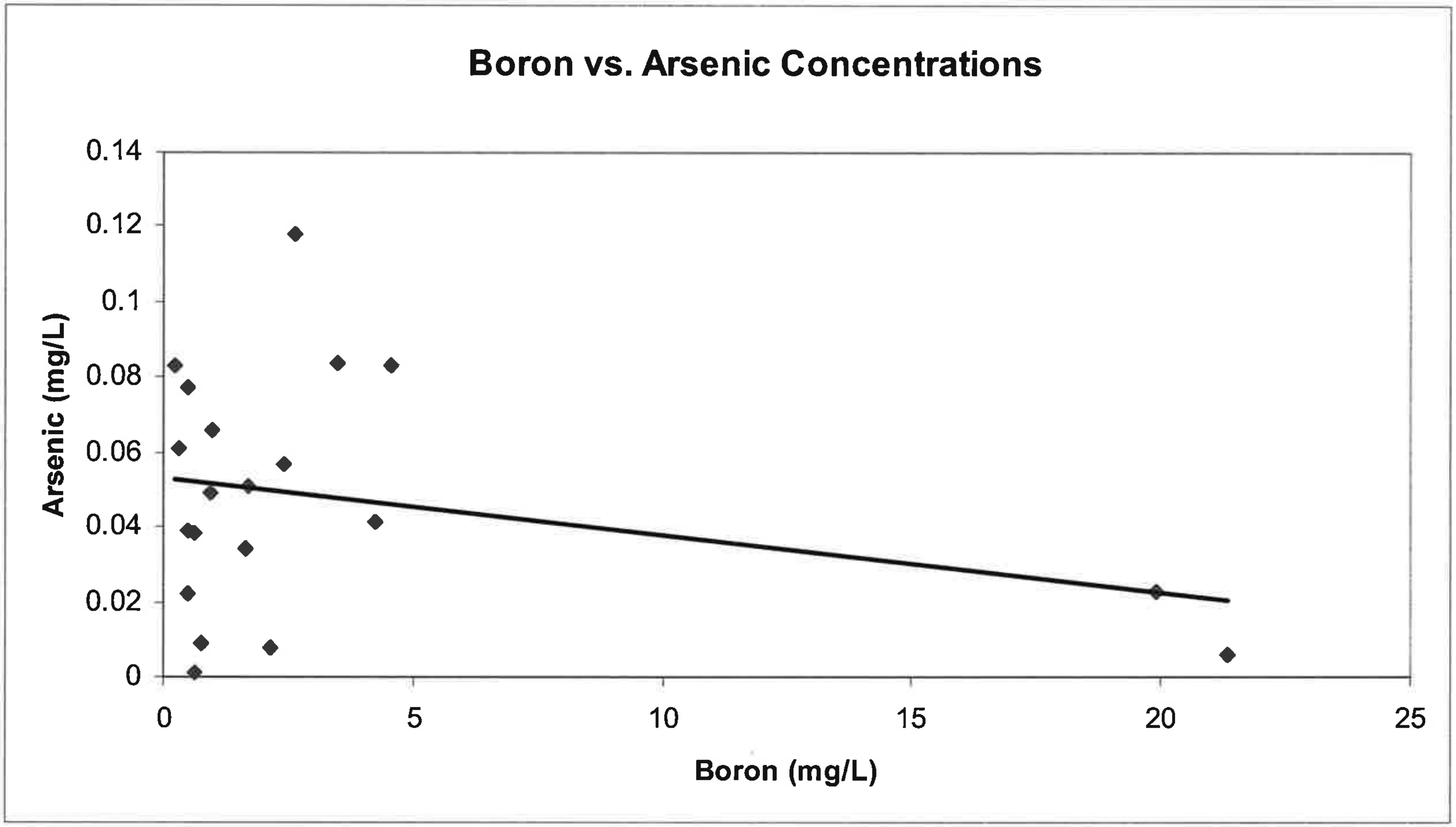
Bold and Underline indicate dissolved concentrations in excess of standard:

