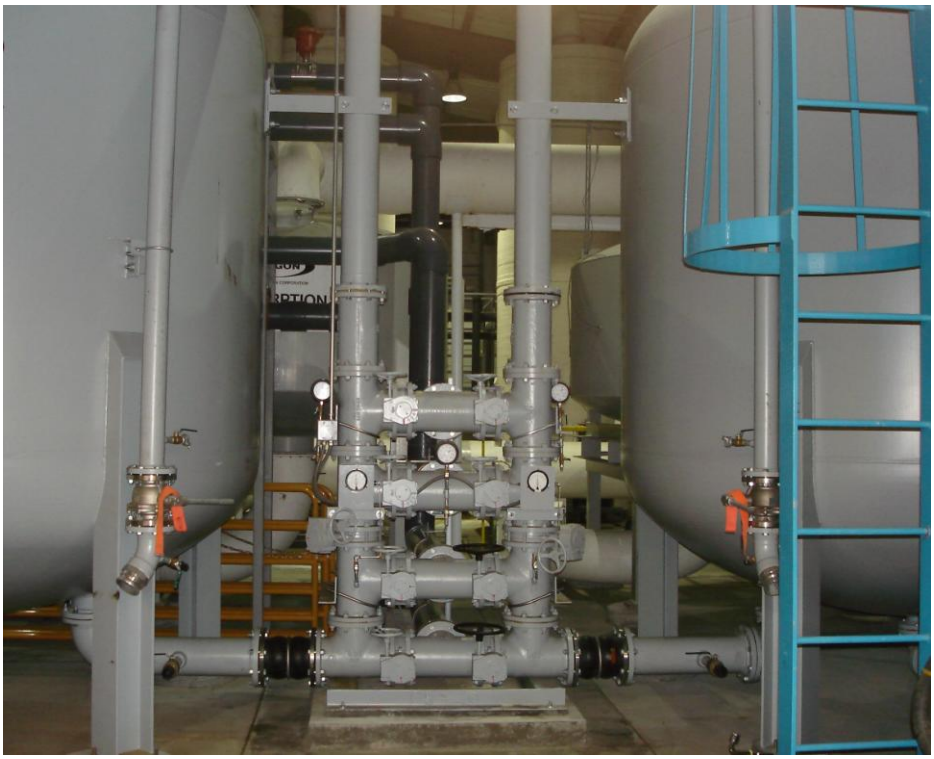
Revised Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant



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LIST OF ACRONYMS

1,1,1-TCA	1,1,1-Trichloroethane
1,1,2-TCA	1,1,2-Trichloroethane
2,4-DNT	2,4-Dinitrotoluene
2,6-DNT	2,6-Dinitrotoluene
µg/l	Micrograms per liter
AFS	Alternative Feasibility Study
Army	Department of the Army
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
BAAP	Badger Army Ammunition Plant (WDNR designation)
BAAAP	Badger Army Ammunition Plant (Department of Defense designation)
BEST	Biologically Enhanced Subsurface Treatment
BNA	Base Neutral Acid
BSD	Bluffview Sanitary District
cm/sec	Centimeters per second
COC	Contaminant of Concern
CSM	Conceptual Site Model
CTET	Carbon Tetrachloride
DBG	Deterrent Burning Ground
DNT	Dinitrotoluene
ES	Enforcement Standard
^{o}F	Degrees Fahrenheit
FS	Feasibility Study
ft/ft	Feet per foot
GAC	Granular Activated Carbon
gpm	Gallons per minute
HCC	Human Cancer Criteria
HDPE	High-Density Polyethylene
HTC	Human Threshold Criteria
HWTTU	Hazardous Waste Thermal Treatment Unit
IFCR	In-Field Conditions Report
IRM	Interim Remedial Measures
LOD	Limit of detection
LOQ	Limit of quantification
MCL	Maximum Contaminant Level
MEC	Munitions and Explosives of Concern
MIRM	Modified Interim Remedial Measures
mg/l	Milligrams per liter
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
NC	Nitrocellulose
NG	Nitroglycerin
NPS	National Park Service
NR	Natural Resources

NPWS	Non-Public Water System
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Preventive Action Limit
PBG	Propellant Burning Ground
ppt	Inches of Precipitation
PSTS	Pilot-Scale Treatability Study
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SVE	Soil Vapor Extraction
SVOC	Semi-volatile Organic Compounds
TCE	Trichloroethylene or Trichloroethene
USDA	United States Department of Agriculture
VOC	Volatile Organic Compounds
WDHFS	Wisconsin Department of Health and Family Services
WDNR	Wisconsin Department of Natural Resources
WDOT	Wisconsin Department of Transportation
Wis. Adm. Code	Wisconsin Administrative Code
WPDES	Wisconsin Pollutant Discharge Elimination System
WP&L	Wisconsin Power and Light
WWTP	Wastewater Treatment Plant

1.0 CERTIFICATION PAGE

In accordance with section NR 712.09, Wisconsin Administrative Code (Wis. Adm. Code), a registered professional engineer, a hydrogeologist, or a scientist from the State of Wisconsin shall certify this report. The required certification statements are presented, and signed and sealed, as follows:

Report prepared by:

"I, **Joel L. Janssen,** *hereby certify that I am a scientist as that term is defined in s. NR 712.03(1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."*

Senior Geologist — December 15, 2011

Signature and title — **Date**

"I, **Brenda H. Boyce, P.G.**, *hereby certify that I am a scientist as that term is defined in s. NR 712.03(1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."*

Environmental Geologist — December 15, 2011

Signature and title — **Date**

Report reviewed by:

"I, **Clair E. Ruenger P.G.**, *hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03(1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."*

Environmental Services Manager — December 15, 2011

Signature and title — **Date**

2.0 EXECUTIVE SUMMARY

The Badger Army Ammunition Plant (BAAAP), located in south-central Wisconsin within Sumpter and Merrimac Townships in Sauk County, was constructed in 1942 to produce smokeless gunpowder and solid rocket propellant as munitions components for World War II. The installation is located on the Sauk Prairie, between the Baraboo Range and the Wisconsin River. As a result of production and waste disposal practices that were common at the time, soil and groundwater at the BAAAP were impacted.

Numerous site investigations and remedial actions have been conducted at the BAAAP. Groundwater investigation activities at BAAAP began in 1980 and continue today. Site-wide groundwater-related assessment activities include the following: monitoring well installation; water level measurements; pump testing; and monitoring well and residential drinking water well sampling. Groundwater impact source-related investigations and remedial actions have been conducted for the three source areas: Propellant Burning Ground (PBG), Central Plume area, and Deterrent Burning Ground (DBG). Groundwater in the PBG and DBG areas are impacted by dinitrotoluene (DNT) and chlorinated solvents. Groundwater in the Central Plume area is impacted by DNT.

An *In-Field Conditions Report* (IFCR), issued by the Wisconsin Department of Natural Resources (WDNR) in 1987, required groundwater monitoring, reporting, and performance-based responses at the BAAAP. The current site-wide groundwater monitoring program follows the IFCR dated August 15, 2005. The interim groundwater remedial action at the PBG began in 1990 and continues today. Groundwater monitoring with the current remedies in place could continue indefinitely (30 years or more).

Because monitored natural attenuation (MNA) is proposed as an element of all the suggested remedial options, an evaluation is provided in this Alternative Feasibility Study (AFS) to illustrate MNA has a probability of restoring groundwater within a reasonable amount of time.

MNA is recognized as an alternative means of achieving remediation objectives in circumstances where its use meets the applicable statutory and regulatory requirements. As proposed in this AFS, MNA is one component of the total remedy. It is used in conjunction with other remedies as a follow-up measure that will be monitored and compared with expectations.

The determination of whether MNA is an appropriate remedy for groundwater is based on field geochemistry data collected from monitoring wells. In addition, natural attenuation studies in the PBG plume at BAAAP provide evidence that DNT and VOCs are naturally attenuating in the subsurface and historical groundwater data demonstrates MNA is already restoring groundwater within the DBG and Central Plumes.

A Conceptual Site Model (CSM) is provided in this AFS to explain the relationship of contaminant sources, environmental media, exposure pathways, and potential human and ecological receptors. All applicable and appropriate regulatory requirements are presented and discussed as they relate to the remediation of the groundwater plumes at BAAAP. These regulations help frame the remedial objective, which is to protect human health by preventing

exposure to contaminated groundwater from BAAAP, to restore groundwater to the extent practicable, and minimize the impact of the contaminant plumes on the environment.

The purpose of this AFS is to determine the most appropriate and cost-effective final remedy for the groundwater plumes at BAAAP. A discussion of the three source areas of groundwater impact is included in this AFS and three alternatives are evaluated to address the residual groundwater impacts. Remedial action alternatives were assembled and screened resulting in three alternatives. Each alternative is capable of accomplishing the remedial objective. The final three remedial alternatives evaluated include:

Alternative 1: Interim Remedial Measures/Modified Interim Remedial Measures (IRM/MIRM) Treatment and Monitored Natural Attenuation
This alternative continues IRM/MIRM treatment of the PBG plume, continued groundwater monitoring, and natural attenuation of the DBG and Central Plumes.

Alternative 2: In-Situ Biochemical Treatment and Monitored Natural Attenuation
This alternative would use in-situ groundwater treatment, a modified groundwater monitoring program, and natural attenuation of the PBG, DBG, and Central Plumes.

Alternative 3: Public Water System and Monitored Natural Attenuation
This alternative involves the installation of a public water system, a phased shutdown of the IRM and MIRM systems, a modified groundwater monitoring program, and natural attenuation of the PBG, DBG, and Central Plumes.

Each alternative is evaluated using the following nine criteria: overall protection of human health and the environment; compliance with applicable regulations; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. Based on a thorough evaluation, Alternative 3, Public Water System and Monitored Natural Attenuation, is proposed as the final groundwater remedy for the groundwater contaminant plumes at BAAAP.

3.0 INTRODUCTION

This AFS report was prepared to serve as a principal source for decision-making relating to remediation of groundwater impacts from the BAAAP. The AFS provides a summary of historic and current groundwater investigation and remediation efforts by the Department of the Army (Army) and describes the development and re-evaluation of groundwater remedial action alternatives for the BAAAP.

The IFCR, issued by the WDNR in 1987, and subsequent amendments, calls for groundwater monitoring, reporting, and performance-based responses at the BAAAP. The current site-wide groundwater monitoring program follows the IFCR dated August 15, 2005. On November 23, 2009, additional changes to the northeast area (including the DBG) groundwater monitoring requirements were approved by the WDNR. Investigation of groundwater has been ongoing at the BAAAP from 1980 to the present. The interim groundwater remedial action for the PBG

plume began in 1990 and continues today. Groundwater monitoring with the current remedies in place would continue indefinitely (30 years or more) until the WDNR approved case closure.

The initial site-wide remedial investigation (RI) and feasibility study (FS) was completed in 1993 and 1994 (ABB-ES, 1993 and 1994). Soil and groundwater remedial alternatives were analyzed, selected, and approved by the Army and state and federal regulators for the PBG and DBG areas, and their associated groundwater contaminant plumes. In addition to the PBG and DBG areas and their associated plumes, the Rocket Paste Area/Central Plume has since been identified through further groundwater investigations.

A re-evaluation of the current groundwater remediation alternative at the BAAAP was warranted because: 1) the current remedial alternative in place is an interim action, which addresses only the PBG plume, 2) the timeframe required for the IRM/MIRM to meet cleanup standards is indefinite, and 3) recent changes in state groundwater standards make meeting those cleanup standards even more difficult. The revised alternatives were developed and evaluated to achieve the remedial objective. The objective of the groundwater remedial action is to protect human health by preventing exposure of contaminated groundwater from BAAAP, to restore groundwater to the extent practicable, and minimize the impact of the contaminant plumes on the environment.

4.0 SITE BACKGROUND

4.1 Site Description

The BAAAP, located in south-central Wisconsin within Sumpter and Merrimac Townships in Sauk County, was constructed in 1942 to produce smokeless gunpowder and solid rocket propellant as munitions components for World War II. The installation is located on the Sauk Prairie, between the Baraboo Range and the Wisconsin River. The impoundment of the Wisconsin River forms Lake Wisconsin, which borders the southeast side of the BAAAP.

Production of nitric acid, sulfuric acid, oleum (also known as fuming sulfuric acid), nitrocellulose (NC), and nitroglycerin (NG) occurred in support of munitions components production. Production periods were as follows: World War II (1942 to 1945), Korean War (1951 to 1958), and Vietnam Conflict (1966 to 1975). Disposal of excess hazardous substances occurred at primarily two locations on-site: the PBG and the DBG. As a result of production and waste disposal practices that were common at the time, soil and groundwater at the BAAAP were impacted with several contaminants of concern (COCs).

The primary land uses in the immediate vicinity of the BAAAP are agricultural, recreational, and residential. The agricultural use of the BAAAP is raising crops and cattle grazing, which continues to be the primary use of lands within and adjacent to the installation. The United States Department of Agriculture (USDA) has used the land in and around the southern portion of the installation for grazing and crop development research for many years. The Dairy Forage Research Center Farm was constructed in the 1980s on land transferred from the Army to the USDA.

The primary land use to the north of the installation is for recreation at Devil's Lake State Park, managed by the WDNR. This area is not impacted by past activities at BAAAP as it is located hydrologically upgradient. Lake Wisconsin and the Wisconsin River, to the south and southeast of the BAAAP, are hydraulically connected to the installation. Lake Wisconsin was formed in 1914 by the Wisconsin Power and Light (WP&L) dam on the Wisconsin River, near Prairie du Sac.

The 2010 United States Census estimated the Township of Sumpter population at 1,191 residents and the Township of Merrimac at 942 residents. Since 1980, 256 private residential wells to the south, east, and west of the installation have been sampled as part of the groundwater monitoring program at BAAAP. Five residential drinking water wells, downgradient of the installation, have been replaced by the Army due to groundwater impacts.

4.2 Site History

Production and Standby Periods

During World War II, BAAAP employed approximately 7,500 workers and produced approximately 271 million pounds of single- and double-base propellant. Oleum and smokeless powder production began in 1943. Rocket paste powder production began in 1945. The solventless extrusion smokeless propellant process was installed in 1944 and 1945. From 1945 to 1951, the installation was in standby status.

BAAAP was reactivated for the Korean War in 1951. Reactivation activities were completed by 1954. Facilities for the manufacture of Ball Powder® propellant were constructed during 1954 and 1955. A facility to recycle old cannon powder as a source of NC for the new propellant was also constructed in 1954 and 1955. BAAAP remained in production until the Korean War ended and the propellant magazines were full (1958). During the Korean War, approximately 286 million pounds of single- and double-base propellant were manufactured with a peak production employment of 5,022 employees. The installation was in standby status again from 1958 to 1966.

BAAAP was reactivated in 1966 for the Vietnam Conflict. The installation manufactured Ball Powder® propellant, rocket propellant, and smokeless propellant from 1966 to 1975. In 1972, construction included new sewage treatment systems, new acid production, and new NG production facilities. During the Vietnam Conflict, approximately 487 million pounds of single- and double-base propellant were manufactured with a peak production employment of 5,400 employees. The installation was placed in standby status in 1975 and was declared excess in 1998, which began the dismantling process.

Waste Disposal Practices

The PBG, DBG, and Rocket Paste Area have been identified as the source areas of groundwater contamination. The PBG plume source area includes Landfill #1, PBG Waste Pits, 1949 Pit, and

the Racetrack Area. The DBG plume source area includes Landfill #3, Landfill #5, and the DBG Waste Pit. The Central Plume source area is near the NG and Rocket Paste areas. The locations of these areas are depicted in Figure 1.

During production periods, the PBG and DBG were used as disposal areas for waste and excess production chemicals, primarily solvents, plasticizers, and explosives. Excess chemicals and munitions components were placed in open pits and burned to dispose of them.

Process wastewater from the Rocket Paste Area and the Nitroglycerin Area was conveyed in open ditches from the north-central to the south side of the installation where it subsequently flowed to the Settling Ponds and Spoils Disposal Areas, and eventually to the Wisconsin River.

Demolition and Restoration

Environmental investigation and restoration activities began at the BAAAP in 1977. Groundwater monitoring and characterization activities began in 1980, with groundwater treatment beginning in 1990. These activities are still in progress today.

Ongoing demolition activities include the following: removal of all process chemicals, equipment, piping, process and storage tanks, munitions and explosives of concern (MEC) that may reasonably be expected to cause an environmental or safety hazard, and the majority of the structures on the installation. Many of the concrete slabs that lay underneath these structures have been removed or are planned for removal and recycling. Current environmental restoration activities include the following: soil investigation and remediation; groundwater monitoring and remediation; impacted process and sanitary sewer removal; friable asbestos removal; and MEC screening, clearance, and certification.

4.3 Environmental Setting

Topography

The land surface at the installation is the result of glaciation. The installation is located on the southern edge of the Baraboo Range, also commonly referred to as the Baraboo Hills. The terminal moraine, deposited by the leading edge of the last glacier as it moved from east to west, extends from north to south across the central portion of the installation. The topography in the eastern two-thirds of the installation consists of gently rolling hills with numerous depressions. The western third of the installation is an outwash plain that is nearly level to gently sloping towards the southwest.

Climate

The climate of the installation area is typically continental with some influence from the Great Lakes system. Average annual temperatures in the region vary from 39 degrees Fahrenheit (°F) to 50°F. The freeze-free season is typically 80 to 180 days. From 1971 to 2000, the Southwest Wisconsin Divisional Climate Summary included the following averages: Winter: 19.7°F, 3.44 inches of precipitation (ppt); Spring: 45.8°F, 9.24 ppt; Summer: 69.2°F, 13.14 ppt; Fall: 48.0°F,

8.10 ppt (Wisconsin State Climatology Office Website, 2010). Precipitation for the area averages approximately 30 inches annually. Typically, 70% of this rainfall occurs during the growing season; April through September. The one year and ten year predicted maximum 24-hour rainfall totals for Sauk County are 2.3 and 4.1 inches, respectively.

Surface Water Hydrology

Surface drainage consists of overland flow to the west, south, and east. Much of the run-off collects in isolated depressions on-site and infiltrates or evaporates. The ditches in the northwest portion of the installation drain toward the Ballistics Ponds and subsequently to Otter Creek to the west of the installation. The surface water from the NG, Rocket Paste, and Magazine Areas, located in the central and southeast areas of the installation, discharges to the Settling Ponds and Spoils Disposal Areas in the south-central portion of BAAAP. The Settling Ponds are manmade areas that received wastewater from production, but are now almost entirely dry except in severe rain events. The Settling Pond Area drains to the south and east at Gruber's Grove Bay, on Lake Wisconsin. Ponds that contain water throughout most of the year include the Ballistics Pond, Oleum Pond, Wood Duck Pond, Rocket Paste Pond, and NG/Over Flow Ponds. Appendix A contains a surface water runoff map.

Geology

A thick sequence of unconsolidated sediments was deposited during multiple glaciation events. A glacial terminal moraine transects the installation from north to south, as shown in Figure 2. Figure 2 is a map depicting the geological features at the surface. This map was adapted from the Geology of Sauk County by Attig and Clayton, 1990. Bisecting BAAAP from north to south is the terminal moraine shown in dark green (gj) and classified as thick till of the Johnstown Moraine. Thinner glacial till, shown in light green (gd), is found east of the terminal moraine. On the far eastern side of BAAAP is a unit classified as a collapsed meltwater-stream sediment (sc). West of the terminal moraine is stream sediment (sj) of the Johnstown Moraine, shown in pink. There is also a unit of stream sediment (ss) shown cutting through the terminal moraine in the southern portion of BAAAP. This stream sediment unit is younger than the Johnstown sediment, contains ice rafted boulders, and was deposited by floodwater during the drainage of glacial Lake Wisconsin during the Elderon Phase of glaciation.

Based on the borings advanced at BAAAP, the glacial till varies in thickness from 10 to 90 feet. Outwash sand and gravel or fluvial deposits (stream sediment) lie beneath the till. The water table does not intersect the till beneath BAAAP, only the outwash is in contact with the groundwater. West of the terminal moraine, a thick sequence of glacial outwash sand and gravel was deposited (sj). Glacial tills to the east are primarily silty sands with cobbles and boulders. Several feet of clay and silt (loess) overlie the glacial sediments.

Figures 3 and 4 are generalized geologic cross sections that show thickness of the unconsolidated sediment (sand and gravel) overlying bedrock. These two cross sections were adapted from figures in *Hydrogeology and Simulation of Groundwater Flow in Sauk County, Wisconsin* (Gotkowitz et al, 2005). The unconsolidated sediment and bedrock unit thicknesses were

derived by reviewing boring logs from wells at and near BAAAP. Bedrock geology at BAAAP is dominated by the Eau Claire Formation (Cambrian age) beneath most of BAAAP, with some Precambrian metamorphosed quartzite, granite, and rhyolite. The Eau Claire Formation consists of sandstone/shale/siltstone/dolomite. The Baraboo Range to the north of the installation contains Precambrian conglomerate and quartzite, which are part of the Baraboo Syncline, rising approximately 500 feet above the installation. The bedrock surface dips steeply toward the south, where soil deposits quickly thicken to a maximum of approximately 250 feet. Along the northern installation boundary, soil deposits are thin or absent and bedrock outcrops are common. Figure 5 illustrates the bedrock surface beneath and surrounding BAAAP. This bedrock surface map was based on available monitoring well, production well, and private well construction logs. The bedrock contours in the northeastern portion of Figure 5 were refined by using the results from a 2001 bedrock depth seismic refraction survey conducted by MicroGeophysics. The bedrock surface drops 200 feet in the northern third of BAAAP and flattens out in the southern two-thirds of BAAAP.

Figure 3 shows the BAAAP Well #1 on the far left penetrating the entire Eau Claire Formation and entering the Baraboo quartzite. A layer of shale is shown to underlay the western half of BAAAP. The shale layer acts as an aquitard, which retards groundwater in the sand and gravel aquifer and the upper sandstone aquifer from moving downward into the lower sandstone aquifer. The Eau Claire Formation is shown to thin out to the east and acts as both an aquitard and an aquifer based on the thickness of the sandstone. The BAAAP Well #1 draws its water from the Eau Claire Formation.

Figure 4 is a cross section that runs from the Baraboo Range south to the Village of Prairie du Sac. This section also shows the BAAAP Well #1 on the far left and the Prairie du Sac (PDS) Well #3 on the far right. The PDS Well #3 penetrates through the Eau Claire Formation and a layer of shale before entering the Mt. Simon Formation (sandstone). The shale layer is shown to be present from just north of the BAAAP Well #1 down to PDS. This shale layer acts as an aquitard, which restricts groundwater from migrating deeper into the Mt. Simon Formation. Based on the well log, the PDS Well #3 has a water depth at the ground surface, whereas the local water table is located 45 feet below ground. This implies that the PDS Well #3 is a flowing or artesian well. The thick sequence of the Eau Claire Formation and the shale layer protect the PDS Well #3 from contaminants on the surface and in the sand and gravel aquifer.

Geologic cross sections depicting stratigraphic relationships between the various soil units, bedrock units, and water table are orientated in Figure 6. Figures 7, 8, 9, and 10 are geologic cross sections that are orientated through the PBG area. Figures 11 and 12 are geologic cross sections that are orientated through the DBG area. Figure 13 is a geologic cross section orientated through the Central Plume area. The terminal moraine is shown in many sections, represented as glacial till (SP-SM or SM-SP), and consists mostly of varying grain sizes of sand with fines and some gravel/cobbles/boulders. Based on the cross sections, the glacial till is not present beneath the water table. Beneath the glacial till lies sand of varying grain sizes that was deposited by glacial fluvial processes (glacial outwash). The sand outwash contains many pockets of gravel with some being localized and others interconnecting. The gravel layers have been encountered up to 40 feet thick. A uniform layer of gravel exists near the bedrock surface,

south of the PBG. A layer of clay and silt (CL-ML), up to 30 feet thick, is present in the DBG area. As shown in Figure 11, the fine grained layer appears to pinch out approximately 1,300 feet east of the DBG. Both Figure 11 and 12 show the fine grained unit located beneath the water table. The bedrock shown in each cross section consists of the Eau Claire Formation.

Hydrogeology

Two major aquifers and one minor aquifer are present beneath the installation: the surficial sand and gravel aquifer, the Eau Claire Formation, and the deeper Mt. Simon Formation (sandstone aquifer), respectively. The sand and gravel aquifer and the Eau Claire are un-confined to semi-confined and possibly hydraulically connected. The Eau Claire Formation varies between 80 to 280 feet below ground surface (bgs). The Mt. Simon Formation is located approximately 400 feet bgs and is mostly present to the east and south of BAAAP. The general direction of groundwater flow is south to southeast. Steep gradients exist along the northern boundary of the installation. The gradient flattens substantially in the central and southern portions of the installation. Recharge to the sand and gravel aquifer is limited by infiltration through a fine-grained loess unit (silt/clay) in some areas.

As previously mentioned, Figures 3 and 4 show that the Eau Claire Formation contains at least one uniform shale layer that acts as an aquitard, which retards groundwater in the sand and gravel aquifer from moving downward into the lower sandstone aquifer (Mt. Simon Formation). The Eau Claire Formation also contains many thinner layers of shale and thick sequences of dolomite that act as an aquitard.

The regional groundwater flow direction in the BAAAP area is south-southeast towards the Wisconsin River as depicted in *Water-Table Elevation Map of Sauk County, Wisconsin* (Gotkowitz and Zeiler, 2003) and *Hydrogeology and Simulation of Groundwater Flow in Sauk County, Wisconsin* (Gotkowitz et al, 2005). This direction of flow correlates well with the groundwater contours generated by collecting water levels in the BAAAP monitoring wells. Figure 14 depicts the groundwater contours at BAAAP during September 2010.

The Wisconsin River acts as a discharge point for groundwater east and south of BAAAP. As depicted in *Water Resources of Wisconsin Lower Wisconsin River Basin* (Hindall and Borman, 1974) groundwater on both the west and east sides of the Wisconsin River discharges into the Wisconsin River. The Lake Wisconsin Reservoir, caused by the hydroelectric dam on the Wisconsin River, influences groundwater flow across the installation. The Reservoir is north of the dam where there is an approximate 40-foot surface water drop. The water level in the Reservoir is elevated above the water table for much of the southeastern portion of the installation. Anywhere the Reservoir elevation is higher than the water table, the water in the Reservoir will discharge to the groundwater. Subsequently, the Reservoir discharges to the groundwater in the Gruber's Grove Bay area and continues to discharge to the groundwater until it reaches the WP&L dam. The net result is groundwater flow parallel to the Reservoir with discharge to the Wisconsin River south of the dam. Groundwater in the northeast portion of the installation is higher in elevation than the Reservoir; therefore, the groundwater discharges to the Reservoir in this area.

5.0 SOURCE INVESTIGATIONS AND REMEDIAL MEASURES

Numerous site investigations and remedial actions have been conducted at the BAAAP. Groundwater investigation activities at BAAAP began in 1980 and continue today. Site-wide groundwater related assessment activities, agreed upon by the Army and WDNR, include the following: monitoring well installation; water level measurements; pump testing; and monitoring well and residential drinking water well sampling. Groundwater impact source-related investigations and remedial actions, for the PBG, Central Plume area, and DBG are discussed below. Figure 15 shows the locations of the monitoring wells and Figure 16 shows the locations of the private wells. Information regarding the construction and depths of private wells near BAAAP was included in the *Final Remedial Investigation Report* (ABB Environmental Services, Inc., 1993). SpecPro maintains an updated database of private wells located near BAAAP and their corresponding well construction logs (when available).

5.1 Propellant Burning Ground

The PBG is located in the southwestern portion of the BAAAP. The PBG is comprised of the following areas: Waste Pits, 1949 Pit, Racetrack/Hazardous Waste Thermal Treatment Unit (HWTTU) area, and Landfill #1. The location and layout of the PBG is shown in Figure 17.

DNT and organic solvent-containing materials are known to have been disposed of at the PBG through open burning and burial during production periods. Subsequently, localized impacts to soil consisted of 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), polycyclic aromatic hydrocarbons (PAHs), benzene, trichloroethylene (TCE), arsenic, chromium, lead, selenium, and zinc above soil cleanup remedial action objectives.

The PBG Waste Pits consisted of three waste pits and an open burning area. The Waste Pits were approximately 40 feet in diameter and 12 to 15 feet deep. A soil vapor extraction (SVE) system operated at the Waste Pits from 1997 to 1999. Approximately 1,600 pounds of solvent-related Volatile Organic Compounds (VOCs) were successfully removed from within the vadose zone. Approximately 2,280 cubic yards of soil were removed from the PBG Waste Pits, from ground surface to approximately 23 feet bgs in 1999. The soil was transported off-site and incinerated by a licensed hazardous waste contractor. The Waste Pits were filled with clean gravel to grade.

A pilot biotreatment system was installed at Waste Pit 1 in 1999. A Pilot-Scale Treatability Study (PSTS) was conducted in 2000 to evaluate the effectiveness of bacterial degradation of DNT by naturally occurring bacteria in the soil (in-situ). The PSTS extracted groundwater beneath Waste Pit 1, treated the water with phosphate, and reinjected it into the soil column above the waste pit. Oxygen was added to the vadose zone by injecting air through the former SVE system wells, which now served as air injection wells. Carbohydrate (ethanol) injection wells for the control of nitrate byproduct were installed downgradient, but never used. Monitoring results indicated the indigenous bacteria were aerobically biodegrading DNT in the soil column successfully; therefore, the Army decided to go full-scale with the biotreatment system.

The Biologically Enhanced Subsurface Treatment (BEST) system was installed in 2000 and operated from 2001 to 2005. From 2001 through 2003, additional air injection wells were installed to aid bacterial degradation of DNT in the groundwater. The air injection wells were in operation until 2006. Evaluation of the BEST system indicated effective DNT reduction in groundwater occurred during the operation of the system.

A geocomposite cap was installed at the 1949 Pit in 1998 to inhibit the movement of contaminants in the soil. The *1949 Pit Phase One Cap, Final Construction Report* (Olin Corporation, 1999) was submitted and approved by the WDNR in 1999.

The Racetrack/HWTTU area consisted of an oval gravel road, three refuse pits, and burning plates, as well as the HWTTU. In 1995, three-fourths of the Racetrack/HWTTU area was closed with a soil cover to prevent contact with residual lead in the soil. The *Final Documentation Report For Soil Cover Construction Racetrack And Thermal Treatment Unit Closure* (Olin Corporation, 1996) was approved by the WDNR. The remaining portion of the Racetrack area had impacted soil removed in 1997 with no cover required.

Landfill #1 contained structural timbers, asphalt shingles, cardboard, and other office refuse. Landfill #1 was covered with a WDNR-approved geocomposite cap in 1997.

In 2005, Shaw Environmental, Inc. (Shaw) conducted an investigation in the PBG area to evaluate the existing soil conditions beneath the PBG Waste Pits. This investigation included drilling borings through each of the waste pits and collecting soil samples for laboratory analysis. No additional soil sampling has been conducted since 2005. This investigation determined that carbon tetrachloride (CTET) and other VOCs were no longer present in the soil beneath the PBG Waste Pits. A summary of the VOC soil sample results are provided in Table 1.

Based on the 2005 Shaw investigation data SpecPro, Inc. (SpecPro) calculated that the amount of DNT-impacted soil beneath the PBG cap to be approximately 3,481 pounds. Input parameters and calculations are provided in Table 2.

In 2006, a draft AFS was completed to re-evaluate the interim remedial actions for soils at the PBG and determine the final remedy. The selected remedy included the previous remedial actions: soil vapor extraction, partial soil excavation and incineration, and full-scale bioremediation. The final remedy chosen included removal of the bioremediation system, installation of an impermeable cap and cover, and continued groundwater monitoring and remediation. On March 17, 2008, the WDNR approved the final remedy for the PBG subsurface soil.

Removal of the BEST system was completed in 2008. The Waste Pits were then capped with a geosynthetic barrier and compacted clay, according to regulatory requirements. The area was then covered with topsoil, graded, and seeded. The *Construction Documentation Report, PBG Phase 2, Cap and Construction* (SpecPro, Inc., 2009) report was submitted to the WDNR and approved in 2009.

The Waste Pits, 1949 Pit, Racetrack/HWTTU, and Landfill #1 areas are regularly inspected. Signage and fencing are inspected and maintained. Cover areas are inspected annually for erosion, settlement, undesirable vegetation, and other deficiencies. Required repair work to maintain proper grade and drainage is completed. Annual Cap and Cover Reports are submitted to the WDNR.

Interim Remedial Measures/Modified Interim Remedial Measures

Groundwater contamination in monitoring wells at the PBG was first detected in 1982 (Tsai, 1988). Although an exhaustive investigation of groundwater contamination was not completed at the time, proposed interim remedial measures were evaluated in 1989. The goals of the early groundwater remedial action were to: 1) curb the advancement of the plume, 2) reduce contaminants within the plume, and 3) be compliant with local, state, and federal regulations. Options considered included: total plume capture, boundary control extraction, source control extraction, and a combination of boundary and source control extraction. Components of the remedy that were evaluated included: air stripping, activated carbon adsorption, and combined air stripping and carbon adsorption.

The IRM groundwater pump and treat system began operations during June 1990 by pumping approximately 350 gallons per minute (gpm). The IRM groundwater treatment system originally consisted of one source control well (SCW-1) and three boundary control wells (BCW-1, BCW-2, and BCW-3) located within the installation boundary. The groundwater is treated with liquid phase granular activated carbon (GAC) treatment. BCW-4 was installed in 1993 but was never connected to the IRM. By April 1998, BCW-1, BCW-2, and BCW-3 were shut down and SCW-1 and SCW-2R (installed in 1997) were pumping approximately 310 gpm. Since November 2008, the two source control wells (SCW-1 and SCW-2R) have extracted groundwater from the PBG source area at a combined rate of approximately 350 gpm. Figure 17 shows the locations of the existing IRM extraction wells and the former boundary control wells. Table 3 summarizes the well depth, screened interval, and pumping rate for the existing IRM extraction wells.

Extracted groundwater from the IRM extraction wells is pumped through a GAC system that removes VOCs and DNT from the water by adsorption. The GAC system consists of two units that each contain 20,000 pounds of carbon. The treated water then flows through a 30-inch high-density polyethylene (HDPE) pipeline and discharges into the Lake Wisconsin Reservoir near Gruber's Grove Bay, regulated under a Wisconsin Pollutant Discharge Elimination System (WPDES) permit. A 10-inch pipeline to the Lake Wisconsin Reservoir was the original discharge line, and was used until the 30-inch line was constructed in 1995. Once the BEST system was removed, the ozone treatment and multi-media filter were not needed and therefore removed from the IRM system in 2008.

An evaluation of the IRM was conducted in 1993 to address new regulatory requirements. This evaluation concluded that the PBG plume was not being entirely captured by the IRM system. In particular, the plume was extending beneath and east of the three original boundary control wells. A groundwater model was used to evaluate alternative groundwater extraction and

treatment options. A groundwater treatment system was designed to augment the existing IRM system.

This augmented groundwater treatment system called the MIRM system was installed in 1995 and 1996 and began operations on June 20, 1996. The MIRM groundwater treatment system originally consisted of six boundary extraction wells (EW-161, EW-162, EW-163, EW-164, EW-165, and EW-166) pumping a combined 3,000 gpm. These MIRM extraction wells were located along the southern BAAAP boundary (see Figure 17). The MIRM system utilized automatic self-cleaning strainers, air strippers, vapor phase GAC treatment, and liquid phase GAC treatment. Four additional extraction wells (EW-167, EW-168, EW-169, and EW-170) were installed along the axis of the plume in 2005. These four new wells and EW-163R pumped approximately 1,600 gpm. The pumping of these extraction wells was refined over the years to optimize removal of groundwater contaminants. The currently operating five MIRM extraction wells (EW-163R, EW-167, EW-168, EW-169, and EW-170R) extract groundwater from the PBG plume at a combined rate of approximately 2,400 gpm. MIRM extraction well EW-164 is currently on standby and not pumping. Figure 17 shows the locations of the existing and former MIRM extraction wells. Table 3 summarizes the well depth, screened interval, and pumping rate for the existing MIRM extraction wells.

A sulfuric acid tank and pumps are used for descaling the system periodically. A phosphate-based sequestering agent is added to avoid carbonate scaling and fouling of the system.

The water from the MIRM extraction wells flows through three individual air strippers for treatment of VOCs. Each air stripping tower is 27 feet high, eight feet in diameter, and constructed of fiberglass reinforced plastic. A 15.5-foot neoprene packing bed of 3.5-inch media is contained within each tower, which is designed to handle a normal flow of 1,000 gpm and a maximum flow of 1,500 gpm. Each air stripper contains a centrifugal blower capable of supplying 4,600 standard cubic feet per minute of air. The VOCs are thus transferred from water to air.

The air then flows through three GAC vapor phase units, to remove the VOCs through carbon adsorption before being released to the atmosphere. Each GAC unit contains 5,000 pounds of carbon. The MIRM air emissions have been monitored and found to be well below any applicable regulatory limits. The GAC treatment of the air emissions has been discontinued recently following WDNR approval in 2010.

The water then collects in the air stripper basin after the vapor phase units have removed approximately 98% of the VOCs. The water then flows from the air stripper basin into the liquid phase GAC units. The liquid phase GAC treatment system as originally designed consists of five GAC units arranged in parallel. Each unit has a self-cleaning strainer and two separate beds of GAC adsorbers. The ten liquid phase adsorbers contain 20,000 pounds of carbon each that captures the remaining VOCs and DNTs. The treated water is collected in the treated effluent storage basin. Approximately 500 gpm of treated water is used for the BAAAP fire suppression water supply system. The remaining treated water is discharged under a modified WPDES permit to the Lake Wisconsin Reservoir through the 30-inch HDPE pipeline.

In 2002, extraction well EW-163 was replaced with EW-163R due to equipment getting stuck in the borehole during maintenance operations. Additional modifications were made to the system in 2004 and 2005 by placing more extraction wells within the body of the plume. This allowed the system to treat water with the highest level of contaminants. MIRM well re-alignment activities in 2006 included the installation of four high-capacity wells, pumps, piping, and control systems. In 2008, one of the original source control wells (SCW-2) was abandoned and replaced with SCW-2R to allow the construction of the PBG cap. The MIRM system was modified in 2008 to include two more GAC units to increase the total capacity of the IRM/MIRM system to 4,500 gpm. In 2010, extraction well EW-170 was replaced with EW-170R due to well bio-fouling and poor well performance.

Bio-fouling is caused by iron-oxidizing bacteria, commonly referred to as "iron bacteria". The primary form of iron bacteria present at the IRM/MIRM is *Gallionella sp.*. Iron bacteria are generally aerobic and oxidize iron and manganese to a lesser extent. Dissolved ferrous iron (II) is oxidized to ferric iron (III) or ferric oxide. The result is a mucilaginous slime that contains precipitated ferric oxide. The slime and ferric oxide protect the bacteria, but cause clogging of well screens, pipes, and pumps. Repeated well rehabilitation has been conducted consisting of the following: pre-rehabilitation video logging, wire brushing, bailing debris, adding hydrochloric acid, adding dispersant polymer, surging, acid removal and neutralization, and well sterilization with sodium hypochlorite. The iron bacteria are most likely from an indigenous source.

Total suspended solids cause clogging of the liquid phase GAC units, which subsequently require frequent backwashing. Backwashing currently occurs five to 10 times per month. Backwashing and clogging reduces the treatment capacity at the MIRM.

Currently, the IRM/MIRM and the on-site wastewater treatment plant (WWTP) have a combined WPDES permit. Bluffview Sanitary District (BSD) is scheduled to take over ownership of the WWTP in 2011. It is anticipated this changeover in the WWTP ownership along with the renewal of the WPDES permit in 2012 will result in the submittal of separate permits by the Army for the IRM/MIRM and the BSD for the WWTP.

SpecPro calculated the annual total mass of DNT and VOCs removed by the IRM and MIRM systems over the past four years. The monthly influent concentrations of total DNT, 1,1,1-trichloroethane (1,1,1-TCA), carbon tetrachloride (CTET), chloroform, and TCE were multiplied by the estimated volume of groundwater treated each month. 1,1,1-TCA, CTET, chloroform, and TCE are the primary VOCs of concern at the PBG. The total estimated mass of DNT removed in 2007, 2008, 2009, and 2010 was no more than 44.34, 6.52, 12.62, and 14.40 pounds, respectively. The total estimated mass of VOCs removed in 2007, 2008, 2009, and 2010 was no more than 53.00, 78.52, 81.93, and 65.62 pounds, respectively. Input parameters are provided in Table 4. Mass values preceded with a less than symbol indicate that certain laboratory results were reported below the laboratory detection limit. Mass calculations used the detection limit value, where necessary. Considering an average mass of 19.47 pounds of DNT removed per

year and an annual IRM/MIRM operation and maintenance cost of $1.7 million, the cost to remove one pound of DNT is $87,314.

Table 5 summarizes the analytical results for the IRM/MIRM system from samples collected in December 2010. The table provides total DNT, 1,1,1-TCA, CTET, chloroform, and TCE concentrations for each MIRM extraction well, IRM influent, MIRM influent, and the combined IRM/MIRM effluent. Two concentration over time graphs for the MIRM influent are presented in Appendix B. The first graph displays the MIRM influent concentrations for VOCs (CTET, chloroform, and TCE) in relation to the MIRM pumping rate for the time period from 2001 to 2011. It appears that regardless of the flow rate, the VOC contaminant concentrations in the MIRM influent have been decreasing since 2005. Since June 2009, concentrations for all three VOCs have been below their respective groundwater ES. The second graph displays the MIRM influent concentrations for 2,3-DNT, 2,4-DNT, 2,5-DNT, 2,6-DNT, 3,4-DNT, and 3,5-DNT in relation to the MIRM pumping rate for the time period from 2001 to 2011. Since the flow rate was increased in January 2008, the 2,3-DNT and 3,4-DNT concentrations increased for two years. Since February 2010, the 2,3-DNT and 3,4-DNT concentrations have been decreasing. Total DNT concentrations in the MIRM influent are consistently above the groundwater ES, 0.05 micrograms per liter (µg/l).

5.2 Deterrent Burning Ground

The DBG area consists of seven acres and is located in the northeastern portion of BAAAP. The DBG area was used as a sand borrow pit from the 1940s until the early 1960s, and a waste disposal site from the 1940s to the 1970s. The DBG consisted of three burn areas within a man-made depression, approximately three acres in size and 20 feet deep.

Coal ash from the power plant, construction rubble, trash, and burned garbage were deposited inside the DBG sand borrow pit. From 1966 through 1971 the remaining portion of the DBG was used for open burning in open-topped metal tanks of deterrent, a liquid organic extract from surplus propellant, composed mostly of DNT and di-n-butyl phthalate, as well as minor amounts of diphenylamine, benzene, and NC. Structural timbers, asphalt shingles, cardboard, paper, and office waste were also burned in the pits. Subsurface soils at the DBG were found to be impacted with DNT, n-nitrosodiphenylamine, arsenic, and chromium. The majority of the impacts were found in the shallowest portion of the pit, with arsenic and chromium in limited areas of the site. Investigations also showed DNT spread vertically in the subsurface soils and reached groundwater.

Landfill #5 is located to the northeast of the DBG. During operations, the landfill reportedly received solid waste, including office waste, demolition debris, laboratory waste, and coal ash from the power plant. No hazardous materials were reported to have been disposed in Landfill #5. The landfill was opened in the early 1940s when operations began and was closed in 1989 with a clay cap.

An interim corrective action consisting of the removal and off-site incineration of DBG waste pit soil occurred in 1999 and 2000. Impacted soil from the three pits was excavated to a depth of

approximately 15 feet. The total volume of the excavated and incinerated soil was approximately 4,260 cubic yards. Each pit was backfilled with clean fill to pre-excavation grades. This removed the surface soil contaminated with the highest DNT levels and metals.

In 2001, the backfilled area was temporarily capped and additional soil and groundwater studies were started to better understand the groundwater flow in the area. On May 6, 2002, following submittal of the *Draft Alternative Feasibility Study - Deterrent Burning Ground Waste Pits Subsurface Soil* (Stone & Webster, Inc., 2002), the Army requested a permit modification to perform the remedial action (RA), including partial excavation and incineration (completed in 2000), resource conservation and recovery act (RCRA) cap/cover, institutional controls, and groundwater monitoring. The final remedy, approved by the WDNR, was installed in 2003. Due to limited groundwater contamination and the low risk to potential receptors, active groundwater remediation was not required by the WDNR.

Based on investigation data presented in the *Draft Alternative Feasibility Study - Deterrent Burning Ground Waste Pits Subsurface Soil* (Stone & Webster, Inc., 2002)SpecPro calculated the amount of DNT-impacted soil remaining after capping or before soil removal in 1999/2000? at approximately 5,603 pounds. Input parameters are provided in Table 2. Concentrations and volume data were used to derive a mass volume in pounds. It should be noted that the data used in the calculation was collected from 1991 to 1998. No additional soil sampling has been conducted since 1998.

5.3 Central Plume Area

Based on the knowledge of groundwater flow and monitoring results, the detection of DNT in groundwater at the Water's Edge Subdivision, located on the north side of Gruber's Grove Bay, indicated another source of DNT in groundwater besides the PBG or DBG was likely. The Water's Edge Subdivision is shown in inset B on Figure 16. In 2004, DNT was first detected within private wells located in the subdivision. The 2,6-DNT concentration in two private wells exceeded the Chapter NR 140, Wisconsin Administrative Code (Wis. Adm. Code), Enforcement Standard (ES). In 2005, the Army replaced these two private wells.

In 2006, the USDA installed a well (USDA 6) in the southeast portion of BAAAP to water cattle. The USDA 6 well is located approximately 4,300 feet north of the Water's Edge Subdivision (see Figure 16). Sampling results indicated 2,6-DNT exceeded the Chapter NR 140 ES. Based on the groundwater flow direction and the groundwater contaminant detections, the source of DNT contaminated groundwater is believed to be from the north-central portion of BAAAP where rocket paste and rocket propellant were produced. However, several investigations to date have not determined a specific source of DNT contamination. It is believed that the broad production area may have caused the groundwater impacts. Production wash waters were last discharged to open ditches in this area in 1975. The following is a summary of the DNT source investigations that were conducted in the Central Plume area.

DNT Source Investigation

In 2006, monitoring well sample results north and south of the USDA 6 well indicated the source of the Central Plume groundwater contamination was most likely located north of the Rocket Production area. A DNT sources investigation followed.

Groundwater data and historical standard operating procedures were reviewed. Based on these reviews, the investigation of the source of DNT contamination focused on the Pre-Mix Houses, located near the Rocket Paste area. The Pre-Mix Houses supported the production of rocket paste. Barrels of production chemicals, which contained DNT, were transported by rail to each Pre-Mix House from the Bag Loading House. NC and NG were added to the chemical mixture in each Pre-Mix House. The resulting slurry was then pumped to the Final Mix Houses.

In 2007, soil borings to a depth of 20 feet bgs were completed and continuously sampled at locations where releases of DNT may have occurred. Soil samples were analyzed for DNT, base neutral acids (BNAs), and total lead. DNT was not detected in soil samples collected adjacent to the Pre-Mix Houses. In 2008, soil samples were collected to a depth of nine feet bgs in ditches and potential drainage pathways leading from the Rocket Paste and NG Production areas. Only very low concentrations of DNT were detected in several soil samples. In 2010, soil samples were collected to a depth of eight feet bgs near over 20 production buildings located in the NG Production area. Only very low concentrations of DNT were detected in several soil samples. Seven groundwater monitoring wells were installed in 2007. Three of the wells were constructed so that the screen intersected the water table. The four remaining monitoring wells were constructed so that the screen was submerged below the water table (approximately two-thirds the depth of the sand and gravel aquifer). The wells ranged in depth from 115 to 207 feet bgs. Groundwater samples from each well were analyzed for VOCs, DNT, and BNAs. 2,4-DNT was detected in several monitoring wells and also the laboratory method blanks. The laboratory equipment may have contaminated the well samples, rendering these results invalid. Subsequent groundwater sampling conducted during June 2008 confirmed that 2,4-DNT and 2,6-DNT were present in one of the deeper wells (RIN-0702C) and 2,6-DNT was present in another deeper well (RIN-0703C). These detections of DNT confirmed that the source of DNT contamination was located northwest of the USDA 6 well.

6.0 GROUNDWATER CHARACTERIZATION

Monitoring well locations are shown on Figure 15. Since 1979, the Army has installed over 400 monitoring wells at BAAAP. Groundwater quality data is collected from monitoring wells to assess contaminant concentrations. The groundwater results are reported to the WDNR.

Between April and July of 2010, the Army installed 40 monitoring wells inside and outside BAAAP to supplement the existing groundwater monitoring network. Eleven of those monitoring wells were installed downgradient from the DBG. The installation and sampling of those eleven wells were documented in the *Northeast Boundary Monitoring Well Installation Report* (SpecPro, Inc., 2010). The other 29 monitoring wells were installed within the DBG,

PBG, and Central Plumes. Appendix C contains documentation of the installation of these 29 monitoring wells and a well location map.

6.1 Groundwater Properties

Water Level Elevations and Flow Direction

Water level data collected from monitoring wells across BAAAP indicate groundwater depths ranging from 40 to 130 feet bgs or 765 to 855 feet above mean sea level (MSL). Figure 14 is a representation of the groundwater elevation surface in September 2010. The groundwater flow direction is generally to the south-southeast. In the southeast corner of BAAAP, groundwater flow is deflected slightly to the south, presumably due to influences from the Lake Wisconsin Reservoir. In the southwest corner of BAAAP, groundwater flow is influenced by the IRM/MIRM extraction wells. Due to the large number of monitoring wells, the elevation measurements for a sampling round are taken within a 30-day period. Due to the groundwater being highly conductive, the groundwater table does not radically change after precipitation and snowmelt events.

The general groundwater flow direction at the installation is from north to south, but is locally influenced by the Lake Wisconsin Reservoir and the IRM/MIRM pumping wells. The Lake Wisconsin Reservoir, located to the east and southeast of BAAAP, is formed by the WP&L dam, which results in a constant lake elevation of approximately 774 feet MSL. Below the dam, the water elevation drops abruptly to 736 feet MSL as the lake reverts to the flowing Wisconsin River. The rapid change in water elevations at the dam results in a dramatic hydraulic drop in groundwater elevations around the dam. The pumping of the IRM/MIRM extraction wells located on the western half of the BAAAP southern boundary results in an abrupt elongated groundwater depression zone. Groundwater captured by the depression zone flows toward the IRM/MIRM extraction wells where it is eventually pumped from the sand and gravel aquifer.

Comparison of groundwater and Reservoir level elevations indicates water from the Reservoir recharges groundwater or, depending on relation to the WP&L dam, groundwater discharges to the Wisconsin River. Groundwater discharges to the Reservoir when adjacent groundwater levels are higher than the Reservoir level. Groundwater discharges to the Reservoir in the northeastern portion of BAAAP. The Reservoir discharges to the sand and gravel aquifer when adjacent groundwater levels are lower than the Reservoir level. About three miles north of the WP&L dam, the Reservoir transitions from recharging to discharging to the underlying sand and gravel aquifer. Directly south of the WP&L dam, the Wisconsin River resumes with groundwater discharging to the river.

Hydraulic Conductivity

Hydraulic conductivity values were calculated based on aquifer testing at two MIRM extraction wells located near the PBG in 2005. The aquifer tests, which were comprised of a pump test followed by a step test, were conducted at extraction well EW-169 in February 2005 and at EW-167 in March 2005. The tests were conducted by continuously pumping the extraction wells

over a period of time and measuring the drawdown in nearby observation wells. Observation wells (PBN-8504A, PBM-8505, and PBM-8904C) were monitored for the test at EW-169, which lasted two and one half days. The aquifer test at EW-169 yielded a hydraulic conductivity value between 1.39E-02 to 6.27E-02 centimeters per second (cm/sec). The aquifer test at extraction well EW-167 lasted seven days and drawdown was measured in four nearby observation wells (PBM-8503, PBN-8502A, PBN-8901C, and PBN-8902C). The results of this testing yielded a hydraulic conductivity value between 4.85E-02 and 9.60E-02 cm/sec. Testing methodology is presented in further detail in the *Draft Corrective Measures Implementation Report, MIRM Extraction Well Realignment Project* (Shaw Environmental, Inc., 2006).

During the RI (ABB-ES, 1993), slug tests were performed on monitoring wells across the BAAAP. The RI report included hydraulic conductivity values for 54 monitoring wells. Table 6 summarizes the hydraulic conductivity data collected during the RI. The average hydraulic conductivity of these 54 wells was 4.0E-02 cm/sec. The hydraulic conductivity values obtained during the MIRM pump tests correlated well with the average value obtained from the RI slug tests.

Hydraulic Gradients

Wells are screened at various depths and assigned an alphabetical designation after the number of the well ID. A is the shallow water table interval, and B, C, D, and E are piezometric intervals that increase in depth from B to E. The piezometers ending in E were constructed so that the screen was located in the bedrock. It should be noted that the unconsolidated sand and gravel aquifer is unconfined vertically.

As evident from the groundwater elevation map showing the September 2010 data (Figure 14), the northern half of BAAAP has a much steeper horizontal hydraulic gradient than the southern half. The magnitude and direction of flow for the three plume areas are represented by the groundwater contours presented in Figure 14. Data sets from each groundwater plume were used to calculate horizontal hydraulic gradient. Groundwater elevations from the sampling periods of March 2010, September 2010, and March 2011 were used to calculate an average hydraulic gradient for each plume area (Table 7). The average hydraulic gradient calculated for the PBG area wells was 0.00165 feet per foot (ft/ft). The average hydraulic gradient calculated for the DBG area wells was 0.00127 ft/ft. The hydraulic gradient calculated for the Central Plume area wells was 0.001063 ft/ft.

Vertical groundwater movement is evaluated by comparing groundwater levels from the different aquifer layers to determine vertical gradient. Monitoring well clusters, where two or more wells have screens positioned at different depths within the aquifer, are used to examine differences in the potentiometric groundwater surface between different layers of the aquifer. Vertical hydraulic gradients were evaluated for nested well pairs in the three plume areas. Table 8 summarizes the vertical groundwater gradients for the chosen well nests. Gradients were evaluated from the groundwater elevation data collected during the March 2010, September 2010, and March 2011 monitoring events. Positive vertical gradients indicate groundwater is flowing upward and negative vertical gradients indicated groundwater is flowing downward.

The majority of the well pairs in the PBG exhibited an upward vertical groundwater gradient between deep to shallow wells. Because well pair located both on-site and off-site exhibited upward vertical gradients, the vertical gradient does not appear to be influenced by the IRM/MIRM extraction wells. The majority of the well pairs in the DBG exhibited a downward vertical groundwater gradient between shallow to deep wells. The four well pairs in the Central Plume were split between a downward or upward vertical groundwater gradient between shallow to deep wells.

Groundwater Flow Velocities

The advective groundwater flow velocity is derived from the hydraulic conductivity value, horizontal gradient, and effective porosity. Advective groundwater movement does not take into account dispersion, diffusion, or chemical retardation of groundwater contaminants, which can increase or decrease the rate of groundwater flow. It is a calculated value that provides an estimate of the rate of groundwater flow over time. The mathematical formula for determining advective groundwater flow velocity (v) is:

$v = Ki/n_e$ Where:

K = hydraulic conductivity (feet/day)

i = hydraulic gradient (feet/feet)

n_e = effective porosity

The average hydraulic conductivity value from the RI, 0.04 cm/sec or 113.4 ft/day, was used in all the groundwater flow velocity calculations. The effective porosity is estimated at 0.26 or 26%. Average horizontal gradients of 0.00165 ft/ft for the PBG, 0.00127 ft/ft for the DBG, and 0.00103 ft/ft for the Central Plume were used to calculate the groundwater flow velocities. The calculated average groundwater flow velocities as shown in Table 6 equal 0.72 ft/day for the PBG, 0.55 ft/day for the DBG, and 0.45 ft/day for the Central Plume. These groundwater flow velocity values equate to 263 ft/year for the PBG, 201 ft/year for the DBG, and 164 ft/year for the Central Plume.

6.2 Nature and Extent of Groundwater Contamination

Groundwater investigation activities at BAAAP began in 1980 and continue today. Site-wide groundwater-related assessment activities, agreed upon by the Army and WDNR, include the following: soil vapor surveys; monitoring well drilling, installation, and surveying; water level measurements; pump testing; and monitoring well and residential drinking water well sampling. Each year, the Army completes an *Annual Groundwater Narrative Summary Report* that summarizes the groundwater data collected during the previous year.

Historical Groundwater Plume Characterization

Groundwater contamination in monitoring wells at the PBG was first detected in 1982 (Tsai, 1988). During the 1980s, monitoring wells were installed across BAAAP during various investigations. The draft final (Phase 1) RI report (January 1990) indicated that two plumes of contamination had migrated beyond BAAAP boundaries. From the DBG/Landfill #5 area, a sulfate plume had been detected past the eastern boundary. Concentrations of sulfate at the eastern boundary were reported at 640 milligrams per liter (mg/l), but concentrations in private wells outside the boundary were below the Chapter NR 140 PAL of 150 mg/l. From the PBG area, a plume of VOCs with CTET as the primary contaminant had moved past the southern boundary.

An off-site groundwater monitoring program was initiated in January 1990. In late April 1990, results of monitoring residential supply wells south of BAAAP showed that three private potable water wells had been contaminated with CTET and chloroform. The maximum concentrations of CTET and chloroform were 80 µg/l and 9.9 µg/l, respectively. A VOC plume moved south from the PBG Waste Pits, past the installation's southern boundary, then easterly to the Wisconsin River below the WP&L dam. Two replacement residential wells were installed in December 1990 as a remedial measure. The third resident finalized their agreement with the Army in 1995, and the well replacement was completed in 1996. Prior to well replacement, bottled water had been provided to the affected residences. At the southern boundary of the PBG Waste Pits, the IRM system was constructed and began operating in June 1990.

The 1993 RI and 1994 FS identified the types, concentrations, and locations of contamination at the installation. This RI/FS looked at the possible ways to treat the contamination and recommended remedies for each site. The regulators agreed with the Army's recommendations for remedies. These were incorporated into the IFCR modifications of June 1995 and the RCRA permit modification of January 6, 1996.

The August, September, and October 2010 groundwater data reported to the WDNR included results for 187 monitoring wells and 69 private wells. The August, September, and October 2010 groundwater monitoring well data is summarized in Tables 9, 10, and 11, respectively. The August and September 2010 private well data is summarized in Tables 12 and 13, respectively. See Appendix D for maps displaying groundwater concentrations from the August, September, and October 2010 groundwater data for CTET, chloroform, total DNT, ethyl ether, 1,1,1-TCA, 1,1,2-trichloroethane (1,1,2-TCA), and TCE. Appendix D also contains maps of the August, September, and October 2010 groundwater exceedances.

Wisconsin Groundwater Rule Revisions

Effective January 1, 2011, Chapter NR 140 groundwater standards were revised. The revision included new standards for DNT (total residues). The ES for DNT (total residues) is 0.05 µg/l and the PAL is 0.005 µg/l. All six DNT isomers (2,3-DNT; 2,4-DNT; 2,5-DNT; 2,6-DNT; 3,4-DNT; and 3,5-DNT) must be added together to determine the DNT (total residues) value, or total

DNT. There is no existing federal standard for total DNT. The SpecPro laboratory's current limit of detection (LOD) for all DNT isomers is 0.015 µg/l.

6.2.1 Propellant Burning Ground Plume

The PBG plume originates at the PBG and extends southeast beyond the installation boundary. South of BAAAP, the plume turns southeast towards the Wisconsin River due to the influence of the WP&L dam, just north of Prairie du Sac. The PBG groundwater plume shown in Figures 18 and 19 represents the area where groundwater concentrations exceed a Chapter NR 140 PAL for one or more of the following compounds: CTET, total DNT, ethyl ether, or TCE. All six DNT isomers (2,3-DNT, 2,4-DNT, 2,5-DNT, 2,6-DNT, 3,4-DNT, and 3,5-DNT) have been detected in the PBG plume, mostly in the PBG Waste Pits. The plume boundary is an interpretation of the September and October 2010 groundwater data collected from both monitoring wells and private wells. Tables 10 and 11 summarize the groundwater analytical results from the September and October 2010 monitoring well sampling events. Table 13 summarizes the groundwater analytical results from the September 2010 quarterly private well sampling event.

Figure 19 is a conceptual model of the groundwater contamination plume originating from the PBG. The conceptual model shows the plume in relation to the water table and the underlying bedrock. Concentrations of DNT and CTET, above the PAL, have been detected in several monitoring wells that are screened in the bedrock. As shown in Figure 19, there is a shale layer beneath the contamination plume that retards groundwater contamination from migrating into the lower Mt. Simon Formation (sandstone).

The horizontal distribution of CTET is illustrated in Figures 20 and 21. These isoconcentration maps were prepared using groundwater data collected during September and October 2010. Figure 20 displays the horizontal extent of CTET that is located above an elevation of 705 feet. Figure 21 displays the horizontal extent of CTET that is located below an elevation of 705 feet. An elevation of 705 feet was chosen to help visualize the difference between the shallow and deeper zones of CTET contamination in the sand and gravel aquifer.