Stnd.	B	As
Class I	**2.0**	**0.05**



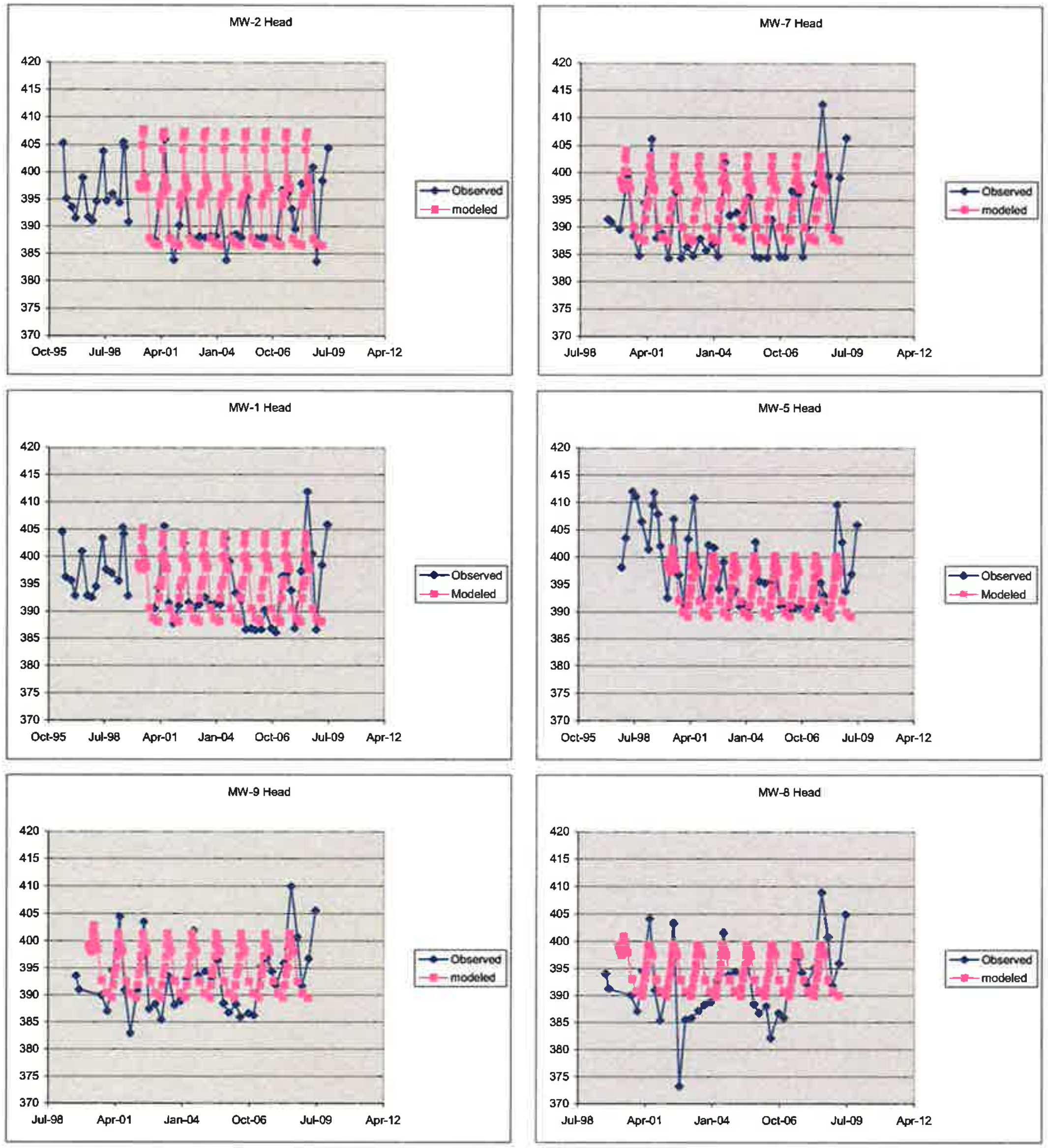
NATURAL RESOURCE TECHNOLOGY

Figure 2-9 Scatter Plot Comparing Boron and Arsenic Concentrations in Groundwater Samples Collected in 2009



NATURAL RESOURCE TECHNOLOGY

Figure 2-10 Flow Model Calibration Results



Head calibration graphs [Run 19]. MW-2 and MW-7 represented downgradient calibration; MW-1 and MW-5 represented on-site calibration; and MW-8 and MW-9 represented upgradient calibration.

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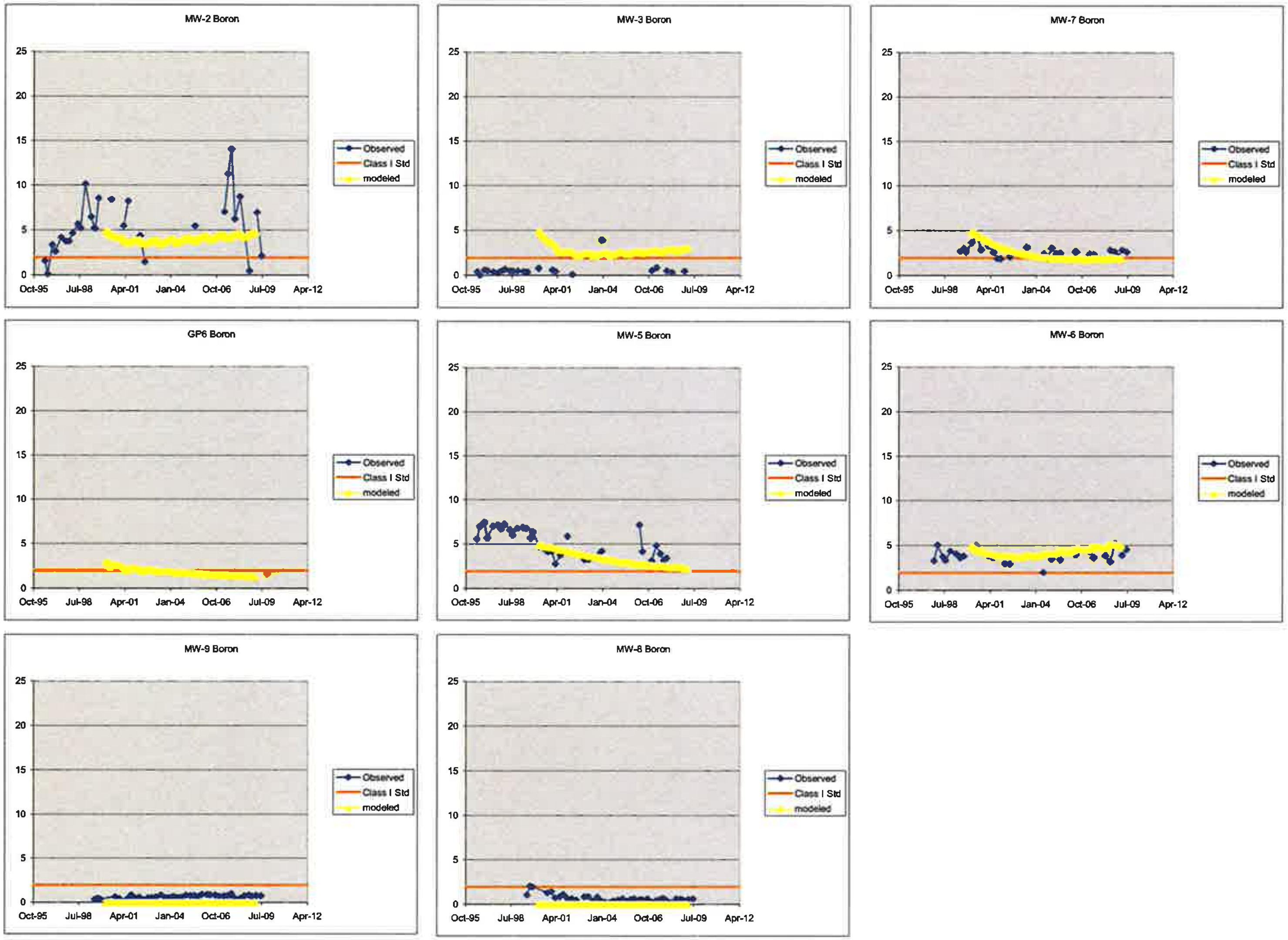
Figure 2-11 Transport Model Calibration Results



Concentration calibration graphs [Run 19]. MW-2, MW-3, MW-7, and GP-6 represented downgradient concentrations. GP-6 is a monitoring point placed in the model to compare to a groundwater grab sample collected in the fall of 2009. MW-5 and MW-6 represented on-site conditions; and MW-8 and MW-9 represented upgradient conditions.

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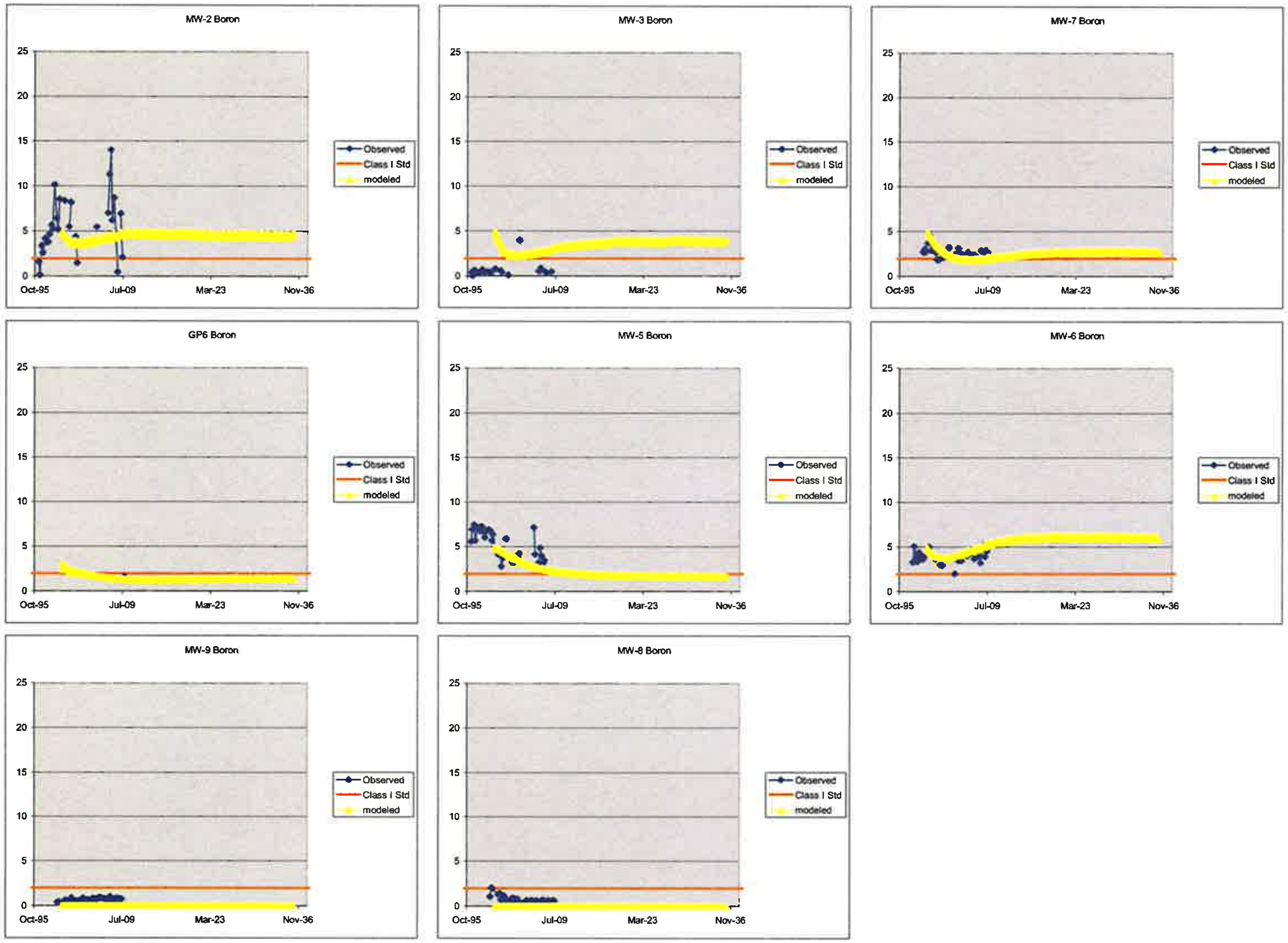
Figure 2-12 Prediction Model Results (No Action Scenario)



No Action Prediction Scenario [Run 19pna]. MW-2, MW-3, MW-7, and GP-6 represented downgradient concentrations. GP-6 is a monitoring point placed in the model to compare to a groundwater grab sample collected in the fall of 2009. MW-5 and MW-6 represented on-site conditions; and MW-8 and MW-9 represented upgradient conditions.

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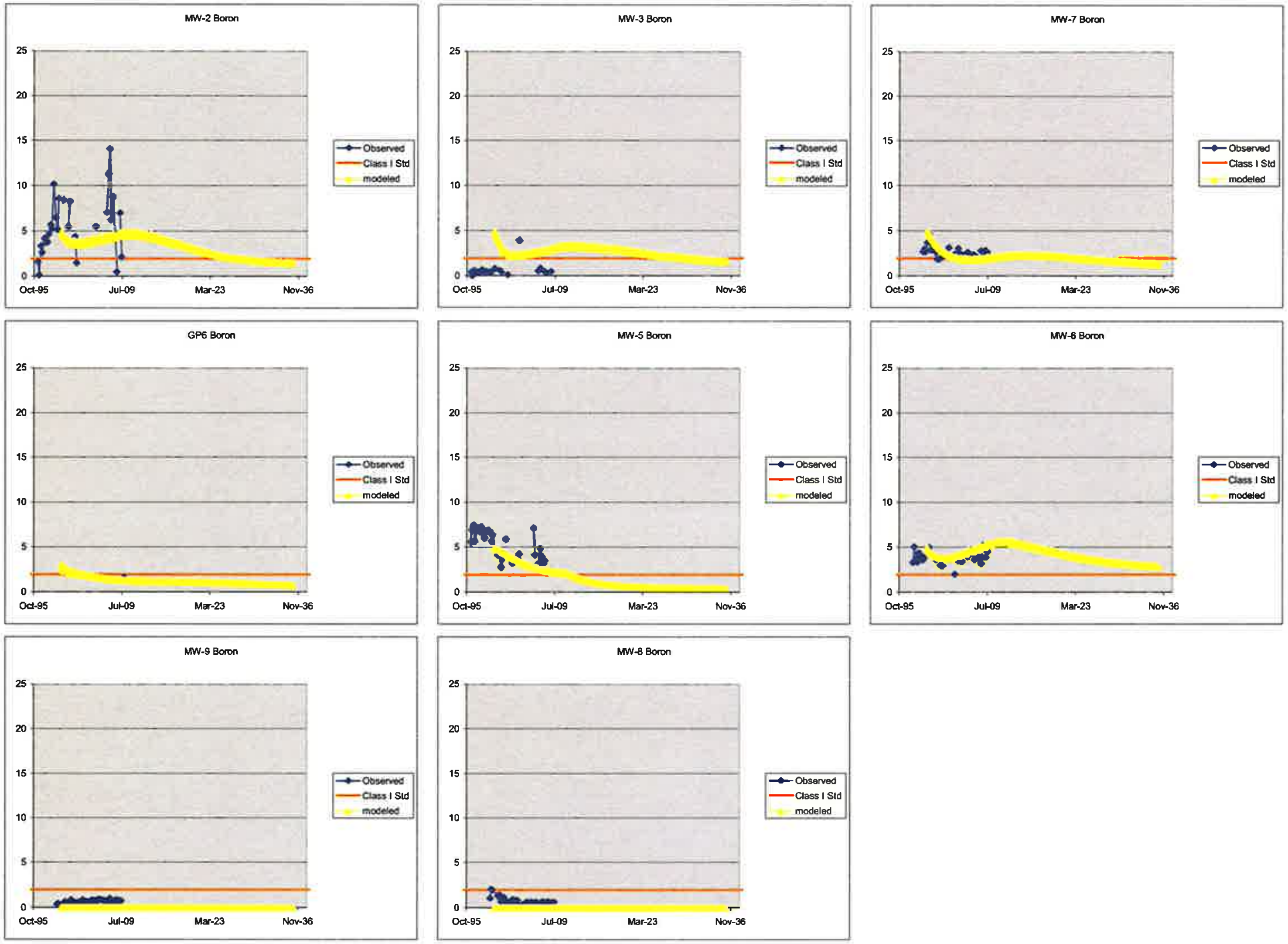
Figure 2-13 Prediction Model Results (Base Case Scenario)



Base Case Prediction Scenario [Run 19pbc]. MW-2, MW-3, MW-7, and GP-6 represented downgradient concentrations. GP-6 is a monitoring point placed in the model to compare to a groundwater grab sample collected in the fall of 2009. MW-5 and MW-6 represented on-site conditions; and MW-8 and MW-9 represented upgradient conditions.