Figure 22 illustrates how the CTET concentrations in the PBG plume have changed between 1993 and 2010. Figure 21 displays only the area south of the BAAAP boundary where the PBG plume has not been influenced by pumping from the IRM and MIRM extraction wells. The isoconcentration map is broken up into three separate vertical well screen intervals, B series (shallow aquifer zone), C series (intermediate aquifer zone), and D-E series (deep aquifer zone). This area located downgradient of BAAAP does not contain any monitoring wells that are screened at the water table surface (A level). CTET represents the dissolved chlorinated solvent plume migrating in the direction of groundwater flow.

Figure 6 shows the orientation of the contaminant plume isoconcentration cross sections for CTET, which are illustrated in Figures 23, 24, and 25. CTET was chosen for visual representation because it best represents the horizontal and vertical extents of the VOC plume.

Figure 23 (A-A') illustrates the estimated vertical extent of CTET from the PBG in the north to the Wisconsin River in the south (centerline of PBG plume). The CTET concentrations are highest south of the BAAAP boundary and in wells screened approximately 70 to 100 feet below the water table. The CTET plume extends north to south from the PBG to the Wisconsin River with an average thickness of 90 feet beneath BAAAP and 140 feet south of BAAAP. The maximum depth of CTET is 145 feet below the water table at monitoring well PBN-9903D, which is screened in sandstone at the top of the Eau Claire Formation. CTET concentrations beneath the PBG (source area) are much lower than what is found downgradient of the PBG. The estimated boundary of the CTET plume is shown to approach the Wisconsin River, but first encounters the groundwater/surface water interface. The groundwater/surface water interface is an area beneath a river where the groundwater mixes with the surface water. The fate of groundwater contaminant plumes as they discharge through river beds and the groundwater/surface water interface is not well understood (Conant, 2000). Dilution and volatilization of the CTET plume is expected to occur at the groundwater/surface water interface.

Figure 24 (B-B') illustrates the width and depth of the CTET plume approximately 2,000 feet south of the PBG. Figure 25 (D-D') illustrates the width and depth of the CTET plume, but off-site and approximately 12,000 feet south of the PBG. An isoconcentration section for CTET was not prepared for section C-C'. The CTET plume is estimated to be approximately 3,100 feet wide and a maximum depth of 135 feet below the water table in Figure 24, which is close to the source area. The CTET plume is estimated to be approximately 2,200 feet wide and a maximum depth of 135 feet below the water table in Figure 25, which is 12,000 feet downgradient of the source area.

The following private wells are shown on either Figure 23 (A-A') or Figure 25 (D-D'): Judd, Lins-K, Lins-L, Mueller-J, and Urban. These private wells represent all the private wells located near the PBG plume. As shown in the figures, the Judd well is screened in the sand and gravel aquifer and the Lins-K, Lins-L, Mueller-J, and Urban wells are screened in the bedrock aquifer. There are several private wells that were drilled through the CTET plume and then screened beneath the CTET plume. Based on the depth and location of these private wells in relation to the CTET plume and the historic groundwater monitoring data results, the private wells are not drawing their water from the CTET plume.

The horizontal distribution of total DNT is illustrated in Figures 26 and 27. These isoconcentration maps were prepared using groundwater data collected during September and October 2010. Figure 26 displays the horizontal extent of total DNT that is located above an elevation of 705 feet. Figure 27 displays the horizontal extent of total DNT that is located below an elevation of 705 feet. An elevation of 705 feet was chosen to help visualize the difference between the shallow and deeper zones of total DNT contamination in the sand and gravel aquifer. Below an elevation of 705 feet, groundwater beneath the PBG source area does not contain DNT (see Figure 27).

Figure 6 shows the orientation of the contaminant plume isoconcentration cross sections for total DNT, which are illustrated in Figures 28, 29, and 30. Total DNT was chosen for visual representation because it best represents the horizontal and vertical extents of the DNT plume.

Figure 28 (A-A') illustrates the estimated vertical extent of total DNT from the PBG in the north to the Wisconsin River in the south (centerline of PBG plume). Total DNT concentrations beneath the PBG (source area) are higher than what is found downgradient. The total DNT concentrations are much lower south of the BAAAP boundary than what is found on BAAAP. The total DNT plume extends north to south from the PBG to the Wisconsin River with a thickness between 50 and 120 feet. The influence of the IRM can be seen on the far left side of Figure 28 (north) of the cross section by the separation of the DNT plume. The influence of the MIRM can be seen in the middle of the cross section (BAAAP boundary) by the higher DNT concentrations on the left side of Figure 28 (north) and the lower DNT concentrations of the right side of Figure 28 (south). The estimated boundary of the DNT plume is shown to approach the Wisconsin River but first encounters the groundwater/surface water interface. Dilution of the DNT plume is expected to occur within the groundwater/surface water interface.

Figure 29 (B-B') illustrates the width and depth of the total DNT plume approximately 2,000 feet south of the PBG. Figure 30 (D-D') illustrates the width and depth of the total DNT plume, but off-site and approximately 12,000 feet south of the PBG. An isoconcentration section for DNT was not prepared for section C-C'. The total DNT plume is estimated to be approximately 3,100 feet wide and a maximum depth of 135 feet below the water table in Figure 29, which is close to the source area. The total DNT plume is estimated to be approximately 2,200 feet wide and a maximum depth of 135 feet below the water table in Figure 30, which is 12,000 feet downgradient of the source area.

The following private wells are shown on either Figure 28 (A-A') or Figure 30 (D-D'): Judd, Lins-K, Lins-L, Mueller-J, and Urban. These private wells represent all the private wells located near the PBG plume. As shown in the figures, the Judd well is screened in the sand and gravel aquifer and the Lins-K, Lins-L, Mueller-J, and Urban wells are screened in the bedrock aquifer. There are several private wells that were drilled through the DNT plume and then screened beneath the DNT plume.

DNT is routinely detected in monitoring wells located both inside and outside of BAAAP. DNT has been detected at varying depths in the sand and gravel aquifer. The highest DNT concentrations are found at the PBG source area. The IRM extraction wells, SCW-1 and SCW-2R, capture contaminated groundwater migrating from the PBG Waste Pits. The highest total DNT concentration detected during September 2010 was 1,166.1 µg/l in PBM-0002. PBM-0002 is located at the PBG Waste Pits. DNT is occasionally detected in private wells located south of BAAAP, but always at concentrations below the ES. A summary of the September 2010 quarterly private well sampling results is provided in Table 13.

Elevated levels of CTET (above the ES) are routinely detected in monitoring wells located both inside and outside of BAAAP. CTET has been detected at varying depths in the sand and gravel aquifer. The highest of the CTET detections are found south of the PBG Waste Pits. Elevated concentrations of CTET are found near the MIRM extraction wells, near the BAAAP boundary, and in several wells located off-site towards the Wisconsin River. The highest CTET concentration detected during September 2010 was 75.9 µg/l in SWN-9103C. SWN-9103C is

located south of BAAAP along County Road Z. The highest CTET concentration, 23 µg/l, located on BAAAP was detected in PBN-8502A. CTET (below the PAL) is rarely detected in private wells located south of BAAAP.

Elevated levels of TCE (above the ES) are routinely detected in monitoring wells located both inside and outside of BAAAP. TCE has been detected at varying depths in the sand and gravel aquifer. The highest of the TCE detections are found south of the PBG Waste Pits. Elevated concentrations of TCE are found near the MIRM extraction wells, near the BAAAP boundary, and in several wells located off-site towards the Wisconsin River. The highest TCE concentration detected during September 2010 was 13.1 µg/l in SPN-8904C. SPN-8904C is located near the BAAAP boundary. The highest TCE concentration, 6.82 µg/l, located off-site was detected in PBN-9903C. TCE (below the PAL) is rarely detected in private wells located south of BAAAP.

Elevated concentrations of ethyl ether have only been detected near the BAAAP boundary. Only low concentrations of ethyl ether have been detected off-site. The highest ethyl ether concentration detected during October 2010 was 4,610 µg/l (above the ES) in PBN-1001C, located near an extraction well.

During the operation of the BEST system (source area remediation) from 2001 to 2005, elevated concentrations (over 1,000 µg/l) of DNT breakdown products, nitroanilines and aminonitrotoluenes, were routinely detected near the PBG Waste Pits. Since 2008, the DNT breakdown products have been tested in a variety of monitoring wells that are located adjacent to and downgradient of the PBG Waste Pits. DNT breakdown products have been detected in 15 different monitoring wells, all located on-site. Since March 2010, DNT breakdown products have only been detected in monitoring well PBM-0002, located between the former waste pits and extraction well SCW-2R. Based on the groundwater data collected to date, DNT degradation continues to occur near the PBG source area. Further information on DNT degradation is provided in Section 9.0 Monitored Natural Attenuation Evaluation.

SpecPro calculated a contaminant mass estimate for the CTET and total DNT groundwater contamination in the PBG plume. Assuming a porosity of 26 percent, the pore space volume was derived based on the dimensions of the plume. The plume dimensions were approximated by using the isoconcentration cross sections and maps contained in this report. This volume was multiplied by the average concentration within the plume and converted from cubic feet of liquid to pounds. The mass of the CTET within the plume is estimated to be 4,648 pounds. The mass of the total DNT within the plume is estimated to be 634 pounds. A summary of the input parameters is provided in Table 14.

DNT is known to readily adsorb to soil particles within a groundwater contaminant plume. Adsorption is the attraction between the outer surface of a soil particle (sand grain) and a contaminant. An organic contaminant may remain dissolved in water or adsorbed onto the soil organic carbon, depending on the total organic content (TOC) of the soil or the fraction of organic carbon in soil (foc). Retardation happens when the contaminant is adsorbed onto the soil. The distribution coefficient or soil-water portioning coefficient (Kd) for a contaminant is

used to determine the retardation factor of groundwater in soil. An important factor in this calculation is the soil adsorption coefficient or organic carbon soil-water partition coefficient (Koc). The distribution coefficient is calculated by multiplying the soil adsorption coefficient by the total organic carbon or Kd = Koc x TOC. A calculation of the Kd for 2,4-DNT is being provided. A USEPA published value for the Koc of 2,4-DNT (95.5 ml/g) was obtained from *Soil Screening Guidance: User's Guide* (1996). A TOC value (0.06%) was obtained from a soil sample collected, in August 2002 from beneath PBG Waste Pit 1 at a depth of 100 feet (approximately five above the water table). The boring was installed by Shaw Environmental, Inc. (*Biologically Enhanced Subsurface Treatment System – Soil Boring and Air Sparge Well Installation – Propellant Burning Ground, Badger Army Ammunition Plant, 2003)*. Kd for 2,4-DNT: Kd = 95.5 x 0.0006 = 0.0573 ml/g.

In order to evaluate plume dynamics, analytical data from select on-site and off-site wells were graphed over time. Concentration over time graphs are presented in Appendix B. Four contaminants of concern (CTET, chloroform, TCE and total DNT) were used for trend analysis. Generally, the VOC compounds showed similar characteristics in the PBG plume. In the on-site portion of the plume, the VOC compounds show a decreasing trend in both the shallow and deep wells. Concentration over time graphs for wells located on-site and in the center axis of the plume are provided for PBN-8205A, B, and C (1,540 feet downgradient of source), PBN-8501A, PBN-8901C, and PBN-8901D (2,520 feet downgradient of source), and PBN-8912A, PBN-8912B, PBN-9112C, and PBN-9112D (5,600 feet downgradient of source). As the plume extends off-site, the VOC compounds show a decreasing trend in the shallow wells and an increasing trend in the deeper wells. Based on groundwater elevations collected in nested monitoring wells, groundwater in the PBG plume exhibits a slight upward vertical gradient. One of the wells at the leading edge of the plume, screened within the D interval, shows a gradual increase up until 2009 followed by a steep increase over the past two years; however, other leading edge wells showed decreasing trends in recent years to below the PAL. Further details on trend analyses are provided below for each compound evaluated.

For CTET at the on-site plume axis, all wells show decreasing trends. For CTET at the off-site plume axis, wells PBN-9903A, B, C, and D show stable to decreasing trends, but an increasing trend in the deep well (D) since 2008. At the off-site west plume edge, both SWN-9102C and D show decreasing trends. The downgradient, off-site plume axis nested wells, SWN-9103B, C, D and E showed a decreasing trend in the shallow interval since 2004, an increasing trend in the C well since 2008, a stable trend in both the D and E wells. The downgradient, off-site plume axis wells, SWN-9104C and D show stable trends, and the plume leading edge well, PBM-9001D shows a gradual increase up until 2009 followed by a steep increase over the past two years. Three other nested leading edge wells (PBN-9102B, C and PBM-9002D showed decreasing CTET trends to below the PAL over the past year.

For chloroform at the on-site plume axis, all wells show decreasing trends. For chloroform at the off-site plume axis, wells PBN-9903A, B, and C show stable to decreasing trends, but an increasing trend in the deep well (PBN-9903D) since 2008. At the off-site west plume edge, both SWN-9102C and D show stable to decreasing trends with concentrations around the PAL. The downgradient, off-site plume axis nested wells, SWN-9104C and D show increasing trends,

but the concentrations remain below the PAL. Another well nest in this location (SWN-9103B, C, D, and E) showed a decreasing trend in the B well, an increasing trend in the C well, a decreasing trend in the D well since 2006 and a stable trend in the deep E well. The plume leading edge well, PBM-9001D showed a gradual increase up until 2009 followed by a steep increase over the past two years. Three other nested leading edge wells, PBN-9102B, C and PBM-9002D, showed decreasing chloroform trends since 2006 to below the PAL.

For TCE at the on-site plume axis, all wells show decreasing trends. For TCE at the off-site plume axis, nested wells PBN-9903A, B, C and D show stable to decreasing trends in the upper zones, but an unstable to increasing trend in the deeper wells. The downgradient, off-site plume axis nested wells, SWN-9103B, C, D and E showed a decreasing trend in the shallow interval since 2000, an increasing trend in the C well since 2009, a decreasing trend in the D well depth since 2007, and a stable trend in the deep E well. The plume leading edge well, PBM-9001D showed a gradual increase up until 2009 followed by a steep increase over the past two years.

Trend analysis for total DNT concentrations was difficult as concentrations showed variability from one sampling event to the next with no consistent trend. It should be noted that the DNT isomer concentrations were extremely low if detected at all.

6.2.2 Deterrent Burning Ground Plume

The DBG groundwater plume shown in Figure 18 represents the area where groundwater concentrations exceed a Chapter NR 140 PAL for either total DNT or 1,1,2-TCA. Only five DNT isomers (2,3-DNT, 2,4-DNT, 2,6-DNT, 3,4-DNT, and 3,5-DNT) have been detected in the DBG plume, mostly in the DBG source area. The plume boundary is an interpretation of the August, September, and October 2010 groundwater data collected from both monitoring wells and private wells. Tables 9, 10, and 11 summarize the groundwater analytical results from the August, September, and October 2010 monitoring well sampling events. Table 12 summarizes the groundwater analytical results from the August 2010 annual private well sampling event. Table 13 summarizes the groundwater analytical results from the September 2010 quarterly private well sampling event.

The horizontal distribution of total DNT is illustrated in Figures 31, 32, and 33. Isoconcentration boundaries in Figures 31 and 32 were prepared using groundwater data collected during September and October 2010. Figure 31 displays the horizontal extent of total DNT that is located above an elevation of 752 feet. Figure 32 displays the horizontal extent of total DNT that is located below an elevation of 752 feet. An elevation of 752 feet was chosen to help visualize the difference between the shallow and deeper zones of total DNT contamination in the sand and gravel aquifer. Total DNT concentrations are shown to be lower below an elevation of 752. Isoconcentration boundaries in Figure 33 were prepared using groundwater data collected during March 2007. Figure 33 displays the horizontal extent of total DNT in all monitoring wells and private wells. Based on a comparison between the 2007 and 2010 isoconcentration maps, the areal extent of the DNT in the DBG plume did not change.

Figure 6 shows the orientation of the contaminant plume isoconcentration cross sections for total DNT, which are illustrated in Figures 34 and 35. Total DNT was chosen for visual representation because it best represents the horizontal and vertical extents of the DNT plume.

Figure 34 (E-E') illustrates the estimated vertical extent of total DNT, along the centerline of the DBG plume, from the DBG (northwest) towards the Wisconsin River or Weigand's Bay (southeast). The total DNT concentrations are highest south of the DBG and in wells screened approximately 0 to 40 feet below the water table. The total DNT plume extends northwest to southeast from the DBG with an average thickness of 90 feet. Total DNT concentrations beneath the DBG (source area) are lower than what is found downgradient. Figure 34 supports the interpretation that the DNT plume is vertically distributed across the sand and gravel aquifer as it moves southward.

Figure 35 (F-F') illustrates the width and depth of the total DNT plume between 200 to 1,200 feet south of the DBG. The total DNT plume is estimated to be approximately 1,300 feet wide and a maximum depth of 55 feet below the water table in Figure 35 (F-F'), which is close to the source area.

The Puccio private well is shown on Figure 34 (E-E'). The Puccio private well was chosen based on its location along the cross section and an available well construction report. The majority of the private wells in the Weigand's Bay area (downgradient of the DBG plume) are screened in the sand and gravel aquifer along with a few bedrock wells. Based on the depth and location of these private wells in relation to the DNT plume and the historic groundwater monitoring data results, the private wells are not drawing their water from the DNT plume.

DNT is routinely detected in monitoring wells located near the DBG. DNT has been detected at varying depths in the sand and gravel aquifer. The highest total DNT concentration detected during September 2010 was 5.982 µg/l in ELM-8901. ELM-8901 is located 650 feet east of the DBG. DNT has migrated downgradient from the DBG, east and southeast, and has been detected in several monitoring wells located on the BAAAP boundary. Since 2003, DNT is routinely detected in the ELM-9501 well nest, consisting of ELM-9501, ELN-0801B, ELN-0801C, and ELN-0801E.

Detections of DNT have been sporadic in private wells located southeast of BAAAP (Weigand's Bay area). During July 2009, two private wells (Curto and Nowotarski) had DNT detections that were below the Chapter NR 140 ES. Since 2009, these two private wells have been quarterly sampled and DNT has not been detected again. Results from the August 2010 sampling of 21 private wells located in the Weigand's Bay area, found that DNT was not detected (see Table 12).

Elevated levels of 1,1,2-TCA, between the PAL and ES, are routinely detected in one monitoring well (ELN-8203B) located east of the DBG. The concentration of 1,1,2-TCA in ELN-8203B was 1.12 µg/l in September 2010. 1,1,2-TCA is detected in several other monitoring wells but below the PAL. Since August 2009, 1,1,2-TCA has been routinely detected (below the PAL) in a private well located east of BAAAP.

In 2009, additional investigation work was conducted southeast of the DBG to delineate the downgradient extent of the DBG plume. Groundwater samples were collected from 12 temporary soil borings. The investigation defined the extent of the DNT and VOC plume. The data indicated that DNT had migrated outside the BAAAP boundary. The results from this investigation were used to determine the best placement of permanent monitoring wells in the area. Further information on this investigation is presented in the *Northeast Boundary Groundwater Investigation Report* (SpecPro, Inc., December 2009).

During 2010, 11 monitoring wells were installed downgradient of the ELM-9501 well nest. These wells were intended to monitor any off-site migration of DNT and VOCs. DNT was not detected in these 11 monitoring wells. The low 1,1,1-TCA concentrations found in ELN-1003B and ELN-1003C are well below the PAL. Because 1,1,1-TCA has also been consistently detected in upgradient wells near the DBG, the DBG is a likely source of these off-site 1,1,1-TCA detections. Table 9 summarizes the groundwater analytical results from the August 2010 well sampling event. Further information on the monitoring well installation is presented in the *Northeast Boundary Monitoring Well Installation Report* (SpecPro, Inc., September 2010).

Between 1998 and 2005, the DNT breakdown product 2-nitroaniline was routinely detected, concentrations up to 32.4 µg/l, near the DBG source area. Since 2008, groundwater samples from monitoring wells located adjacent to the DBG source area have been tested semiannually for the breakdown products of DNT. Since 2008, both nitroanilines and aminonitrotoluenes have not been detected in wells adjacent to the DBG source area. Based on the groundwater data collected to date, DNT degradation was occurring prior to 2006 near the DBG source area. Additional information on DNT degradation is found in section 9.0 Monitored Natural Attenuation Evaluation.

SpecPro calculated a contaminant mass estimate for the total DNT contamination in the DBG plume. Assuming a porosity of 26 percent, the pore space volume was derived based on the dimensions of the plume. This volume was multiplied by the average concentration within the plume and converted from cubic feet of liquid to pounds. The total mass of the total DNT within the plume is 75.3 pounds. A summary of the input parameters is provided in Table 15.

In order to evaluate contaminant trend data for the DBG plume, SpecPro selected wells within the plume and graphed the concentration over time. Graphs showing DBG plume contaminant concentration over time are presented in Appendix B. The primary contaminant of concern in the DBG plume is DNT; therefore, concentrations of total DNT were evaluated. In the source area, data from wells DBM-8201 and 8202 were graphed. Well DBM-8201 shows a generally stable trend with some periods of elevated concentrations. Well DBM-8202 shows a spike in 2003 followed by a stable to decreasing trend. At the center of the DBG plume, data from wells ELM-8907 and ELM-8908 were graphed. ELM-8907 showed a generally stable trend followed by an increase since 2008. ELM-8908 showed variability up to 2007 followed by a steadily decreasing trend. Data from four wells (ELM-9501, ELN-0801B, ELN-0801C, and ELN-0801E) were used to evaluate the downgradient portion of the plume. ELM-9501 and ELN-

0801E demonstrated stable trends since 2009. Wells ELN-0801B and C showed a steady decrease in total DNT concentrations since 2008.

6.2.3 Central Plume

The Central groundwater plume shown in Figure 18 represents the area where groundwater concentrations exceed a Chapter NR 140 PAL for total DNT. Only 2,4-DNT and 2,6-DNT have been detected in either monitoring wells or private wells in the Central Plume. The plume boundary is an interpretation of the September and October 2010 groundwater data collected from both monitoring wells and private wells. DNT has been detected at shallow depths in the sand and gravel aquifer. The highest total DNT concentration detected during October 2010 was 0.061 µg/l in RIN-1004B. RIN-1004B is located between the USDA 6 well and the Water's Edge Subdivision (see Figures 15 and 16). Tables 10 and 11 summarize the groundwater analytical results from the September and October 2010 monitoring well sampling events. Table 13 summarizes the groundwater analytical results from the September 2010 quarterly private well sampling event.

The horizontal distribution of total DNT is illustrated in Figure 36. This isoconcentration map was prepared using groundwater data collected during September and October 2010. The isoconcentration map could not be broken into two vertical zones because fewer wells have been installed in the Central Plume. The elevated concentrations of DNT (above 0.05 µg/l) are located approximately 7,500 feet downgradient of the potential source area. Because the total DNT in the northern section of the plume (source area) is depleted, it appears there was not a continuous source of contamination.

Figure 6 shows the orientation of the contaminant plume isoconcentration cross for total DNT, which is illustrated in Figure 37. Total DNT was chosen for visual representation because it best represents the horizontal and vertical extents of the DNT plume.

Figure 37 (G-G') illustrates the estimated vertical extent of total DNT, along the centerline of the Central Plume, as it migrates towards the Wisconsin River Reservoir. The total DNT concentrations are highest near the BAAAP boundary and in wells screened approximately 0 to 40 feet below the water table. The total DNT plume extends from the north to the south with an average thickness of 90 feet. Figure 37 indicates that the highest concentrations of DNT are located in the upper portions of the sand and gravel aquifer and downgradient of the potential source area.

The WE-UK125 private well is shown on Figure 37 (G-G'). The WE-UK125 private well was chosen based on its location along the cross section. The WE-UK125 private well is screened in the bedrock aquifer, but the majority of the private wells in the Central Plume area are screened in the sand and gravel aquifer. Many of the private wells located in the Water's Edge Subdivision are screened at the same depth (100 feet) that the DNT plume occurs and are at risk.

In 2004, DNT was first detected within private wells located in the Water's Edge Subdivision, along the north shore of Gruber's Grove Bay (see Figure 16). The 2,6-DNT concentration in two

private wells exceeded the Chapter NR 140 ES. In 2005, the Army replaced the WE-RM385 and WE-RR541 private wells with WE-SQ017 and WE-SQ001, respectively. The WE-RM385 private well was screened from 96 to 99 feet bgs or 694 to 697 feet MSL. The WE-RR541 private well was screened from 97 to 100 feet bgs or 692 to 695 feet MSL. The new WE-SQ017 and WE-SQ001 private wells are screened from 615 to 618 feet MSL and 613 to 616 feet MSL, respectively. The location of the former private wells (WE-RM385 and WE-RR541) and replacement private wells (WE-SQ017 and WE-SQ001) on Figure 37 would be between SEN-0503A,B,D and WE-UK125.

In 2005, the Army installed eight monitoring wells in the Water's Edge Subdivision to monitor the groundwater quality. Sampling results indicate that 2,6-DNT has been present above the Chapter NR 140 ES at two of these monitoring wells (SEN-0501B and SEN-0503B). It should be noted that during 2005 the former private well WE-RR541 was converted to monitoring well SEN-0502B. This monitoring well was located in a homeowner's lawn who requested that it be abandoned. On September 15, 2010, Harlan Kuehling of the WDNR granted approval to abandon monitoring well SEN-0502B without replacing it.

In 2006, the USDA installed a well (USDA 6) at BAAAP. The well is located approximately 4,300 feet upgradient of the Water's Edge Subdivision. 2,6-DNT is routinely found above the Chapter NR 140 ES in the USDA 6 well. The Army has sampled existing monitoring wells at BAAAP and installed additional monitoring wells to define the DNT groundwater plume. Results from these additional wells indicate the source of DNT groundwater contamination is located north of the Rocket Production area in BAAAP. The source of the Central Plume is suspected to be related to production waste water, which was discharged to open ditches in the Rocket Production area. Although the soil in this area has been thoroughly investigated, no clearly identifiable source has been found.

SpecPro calculated a contaminant mass estimate for the total DNT contamination in the Central Plume. Assuming a porosity of 26 percent, the pore space volume was derived based on the dimensions of the plume. This volume was multiplied by the average concentration within the plume and converted from cubic feet of liquid to pounds. The total mass of the total DNT within the plume is estimated to be 24.5 pounds. A summary of the input parameters is provided in Table 15.

In order to evaluate contaminant trend data for the Central Plume, SpecPro selected wells within the plume and graphed the concentration over time. Concentration over time graphs are provided in Appendix B. The primary contaminant of concern in the Central Plume is DNT; therefore, concentrations of total DNT were evaluated. There was not enough data to establish any trends from the upgradient portion of the plume; however, the downgradient portion contained several wells with sufficient data to support trend analyses. All the wells selected (USDA 6, SEN-0501A, B, D, SEN-0502B, and SEN-0503A, B, D) showed stable to decreasing trends at the downgradient, leading edge of the plume. This indicates that the Central Plume is receding or decreasing in concentration.

7.0 CONCEPTUAL SITE MODEL

In order to more fully understand the relationships between contaminants, affected environmental media, exposure pathways, and human and ecological receptors, a CSM was developed. A CSM is a conceptual understanding of a site that identifies suspected sources of hazardous substances, types, and concentrations of hazardous substances, potentially contaminated media, and actual and potential exposure pathways and receptors. Figure 38 shows a CSM based on the known presence and transport of COCs.

7.1 Current and Potential Land Uses

The BAAAP is a former munitions components production facility undergoing demolition, investigation, and remediation activities. The property under Department of Defense ownership has an active security, administration, environmental, maintenance, and demolition workforce. Army staff manage all aspects of ongoing work. Currently, a portion of the installation is off limits to the public and is secured by a security fence.

Future use of the former BAAAP will be divided between the USDA, Wisconsin Department of Transportation (WDOT), United States Department of Health Services on behalf of the BSD, Town of Sumpter, and the National Park Service (NPS) on behalf of the WDNR. The installation will serve as agricultural and grazing land (USDA), recreational land (NPS/WDNR), cemeteries (Town of Sumpter), and as a wastewater treatment plant (BSD).

7.2 Sources of Contamination

On-Site Sources

Sources of groundwater contamination include the PBG, DBG, and the Central Plume source areas. Figure 1 shows the locations of these source areas and Figure 6 shows groundwater contaminant plumes. DNT and chlorinated solvents are known to have been disposed in the PBG and DBG source areas. WDNR-approved remedial actions relating to soil contamination at the PBG and DBG source areas have been implemented. The source of the Central Plume contamination is generally located based on groundwater flow direction and the groundwater contaminant detections. DNT contaminated groundwater is believed to be from the north-central portion of BAAAP where rocket paste and rocket propellant were produced. It is believed general production operations in this area caused the groundwater impacts.

Off-Site Sources

Nitrates from non-point sources that are outside of Army control are known to affect groundwater in and around BAAAP. The WDNR has a best management practice program it administers for these agricultural and grazing-related sources.

An unknown source of TCE has been detected in monitoring well BGM-9103, on the west-central boundary of BAAAP. Based on the groundwater flow direction, the source of TCE appears to be located off-site (northwest of BGM-9103).

7.3 Environmental Medium and Exposure Points

Groundwater is the environmental medium of concern at the BAAAP. Both the shallow unconsolidated and deeper bedrock groundwater aquifers are sources of potable water in residential communities downgradient (south and east) of the installation boundaries. In addition, groundwater discharges into the Lake Wisconsin/Lower Wisconsin River area.

7.4 Exposure Pathways and Receptors

Workers involved with groundwater remediation, investigation, actions, and monitoring are subject to some level of risk when working at the BAAAP. Worker safety is currently managed through a health and safety program that complies with all Occupational Safety and Health Administration (OSHA), Department of Defense, and other state and federal health and safety requirements; therefore, this exposure route is not currently a risk or regulatory concern.

The potential exists for VOCs present in the groundwater plumes to migrate vertically in the unsaturated soil column. According to the WDNR's vapor intrusion guidance (2010), light end petroleum compounds and chlorinated VOCs are most likely to create a vapor intrusion problem. DNT is not a risk for vapor intrusion because it has a low vapor pressure and is a SVOC. A vapor intrusion pathway screening will be conducted by the Army for the groundwater contamination originating from BAAAP. The vapor migration pathway will be addressed separately from the determination of a final groundwater remedy.