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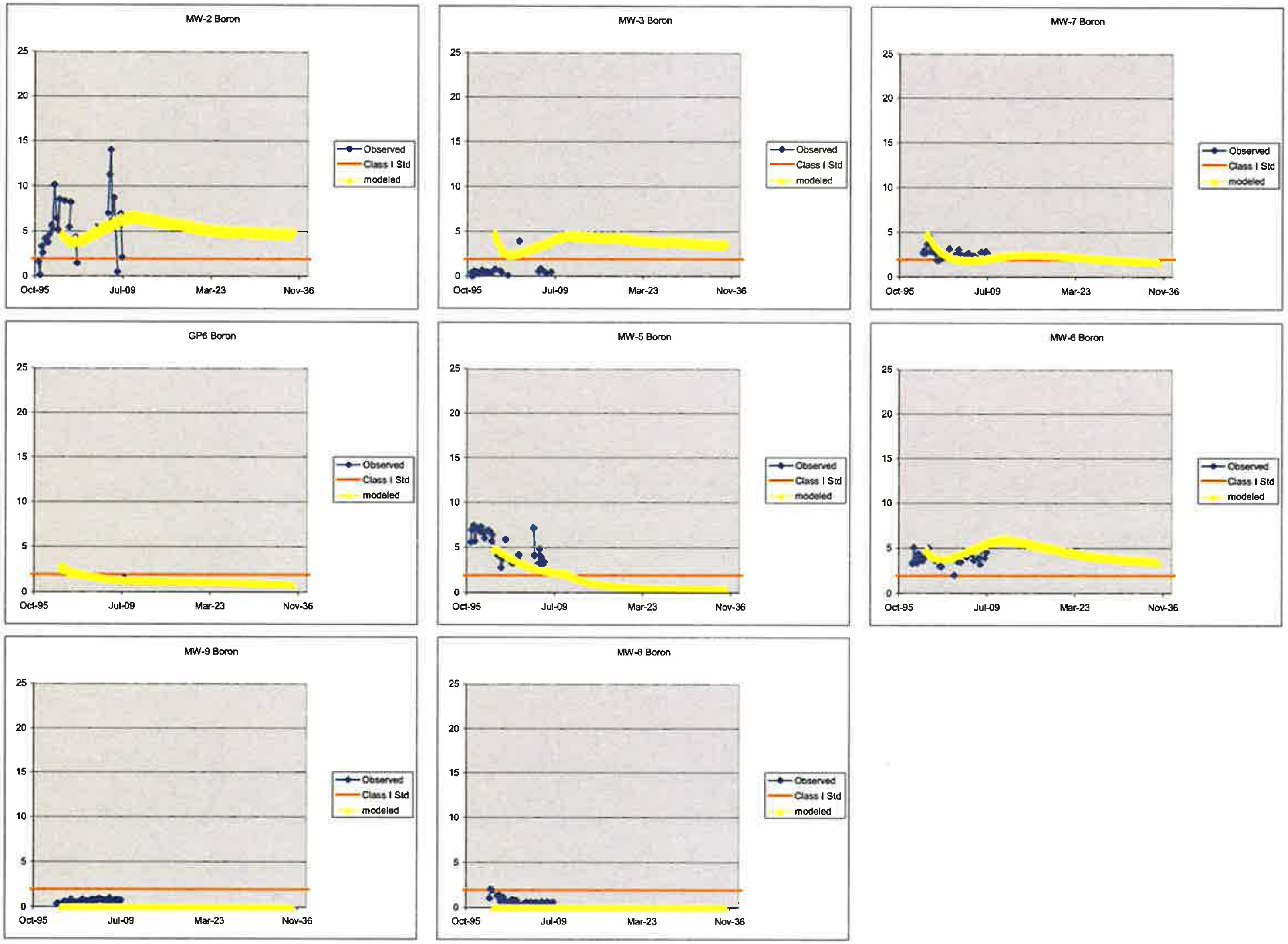
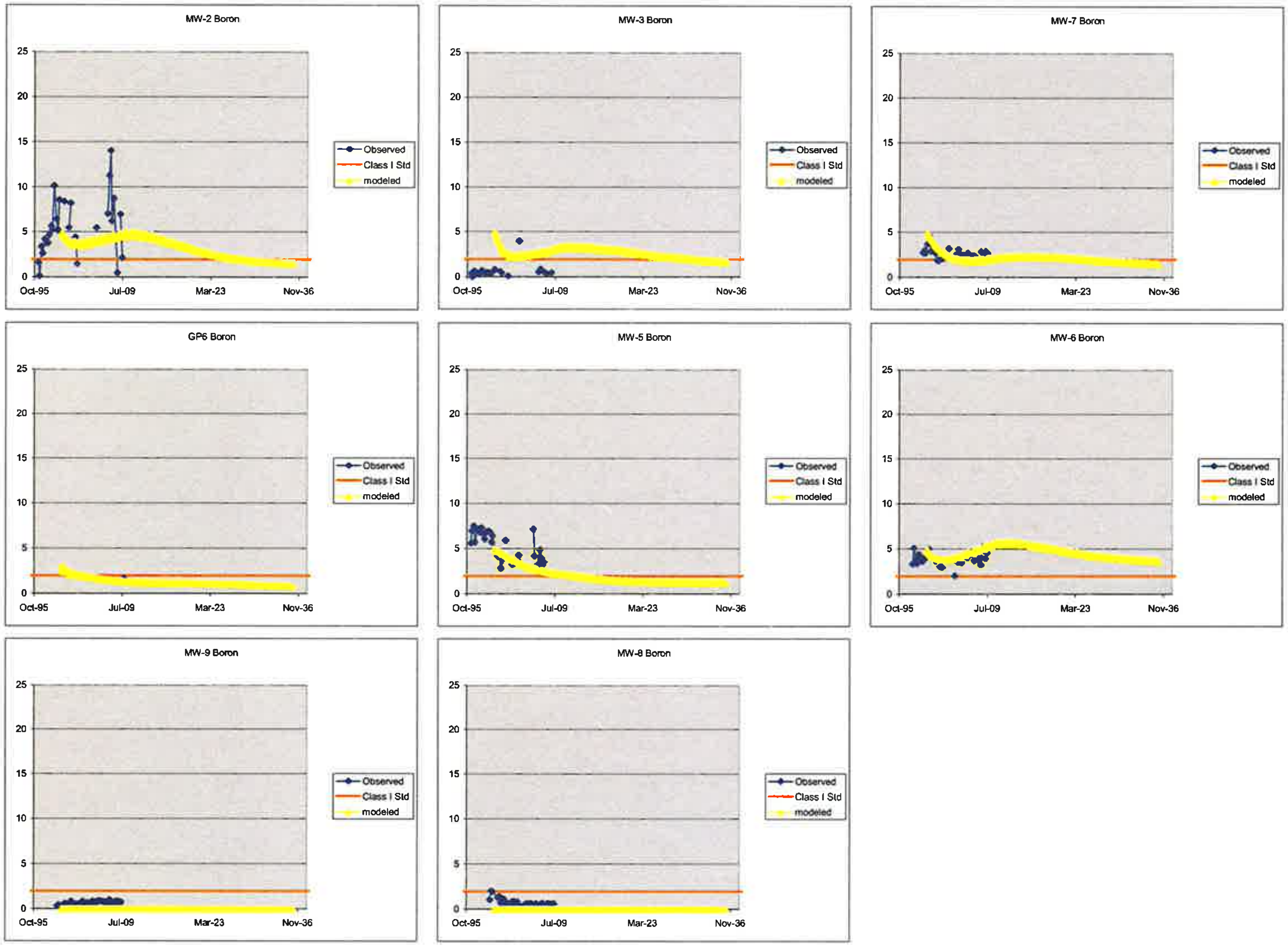
Figure 2-14 Prediction Model Results (Base Case Sensitivity)