During December 2007, six temporary wells were installed between the east boundary of BAAAP and Weigand's Bay. The investigated area was located downgradient of the DBG plume. Investigation results were presented at the January 9, 2008 Environmental Restoration Advisory Board meeting and summarized in the meeting minutes (Army, 2008). Four of the six temporary wells were located within 200 feet of either Weigand's Bay, a pond, or a wetland. The temporary wells were installed so that the screen intersected the groundwater surface (between 5 to 22 feet deep). Groundwater samples were collected from each temporary well and laboratory analyzed for DNT and VOCs. One sample had a very low detection of toluene, otherwise no VOCs were detected in the temporary wells. DNT was not detected in the temporary wells. The 2,4-DNT limit of detection of 0.01 µg/l was well below the NR 105.08 Table 9 concentration of 13 µg/l. In addition, a surface water sample collected in April 2007 from Weigand's Bay did not have any detects for 2,4- or 2,6-DNT. The 2,4-DNT limit of detection of 0.9 µg/l was well below the NR 105.08 Table 9 concentration of 13 µg/l. Therefore, no impacts to wetlands or the Wisconsin River is anticipated.

As shown in Figures 23, 28, and 37, the groundwater associated with the Central and PBG Plumes are located below and hydrogeologically isolated from overlying ponds and potential wetlands. In addition, as stated in Section 8.3 of this report, chronic exposure to 2,4-DNT at 13

µg/l and 1,1,1-TCA at 270,000 µg/l have been shown to have no adverse effect due to human ingestion of surface water and organisms. The maximum value of 2,4-DNT found off-site in 2010 was 0.02 µg/l, or less than 1% of the permissible surface water quality criteria and 1,1,1-TCA was not found above detectible levels off-site in 2009. Therefore, no impacts to wetlands or the Wisconsin River is anticipated.

The general public is subject to some level of risk through recreational use of the Lake Wisconsin/Lower Wisconsin River. VOCs and SVOCs do not bioaccumulate in organisms. For this reason, consumption of fish from Lake Wisconsin or the Lower Wisconsin River way is identified as a pathway of no regulatory concern. In addition, a comparison of National Recommended Water Quality Criteria, developed to protect aquatic life from acute and chronic health effects, shows all surface water criteria are much higher than the groundwater concentrations off-site. Therefore, exposure through surface water is currently not a risk or regulatory concern. For more information on National Recommended Aquatic Life Values, refer to United States Environmental Protection Agency publication *2009 National Recommended Water Quality Criteria* available at http://www.epa.gov/ost/criteria/wqctable/.

Groundwater used for private drinking water has been a concern of residents nearby BAAAP. The Army currently has an environmental monitoring and health protection program in place that is protective of the private water well users. If a Chapter NR 140 ES is exceeded in a private well in two consecutive sampling rounds, bottled water is made available to the occupant. If the exceedances continue, well replacement is offered to the owner. To date, the Army has replaced five shallow private wells with deeper aquifer private wells. However, this exposure route continues to be a potential risk and regulatory concern.

According to the Wisconsin Department of Health and Family Services (WDHFS), DNT has a number of known toxic effects on the health of both people and animals, but these harmful effects occur at levels that are many times higher than the levels found in private well water near BAAAP (ATSDR, 2006).

The former DuPont Barksdale Works in Barksdale, Wisconsin was an explosives manufacturing plant where groundwater has been impacted with DNT and chlorinated solvents. The highest level of combined DNT isomers (2,4 and 2,6-DNT) that has been found in any private well near the former DuPont Barksdale Works was 3.5 µg/l. Based on the Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk level (MRL) and EPA reference dose (RfD), drinking water over a long term with the highest level of DNT is not expected to result in a non-cancer health effect (ATSDR, 2002).

There are irrigation wells located in the off-site portion of the PBG plume. However, the WDNR has not required monitoring of the irrigation wells.

8.0 REGULATORY REQUIREMENTS

Under Section NR 722.09(2), Wis. Adm. Code, *Standard for Selecting Remedial Actions*, responsible parties shall select a remedial action...(that shall) comply with all applicable state and

federal public health and environmental laws and standards. The following subsections outline the regulations applicable and relevant to the groundwater plumes at BAAAP.

8.1 Wisconsin Spill Statute

Wisconsin Spill Statute 292.11 (3) states, "A person who possesses or controls a hazardous substance which is discharged or who causes the discharge of a hazardous substance shall take the actions necessary to restore the environment to the extent practicable and minimize the harmful effects from the discharge to the air, lands, or waters of this state." The Army has met the requirement of restoring the environment to the extent practicable and minimizing the harmful effects by the remediation of the soil in the source areas and the installation and operation of the IRM/MIRM groundwater treatment system for the past 20 years.

8.2 Groundwater Quality Regulations

Chapter NR 140 establishes ESs and PALs for groundwater beneath the State of Wisconsin. The Wisconsin groundwater ES is consistent with federal and Wisconsin drinking water Maximum Contaminant Levels (MCLs), which applies to public water systems.

Enforcement Standards

The groundwater ESs are protective of public health and welfare on the premise that the groundwater may be ingested through use as drinking water. ESs exist for all the groundwater VOC and SVOC COCs listed in Table 16. All ESs are Public Health Groundwater Quality Standards listed in Table 1 at Section NR 140.10, Wis. Adm. Code, except sulfate, which is a Public Welfare Groundwater Quality Standard listed in Table 2 at Section NR 140.12, Wis. Adm. Code.

Preventive Action Limits

The PALs serve "to inform the WDNR of potential groundwater contamination problems (and to) establish the level of groundwater contamination at which the WDNR is required to commence efforts to control the contamination". PALs exist for all the groundwater COCs listed in Table 13. All PALs are Public Health Groundwater Quality Standards listed in Table 1 of Section NR 140.10, Wis. Adm. Code, except sulfate, which is a Public Welfare Groundwater Quality Standard listed in Table 2 in Section NR 140.12, Wis. Adm. Code.

Action Required for Exceedance of an ES or a PAL

Actions required by a groundwater ES exceedance are codified in Section NR 140.26, Wis. Adm. Code (Table 6). The regulation lists eight responses appropriate to the detection of an ES exceedance. They are as follows:

1. Require a revision of the operational procedures at a facility, practice or activity.
2. Require a change in the design or construction of the facility, practice or activity.

3. Require an alternate method of waste treatment or disposal.
4. Require prohibition or closure and abandonment of a facility, practice or activity.
5. Require remedial action to renovate or restore groundwater quality.
6. Require remedial action to prevent or minimize the further release of the substance to groundwater.
7. Revise rules or criteria on facility design, location or management practices.
8. Require the collection and evaluation of data to determine whether natural attenuation can be effective to restore groundwater quality within a reasonable period of time, considering applicable criteria specified in ss. NR 140.24, 722.07 and 722.09 or 722.11, and require monitoring to determine whether or not natural attenuation is occurring in compliance with the requirements of s. NR 140.26(2)(a).

The Army has completed or has in place action specific steps 1 through 7 and will evaluate action step 8 more thoroughly during this AFS.

Section NR 140.24, Wis. Adm. Code, (Table 5) lists 12 responses appropriate to the detection of a PAL exceedance. They are as follows:

1. No action pursuant to s. NR 140.24(5) and consistent with s. 160.23, Stats.
2. Require the installation and sampling of groundwater monitoring wells.
3. Require a change in the monitoring program, including increased monitoring.
4. Require an investigation of the extent of groundwater contamination.
5. Require a revision of the operational procedures at the facility, practice or activity.
6. Require a change in the design or construction of the facility, practice or activity.
7. Require an alternate method of waste treatment or disposal.
8. Require prohibition or closure and abandonment of a facility, practice or activity in accordance with sub. (6).
9. Require remedial action to renovate or restore groundwater.
10. Require remedial action to prevent or minimize the further discharge or release of the substance to groundwater.
11. Revise rules or criteria on facility design, location or management practices.
12. Require the collection and evaluation of data to determine whether natural attenuation can be effective to restore groundwater quality within a reasonable period of time, considering applicable criteria specified in ss. NR 140.24, 722.07 and 722.09 or 722.11, and require monitoring to determine whether or not natural attenuation is occurring in compliance with the requirements of s. NR 140.26(2)(a).

The Army has completed or has in place action specific steps 1 through 11 and will evaluate action step 12 more thoroughly during this AFS.

8.3 Wisconsin Water Quality Standards and Criteria

The Wisconsin Water Quality Standards and Criteria requirements are applicable to existing and proposed point source discharges to surface waters of the state that may be associated with the final groundwater remedy. Two downgradient surface water bodies are in the area: the Lake Wisconsin Reservoir (above the WP&L dam) and the Lower Wisconsin River (below the WP&L dam).

The designated use for the Lake Wisconsin Reservoir is defined as "warm water sport fish community" in Section NR 102.13, Wis. Adm. Code. The use classification for the Lower Wisconsin River, below the WP&L dam to Prairie du Chien, is "Exceptional Resource Water" in Section NR 102.11, Wis. Adm. Code.

Water Surface Quality Criteria have been developed in Wisconsin as "Human Threshold Criteria" for 2,4-DNT and 1,1,1-TCA. Wisconsin "Human Cancer Criteria" have been developed for the following: CTET, chloroform, 2,4-DNT, 1,1,2–TCA, and TCE.

Wisconsin Human Threshold Criteria

The human threshold criterion (HTC) is the maximum concentration of a substance established to protect humans from adverse effects resulting from contact with or ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state. Human threshold criteria are derived for those toxic substances for which a threshold dosage or concentration can be estimated below which no adverse effect or response is likely to occur (Section NR 105.08, Wis. Adm. Code). Currently, HTC-Non-Public Water System (NPWS) have been developed in Wisconsin for two relevant COCs: 2,4-DNT and 1,1,1-TCA.

Chronic exposure to 2,4-DNT at 13 µg/l has been shown to have no adverse effect due to human ingestion of surface water and organisms. The maximum value of 2,4-DNT found in off-site wells (monitoring or residential well) in 2010 was 0.02 µg/l, or less than 1% of the permissible HTC-NPWS criteria.

Chronic exposure to 1,1,1-TCA at 270,000 µg/l has been shown to have no adverse effect due to ingestion of surface water and organisms. 1,1,1-TCA was not found above detectible levels in any off-site wells in 2009.

Wisconsin Human Cancer Criteria

The human cancer criterion (HCC) is the maximum concentration of a substance or mixture of substances established to protect humans from an unreasonable incremental risk of cancer resulting from contact with or ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state over a lifetime of 70 years (Section NR 105.09, Wis. Adm. Code). Currently, HCC- NPWS have been developed in Wisconsin for five relevant COCs: CTET, chloroform, 2,4-DNT, 1,1,2–TCA, and TCE.

Chronic exposure to chloroform at 1,960 µg/l, 2,4-DNT at 13 µg/l, 1,1,2-TCA at 195 µg/l, and TCE at 539 µg/l has been shown to have no unreasonable incremental risk of cancer due to ingestion of surface water and organisms. The maximum concentrations detected in off-site monitoring wells during 2010 were: chloroform at 6.64 µg/l (SWN-9103C), 2,4-DNT at 0.018 µg/l (SWN-9103B), and TCE at 4.85µg/l (PBM-9001D). 1,1,2-TCA was not detected. All these concentrations are significantly less than their chronic exposure criteria.

Chronic exposure to CTET at 29 µg/l has been shown to have no unreasonable incremental risk of cancer due to ingestion of surface water and organisms. The maximum concentration detected in an off-site monitoring well during 2010 was 90.1 µg/l in SWN-9103C. SWN-9103C is located approximately 3,200 feet northwest of the Wisconsin River. Monitoring well PBN-9101C is located further downgradient and only 1,400 feet west of the Wisconsin River. PBN-9101C is not routinely sampled and was not sampled during 2010. PBN-9101C was recently sampled on September 14, 2011 and had a CTET concentration of 37.7 µg/l. Both SWN-9103C and PBN-9101C had CTET concentrations above the chronic exposure criteria. Because these results are from groundwater samples collected from monitoring wells that are located over 1,400 feet from the Wisconsin River, it is difficult to extrapolate what the actual concentrations are at the point of reaching the surface water. Significant dilution and degradation (exposure to sunlight) is likely occurring in the groundwater/surface water mixing zone, thus reducing concentrations and potential exposure risk to humans and/or organisms.

Numerous studies or tests have been conducted throughout the years in which surface water samples have been collected and analyzed. These studies include Gruber's Grove Bay investigations conducted by Shaw Environmental, Inc. and an April 2007 Weigand's Bay water sample, the December 2007 shallow temporary well water samples (adjacent to Weigand's Bay), and the annual WPDES Whole Effluent Toxicity Monitoring (background samples collected near Inspiration Point and Weigand's Bay) conducted by SpecPro, Inc. None of the surface water samples collected during these studies showed evidence of contaminants of concern. Based on the data from these investigations and applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors.

9.0 MONITORED NATURAL ATTENUATION EVALUATION

Because monitored natural attenuation (MNA) is proposed as an element of all the suggested remedial options, an evaluation is being provided to illustrate that MNA has a probability of restoring the groundwater to Chapter NR 140 standards within a reasonable amount of time.

Overview of Monitored Natural Attenuation

MNA relies on natural attenuation processes to achieve remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. These natural attenuation processes include a variety of physical, chemical, or biological processes that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater. These in-situ processes include biodegradation, dispersion,

dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.

Natural attenuation processes typically occur at all sites, but to varying degrees of effectiveness depending on the types and concentrations of contaminants present and the physical, chemical, and biological characteristics of the soil and groundwater. Natural attenuation processes may reduce the potential risk posed by site contaminants in three ways: (1) Transformation of contaminant(s) to a less toxic form through destructive processes such as biodegradation or abiotic transformations; (2) Reduction of contaminant concentrations whereby potential exposure levels may be reduced; and (3) Reduction of contaminant mobility and bioavailability through sorption onto the soil or rock matrix.

According to the USEPA (OSWER Directive 9200.4-17P), MNA can be considered to be an alternative means of achieving remediation objectives that may be appropriate for specific site circumstances where its use meets the applicable statutory and regulatory requirements. As there is often a variety of methods available for achieving remediation objectives at any given site, MNA may be evaluated and compared to other viable remediation methods. As proposed in this AFS, MNA is one component of the total remedy. It is used in conjunction with other remedies as a follow-up measure that will be monitored and compared with expectations.

MNA has several potential advantages and disadvantages, and these factors should be carefully considered before selecting MNA as part of a remedial alternative. Potential advantages of MNA include:

- Some natural attenuation processes may result in in-situ destruction of contaminants;
- Less intrusion as few surface structures are required;
- Potential for application to all or part of a given site, depending on site conditions and remediation objectives;
- Use in conjunction with, or as a follow-up to, other (active) remedial measures; and
- Potentially lower overall remediation costs than those associated with active remediation.

The potential disadvantages of MNA include:

- Longer time frames may be required to achieve remediation objectives, compared to active remediation measures at a given site;
- Site characterization can be more complex and costly;
- Long-term performance monitoring will be required;
- Institutional controls may be necessary to ensure long term protectiveness;

- Potential exists for contaminant migration, and/or cross-media transfer of contaminants;

- Degradation to more toxic daughter products.

The regulatory and policy frameworks for corrective actions under the RCRA program have been established to implement their respective statutory mandates and to promote the selection of technically defensible, consistent, and cost effective solutions for the cleanup of contaminated media. The WDNR and EPA recognize MNA may be an appropriate remediation option for contaminated soil and groundwater under certain circumstances.

Site-Specific Monitored Natural Attenuation Information

The determination of whether MNA is an appropriate remedy for groundwater is based on the following:

- *Are the contaminants present in the groundwater being effectively remediated by natural attenuation processes?* Based on field geochemistry data collected from monitoring wells, aerobic conditions exist in the groundwater in the DBG, Central, and PBG Plumes. Studies investigating natural attenuation in the PBG plume at BAAAP provide evidence that DNT and VOCs are naturally attenuating in the subsurface. Nishino and Spain (2001) state there is evidence to suggest that natural attenuation of DNT is taking place at BAAAP. The *Draft Technical Report Natural Attenuation Screening Study for the Propellant Burning Ground* (Stone & Webster, August 1999) states that biological degradation of DNT was clearly demonstrated under the oxidative conditions that exist in the subsurface, but other processes are reducing the VOC contaminant mass based on the concentrations of chlorinated solvents in the groundwater, which generally decrease over both distance from the source area and over time.

  Historical groundwater data demonstrate MNA is already restoring, by means of biodegradation, dispersion, dilution, and sorption, groundwater within the DBG and Central Plumes. Appendix B presents graphs showing the DBG plume contaminant concentration over time. These graphs show the decrease in DNT concentrations, since the installation of the DBG cap, both over time and away from the source. The graphs also show the relative stability of the plume over the last two years. A generalized summation of groundwater analytical data findings relating to the DBG plume is shown below.

Monitoring Well	Distance from Source Area (feet)	Date Sampled	Total DNT
DBM-8202	25	12/03 09/10	70.9 0.972
DBM-8201	140	12/03 09/10	7.89 2.2
ELM-8908	1,080	09/03 09/10	1.99 1.466
ELM-8907	1,525	09/03 09/10	0.13 2.356

Note: All results expressed in micrograms per liter (µg/l)

DNT concentration over time graphs for four wells located in the Central Plume (USDA 6, SEN-0501B, SEN-0502B, and SEN-0503B) show stable to slightly decreasing trends at the downgradient, leading edge of the plume. Appendix B presents graphs showing the Central Plume contaminant concentrations over time. A generalized summation of groundwater analytical data findings relating to the Central Plume is shown below.

Monitoring Well	Distance from Source Area (feet)	Date Sampled	Total DNT
USDA 6	9,500	10/06 09/10	0.056 0.041
SEN-0503B	14,000	09/06 09/10	0.062 0.049
SEN-0502B	14,400	09/06 09/10	0.056 0.039
SEN-0501B	14,800	09/06 09/10	0.049 0.024

Note: All results expressed in micrograms per liter (µg/l)

The distribution of CTET in the portion of the PBG plume located off-site has not increased in width between 1993 and 2010 (see Figure 22).
During a 1999 natural attenuation screening study conducted by Stone & Webster (1999), it was determined that anaerobic biodegradation (reductive dechlorination) was unlikely occurring downgradient of the PBG source area. During December 1998, Stone & Webster collected groundwater samples from 38 monitoring wells located within or near the PBG plume. Wells were chosen upgradient of the source area, in the source area, and downgradient of the source area. The samples were analyzed for VOCs, DNT, and SVOCs. The samples were also analyzed for the following geochemical parameters: chloride, dissolved oxygen, iron II, methane, nitrate, nitrite, oxidation reduction potential (ORP), pH, sulfate, sulfide, temperature, total dissolved solids, and total organic carbon. Based on the data collected in 1998 and the historical groundwater monitoring data, there has been no evidence to suggest that reductive dechlorination has occurred in the PBG plume over the past 14 years. The PBG plume is a well-oxygenated groundwater system with little or no organic matter. According to T. H. Wiedemeier & Associates (Wiedemeier, 2004), the most significant natural attenuation processes (chlorinated solvents) for this type of oxygenated plume environment are likely dilution, dispersion, sorption, and volatilization. Wiedemeier (2004) also states that plume stabilization can occur with or without destructive attenuation mechanisms.

Stone & Webster also documented that CTET, Chloroform, and TCE concentrations dropped between 1990 and 1998 in six monitoring wells that are located along the axis of the PBG plume (PBN-8910A, PBN-8205A, PBN-8501A, PBN-8504A, PBN-8912B, and SPN-8903B). A generalized summation of the Stone & Webster groundwater analytical data findings is shown below.

Monitoring Well	Distance from Source Area (feet)	Date Sampled	Carbon Tetrachloride	Chloroform	Trichloroethylene
PBN-8910A	700	03/90	31.0	5.6	103.0
		12/98	11.0	1.6	48.0
PBN-8205A	1,540	03/90	88.0	5.5	112.0
		12/98	42.0	2.6	41.0
PBN-8501A	2,520	03/90	43.0	14.0	30.0
		12/98	17.0	3.3	20.0
PBN-8504A	3,920	03/91	21.0	6.9	11.0
		12/98	0.8	<0.2	<0.2
PBN-8912B	5,600	03/90	51.0	7.8	20.0
		12/98	<0.4	<0.2	<0.2
SPN-8903B	7,000	03/90	130.0	11.0	<5.0
		12/98	24.0	2.1	1.3

Note: All results expressed in micrograms per liter (µg/l)

Shown on Figure 15 are locations of these six monitoring wells in relation to the existing and former IRM and MIRM extraction wells. Even though the four IRM wells (BCW-1, BCW-2, BCW-3, and SCW-1) were running from 1990 to 1998, they were only pumping a combined 350 gpm. Four of the six monitoring wells were isolated from the IRM wells and therefore not influenced by their pumping. The MIRM became operational in 1996 with six boundary extraction wells (EW-161, EW-162, EW-163, EW-164, EW-165, and EW-166) pumping a combined 3,000 gpm. Five of the six monitoring wells were isolated (located far north) from the MIRM wells and therefore not influenced by their pumping. Shown in the above summary table are reductions in VOCs that clearly indicate that the PBG plume was undergoing natural attenuation during the 1990s.

Concentration over time graphs for monitoring wells PBN-8205A, B, and C, PBN-8501A, PBN-8901C, and PBN-8901D, and PBN-8912A, PBN-8912B, PBN-9112C, and PBN-9112D are provided in Appendix B. These wells are located south of the existing IRM wells and north of the original MIRM wells. These wells were not influenced by pumping operations until the MIRM was realigned in 2005 (noted on each graph). CTET, Chloroform, and TCE concentrations for all nine monitoring wells show decreasing trends.

Based on the historic groundwater data, MNA has a reasonable probability of bringing the groundwater into compliance with Chapter NR 140 groundwater quality standards within a reasonable period of time.

- *Are the contaminant plumes stable and does the potential exist for the environmental conditions that influence plume stability to change over time?* The contaminant sources of the PBG and DBG groundwater plumes have undergone active remediation (bioremediation, soil vapor extraction, passive venting, soil flushing, capping, and/or pump and treat) thereby greatly reducing the source loading on the plumes. Investigations relating to the Central Plume have not determined a specific source of DNT contamination; however, it is believed that production wastewater released to ditches across the broad

production area may have caused the groundwater impacts. Reduction/removal of the source loadings for these groundwater contaminant plumes have resulted in relatively stable plumes, which should remain stable over time. Although fluctuations in the concentrations of contaminants within the plumes occur, in general, the overall concentrations decrease over both distance from the source area and over time. In addition, the lateral extents of the three contaminant plumes are stable, and there are no potential conditions that would change this.

- *Could human health, drinking water supplies, other groundwater, surface waters, ecosystems, sediments, air, or other environmental resources be adversely impacted as a consequence of selecting MNA as the remediation option?* Natural attenuation of all three plumes is already occurring and has been for many years. Even with the potential shut down of the IRM/MIRM, continuing to allow natural attenuation to occur will not result in any adverse impacts to the environment beyond what currently exist. With the implementation of a public water system in the remedy zone, the human health exposure pathway would be eliminated.

- *Could the current and projected demand for the affected resource over the time period that the remedy will remain in effect change?* Transfer of BAAAP to other owners is not expected to increase groundwater usage within the installation boundary. Additional residential development outside the installation boundary is not expected to increase groundwater use as any new development within the affected zone would be required to hook up to the public water supply. Abandonment of private wells for inclusion in a municipal water system would decrease demand on the groundwater in the area of the remedy. The resulting reduced drawdown after private well abandonment is not anticipated to significantly affect plume dynamics or conditions.

- *Will the contamination exert a long-term detrimental impact on available water supplies or other environmental resources?* No, not as long as the public water supply is available with the water resources located away from the plume areas. The groundwater can still be used for agricultural purposes. No other environmental resources would be affected.

- *Is the estimated timeframe of MNA remediation reasonable compared to timeframes required for the other active methods?* Yes, the other remedial options considered are timeframe comparable as they all include MNA.

- *What is the nature and distribution of sources of contamination and have these sources been, or can be, adequately controlled?* All three of the sources of the contaminant plumes have been adequately investigated and remediated.

- *Do the resulting transformation products present a greater risk, due to increased toxicity and/or mobility, than do the parent contaminants?* No, the breakdown products present no greater risk than the parent compounds. Due to the aerobic conditions in the aquifers, reductive dechlorination of the chlorinated VOCs does not appear to be occurring. Vinyl chloride, which is more toxic than TCE, can be formed from the reductive dechlorination of

TCE. Vinyl Chloride has not been detected in any monitoring wells. Based on the health advisory levels developed by the Wisconsin Department of Health Services (2011), the aminonitrotoluene DNT breakdown products are less toxic than the parent DNT isomers. Outside of the area surrounding the DBG and PBG waste pits, elevated concentrations of DNT breakdown products have not been detected in either monitoring wells or private wells.

- *Are there reliable site-specific mechanisms available for implementing institutional controls (e.g., zoning ordinances), and is an institution responsible for their monitoring and enforcement identifiable?* Yes, there will be municipal ordinances and deed restrictions limiting groundwater use in the affected areas.

9.1 Dinitrotoluene Degradation

The degradation of DNT has been widely studied by Joseph Hughes, Shirley Nishino, and Jim Spain of the Georgia Institute of Technology and their colleagues. The BEST system operated from 2001 to 2005 at the PBG Waste Pits by utilizing indigenous bacteria to aerobically biodegrade DNT. During the operation of the BEST system, localized zones of anaerobic groundwater conditions were identified. After the PBG cap was installed in 2008 over the PBG Waste Pits, the groundwater has remained mostly aerobic with potentially localized zones that are anaerobic and continues to biodegrade DNT. Based on data collected at BAAAP and available research, a list of potential DNT degradation compounds is shown below. Research suggests that nitroanilines are generated from the degradation of aminonitrotoluene compounds.

Both the aerobic and anaerobic degradation of DNT have been known to produce aminonitrotoluene compounds. Localized zones of anaerobic groundwater conditions appear to generate higher concentrations of DNT degradation compounds than aerobic groundwater conditions.

DNT Degradation Compound	Synonym
2-Nitroaniline	o-Nitroaniline
3-Nitroaniline	m-Nitroaniline
4-Nitroaniline	p-Nitroaniline
2-Amino-3-nitrotoluene	2-Methyl-6-nitroaniline
2-Amino-4-nitrotoluene	2-Methyl-5-nitroaniline
2-Amino-6-nitrotoluene	2-Methyl-3-nitroaniline
3-Amino-4-nitrotoluene	5-Methyl-2-nitroaniline
4-Amino-2-nitrotoluene	4-Methyl-3-nitroaniline
4-Amino-3-nitrotoluene	4-Methyl-2-nitroaniline

During a 2008 treatability study conducted at BAAAP using CL-Out®, DNT contaminated groundwater in drums was treated with an enhanced naturally occurring bacteria consortium of *pseudomonas sp* (Saul, 2008). After 29 days of treatment, the originally generated DNT degradation compounds, nitroanilines and aminonitrotoluenes, were consumed.

Aminonitrotoluenes

In July 2011, the Wisconsin Department of Health Services developed a health advisory level of 4 µg/l for the sum of 2-amino-3-nitrotoluene, 2-amino-4-nitrotoluene, 2-amino-6-nitrotoluene, 4-amino-2-nitrotoluene, and 4-amino-3-nitrotoluene. Toxicity data were not sufficient to develop a numerical health advisory for 3-amino-4-nitrotoluene. The SpecPro laboratory's current LOD for 2-amino-4-nitrotoluene is 1.3 µg/l. The LOD for the remaining four aminonitrotoluene compounds is 0.5 µg/l.

Christopher, et al (2000) conducted a biological treatment study on wastewater that contained 2,4-DNT. Christopher, et al (2000) concluded that aerobic biodegradation of 2,4-DNT showed that aminonitrotoluene compounds were consumed shortly after they were formed. Their research confirms that DNT degradation compounds are not likely to persist in the groundwater.

Nishino and Spain (2001) performed a *Technology Status Review: Bioremediation of Dinitrotoluene (DNT)* for the Strategic Environmental Research and Development Program (SERDP) that summarized information about bioremediation utilizing aerobic bacteria to mineralize 2,4 and 2,6-DNT. SERDP is the Department of Defense's environmental science and technology program. Mineralization, the complete catabolism of a compound to its inorganic components is the preferred goal of bioremediation systems. Nishino and Spain (2001) found that DNT degrading bacteria were present in the BAAAP groundwater and also stated that there is evidence to suggest that natural attenuation of DNT is taking place at BAAAP. Nishino and Spain (2001) also found evidence to suggest that complete mineralization of DNT was occurring at BAAAP, which precludes the formation of significant amounts of aminonitrotoluene compounds.

During the operation of the BEST system from 2001 to 2005, elevated concentrations (over 1,000 µg/l) of the aminonitrotoluene compounds were routinely detected near the PBG Waste Pits. Since 2008, the aminonitrotoluenes have been tested semiannually in a variety of monitoring well samples that are located adjacent to the PBG source area. These aminonitrotoluene compounds have been detected in 10 monitoring wells. Since March 2010, these aminonitrotoluene compounds have only been detected in monitoring well PBM-0002, located between the former waste pits and extraction well SCW-2R. The summed aminonitrotoluene concentration in PBM-0002 has varied during April 2008, April 2009, March 2010, September 2010, and March 2011from 3.3, 349, 1,986, 977, and 340 µg/l, respectively. Based on the groundwater data collected to date, DNT degradation continues to occur near the PBG source area.

Since 2008, groundwater samples from monitoring wells DBM-8201 and DBM-8202, which are adjacent to the DBG source area, have been tested semiannually for the aminonitrotoluenes. The aminonitrotoluenes have not been detected in wells adjacent to the DBG source area. Based on the groundwater data collected to date, DNT degradation was occurring prior to 2006 near the DBG source area.

Groundwater samples from monitoring wells that are located in the Central Plume have not been analyzed for the aminonitrotoluene compounds, due to the extremely low levels of DNT in the plume. Based on the ratio of DNT to breakdown products in the other plumes, which is approximately 4:1, it is unlikely that the aminonitrotoluenes would be detected, if present.

Nitroanalines

2-, 3-, and 4-Nitroaniline do not have a Chapter NR 140 groundwater quality standard or a health advisory level.
Since 1998, 2-, 3-, and 4-nitroaniline have been tested in samples from monitoring wells located both on and off-site BAAAP.