Base Case Prediction with entire footprint of saturated ash [Run 18pbc]. Compared to Figure 16, note that the results are similar with the following exception: Concentrations in MW-2 and MW-3 (downgradient, between the levee and ponds) stabilize around 4 to 5 mg/L, twice the Class I standard.

NATURAL RESOURCE TECHNOLOGY

Figure 2-15 Prediction Model Results (Case 1 Scenario)



Case 1 Prediction Scenario [Run 19pc1]. Concentration trends were similar to the Base Case scenario, with all off-site wells below the Class I standard. The most notable exception is that MW-5 concentrations appear to stabilize closer to the Class I standard than in the Base Case.

NATURAL RESOURCE TECHNOLOGY

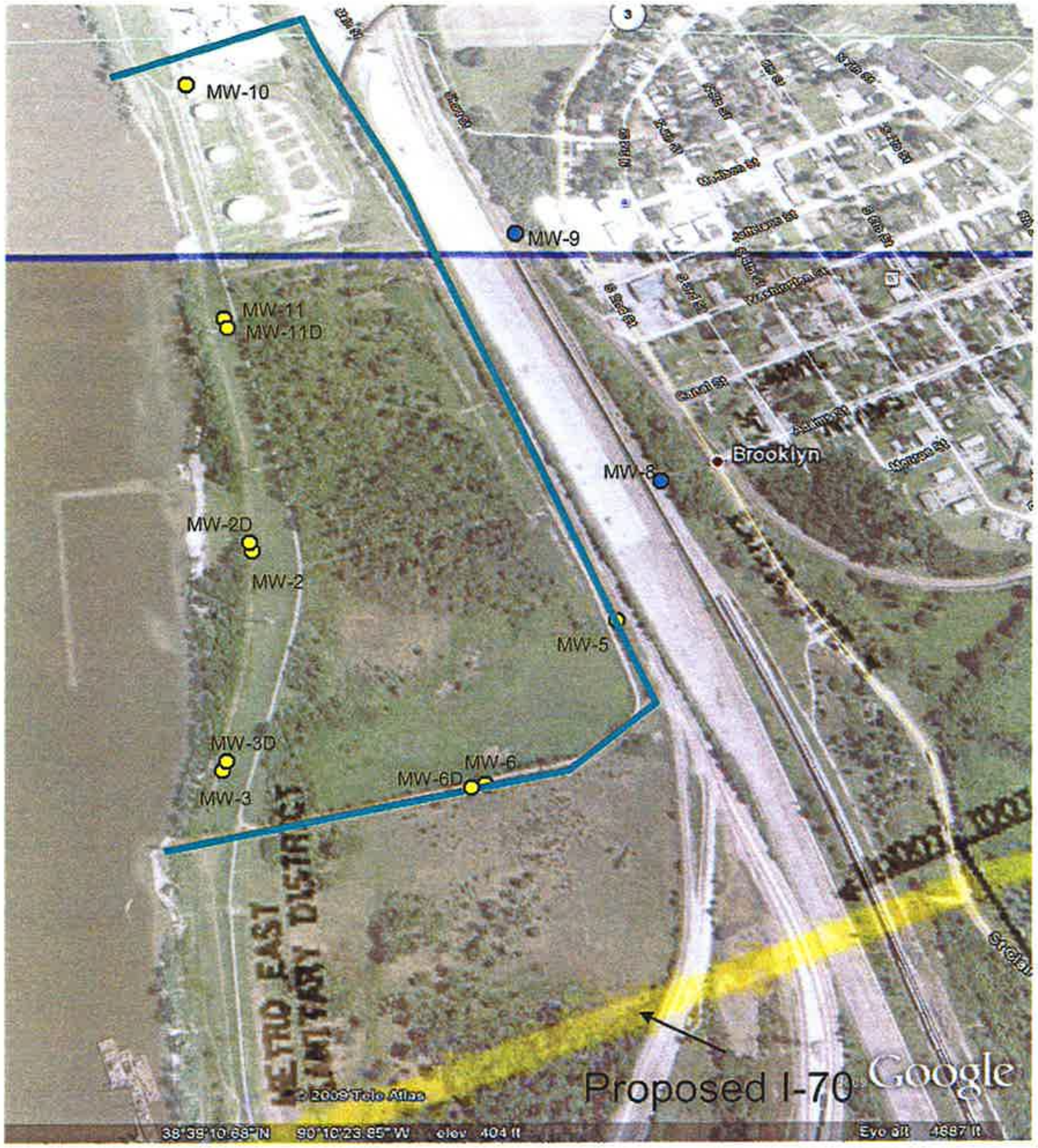
Figure 3-1 Groundwater Monitoring Program Well Locations

Monitoring Well

On-Site Compliance Well

Proposed Groundwater Management Zone (approximate), see Appendix L for exact location

The dark blue line across the top of the page is an artifact of the I-70 overlay on the aerial photo