During the operation of the BEST system from 2001 to 2005, elevated concentrations (over 1,000 µg/l) of nitroaniline compounds were routinely detected near the PBG Waste Pits.
Since 1998, 2-nitroaniline has been detected in 20 monitoring wells that are located on-site and within the PBG plume. The highest concentration of 2-nitroaniline, 2,840 µg/l, was found in PBN-8202A during March 2005. Since 2005, the 2-nitroaniline concentration in PBN-8202A has dropped to 2.1 µg/l (April 2009). During 2010 and 2011, detections of 2-nitroaniline have been restricted to PBM-0002 and PBM-9801 with highest concentrations being 150 and 2.1 µg/l, respectively. 3-Nitroaniline has been detected in PBN-8202A twice with the highest concentration being 906 µg/l in March 2005. 3-Nitroaniline has not been detected in any other monitoring wells located in the PBG plume. 4-Nitroaniline has been detected in four monitoring wells located in the PBG plume. 4-Nitroaniline has been detected in PBN-8202A four times with the highest concentration being 230 µg/l in December 2004. 4-Nitroaniline has been detected in PBM-0002 three times with the highest concentration being 30.2 µg/l in March 2011.

Between 1998 and 2005, 2-nitroaniline was detected 25 times in DBM-8202 with the highest concentration of 32.4 µg/l occurring in June 2000. 2-Nitroaniline was detected once in DBM-8201 during 2005 at a concentration of 2.2 µg/l. Between 2001 and 2004, 2-nitroaniline was detected three times in ELM-8908 with the highest concentration of 0.9 µg/l occurring in March 2001. Since 2005, 2-, 3-, and 4-nitroaniline have not been detected in any monitoring wells adjacent to or downgradient of the DBG.

2-, 3-, and 4-Nitroaniline have not been detected in any monitoring wells that are located within the Central Plume.

Since 1994, 2-, 3-, and 4-nitroaniline have been sampled in private wells near BAAAP. 2-, 3-, and 4-Nitroaniline have not been detected in any private wells near BAAAP. These compounds are included in the semi-volatile organic compound (SVOC) analytical method.

10.0 REMEDIAL ALTERNATIVES

10.1 Groundwater Remedial Action Objective

The objective of the groundwater remedial action is to protect human health by preventing exposure to contaminated groundwater from BAAAP, to restore groundwater to the extent practicable, and minimize the impact of the contaminant plumes on the environment.

10.2 Remedial Alternatives

Based on site conditions and the screening of cleanup action options, three remedial alternatives were developed to address the presence of contaminants in groundwater at the BAAAP. Each alternative is capable of accomplishing the remedial objective.

Alternative 1: IRM/MIRM Treatment and Monitored Natural Attenuation
This alternative continues IRM/MIRM treatment of the PBG plume, residential and groundwater monitoring, and monitored natural attenuation of the DBG and Central Plumes.

Alternative 2: In-Situ Biochemical Treatment and Monitored Natural Attenuation
This alternative would use in-situ groundwater treatment instead of the current IRM/MIRM treatment, a modified residential and groundwater monitoring program, and monitored natural attenuation of the PBG, DBG, and Central Plumes.

Alternative 3: Public Water System and Monitored Natural Attenuation
This alternative involves the installation of a public water system and subsequent elimination of residential wells and IRM/MIRM treatment, a modified groundwater monitoring program, and monitored natural attenuation of the PBG, DBG, and Central Plumes.

10.3 Detailed Analysis of Alternatives

The following describes the conceptual design and criteria for detailed analysis of each alternative. This section provides a description of the criteria for detailed analysis and the detailed analysis of the groundwater alternatives. Each alternative is evaluated against the same criteria established by the WDNR in accordance with Chapter NR 722, Wis. Adm. Code, Standards for Selecting Remedial Actions.

The development of remedial alternatives is evaluated for each contaminated medium or migration or exposure pathway. This evaluation process is to be used to determine which remedial alternative constitutes the most appropriate technology or combination of technologies to restore the environment, to the extent practicable, within a reasonable period of time, and to minimize the harmful effects of the contamination to the air, land, or waters.

Key principles considered during selection of the BAAAP groundwater remedial measures, include:

- Source control measures should use treatment to address "principal threat" wastes where practicable; and engineering controls for waste that pose a relatively low long-term threat, or where treatment is impracticable.

- Contaminated groundwater should be returned to beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of groundwater is not practicable, prevention of further migration of the plume and exposure to the contaminated groundwater is important.

Criteria for Detailed Analysis

Relative performance of each alternative is evaluated using the following nine criteria:

1. Overall protection of human health and the environment
   The remedy should be protective of human health and minimize the harmful effects to the environment.

2. Compliance with applicable regulations
   This shall include federal and state regulations.

3. Long-term effectiveness and permanence
   This shall consider the risks remaining after completion of the remedial action and the adequacy and suitability of controls, if any, that are used to manage untreated contaminants remaining at the site.

4. Reduction of toxicity, mobility, and volume through treatment
   This shall include the expected reduction in toxicity, mobility, and volume measured as a percentage or order of magnitude, and the type and quantity of treatment residuals that will remain following treatment.

5. Short-term effectiveness
   This shall include protection of the community during the remedial action, protection of workers during remedial action, environmental impacts to natural resources, and time until remedial response objectives are achieved.

6. Implementability
   This shall consider the feasibility of the remedy including: construction and operation; reliability of technology; ease of undertaking additional remediation, if necessary; and monitoring considerations, addressing the ability to adequately monitor the effectiveness of the remedy and the risks should monitoring be insufficient to detect a system failure.

7. Cost
   This shall consider capital costs, both direct and indirect; annual operations and maintenance (O&M) costs; and present worth analysis (or net present value) of costs.

8. State Acceptance
   This shall consider the issues and concerns that the state may have regarding each alternative. This criterion will be evaluated throughout the development, screening, and evaluation of alternatives based on comments and input received from the WDNR.

9. Community Acceptance
   This involves an evaluation of issues and concerns the public may have regarding each alternative. This criterion will be evaluated throughout the development, screening, and evaluation of alternatives based on comments and input received from the public.

10.4 Technical Impracticability

The objective of the groundwater remedial action is to protect human health by preventing exposure of contaminated groundwater from BAAAP, to restore groundwater to the extent practicable, and minimize the impact of the contaminant plumes on the environment. To meet these goals, remedial actions at BAAAP have addressed source areas and the associated contaminant plumes, and replaced affected private drinking water wells. At the PBG plume, the IRM/MIRM pump-and treat-technology has been successful at capturing contaminants in groundwater; however, this technology is not able to remove the necessary amount of contaminant mass from groundwater to achieve the expectation of aquifer restoration to beneficial uses (safe drinking water source) within reasonable time frames. Even with a pumping/treatment rate of 3 million gallons per day, the IRM/MIRM only addresses about a third of the entire PBG plume.

Limitations of pump-and-treat technology for many groundwater contaminant scenarios have been well recognized since the late 1980s (AEC, 2004). Despite advances in technologies applicable to groundwater remediation, aquifer restoration for sites with complex geologic and contaminant characteristics is rarely achieved. Technical and regulatory communities generally agree that restoration of groundwater at complex sites like BAAAP is technically impracticable. Therefore, alternative cleanup strategies must be considered and implemented. Information contained in this AFS demonstrates achieving the remediation goal for the contaminated aquifer at BAAAP through groundwater treatment alone is technically impracticable from an engineering perspective.

10.5 Alternative 1 – IRM/MIRM Treatment and Monitored Natural Attenuation

Under this alternative, groundwater extraction and treatment of the PBG plume inside the BAAAP boundaries would continue as currently operating.

The current practice of monitored natural attenuation would continue for the other areas of groundwater concern, including the DBG and Central Plumes. Long-term monitoring of the groundwater and residential wells to ensure that remediation and natural attenuation are progressing toward regulatory standards would continue.

Periodic analysis of groundwater (monitoring wells and private wells) would measure the status of the contaminated groundwater plumes, determining when concentrations have decreased below Chapter NR 140 standards. After WDNR standards are met in the portion of the PBG plume located inside the BAAAP boundary, the IRM/MIRM would be shut down. Groundwater monitoring would continue for several years, monitoring the PBG plume to ensure stable or receding conditions.

Overall Protection of Human Health and the Environment

This alternative would control and limit the migration of the on-site PBG plume only. There is no capture/treatment planned for the off-site portion of the PBG plume. There is also no capture/treatment planned for the DBG plume or the Central Plume. Monitoring of private wells would continue, and private wells would be replaced if a persistent exceedance of a Chapter NR 140 ES is confirmed. Contaminant concentrations are predicted to decrease through natural attenuation processes. Based on the applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors (see Section 7.4).

Compliance with Applicable Regulations

This alternative currently complies with applicable regulations.

Long-Term Effectiveness and Permanence

In this alternative, contaminant concentrations would continue to decrease below regulatory standards through recovery and treatment of the portion of the PBG plume on the installation, and natural processes (dilution, dispersion, and sorption). Monitoring of the plumes would continue for several years after the plumes attenuate to ensure that all areas remain below regulatory standards. Monitoring of residential wells would continue until the WDNR agrees that residential well monitoring is no longer required.

Reduction of Toxicity, Mobility, and Volume through Treatment

Limited reductions in toxicity, mobility, and volume would occur through treatment of the PBG plume on the installation. The groundwater contamination would continue to decrease due to natural attenuation processes.

Short-Term Effectiveness

The short-term impacts of alternatives shall be assessed considering the following: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved.

For this alternative, short-term risks to the community and workers could include those due to potential human or ecological exposure to contaminants. However, there would be no additional short-term risk as this WDNR-approved alternative is already in place and operating on-site.

Implementability

This alternative has already been implemented.

Cost

The estimated present worth costs for Alternative 1 are shown below. See Appendix F for a summary of the costs for Alternative 1.

Engineering design:	$	0
Capital cost:	$	0
Annual O&M:	$	76,911,000
Monitoring and closeout plan/report:	$	55,000
Total present worth:	**$**	**76,966,000**

* Present worth costs use current rates and do not include inflation

State Acceptance

This alternative is a continuation of the current interim groundwater remedy accepted by the WDNR; therefore, it is likely that the WDNR would continue to accept this remedy. However, this criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the WDNR.

Community Acceptance

This alternative is a continuation of the current interim groundwater remedy; therefore, it is likely that the community would continue to accept it. However, this criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the public.

10.6 Alternative 2 – In-Situ Biochemical Treatment and Monitored Natural Attenuation

This alternative would involve the in-situ biochemical treatment of each of the three plumes (PBG, DBG, and Central), with groundwater monitoring. Only the portions of the plumes that are located on BAAAP would be treated. Natural attenuation would continue for other areas outside the installation boundaries.

The treatment of chlorinated solvent contaminated groundwater has been well studied, but DNT has not. The one known effective in-situ treatment for both types of contamination would consist of injecting a consortium of naturally-occurring microbes selected for their ability to

degrade specific chemicals into harmless by-products through aerobic co-metabolism. This bioremediation product, known as CL-Out®, is marketed by CL Solutions, LLC of Cincinnati, Ohio.

This bio-augmentation treatment by CL-Out® introduces a high population of effective degrading organisms, called pseudomonas, into the treatment zone. The population delivered into the treatment zone is 100 to 1,000 times higher than the native bacterial population. While there may be indigenous organisms capable of degrading the contaminants, the benefit of bio-augmentation is that the added population more effectively degrades the contaminants over a shorter amount of time. CL-Out® has been proven at sites across the United States to be capable of remediating chlorinated VOC compounds in the groundwater.

A treatability study was conducted at BAAAP using CL-Out® in 2008. The study consisted of treating two identical groundwater samples as microcosms and a third identical untreated sample maintained under the same conditions as a standard for comparison. One of the microcosms received just a dosage of CL-Out® and the other microcosm was treated with CL-Out® and dextrose. The dextrose was added to determine whether a carbon source was necessary to support microbial growth because the concentration of DNT and other organics in the groundwater were very low. Samples were collected from each microcosm at intervals following treatment. The results of the treatability study showed that the CL-Out® was very effective in degrading the DNT isomers with most of the contaminant reduction complete within seven days of treatment. For further information, see *Sustainable Remediation Alternative Evaluation – Treatability Study of DNT Bio-augmentation at the Badger Army Ammunition Plant* presentation poster found at http://symposiumarchive.serdp-estcp.org/symposium2008/posters/upload/t204-saul.pdf.

The groundwater conditions at BAAAP appear to be favorable to allow bio-augmentation to succeed. Pilot tests in the field would be required to prove this is effective on a larger scale.

The CL-Out® mixture would be pumped into a combination of approximately 1,950 temporary wells and existing monitoring wells in the three plumes.

The injection points would need to be spaced approximately 50 feet by 500 feet apart throughout each plume. The existing wells would have their monitoring apparatus removed for the injection. A truck carrying a water/CL-Out® mixture and a pump would be used to bring the treatment to the wells. Approximately 16 pounds of CL-Out® mixture would be pumped into each injection point. The treatment would spread out through the groundwater and take approximately nine months at each plume to show effectiveness. It is assumed that a single round of injections of the CL-Out® mixture would be sufficient to treat each plume. Upon completion of active treatment, each plume would be monitored for contaminant reduction or stabilization.

This alternative would include monitoring of the plume for several years following treatment to ensure the effectiveness of the bioremediation and confirm that concentrations have decreased

below regulatory standards. This alternative also involves shutting down the IRM/MIRM upon concurrence from the WDNR that the in-situ biochemical treatment has been effective.

Overall Protection of Human Health and the Environment

This alternative meets the requirements of the remedial action objective because it would effectively degrade the contaminants in groundwater on the installation, thereby minimizing the risk of future contaminant migration to human receptors and the environment. Groundwater monitoring at private wells would continue to provide assurance to the residents that their water is safe to drink. Based on the applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors (see Section 7.4).

Compliance with Applicable Regulations

This alternative would be designed to comply with applicable regulations.

Long-Term Effectiveness and Permanence

Both active treatment and natural attenuation components of the alternative would be permanent. If effective, groundwater treatment would permanently remove the majority of DNT and the chlorinated solvents from the groundwater. The remaining contamination would continue to decrease due to natural attenuation processes. However, this alternative may require supplemental post-treatment applications, at considerable cost, and would require a groundwater monitoring program to verify the efficacy of the remedial action. This alternative is expected to be effective over the long-term.

Reduction of Toxicity, Mobility, and Volume through Treatment

In-situ bioremediation of groundwater would reduce the toxicity, mobility, and volume of DNT and chlorinated solvents in the treated area more quickly than natural processes alone. The groundwater contamination would also continue to decrease due to natural attenuation processes and no receptors would be at a significant risk.

Short-Term Effectiveness

The short-term impacts of alternatives shall be assessed considering the following: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved.

For this alternative, short-term risks to the community and workers could include those due to potential human or ecological exposure to contaminants. Because monitoring well and private well sampling would continue, no significant increase in risk is anticipated for potential receptors

with the implementation of this alternative. In addition, there would be little effect on the community as most of the field activity associated with the injection would be conducted by qualified personnel on-site. As observed in the treatability study, the bioremediation occurs very quickly upon introduction of the CL-Out® and no worker safety issues have been identified.

Implementability

CL-Out® has been demonstrated in a drum test to be effective in treating DNT and chlorinated solvents without the production of lasting intermediates or daughter products.

Cost

The estimated present worth costs for Alternative 2 are shown below. See Appendix F for a summary of the costs for Alternative 2.

Engineering design:	$ 45,000
Capital cost:	$ 41,200,000
Post-treatment monitoring:	$ 20,047,000
Monitoring and closeout plan/report:	$ 55,000
Total present worth:	**$ 61,347,000**

* Present worth costs use current rates and do not include inflation

State Acceptance

This criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the WDNR.

Community Acceptance

This criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the public.

10.7 Alternative 3 – Public Water System and Monitored Natural Attenuation

This alternative consists of the installation of a public water system that would provide a safe, clean, reliable water source for all the potentially affected well owners downgradient of BAAAP. The Army has drafted a proposed remedy area for the public water system (see Figure 39). Two public wells would be installed east of the proposed remedy area and outside the limits of the BAAAP groundwater plumes (see Figure 18). These public wells would draw water from a deep sandstone aquifer. This alternative would eliminate the need to monitor private wells once homes are changed over to public water. The Army proposes that all potable (drinking water) wells be abandoned preventing exposure by ingestion so that receptor would be eliminated. Cooperation of the affected municipalities in the formation of a water district is envisioned for the development and long-term management of the system. The details of the public water

system design will be provided once the alternative has been approved by the WDNR. Information on the Army's proposal are available at www.cleanwaterwelldone.com.

This alternative involves preparing a phased shutdown plan for the IRM and MIRM systems. Once construction of the public water system begins, the phased shutdown of the IRM/MIRM is expected to occur. The IRM/MIRM system is anticipated to operate an additional four years. This alternative also involves preparing a groundwater monitoring and closure plan to verify natural attenuation continues to progress toward regulatory case closure standards. Monitoring and closure plans would also be submitted to the WDNR for review and concurrence prior to implementation. These plans would include a systematic procedure to provide the WDNR the necessary information required to make a closure decision. This procedure would also include continued monitoring for steady-state conditions in the three contaminant plumes.

Overall Protection of Human Health and the Environment

This alternative would be the most protective of human health because it completely eliminates the exposure pathway to humans by providing an alternative source of water. Based on the applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors (see Section 7.4).

Compliance with Applicable Regulations

This alternative would comply with applicable regulations.

Long-Term Effectiveness and Permanence

This alternative provides a permanent, long-term solution to the groundwater threat from BAAAP. The groundwater contamination would continue to decrease due to natural attenuation processes and no receptors would be at a significant risk.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative reduces the toxicity, mobility, and volume of the contamination in the groundwater through natural attenuation and eliminates the human exposure pathway by closing the private water wells.

Short-Term Effectiveness

The short-term impacts of this alternative considers the following: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved.

For this alternative, short-term risks to the community and workers would not include those due to potential human or ecological exposure to contaminants, as not all of the proposed work comes in contact with impacted groundwater. There would be some effect (road/lane closures, increased worker traffic, equipment noise, etc.) on the community due to construction of the wells, water tower, and underground piping. The construction of the public water system is estimated to take approximately three years.

Implementability

This alternative would be feasible, with the consent and approval of the community and community leaders. The Towns of Sumpter, Merrimac, and Prairie du Sac must all work effectively together and coordinate efforts for the public water supply alternative to move forward.

Cost

The estimated present worth costs for Alternative 3 are shown below. See Appendix F for a summary of the costs for Alternative 3.

Engineering design:	$ 2,900,000
Capital cost:	$ 24,746,000
Annual O&M:	$ 12,347,400
Monitoring and closeout plan/report:	$ 55,000
Total present worth:	**$ 40,048,400**

* Present worth costs use current rates and do not include inflation

State Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the WDNR.

Community Acceptance

This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from local governments and the public.

11.0 COMPARISON OF ALTERNATIVES

Through the analysis and evaluation of alternatives using the specified criteria, all three of the presented alternatives are capable of remediating the groundwater contaminant plumes in accordance with WDNR requirements. In addition, all the alternatives provide a reduction in risk to drinking water receptors downgradient of the BAAAP. Alternative 3 provides this reduction of risk in a shorter period of time. All three alternatives carry a measure of uncertainty; Alternative 1 relates to the timeframe necessary to complete the pump and treat

phase; Alternative 2 relates to the effectiveness and implementation of the biochemical phase; and Alternative 3 relates to the natural attenuation phase (timeframe). Provided in Table 17 is a comparison of the alternatives.

Alternative 1 – IRM/MIRM Treatment and Monitored Natural Attenuation involves the continued implementation of the existing IRM/MIRM groundwater pump and treat system and groundwater monitoring program. The PBG plume would continue to be recovered and treated along with groundwater monitoring. This alternative has the advantage of already being in place. In addition, this alternative is effective in actively treating only the PBG plume. Total cost for Alternative 1 is approximately $77 million present worth.

Alternative 2 – In-situ Biochemical Treatment and Monitored Natural Attenuation involves in-situ biochemical treatment of the three groundwater contaminant plumes and the implementation of a modified groundwater monitoring program. This alternative is effective in actively treating all three groundwater contaminant plumes located on BAAAP. Total cost for Alternative 2 is approximately $61 million present worth.

Alternative 3 – Public Water System and Monitored Natural Attenuation involves installation of a public water system for potentially affected private well owners downgradient of the BAAAP, a phased shutdown of the IRM and MIRM systems, and the implementation of a modified groundwater monitoring program. Overall, Alternative 3 ultimately relies on natural attenuation to address residual contamination in all three groundwater contaminant plumes. This alternative completely eliminates the potential human exposure pathway, which is the primary remedial action objective. Total cost for Alternative 3 is approximately $40 million present worth.

12.0 REMEDY SELECTION

Considering all the evaluation criteria and comparative aspects associated with the three proposed alternatives, Alternative 3 – Public Water System and Monitored Natural Attenuation has been identified as the preferred final remedy for the BAAAP groundwater plumes. Alternative 3 meets the remedial action objective and regulatory requirements because it is protective of human health and the environment; involves a reasonable implementation and restoration time frame; is feasible; and eliminates down-gradient drinking water receptors.

It should be noted, the Army will retain responsibility for the groundwater contamination and long-term performance monitoring will be a fundamental component of the remedy. Only when the final remedy is in place, and the efficacy of MNA is demonstrated under steady-state conditions, would the Army pursue case closure.

Adequate source control measures have been taken, natural attenuation will bring the groundwater into compliance with Chapter NR 140 groundwater quality standards within a reasonable period of time, and the groundwater plume margins are stable or receding. Alternative 3, in conjunction with all the interim actions completed to date (soil excavation, soil vapor extraction, enhanced bioremediation, capping, and groundwater pump and treat) provides a path for case closure and meets the statutory requirement for restoring the environment to the

extent practicable [see Statute 292.11 (3)]. Therefore, the Army requests WDNR approval of the selected remedial option in accordance with NR 722.

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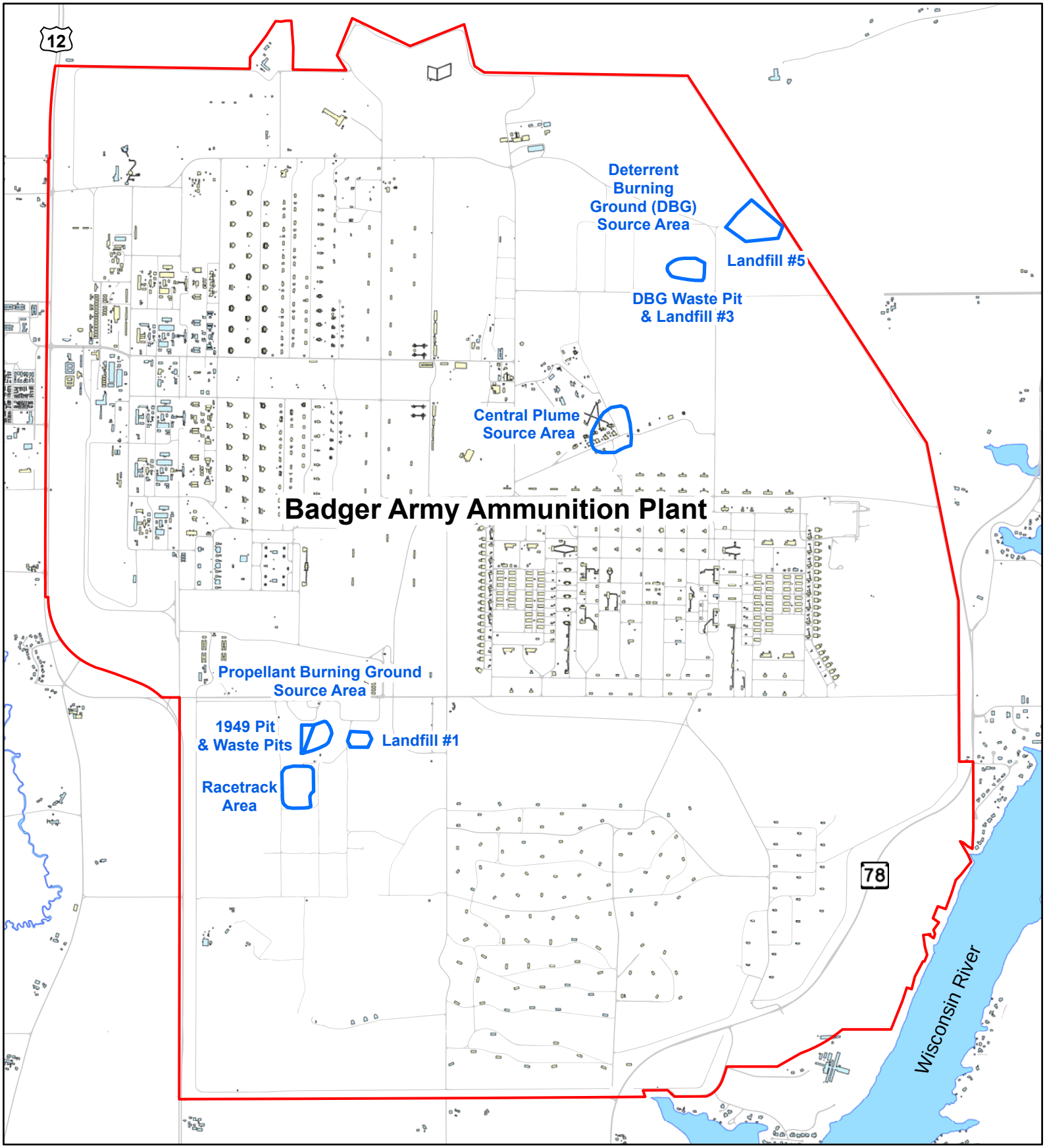
Figures



Legend

- Badger Army Ammunition Plant Boundary
- Source Area
- Paved Road
- Existing Building
- Former Building Footprint

Figure 1

Site Location Map
Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 2,500 feet

0 3,900 7,800 Feet

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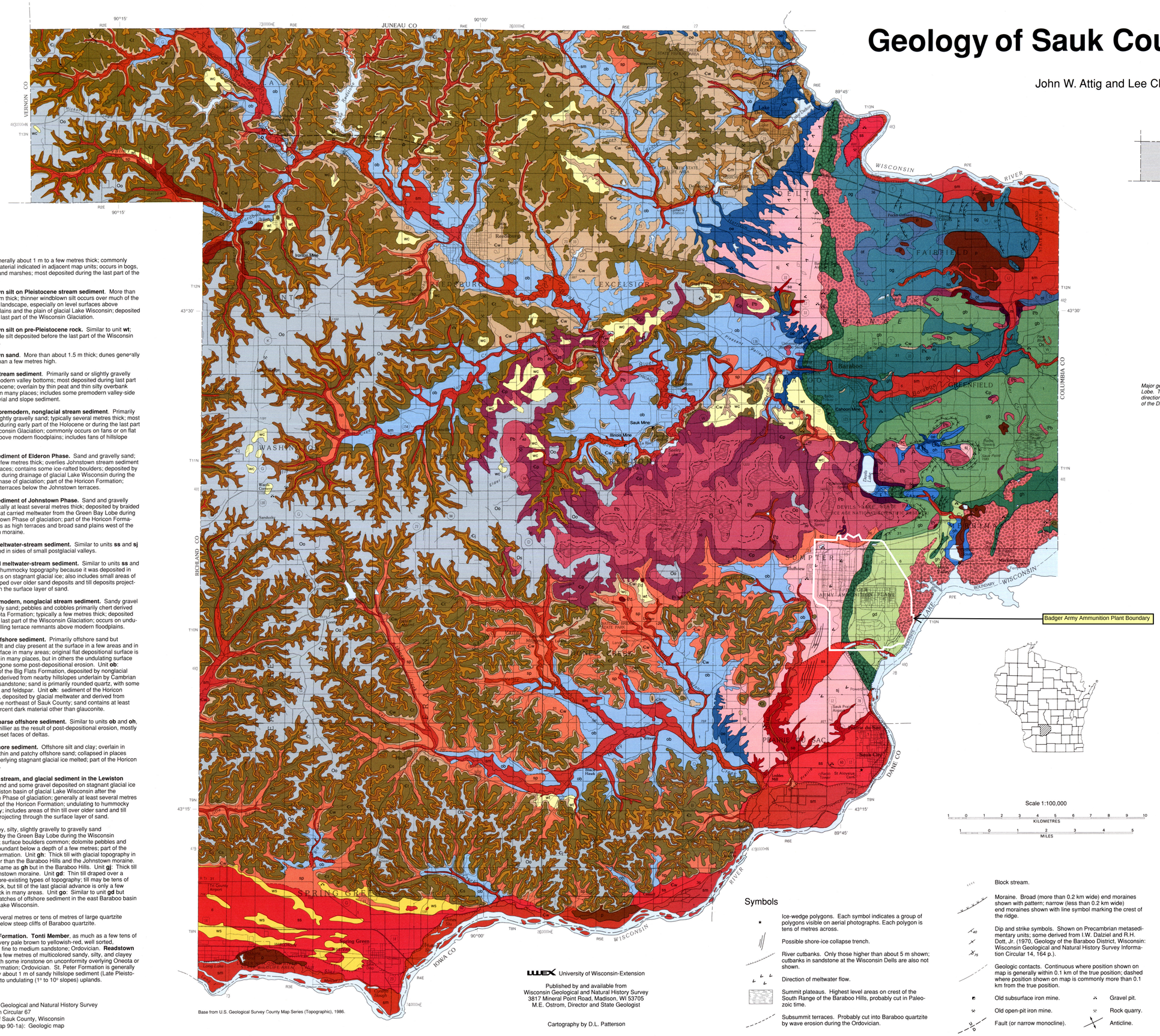
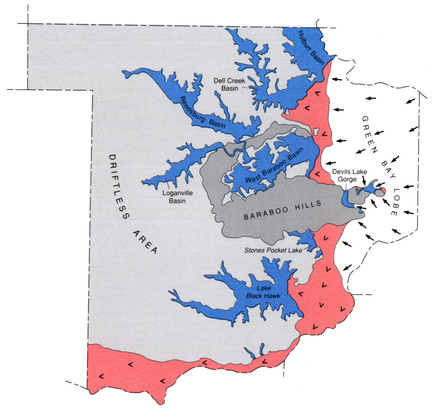
D:\GIS_Projects\Groundwater_Projects\Municipal Well Planning\2011_AFS_GW\MXDs\Fig_1_Site_Loc_Map

Geology of Sauk County, Wisconsin

John W. Attig and Lee Clayton, 1990

Figure 2





Major geologic features of Sauk County during the maximum late Wisconsin extent of the Green Bay Lobe. The map shows the location of the western edge of the Green Bay Lobe (arrows show direction of ice flow), outwash plains (red), and lakes (blue). The Baraboo Hills and the remainder of the Driftless Area in Sauk County are shown in shades of gray.

Explanation

p — **Peat**. Generally about 1 m to a few metres thick; commonly overlies material indicated in adjacent map units; occurs in bogs, swamps, and marshes; most deposited during the last part of the Holocene.

wt — **Windblown silt on Pleistocene stream sediment**. More than about 1.5 m thick; thinner windblown silt occurs over much of the rest of the landscape, especially on level surfaces above outwash plains and the plain of glacial Lake Wisconsin; deposited during the last part of the Wisconsin Glaciation.

wc — **Windblown silt on pre-Pleistocene rock.** Similar to unit **wt**; may include silt deposited before the last part of the Wisconsin Glaciation.

ws — **Windblown sand**. More than about 1.5 m thick; dunes generally no more than a few metres high.

sm — **Modern stream sediment**. Primarily sand or slightly gravelly sand on modern valley bottoms; most deposited during last part of the Holocene; overlain by thin peat and thin silty overbank sediment in many places; includes some premodern valley-side fans of fluvial and slope sediment.

sp — **Younger premodern, nonglacial stream sediment**. Primarily sand or slightly gravelly sand; typically several metres thick; most deposited during early part of the Holocene or during the last part of the Wisconsin Glaciation; commonly occurs on fans or on flat terraces above modern floodplains; includes fans of hillslope sediment.

ss — **Stream sediment of Elderon Phase.** Sand and gravelly sand; typically a few metres thick; overlies Johnstown stream sediment in many places; contains some ice-rafted boulders; deposited by floodwater during drainage of glacial Lake Wisconsin during the Elderon Phase of glaciation; part of the Horicon Formation; occurs on terraces below the Johnstown terraces.

sj — **Stream sediment of Johnstown Phase.** Sand and gravelly sand; typically at least several metres thick; deposited by braided streams that carried meltwater from the Green Bay Lobe during the Johnstown Phase of glaciation; part of the Horicon Formation; occurs as high terraces and broad sand plains west of the Johnstown moraine.

se — **Eroded meltwater-stream sediment.** Similar to units **ss** and **sj** but exposed in sides of small postglacial valleys.

sd — **Collapsed meltwater-stream sediment.** Similar to units **ss** and **sj** but has hummocky topography because it was deposited in some areas on stagnant glacial ice; also includes small areas of thin till draped over older sand deposits and till deposits projecting through the surface layer of sand.

od — **Older premodern, nonglacial stream sediment.** Sandy gravel and gravelly sand; pebbles and cobbles primarily chert derived from Oneota Formation; typically a few metres thick; deposited before the last part of the Wisconsin Glaciation; occurs on undulating to rolling terrace remnants above modern floodplains.

ob — **Coarse offshore sediment.** Primarily offshore sand but offshore silt and clay present at the surface in a few areas and in the subsurface in many areas; original flat depositional surface is preserved in many places, but in others the undulating surface has undergone some post-depositional erosion. Unit **ob**: sediment of the Big Flats Formation, deposited by nonglacial water and derived from nearby hillslopes underlain by Cambrian sand and sandstone; sand is primarily rounded quartz, with some glauconite and feldspar. Unit **oh**: sediment of the Horicon Formation, deposited by glacial meltwater and derived from areas to the northeast of Sauk County; sand contains at least several percent dark material other than glauconite.

oh — **Eroded coarse offshore sediment.** Similar to units **ob** and **oh**, but much hillier as the result of post-depositional erosion, mostly on the foreset faces of deltas.

ot — **Fine offshore sediment.** Offshore silt and clay; overlain in places by thin and patchy offshore sand; collapsed in places where underlying stagnant glacial ice melted; part of the Horicon Formation.

og — **Offshore, stream, and glacial sediment in the Lewiston basin.** Sand and some gravel deposited on stagnant glacial ice in the Lewiston basin of glacial Lake Wisconsin after the Johnstown Phase of glaciation; generally at least several metres thick; part of the Horicon Formation; undulating to hummocky topography; includes areas of thin till over older sand and till deposits projecting through the surface layer of sand.

gh, gb, gj, gd, go — **Till.** Clayey, silty, slightly gravelly to gravelly sand deposited by the Green Bay Lobe during the Wisconsin Glaciation; surface boulders common; dolomite pebbles and cobbles abundant below a depth of a few metres; part of the Horicon Formation. Unit **gh**: Thick till with glacial topography in areas other than the Baraboo Hills and the Johnstown moraine. Unit **gb**: Same as **gh** but in the Baraboo Hills. Unit **gj**: Thick till of the Johnstown moraine. Unit **gd**: Thin till draped over a variety of pre-existing types of topography; till may be tens of metres thick, but till of the last glacial advance is only a few metres thick in many areas. Unit **go**: Similar to unit **gd** but includes patches of offshore sediment in the east Baraboo basin of glacial Lake Wisconsin.

t — **Talus.** Several metres or tens of metres of large quartzite boulders below steep cliffs of Baraboo quartzite.

Os — **St. Peter Formation. Tonti Member**, as much as a few tens of metres of very pale brown to yellowish-red, well sorted, quartzose, fine to medium sandstone; Ordovician. **Readstown Member**, a few metres of multicolored sandy, silty, and clayey breccia with some ironstone on unconformity overlying Oneota or Jordan Formation; Ordovician. St. Peter Formation is generally overlain by about 1 m of sandy hillslope sediment (Late Pleistocene); flat to undulating (1° to 10° slopes) uplands.

Oo — **Oneota and Rountree Formations. Oneota Formation**–up to 20 m of very pale brown to light brownish-gray dolomite, commonly algal, with chert nodules; some sandstone near base of formation; some caverns and cavities, mostly filled with red clay; Ordovician; flat to undulating (1° to 10° slopes) upland plateaus; unit includes some unmappable small areas of St. Peter Formation; scattered residual boulders of St. Peter sandstone are present in many places on the Oneota plateau. **Rountree Formation**–several metres of clay, sandy clay, and clayey sand, typically with red hues, with cobbles and pebbles of chert; includes hillslope sediment derived from residuum from the underlying Oneota dolomite; late Cenozoic.

Cj — **Jordan Formation.** About 20 m of white to brown, quartzose, fine to coarse sandstone, coarsening upward; silicified zone at top; Cambrian; generally overlain by about 1 m of sandy hillslope sediment (Late Pleistocene); outcrops at edge of Oneota plateaus; upper slope is a sandstone cliff in many places, especially in the northwestern part of county; below the cliff is a tree-covered slope of about 15° to 30°.

Cs — **St. Lawrence Formation. Lodi Member**, about 10 to 20 m of pale yellow, thin-bedded, siltstone, and very fine to fine sandstone with some gray shale; Cambrian. **Black Earth Member**, as much as a few metres of dolomite at base of the formation; Cambrian. St. Lawrence Formation is generally overlain by less than 1 m of sandy hillslope sediment (Late Pleistocene); upper part of the St. Lawrence slope is a continuation of the Jordan escarpment (10° to 25°), which flattens into an undulating (5° to 10°) bench near the base of the unit.

Ct — **Tunnel City Formation.** 30 to 45 m thick. **Lone Rock Member**, thin-bedded, quartzose, glauconitic, fine sand and sandstone; shaley near base; Cambrian. **Mazomanie Member**, slightly glauconitic sandstone near middle of the formation; thickens eastward; Cambrian. Tunnel City Formation is generally overlain by less than 1 m of hillslope sediment (Late Pleistocene); commonly a series of billowy hills or a rounded bench (2° to 10°, with slopes of 10° to 15° above and below) occurs near the middle of the formation; flat bench (1° to 7°) occurs near the base of formation in the northwestern part of the county.

Cw — **Wonewoc and Eau Claire Formations. Ironton Member**, at the top of the Wonewoc Formation, a few metres of brown, burrowed, quartzose, fine to medium sandstone; Cambrian; forms a low cliff in most places, especially in the northwestern part of the county. **Galesville Member**, at the bottom of the Wonewoc Formation, 15 to more than 20 m of white, quartzose, medium sandstone; Cambrian; generally a steep (10° to 30°) tree-covered slope, but in some places steeper or flatter; commonly overlain by about 1 m of sandy hillslope sediment (Late Pleistocene). **Eau Claire Formation**–a few metres of poorly sorted, variably colored, quartzose sandstone; commonly silty and bioturbated; Cambrian; forms a low undulating (1° to 5°) bench; overlain by thin (generally less than 1 m) sandy hillslope or shoreline sediment (Late Pleistocene).

Ꞓm — **Mount Simon Formation**. More than 30 m of white, quartzose, fine to medium sand and sandstone; Cambrian; commonly overlain by a few metres of hillslope, shoreline, offshore, or windblown sand (Late Pleistocene); flat to undulating (1° to 3°) in most areas but steeper in some places, with vertical cliffs in the Wisconsin Dells.

Ꞓp — **Parfreys Glen Formation**. Mostly quartz sandstone; parts conglomeratic; locally contains angular talus blocks several metres across, adjacent to the Baraboo Formation; some zones glauconitic; commonly very hard (silica cement); generally unfossiliferous; generally occurs within several hundred metres of the Baraboo Hills; bedding generally slopes a few degrees away from the Baraboo Hills; chronologic equivalent of the Mount Simon, Eau Claire, Wonewoc, Tunnel City, St. Lawrence, and Jordan Formations, and perhaps also of the Oneota, St. Peter, and younger formations; contact with the Baraboo Formation is imprecisely located in most areas.

Pk — **"Dake formation"?** Similar to the Baraboo quartzite; Early Proterozoic.

Pb — **Baraboo Formation.** About 1.5 km of gray to pink quartzite; very well cemented in most places; Early Proterozoic; generally overlain by hillslope debris consisting of quartzose sand and gravel on steep slopes and finer material on gentle slopes (Late Pleistocene).

Pg — **Granite in Baxter Hollow**. Pink to red granite and quartz diorite beneath the Baraboo Formation; Early Proterozoic.

Pd — **Diorite near Denzer**. Gray to red diorite or granodiorite; Early Proterozoic.

Pr — **Rhyolite near the Lower Narrows, Denzer, and Devils Nose**. Metamorphosed red to black tuffaceous rock and lava flows; Early Proterozoic.

Symbols

- Ice-wedge polygons. Each symbol indicates a group of polygons visible on aerial photographs. Each polygon is tens of metres across.
- Possible shore-ice collapse trench.
- River cutbanks. Only those higher than about 5 m shown; cutbanks in sandstone at the Wisconsin Dells are also not shown.
- Direction of meltwater flow.
- Summit plateaus. Highest level areas on crest of the South Range of the Baraboo Hills, probably cut in Paleozoic time.
- Subsummit terraces. Probably cut into Baraboo quartzite by wave erosion during the Ordovician.
- Block stream.
- Moraine. Broad (more than 0.2 km wide) end moraines shown with pattern; narrow (less than 0.2 km wide) end moraines shown with line symbol marking the crest of the ridge.
- 40 — Dip and strike symbols. Shown on Precambrian metasedimentary units; some derived from I.W. Dalziel and R.H. Dott, Jr. (1970, Geology of the Baraboo District, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 14, 164 p.).
- 75
- Geologic contacts. Continuous where position shown on map is generally within 0.1 km of the true position; dashed where position shown on map is commonly more than 0.1 km from the true position.
- Old subsurface iron mine.
- Old open-pit iron mine.
- Fault (or narrow monocline). U D
- Gravel pit.
- Rock quarry.
- Anticline.

Base from U.S. Geological Survey County Map Series (Topographic), 1986.

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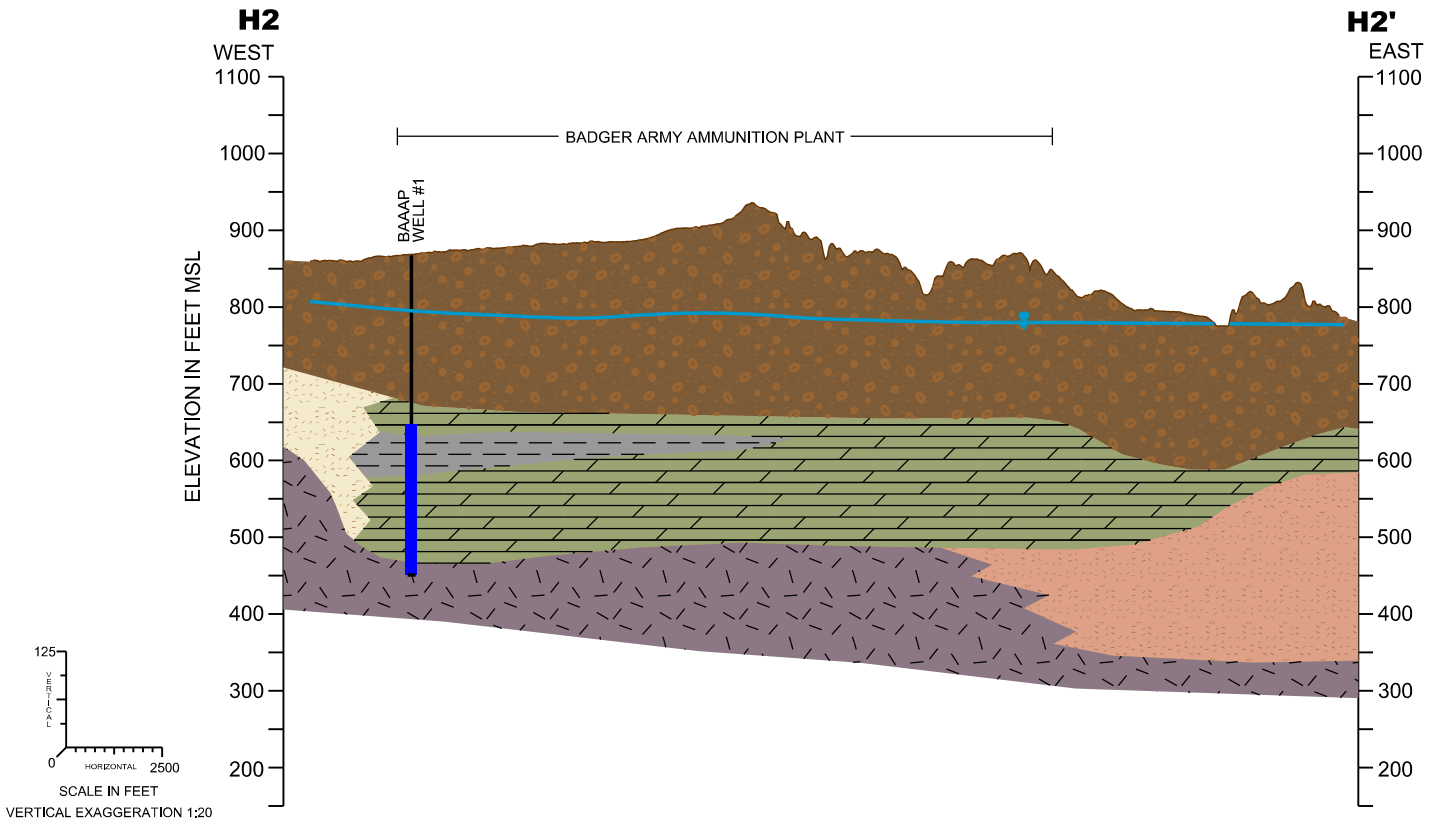
M.E. Ostrom, Director and State Geologist

Cartography by D.L. Patterson

Wisconsin Geological and Natural History Survey
Information Circular 67
Geology of Sauk County, Wisconsin
Plate 1 (Map 90-1a): Geologic map



LEGEND

BAAAP WELL #1 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D &E)

GROUND SURFACE

WATER TABLE ELEVATION

DRINKING WATER WELL SCREEN

BOTTOM OF EXPLORATION

GEOLOGIC DESCRIPTIONS:

- SAND AND GRAVEL, AQUIFER
- WONEWOC FORMATION, AQUIFER (SANDSTONE)
- EAU CLAIRE FORMATION, AQUITARD/AQUIFER (SHALE, DOLOMITE, SILTSTONE, SANDSTONE)
- EAU CLAIRE FORMATION, AQUITARD (SHALE)
- MT. SIMON FORMATION, AQUIFER (SANDSTONE)
- BARABOO FORMATION, AQUITARD (QUARTZITE)

NOTES:
ADAPTED FROM GOTKOWITZ AND OTHERS (2005), HYDROGEOLOGY AND SIMULATION OF GROUNDWATER FLOW IN SAUK COUNTY, WISCONSIN

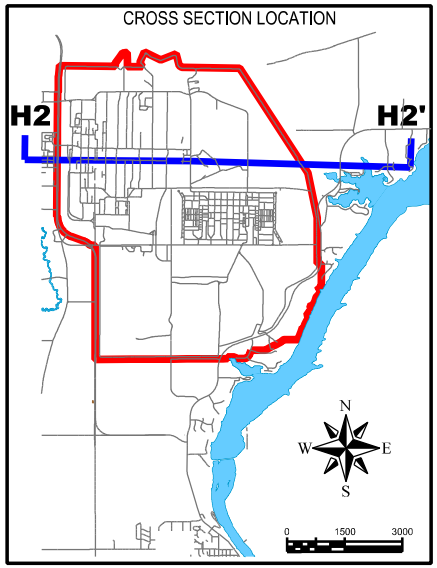


FIGURE 3

GENERALIZED GEOLOGIC CROSS SECTION WEST-EAST

ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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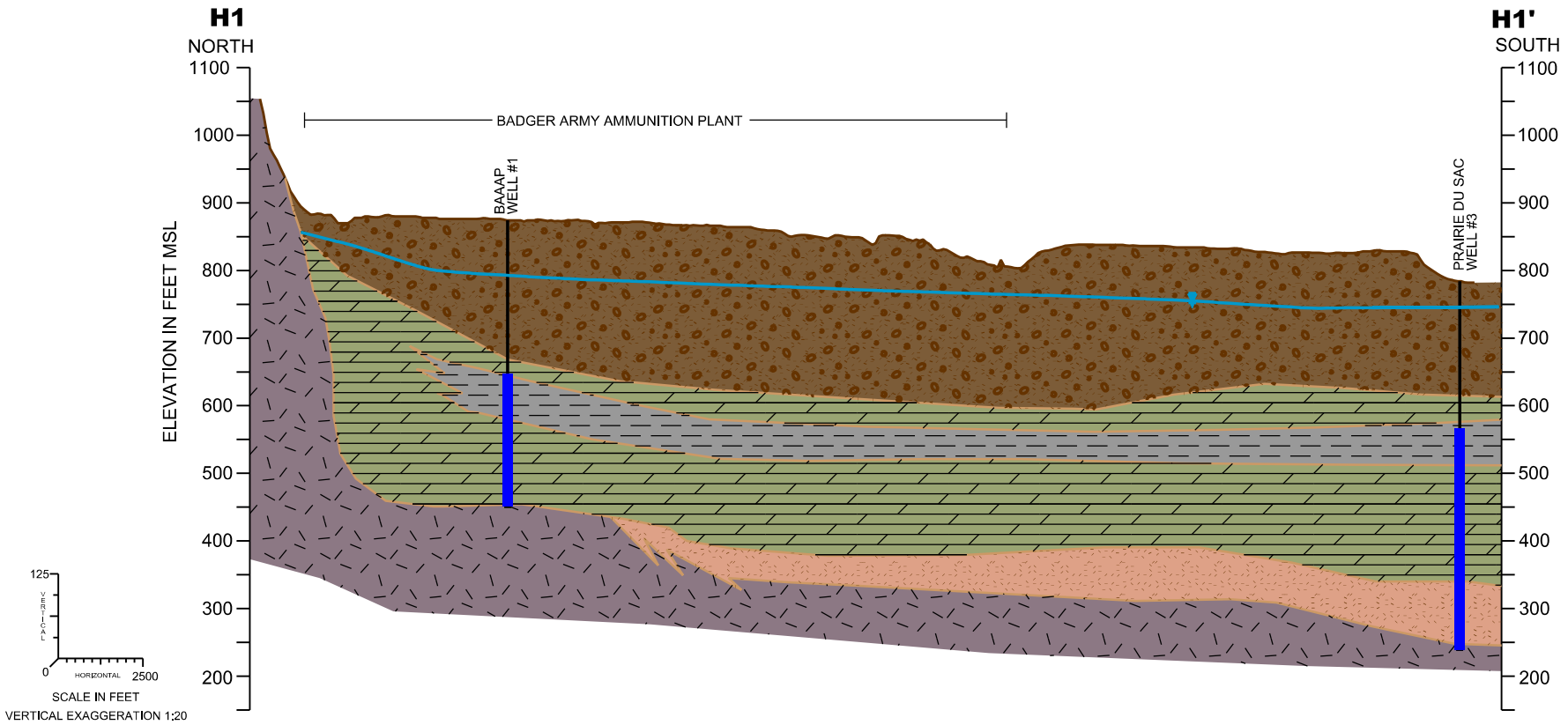

LEGEND

BAAAP WELL #1 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D &E)

GROUND SURFACE

WATER TABLE ELEVATION

DRINKING WATER WELL SCREEN

BOTTOM OF EXPLORATION

GEOLOGIC DESCRIPTIONS:

- SAND AND GRAVEL, AQUIFER
- EAU CLAIRE FORMATION, AQUITARD/AQUIFER (SHALE, DOLOMITE, SILTSTONE, SANDSTONE)
- EAU CLAIRE FORMATION, AQUITARD (SHALE)
- MT. SIMON FORMATION, AQUIFER (SANDSTONE)
- BARABOO FORMATION, AQUITARD (QUARTZITE)

NOTES:
ADAPTED FROM GOTKOWITZ AND OTHERS (2005), HYDROGEOLOGY AND SIMULATION OF GROUNDWATER FLOW IN SAUK COUNTY, WISCONSIN

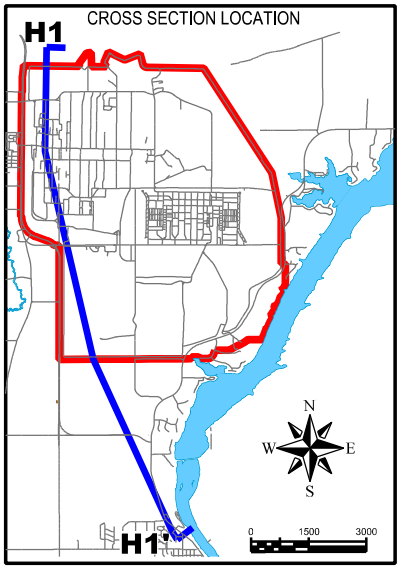

FIGURE 4

GENERALIZED GEOLOGIC CROSS SECTION NORTH-SOUTH

ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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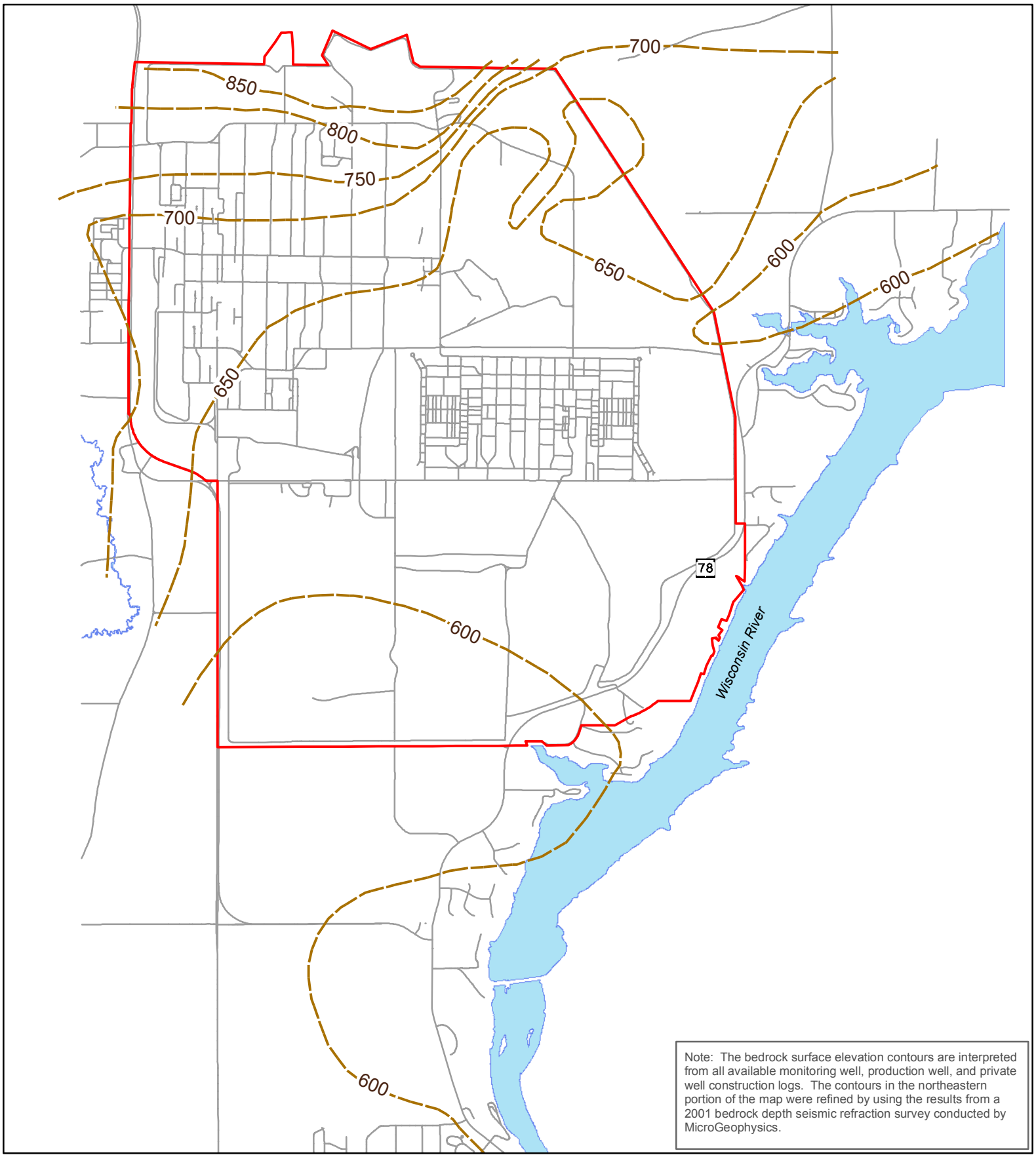

Note: The bedrock surface elevation contours are interpreted from all available monitoring well, production well, and private well construction logs. The contours in the northeastern portion of the map were refined by using the results from a 2001 bedrock depth seismic refraction survey conducted by MicroGeophysics.

Legend

- Badger Army Ammunition Plant Boundary
- Bedrock Surface Elevation Contour
  Contour Interval = 50 feet
- Wisconsin River
- Paved Road

Figure 5

Bedrock Surface Map
Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 3,750 feet

0 6,200 12,400 Feet

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D:\GIS_Projects\Groundwater_Projects\Municipal Well Planning\2011_AFS_GW\MXDs\Fig_5_Bedrock_Surface.mxd

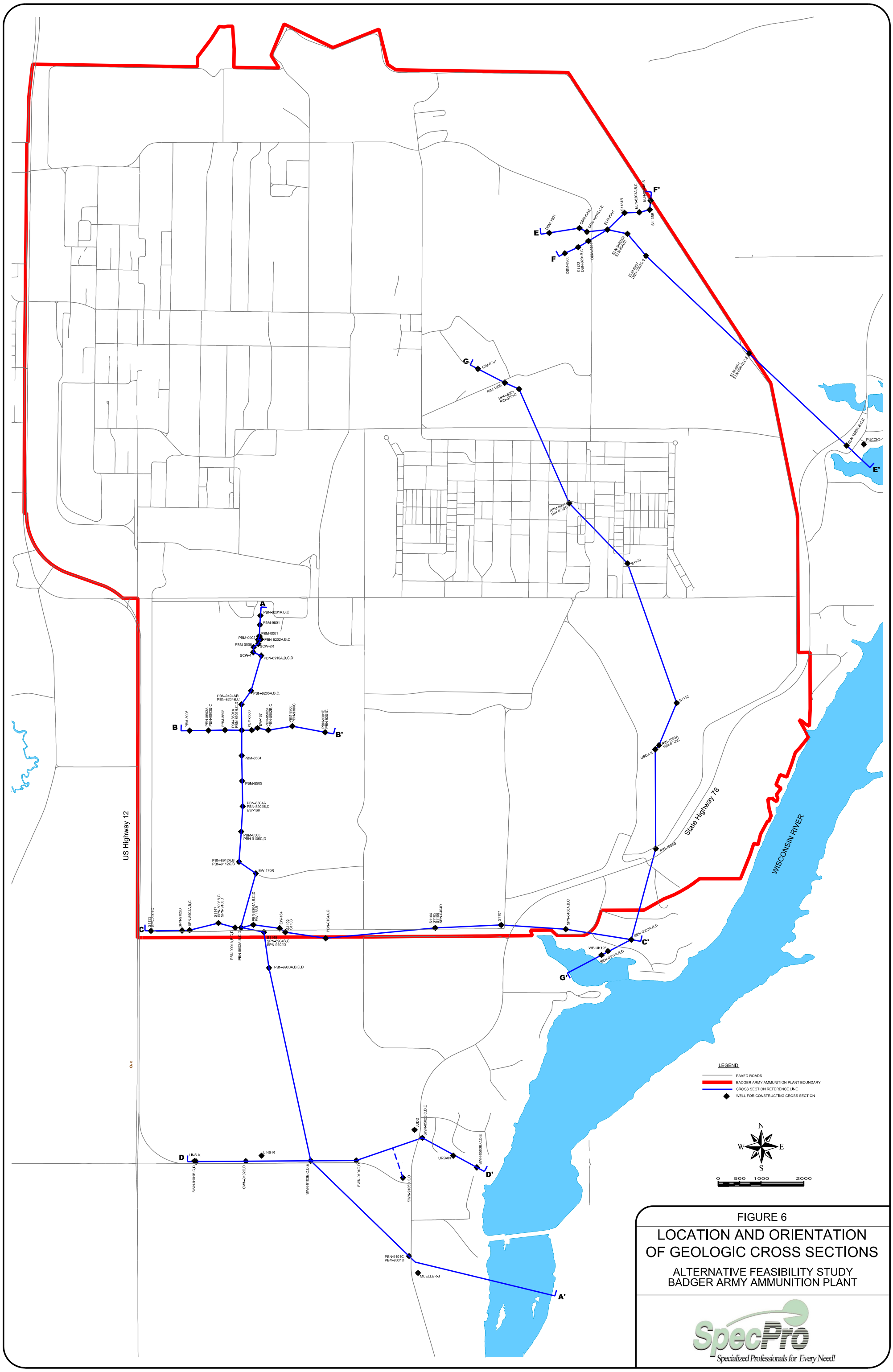

FIGURE 6

LOCATION AND ORIENTATION OF GEOLOGIC CROSS SECTIONS

ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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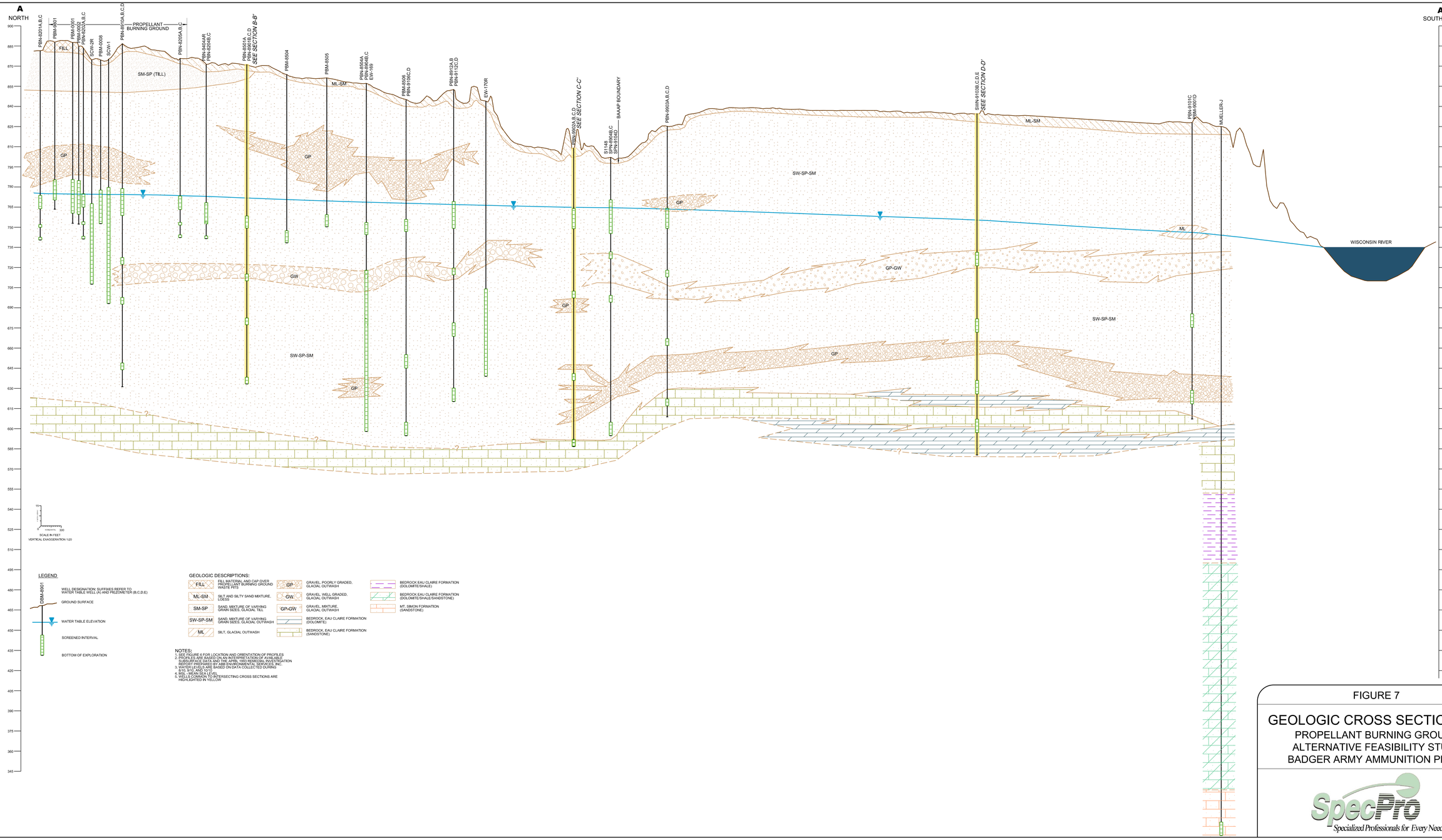