NATURAL RESOURCE TECHNOLOGY

TABLES

Table 1-1
Comparison to 35 IAC Section 840.130 Closure Plan Contents
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Section	Description	Location in this Document
840.130(a)	Site Map	Section 1.2
840.130(b)	Description of [Facility]	Section 1.3
840.130(c)	Description of Closure Activities to be Performed	Section 1.4
840.130(d)	Description and Results of the Hydrogeologic Site Investigation	Section 2
840.130(e)	Description of Groundwater Trend Analysis Methods	Section 3.4
840.130(f)	[Plans] for the Groundwater Monitoring System	Section 3.1
840.130(g)	Description of the Groundwater Monitoring Program	Section 3.2
840.130(h)	Identification and Location of the Monitoring Wells	Section 3.1
840.130(i)	[Plans] for the Groundwater Collection Trench	not applicable
840.130(j)	[Plans] for the Final Slope Design...Compliance with Stability Criteria	Section 4.2
840.130(k)	[Plans] for the Final Cover System	Section 4.3
840.130(l)	Estimates of the Amount of Time to Complete Closure	Section 6
840.130(m)	[Description of] Groundwater Management Zone	Section 1.5
840.130(n)	Description of Construction Quality Assurance Program	Section 4.4
840.130(o)	Description of Actions Proposed to Mitigate Statistically Significant Increasing Trends	Section 3.5
840.130(p)	Signature and Seal of Professional Engineer	Title Page

[ ] indicates paraphrasing

Table 2-1
Mississippi River Mean Monthly Stage
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Mississippi - 27 TW (MI7T) - Mean Monthly River Stage												
	January	February	March	April	May	June	July	August	September	October	November	December
2004	384.73	382.84	**396.43**	**394.39**	**396.07**	**407.11**	**396.88**	389.29	388.31	385.46	391.71	392.36
2005	**398.31**	**397.03**	388.52	**395.58**	393.08	**396.47**	387.57	383.08	383.2	386.53	381	380.89
2006	383.04	382.54	386.03	**395.79**	**395.66**	388.02	382.66	381.89	383.45	381.9	380.44	386.48
2007	388.73	385.49	**399.02**	**404.65**	**405.51**	**397.75**	391.65	390.75	391.28	393.05	387.91	385.99
2008	390.1	**394.22**	**403.82**	**409.83**	**410.25**	**415.92**	**409.98**	392.98	**399.24**	390.56	387.68	386.44

Mean river stage (1965 - 2008): 393.55 ft

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Bold and shaded numbers indicate monthly mean river stage in excess of mean river stage

Data obtained from USACE web archive (http://mvs-wc.mvs.usace.army.mil/archive/mi/mi7t/)

NATURAL RESOURCE TECHNOLOGY

Table 2-2
Hydraulic Gradients and Groundwater Velocity
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Date	Flow Direction	Hydraulic Gradient	Groundwater Velocity (ft/year)
6/26/2008	Away from River	0.004	45
9/26/2008	Toward River	0.001	13
12/2/2008	Toward River	0.008	90
3/14/2009	Away from River	0.006	75

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Table 2-3
Hydraulic Conductivity Values
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

	Date	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity Geomean (cm/sec)	Hydraulic Conductivity Geomean (ft/year)
MW-1	Apr-96	2.40E-03	2.40E-03	2.48E+03
MW-2	Apr-96	3.73E-03	3.63E-03	3.76E+03
	Apr-96	3.53E-03		
MW-3	Apr-96	2.30E-03	2.30E-03	2.38E+03
MW-7	Jul-99	4.53E-03	3.50E-03	3.63E+03
	Jul-99	2.71E-03		
Site Geomean			2.89E-03	3.00E+03

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Source: Hanson, 2000. Table 5.

Table 2-4
Existing Monitoring Well Network Summary
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Monitoring Well	Date Drilled	Depth Below Grade (ft.)	Surface Elevation (ft.)	Top of Well Casing Elevation (ft.)	Top of Screen Elevation (ft.)	Bottom of Screen Elevation (ft.)	Include in Monitoring Network[1]
MW-1	4/16/96	43.5	429.8	429.4	397.8	387.8	No
MW-2P	6/30/99	18	412.7	412.41	405.2	395.2	No
MW-2	4/15/96	29	412.8	412.57	393.8	393.8	Yes
MW-3	4/15/96	29	411.6	411.21	396.6	396.6	Yes
MW-4	10/13/97	50	434.6	434.49	394.6	384.6	No
MW-5P	7/1/99	18.5	433.5	433.2	425.5	415.5	No
MW-5	10/14/97	50	433.5	433.22	393.5	383.5	Yes
MW-6	10/15/97	52	433.8	433.31	391.8	381.8	Yes
MW-7P	6/30/99	18.5	424.5	424.29	416.5	406.5	No
MW-7	6/29/99	43.5	424.5	424.42	394.5	384.5	No
MW-8P	7/2/99	16	416.5	416.35	405.5	400.5	No
MW-8	7/2/99	43.5	416.4	416.25	383.4	373.4	Yes
MW-9P	7/2/99	16	413.9	413.85	407.9	397.9	No
MW-9	7/2/99	43.5	413.8	413.69	381.8	371.8	Yes

Note:

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1: Wells not included in the proposed monitoring network have been or will be permanently abandoned.

Table 2-5
Arsenic Concentrations in Leachate Wells and Upgradient Groundwater
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Location	Date	As, diss (mg/L)
Leachate Samples		
AP-1A	9/16/1999	0.018
AP-2	7/8/1999	0.026
AP-2	9/16/1999	0.029
AP-2	6/26/2001	0.015
AP-2	6/20/2002	0.010
Upgradient Samples		
MW-9	6/20/2009	0.009
MW-8	6/20/2009	<0.001
GP002	10/27/2009	0.038
	10/27/2009	0.077
GP004	10/27/2009	0.049

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Table 2-6
HELP Model Input/Output Parameters (Cap Alternative Evaluation)
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