FIGURE 7

GEOLOGIC CROSS SECTION A-A'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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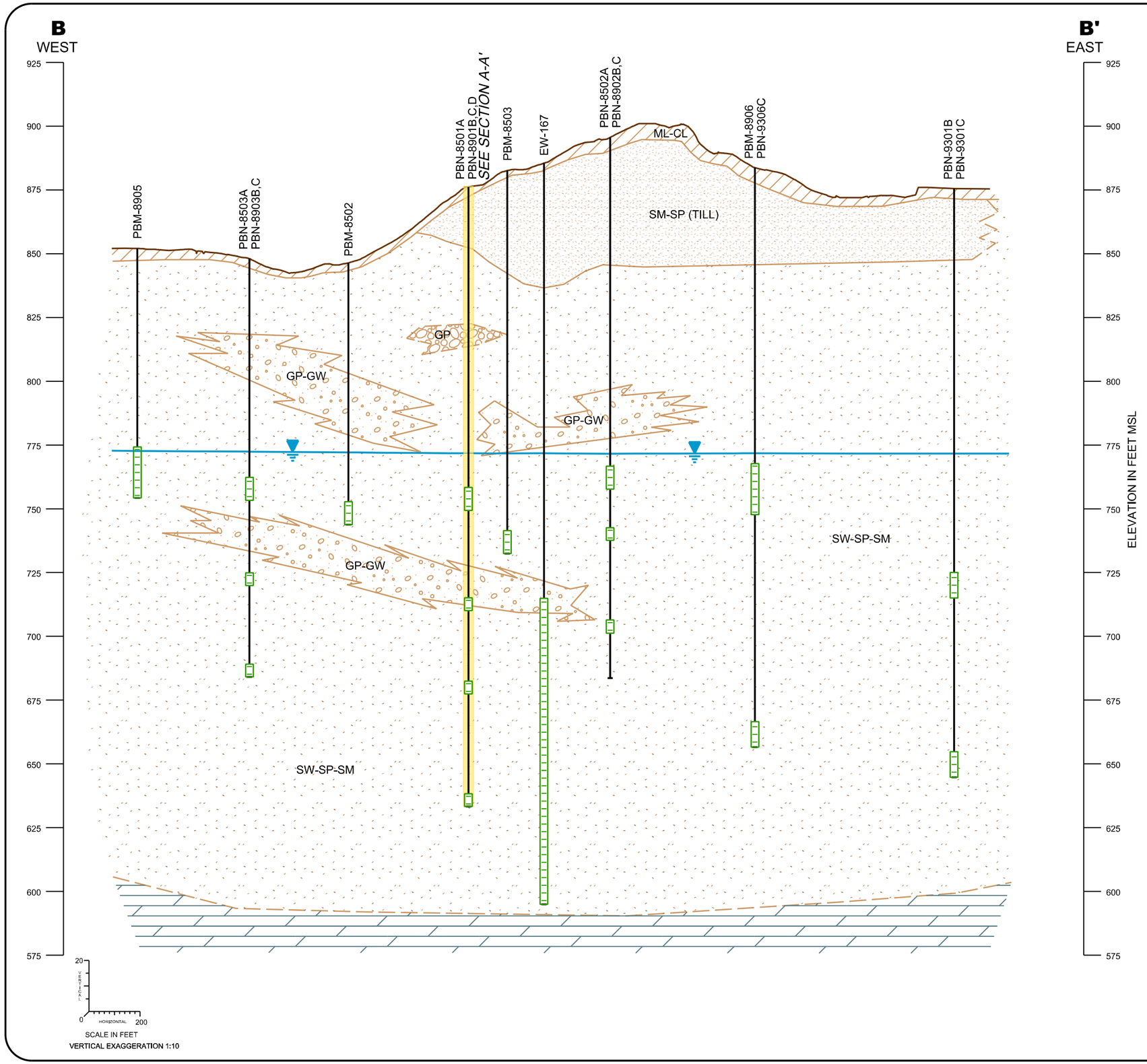

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

BOTTOM OF EXPLORATION

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SM-SP	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
GP	GRAVEL, POORLY GRADED, GLACIAL OUTWASH
GP-GW	GRAVEL, MIXTURE, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. WATER LEVELS ARE BASED ON DATA COLLECTED DURING 8/10, 9/10, AND 10/10
4. MSL - MEAN SEA LEVEL
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 8

GEOLOGIC CROSS SECTION B-B'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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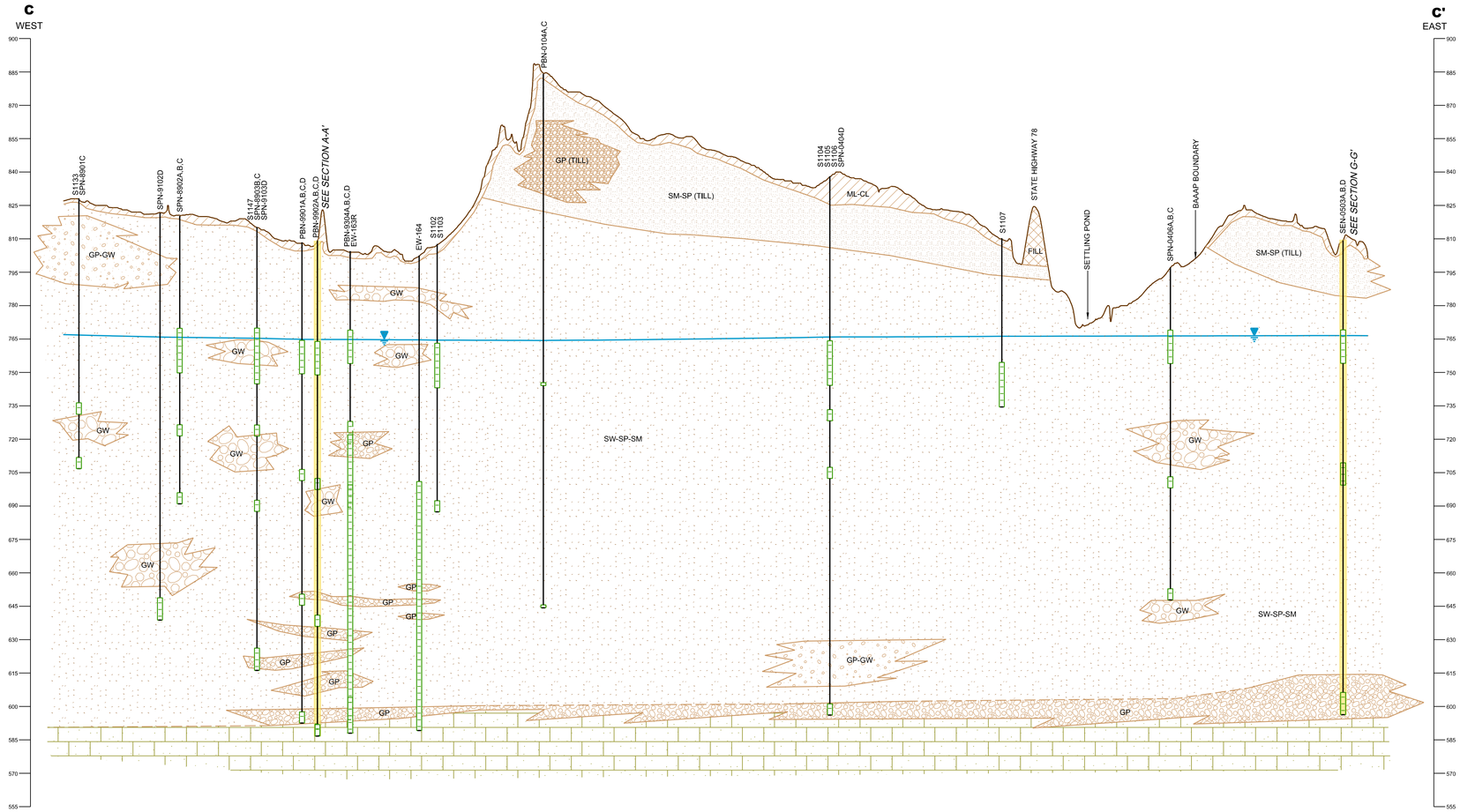
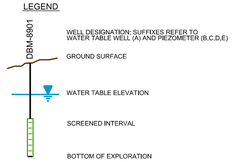


LEGEND



GEOLOGIC DESCRIPTIONS:

FILL	FILL MATERIAL	GP	GRAVEL, POORLY GRADED, GLACIAL OUTWASH
ML-CL	SILT AND CL AY MIXTURE, LOESS	GW	GRAVEL, WELL GRADED, GLACIAL OUTWASH
SM-SP	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL	GP-GW	GRAVEL, MIXTURE, GLACIAL OUTWASH
SW-SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH		BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)
GP	GRAVEL, POORLY GRADED, GLACIAL TILL		

NOTES:
1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION PERFORMED BY ABB ENVIRONMENTAL SERVICES, INC.
3. WATER LEVELS ARE BASED ON DATA COLLECTED DURING 8/10, 9/10, AND 10/10
4. MSL - MEAN SEA LEVEL
5. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 9

GEOLOGIC CROSS SECTION C-C'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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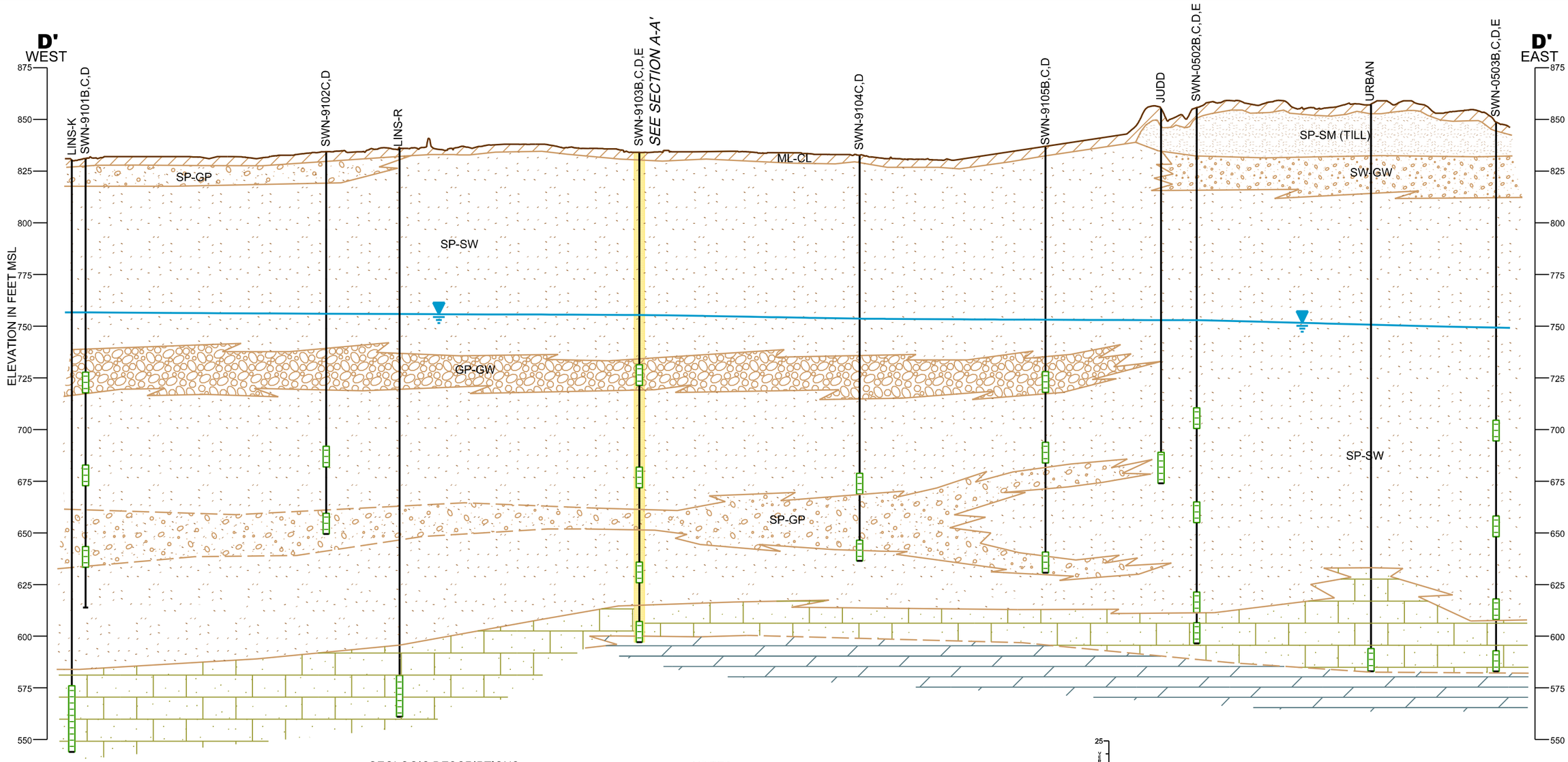

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

BOTTOM OF EXPLORATION

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SP-GP	SAND AND GRAVEL, GLACIAL OUTWASH
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SP-SW	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
GP-GW	GRAVEL, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. WATER LEVELS ARE BASED ON DATA COLLECTED DURING 8/10, 9/10, AND 10/10
4. MSL - MEAN SEA LEVEL
5. SWN-9105 B,C,D ARE OFFSET 750 FEET SOUTH OF THE SECTION LINE.
6. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

SCALE IN FEET

VERTICAL EXAGGERATION 1:10

FIGURE 10

GEOLOGIC CROSS SECTION D-D'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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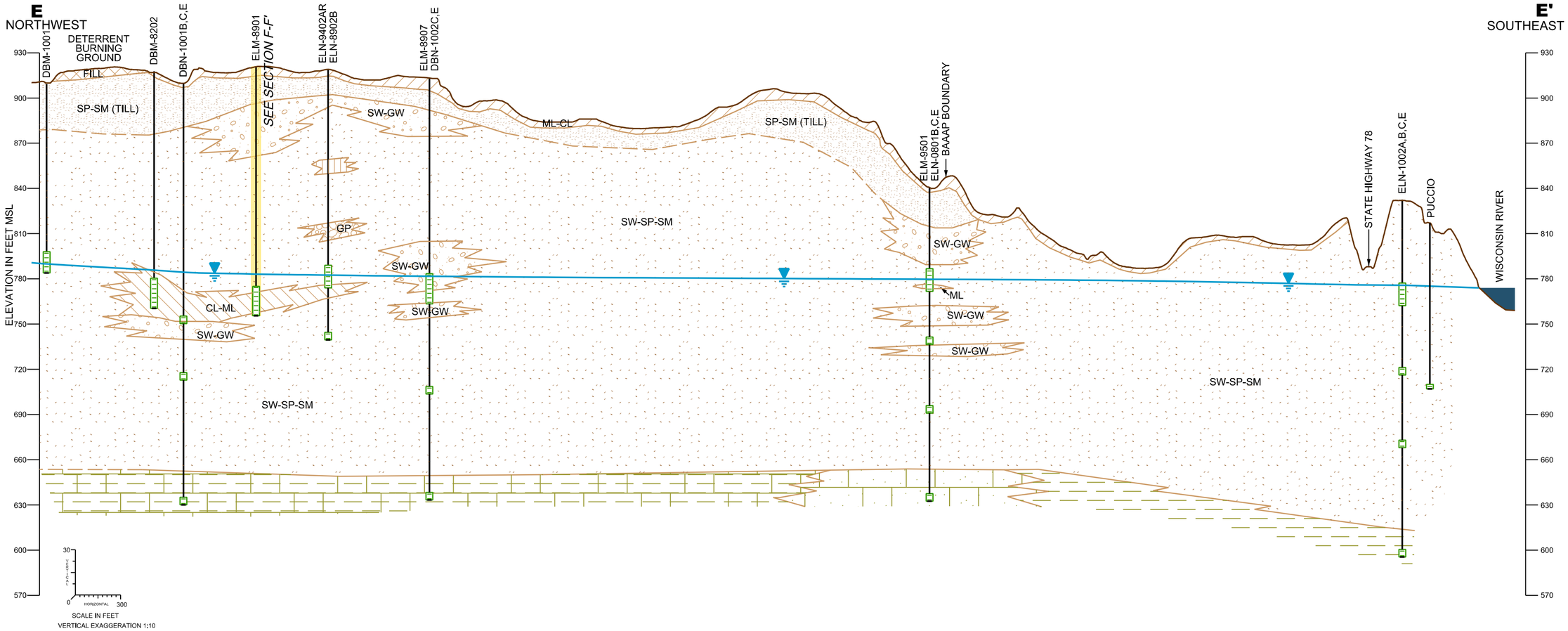

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

BOTTOM OF EXPLORATION

GEOLOGIC DESCRIPTIONS:

FILL	FILL MATERIAL AND CAP OVER DETERRENT BURNING GROUND WASTE PITS
ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SW-SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
ML	SILT, GLACIAL OUTWASH
CL-ML	LAYERED CLAY AND SILT, GLACIAL OUTWASH
GP	GRAVEL, GLACIAL OUTWASH
	BEDROCK, SHALE, EAU CLAIRE FORMATION (INTERBEDDED SANDSTONE)
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)
	BEDROCK, SHALE, EAU CLAIRE FORMATION (INTERBEDDED SILTSTONE)

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. WATER LEVELS ARE BASED ON DATA COLLECTED DURING 8/10, 9/10, AND 10/10
4. MSL - MEAN SEA LEVEL
5. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 11

GEOLOGIC CROSS SECTION E-E'

DETERRENT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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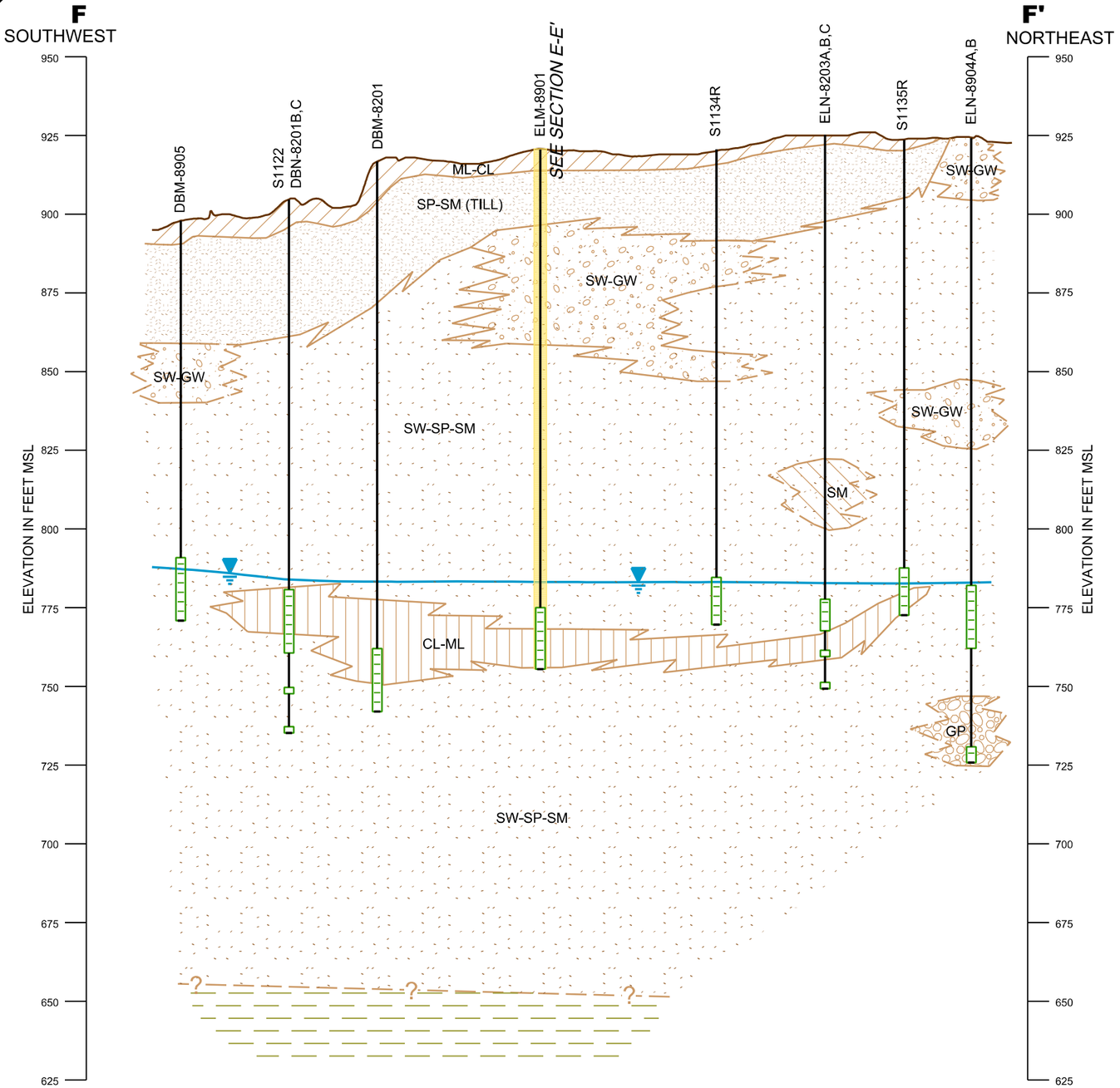
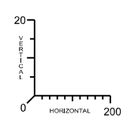
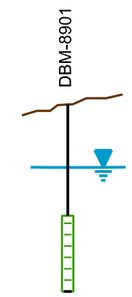




SCALE IN FEET
VERTICAL EXAGGERATION 1:10

LEGEND



WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

BOTTOM OF EXPLORATION

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SW-SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
SM	SILTY SAND, GLACIAL OUTWASH
CL-ML	LAYERED CLAY AND SILT, GLACIAL OUTWASH
GP	GRAVEL, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (SHALE, INTERBEDDED SANDSTONE)

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. WATER LEVELS ARE BASED ON DATA COLLECTED DURING 8/10, 9/10, AND 10/10
4. MSL - MEAN SEA LEVEL
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 12

GEOLOGIC CROSS SECTION F-F'

DETERRENT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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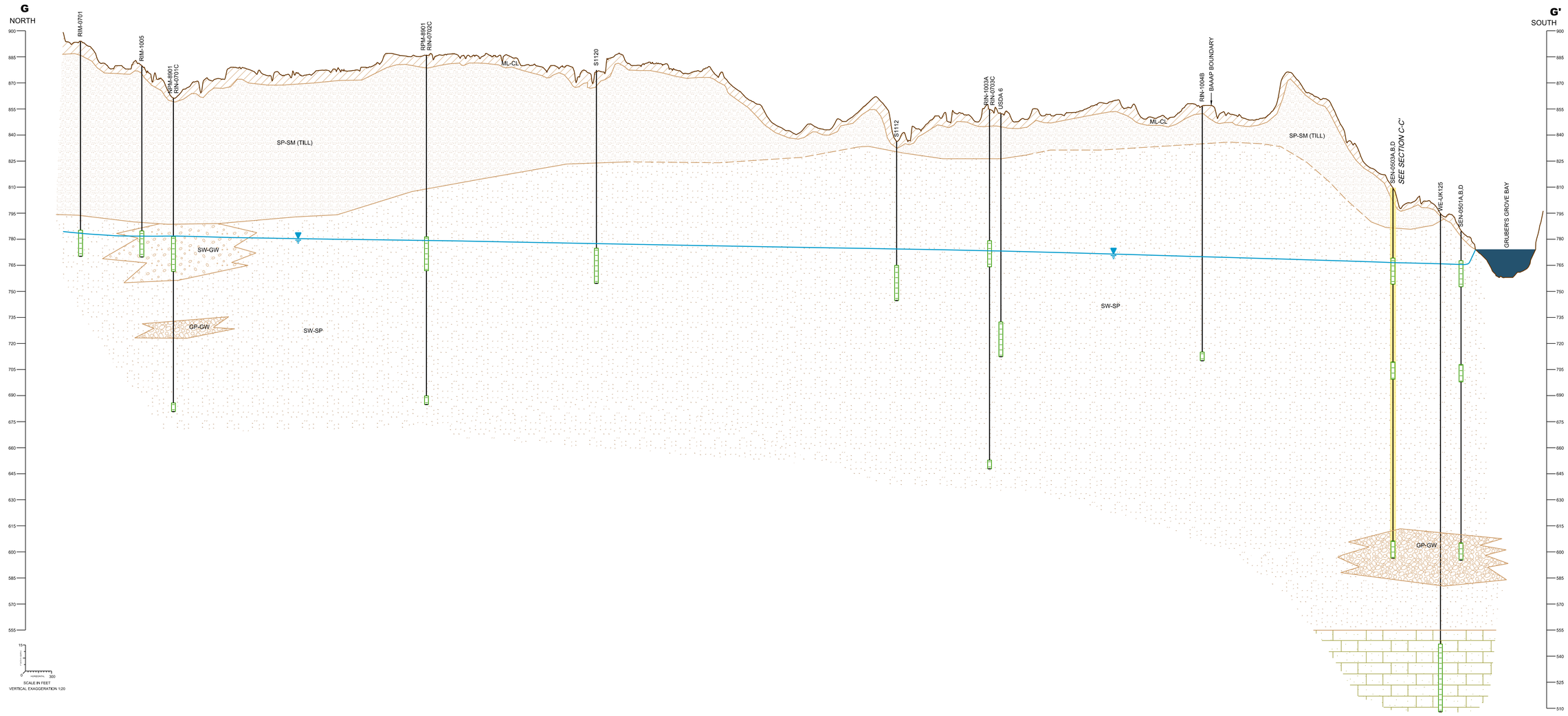

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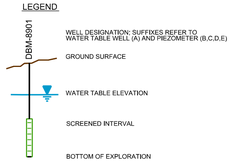

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SW-SP	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
GP-GW	GRAVEL, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)

NOTES:
1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. WATER LEVELS ARE BASED ON DATA COLLECTED DURING APRIL 1993 ONLY
4. MSL = MEAN SEA LEVEL
5. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 13

GEOLOGIC CROSS SECTION G-G'