	Current	Synthetic	Clay	Earthen	
Input Parameter		Existing Footprint			**Notes**
Climate-General					
City	see note	see note	see note	see note	East St. Louis, IL
Latitude	38.65	38.65	38.65	38.65	Plant
Evap Zone	14	21	21	21	poor (14), fair (21)
Leaf Index	1	2	2	2	poor (1), fair (2)
All Others	see note	see note	see note	see note	Defaults for East St. Louis
Climate-precip/temp/ET					
All	see note	see note	see note	see note	Synthetically generated using St. Louis (precipitation) or East St. Louis (ET and solar radiation) defaults
Soils-General					
Area (acres)	58	58	58	58	
% where runoff possible	0	100	100	100	
Specify Initial MC	No	No	No	No	Model calculated
Surface Water/Snow	Calc	Calc	Calc	Calc	Model calculated
Soils-Layers					
1	ash	native	native	native	
2	ash	drainage	clay	ash	
3	ash	synthetic	ash	ash	
4		ash	ash	ash	
5		ash	ash		
		ash			
Soil Parameters--native					
Type	n/a	1	1	1	vertical percolation layer
Thickness (in)	n/a	36	36	18	
Texture	n/a	9	9	9	silt loam, defaults used
Soil Parameters--clay					
Type	n/a	n/a	1	n/a	vertical percolation layer
Thickness (in)	n/a	n/a	36	n/a	
Texture	n/a	n/a	16	n/a	barrier soil, defaults used
Soil Parameters--drainage					
Type	n/a	2	n/a	n/a	drainage layer
Thickness (in)	n/a	0.2	n/a	n/a	
Texture	n/a	20	n/a	n/a	drainage net(pipes@300ft)
Soil Parameters--synthetic					
Type	n/a	4	n/a	n/a	geomembrane
Thickness (in)	n/a	0.03	n/a	n/a	
Texture	n/a	37	n/a	n/a	PVC, defaults used
Pinhole density	n/a	1	n/a	n/a	
Installation Defects	n/a	4	n/a	n/a	
Placement Quality	n/a	3	n/a	n/a	good placement quality
Soil Parameters--ash layers					
Type	1	1	1	1	vertical percolation layer
Thickness (in)	60	60	60	60	
Texture	30	30	30	30	coal fly ash, defaults used
Soils--Runoff					
Equation	n/a	HELP CN	HELP CN	HELP CN	HELP-calculated
Slope	n/a	1.0%	1.0%	1.0%	
Length (ft)	n/a	1000	1000	1000	
Texture	n/a	9	9	9	
Vegetation	n/a	fair	fair	fair	
Execution Parameters					
Years	20	20	20	20	
Report Daily	n	n	n	n	
Report Monthly	n	n	n	n	
Report Annual	y	y	y	y	
Percolation Rate (in/yr)	5.3	0.0012	1.3	3.2	rounded to 2 digits
Percolation Volume (ft^3/yr)	1,100,000	250	280,000	680,000	rounded to 2 digits

Table 2-7
HELP Model Input/Output Parameters (Protective Soil Evaluation)
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Input Parameter	Current	Silty	Sandy	Clayey	Field (south of ponds)	Notes
		Existing Footprint				
Climate-General						
City	see note	see note	see note	see note	see note	East St. Louis, IL
Latitude	38.65	38.65	38.65	38.65	38.65	Plant
Evap Zone	14	21	21	21	21	poor (14), fair (21)
Leaf Index	1	2	2	2	2	poor (1), fair (2)
All Others	see note	see note	see note	see note	see note	Defaults for East St. Louis
Climate-precip/temp/ET						
All	see note	see note	see note	see note	see note	Synthetically generated using St. Louis (precipitation) or East St. Louis (ET and solar radiation) defaults
Soils-General						
Area (acres)	58	58	58	58	5	
% where runoff possible	0	100	100	100	0	
Specify Initial MC	No	No	No	No	No	Model calculated
Surface Water/Snow	Calc	Calc	Calc	Calc	Calc	Model calculated
Soils-Layers						
1	ash	native	native (sandy)	native (clayey)	native	
2	ash	drainage	drainage	drainage		
3	ash	synthetic	synthetic	synthetic		
4		ash	ash	ash		
5		ash	ash	ash		
		ash	ash	ash		
Soil Parameters--native						
Type	n/a	1	1	1	1	vertical percolation layer
Thickness (in)	n/a	36	36	36	36	
Texture	n/a	9	6	11	4	
Description	n/a	silt loam	sand loam	clay	silty sand	
Soil Parameters--clay						
Type	n/a	n/a	n/a	n/a		vertical percolation layer
Thickness (in)	n/a	n/a	n/a	n/a		
Texture	n/a	n/a	n/a	n/a		barrier soil, defaults used
Soil Parameters--drainage						
Type	n/a	2	2	2	n/a	drainage layer
Thickness (in)	n/a	0.2	0.2	0.2	n/a	
Texture	n/a	20	20	20	n/a	drainage net (pipes@300ft)
Soil Parameters--synthetic						
Type	n/a	3	3	3	n/a	geomembrane
Thickness (in)	n/a	0.03	0.03	0.03	n/a	
Texture	n/a	37	37	37	n/a	PVC, defaults used
Pinhole density	n/a	1	1	1	n/a	
Installation Defects	n/a	4	4	4	n/a	
Placement Quality	n/a	3	3	3	n/a	good placement quality
Soil Parameters--ash layers						
Type	1	1	1	1	n/a	vertical percolation layer
Thickness (in)	60	60	60	60	n/a	
Texture	30	30	30	30	n/a	coal fly ash, defaults used
Soils--Runoff						
Equation	n/a	HELP CN	HELP CN	HELP CN	n/a	HELP-calculated
Slope	n/a	1.0%	1.0%	1.0%	n/a	
Length (ft)	n/a	1000	1000	1000	n/a	
Texture	n/a	9	9	9	n/a	
Vegetation	n/a	fair	fair	fair	n/a	
Execution Parameters						
Years	20	20	20	20	20	
Report Daily	n	n	n	n	n	
Report Monthly	n	n	n	n	n	
Report Annual	y	y	y	y	y	
Percolation Rate (in/yr)	5.3	0.00122	0.0024	0.00171	7.58	
Percolation Volume (ft^3/yr)	1,121,171	257	505	360	n/a	

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Table 2-8
HELP Model Input/Output Parameters (Final Grade Evaluation)
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Input Parameter	Current	Synthetic 1 Drainage Net		Notes
Climate-General				
City	see note	see note	see note	East St. Louis, IL
Latitude	38.65	38.65	38.65	Plant
Evap Zone	14	21	21	poor (14), fair (21)
Leaf Index	1	2	2	poor (1), fair (2)
All Others	see note	see note	see note	Defaults for East St. Louis
Climate-precip/temp/ET				
All	see note	see note	see note	Synthetically generated using St. Louis (precipitation) or East St. Louis (ET and solar radiation) defaults
Soils-General				
Area (acres)	58	43.5	14.5	
% where runoff possible	0	100	100	
Specify Initial MC	No	No	No	Model calculated
Surface Water/Snow	Calc	Calc	Calc	Model calculated
Soils-Layers				
1	ash	native	native	
2	ash	drainage	drainage	
3	ash	synthetic	synthetic	
4		ash	ash	
5		ash	ash	
		ash	ash	
Soil Parameters--native				
Type	n/a	1	1	vertical percolation layer
Thickness (in)	n/a	36	36	
Texture	n/a	9	9	
Description	n/a	silt loam	silt loam	
Soil Parameters--clay				
Type	n/a	n/a	n/a	vertical percolation layer
Thickness (in)	n/a	n/a	n/a	
Texture	n/a	n/a	n/a	barrier soil, defaults used
Soil Parameters--drainage				
Type	n/a	2	2	drainage layer
Thickness (in)	n/a	0.2	0.2	
K	n/a	10	10	
Drainage Length	n/a	520	330	
Drainage Slope	n/a	1	2	
Texture	n/a	20	20	
Soil Parameters--synthetic				
Type	n/a	4	4	geomembrane
Thickness (in)	n/a	0.03	0.03	
Texture	n/a	37	37	PVC, defaults used
Pinhole density	n/a	1	1	
Installation Defects	n/a	4	4	
Placement Quality	n/a	3	3	good placement quality
Soil Parameters--ash layers				
Type	1	1	1	vertical percolation layer
Thickness (in)	60	60	60	
Texture	30	30	30	coal fly ash, defaults used
Soils--Runoff				
Equation	n/a	HELP CN	HELP CN	HELP-calculated
Slope	n/a	1.0%	2.0%	
Length (ft)	n/a	520	330	
Texture	n/a	9	9	
Vegetation	n/a	fair	fair	
Execution Parameters				
Years	20	20	20	
Report Daily	n	n	n	
Report Monthly	n	n	n	
Report Annual	y	y	y	
Percolation Rate (in/yr)	5.3	0.00239	0.00053	
Percolation Volume (ft^3/yr)	1,121,171	377	28	
Weighted Average (in/yr)		0.0019		

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Table 3-1
Groundwater Monitoring System Monitoring Wells and Construction Details
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Monitoring Well	Date Drilled	Depth Below Grade (ft.)	Surface Elevation (ft.)	Top of Well Casing Elevation (ft.)	Top of Screen Elevation (ft.)	Bottom of Screen Elevation (ft.)	Objective**
Existing Wells							
MW-2	4/15/96	29	412.8	412.57	393.8	393.8	Compliance
MW-3	4/15/96	29	411.6	411.21	396.6	396.6	Compliance
MW-5	10/14/97	50	433.5	433.22	393.5	383.5	Compliance
MW-6	10/15/97	52	433.8	433.31	391.8	381.8	Compliance
MW-8	7/2/99	43.5	416.4	416.25	383.4	373.4	Background
MW-9	7/2/99	43.5	413.8	413.69	381.8	371.8	Background
Proposed Wells*							
MW-2D	TBD	48	413	TBD	370	365	Compliance
MW-3D	TBD	47	412	TBD	370	365	Compliance
MW-6D	TBD	64	434	TBD	370	365	Compliance
MW-10	TBD	27	411	TBD	394	384	Compliance
MW-11	TBD	26	410	TBD	394	384	Compliance
MW-11D	TBD	46	410	TBD	374	364	Compliance

Note:

KJB/BGH 11/10

* All depths and elevations for proposed wells are estimates.

** Background = monitoring well used to establish background concentration

Compliance = monitoring well used to evaluate compliance with on-site applicable groundwater quality standards

Table 3-2
Groundwater Monitoring Program Parameters and Laboratory Analysis Methods
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Field Parameters	Method
pH	Field
Electrical conductance	Field
Temperature	Field
Water level	Field
Well depth	Field
Laboratory Parameters	**Method**
Antimony	SW-846 #3015 and #6020
Arsenic	SW-846 #3015 and #6020
Barium	EPA 200.7
Beryllium	EPA 200.7
Boron	EPA 200.7
Cadmium	SW-846 #3015 and #6020
Chloride	ASTM D4327
Chromium	EPA 200.7
Cobalt	EPA 200.7
Copper	EPA 200.7
Cyanide	Std. Meth. 4500-CN
Fluoride	Std. Meth. 4500-F
Iron	EPA 200.7
Lead	SW-846 #3015 and #6020
Manganese	EPA 200.7
Mercury	SW-846 #3015 and #6020
Nickel	EPA 200.7
Nitrate as N	ASTM D4327
Selenium	SW-846 #3015 and #6020
Silver	EPA 200.7
Sulfate	ASTM D4327
Thallium	SW-846 #3015 and #6020
Total Dissolved Solids	EPA 160.1
Zinc	EPA 200.7

Table 3-3
Groundwater Monitoring Program Schedule
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Frequency	Duration
Quarterly	Begins: upon approval of this plan.
	Ends: 5 years after completion of cap and upon demonstration that monitoring effectiveness is not compromised and that there are no increasing trends attributable to the Venice ash ponds.
Semiannual	Begins: after IEPA approves that quarterly monitoring requirements have been satisfied.
	Ends: 5 years after initiation of semiannual monitoring and upon demonstration that monitoring effectiveness is not compromised and that there are no increasing trends attributable to the Venice ash ponds.
Annual	Begins: after IEPA approves that semiannual monitoring requirements have been satisfied.
	Ends: upon IEPA approval of a certified post-closure care report.

Table 4-1
Computed Stability Safety Factors for Final Slope Design
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren Services

	Static SF	Seismic SF
Global Stability	4.9	1.3
Rapid Drawdown	5	1.3
Veneer Stability	24.8	1.6
Required Minimum	1.5	1.3

Table 4-2
Rainfall Depths Corresponding to Storm Event Recurrence Intervals
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren Services

Storm Event Recurrence Intervals	Corresponding Rainfall Depth (inches)
100% (1-yr)	2.64
50% (2-yr)	3.16
10% (10-yr)	4.56
4% (25-yr)	5.60
2% (50-yr)	6.54
1% (100-yr)	7.66

Table 4-3
Anticipated Duration of Ponding and Maximum Depth by Storm Event Recurrence Interval
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren Services

Recurrence Intervals	North Station		South Station	
	Anticipated Duration (hrs)	Maximum Ponding Depth (ft)	Anticipated Duration (hrs)	Maximum Ponding Depth (ft)
100% (1-yr)	0.2	<0.1	0.4	0.3
50% (2-yr)	0.7	0.4	1.1	0.7
10% (10-yr)	2.3	1.2	3.2	1.5
4% (25-yr)	4.0	1.6	5.2	1.8
2% (50-yr)	5.3	1.8	7.2	2.1
1% (100-yr)	7.0	2.1	9.6	2.4

Table 4-4
Proposed Seed Mixes and Application Rates for Final Cover
Closure Plan, Venice Power Plant Ash Ponds 2 & 3
Ameren

Common Name	Genus, Species	PLS Application Rate (lbs/acre)
Big Blue Stem	Andropogon, Gerardi	4
Little Blue Stem	Andropogon, Scoparius	5
Side-Oats Grama	Bouteloua, Curtipendula	5
Canada Wild Rye	Elymus, Canadensis	1
Switch Grass	Panicum, Virgatum	1
Indian Grass	Sorghastrum, Nutans	2
Annual Ryegrass		25
Spring Oats		25
Perennial Ryegrass		15

Notes:
PLS = Pure Live Seed
The mix above corresponds to the Illinois Department of Transportation's Class 4 - Native Grass.

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