CENTRAL PLUME
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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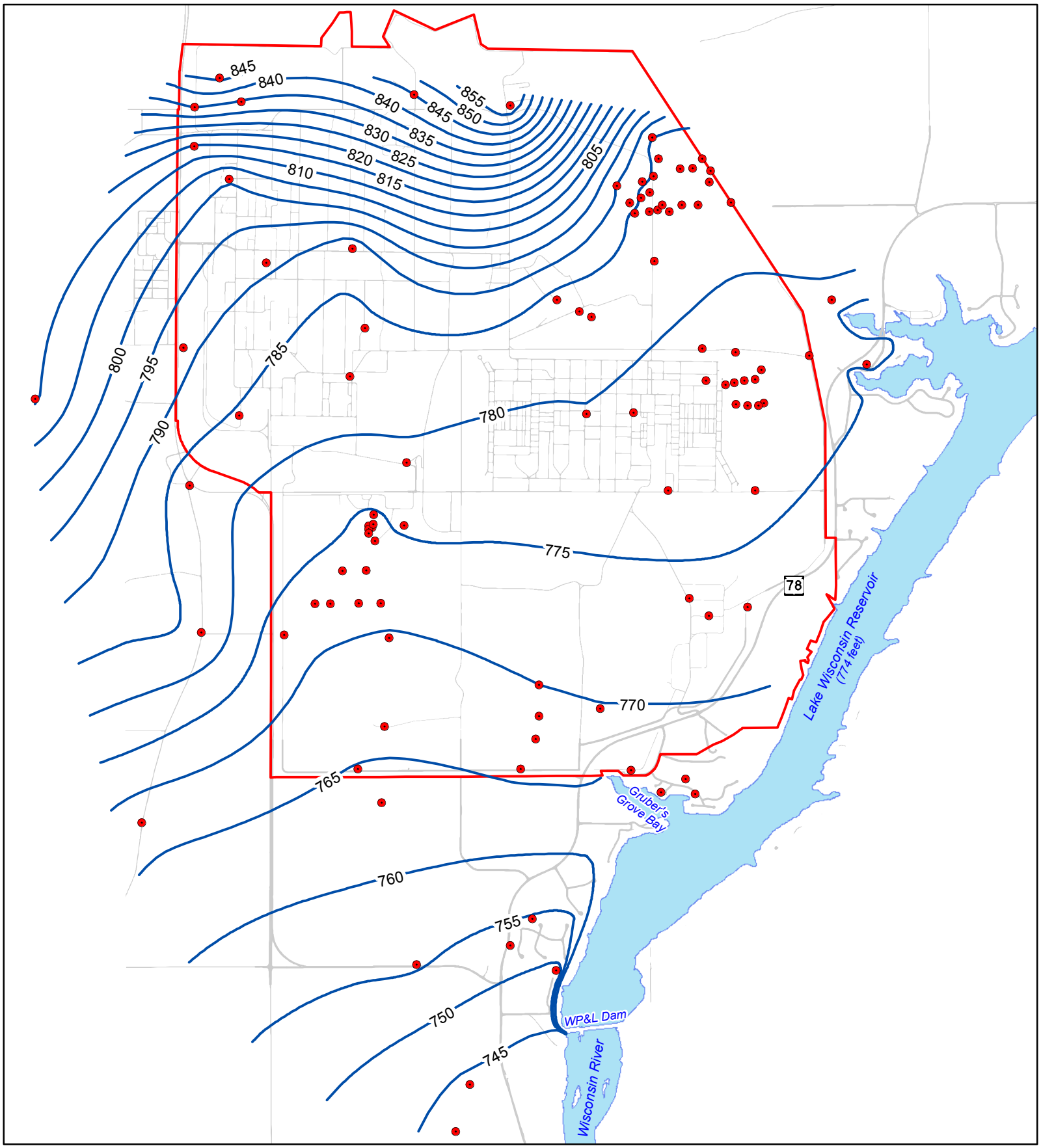

Legend

- Badger Army Ammunition Plant Boundary
- Monitoring Well (used to draw contours)
- Wisconsin River
- Paved Road
- Groundwater Contour
- Contour Interval = 5 feet

Figure 14

September 2010 Groundwater Contours
Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 3,475 feet

0 — 5,300 — 10,600 Feet

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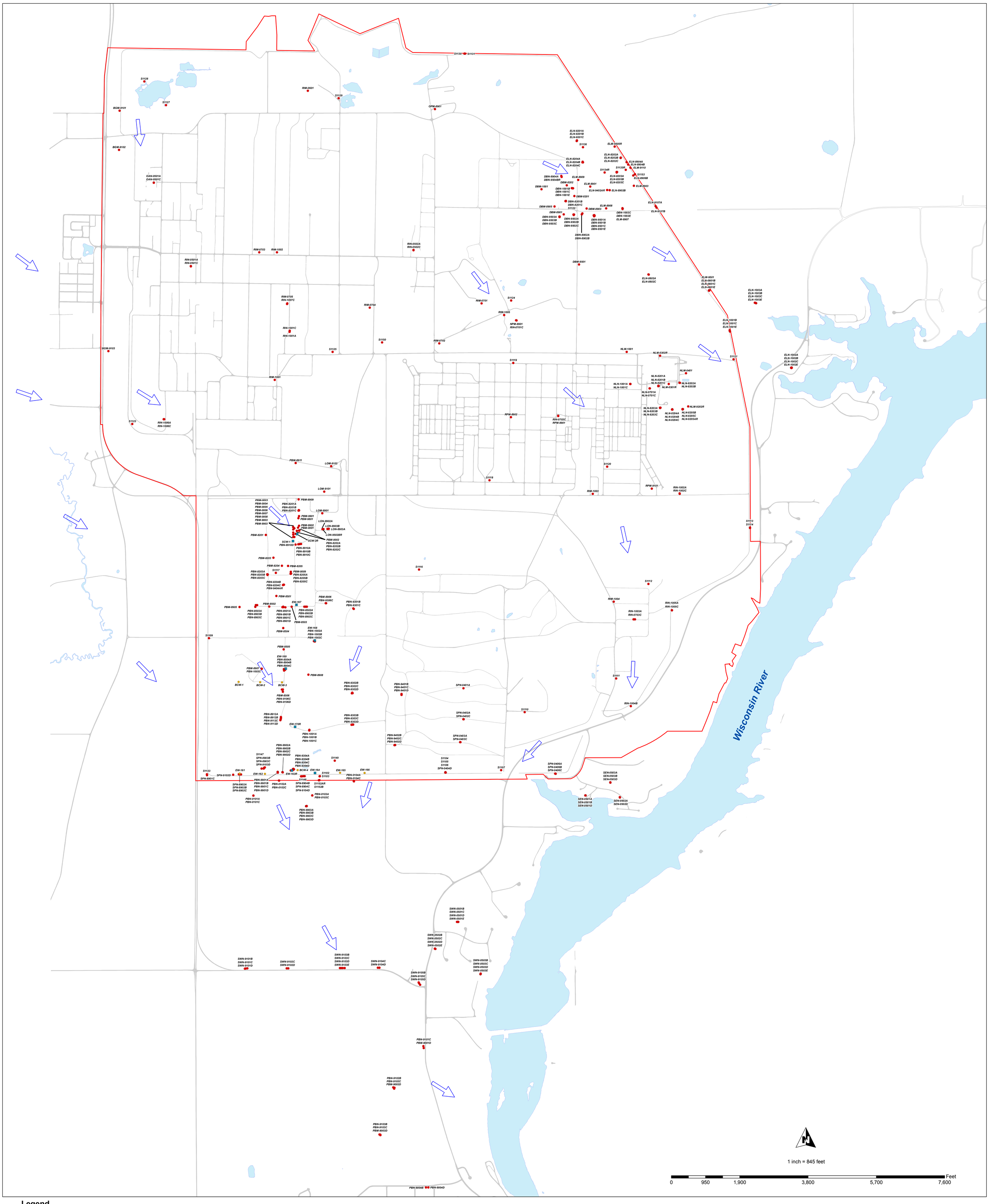
D:\GIS_Projects\Groundwater_Projects\
Municipal Well Planning\2011_AFS_GW\
MXDs\Fig_14_Sep_2010_Contours



Legend

- Badger Army Ammunition Plant Boundary
- Monitoring Well
- Existing Extraction Well
- Abandoned Extraction Well
- Groundwater Flow
- Paved Road
- Wisconsin River/Pond/Reservoir

Figure 15

Monitoring Well Locations
Alternative Feasibility Study Groundwater Remedial Strategy
Badger Army Ammunition Plant

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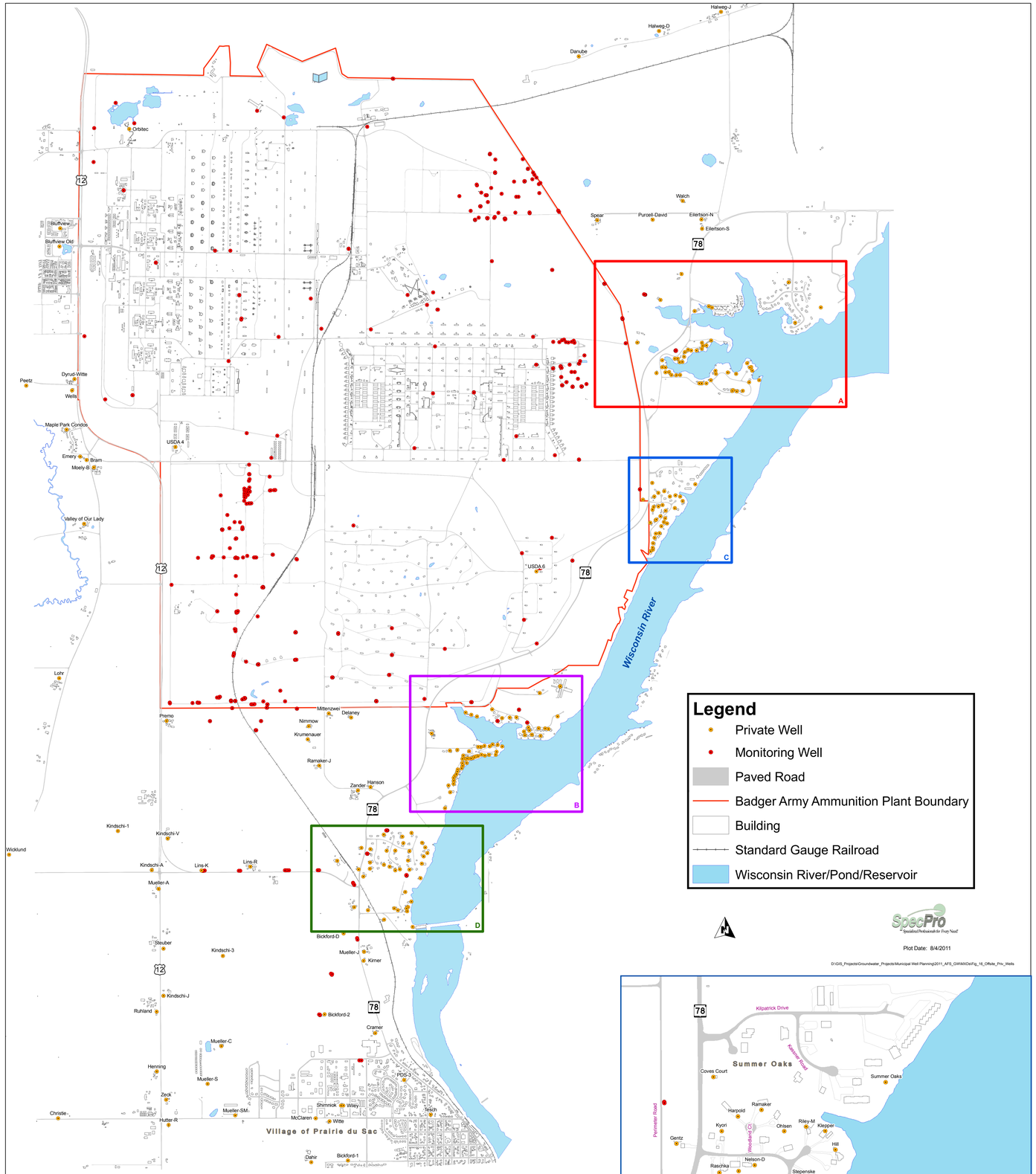
Plot Date: 8/4/2011

D:\GIS_Projects\Groundwater_Projects\Municipal Well Planning\2011_AFS_GW\MXD\s\Fig_15_Mon_Well_Loc_Map



Legend

- Private Well
- Monitoring Well
- Paved Road
- Badger Army Ammunition Plant Boundary
- Building
- Standard Gauge Railroad
- Wisconsin River/Pond/Reservoir

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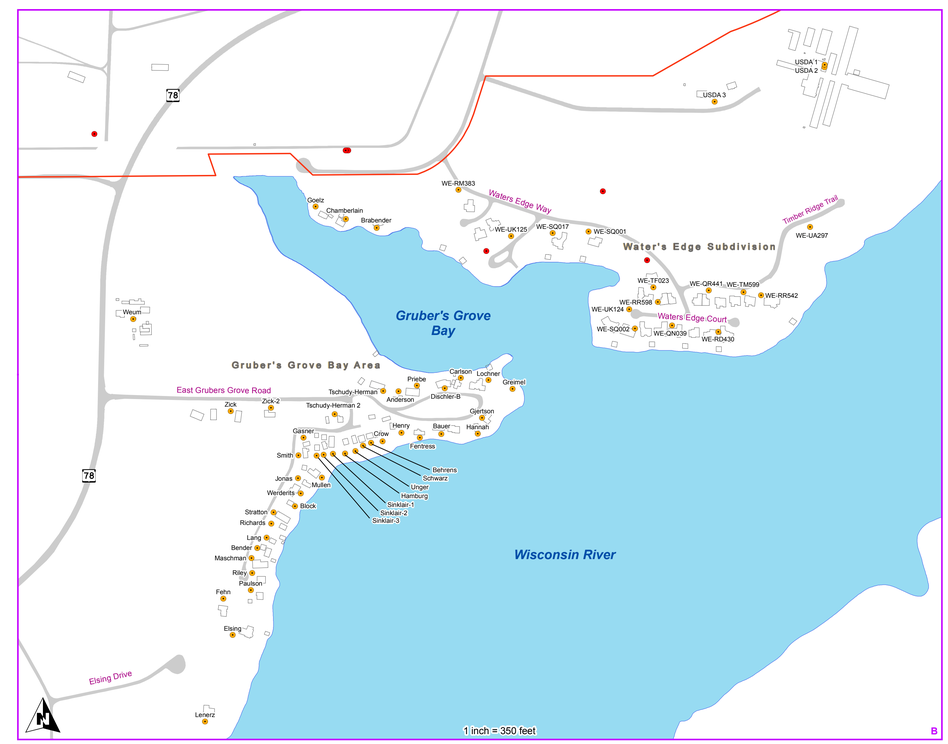
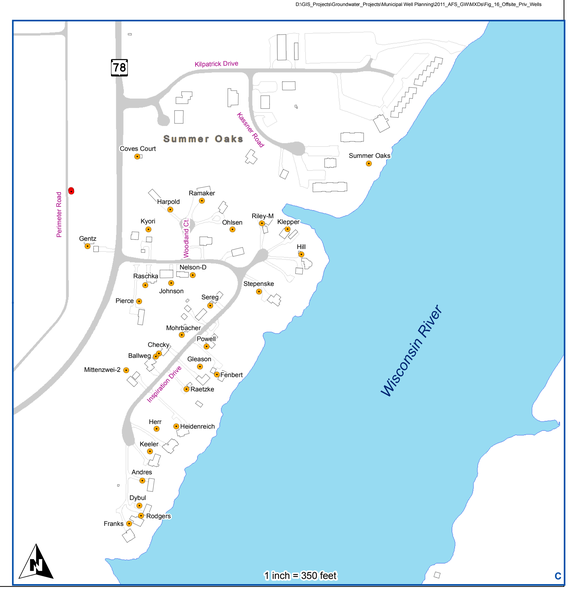
Plot Date: 8/4/2011

D:\GIS_Projects\Groundwater_Projects\Municipal Well Planning\2011_AFS_GWM\MXDs\Fig_16_Offsite_Priv_Wells





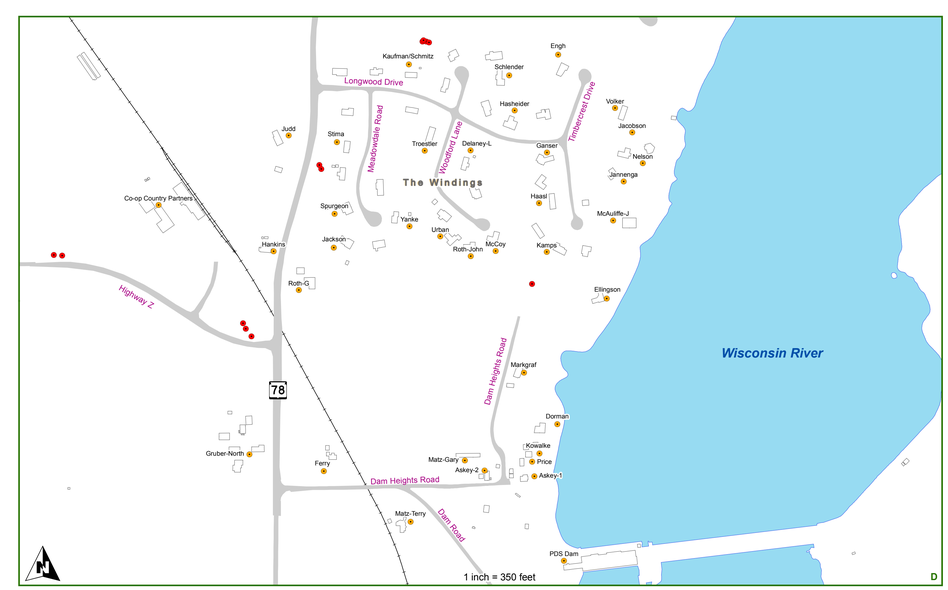
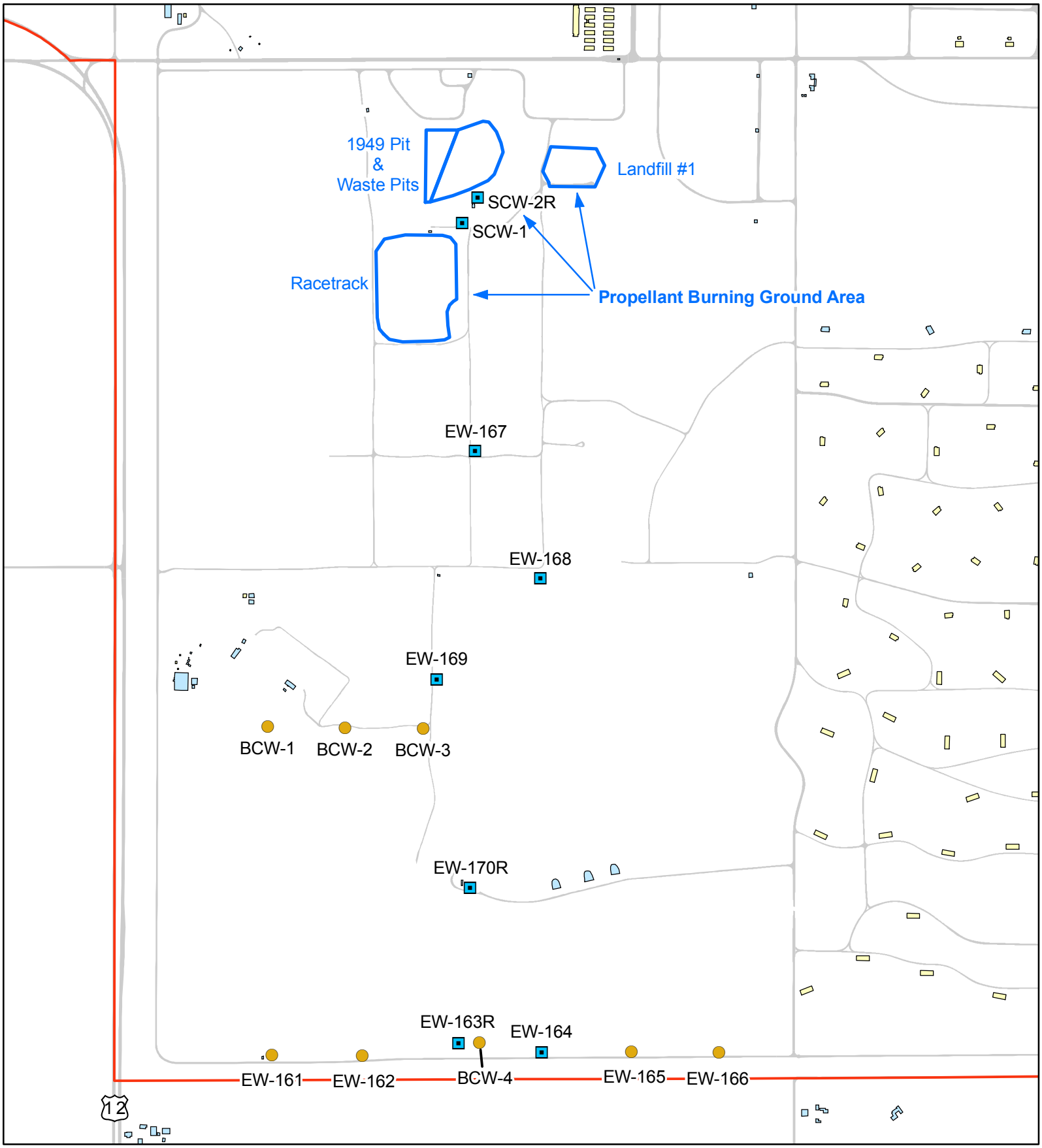


Figure 16

Off-Site Plume Area, Southeast Area, and Private Well Locations
Alternative Feasibility Study Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 1,400 feet

0 1,250 2,500 5,000 7,500 10,000 Feet



Legend

- Badger Army Ammunition Plant Boundary
- Existing Extraction Well
- Abandoned Extraction Well
- Source Area
- Paved Road
- Existing Building
- Former Building Footprint

Figure 17

Interim Remedial Measures (IRM) and Modified Interim Remedial Measures (MIRM) Extraction Wells
Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 975 feet

0 1,500 3,000 Feet

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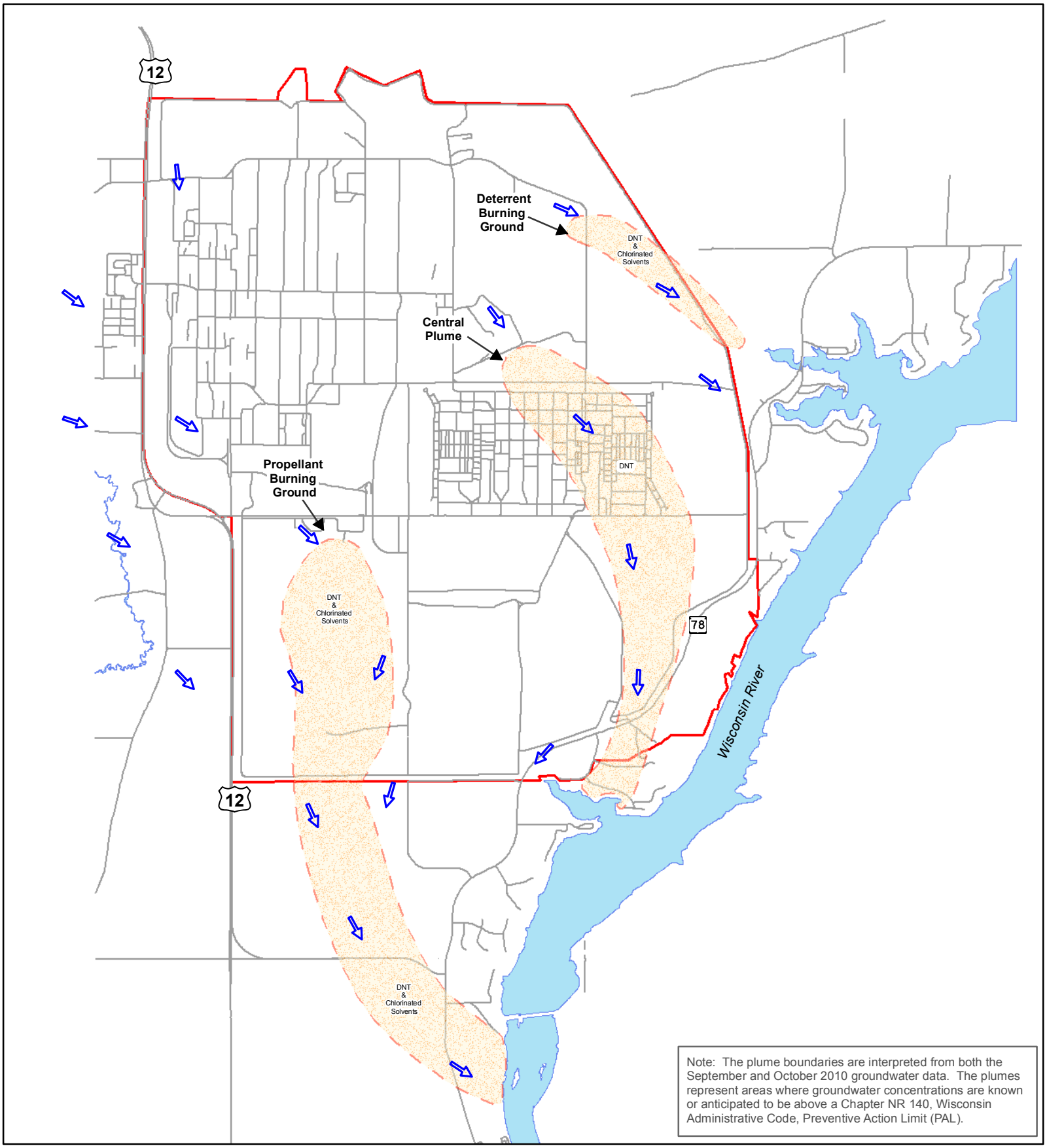
D:\GIS_Projects\Groundwater_Projects\Municipal Well Planning\2011_AFS_GW\MXDs\Fig_17_IRM_MIRM



Legend

- Badger Army Ammunition Plant Boundary
- Paved Road
- Groundwater Flow
- Groundwater Plume
- Wisconsin River
- DNT Dinitrotoluene

Figure 18

Groundwater Plumes
Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 3,750 feet

0 3,050 6,100 12,200 Feet

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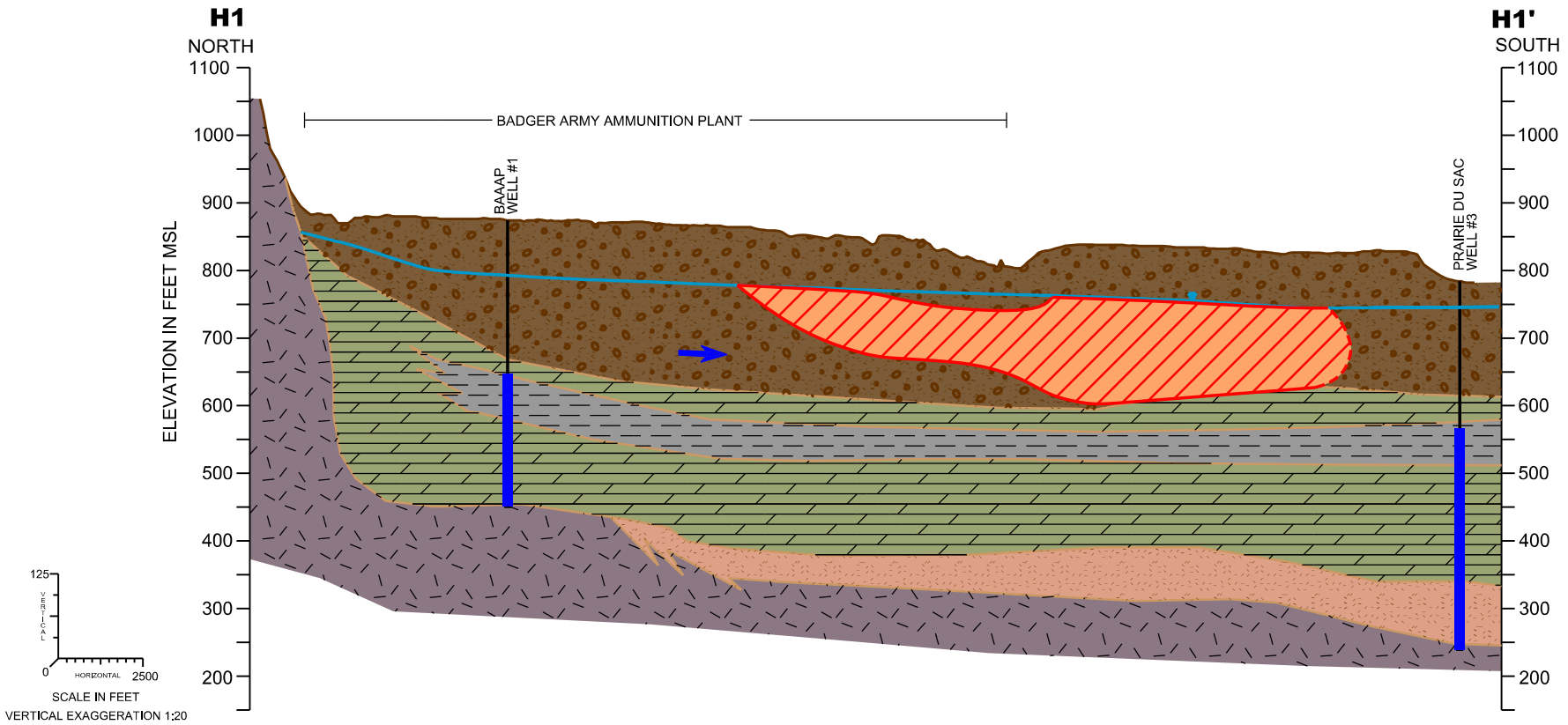
D:\GIS_Projects\Settling_Ponds\AFS_FC_SP_SDA\mxds\Fig_18_Plume_Areas



LEGEND

BAAAP WELL #1 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D &E)

GROUND SURFACE

WATER TABLE ELEVATION

DRINKING WATER WELL SCREEN

BOTTOM OF EXPLORATION

PROPELLANT BURNING GROUND GROUNDWATER CONTAMINATION PLUME, ESTIMATED WHERE DASHED

GROUNDWATER FLOW DIRECTION

GEOLOGIC DESCRIPTIONS:

- SAND AND GRAVEL, AQUIFER
- EAU CLAIRE FORMATION, AQUITARD/AQUIFER (SHALE, DOLOMITE, SILTSTONE, SANDSTONE)
- EAU CLAIRE FORMATION, AQUITARD (SHALE)
- MT. SIMON FORMATION, AQUIFER (SANDSTONE)
- BARABOO FORMATION, AQUITARD (QUARTZITE)

NOTES:
ADAPTED FROM GOTKOWITZ AND OTHERS (2005), HYDROGEOLOGY AND SIMULATION OF GROUNDWATER FLOW IN SAUK COUNTY, WISCONSIN

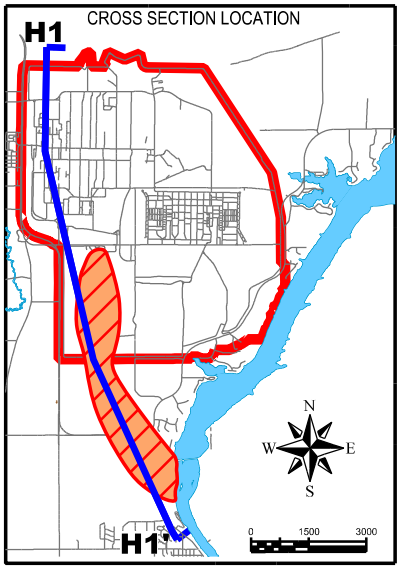


FIGURE 19

PROPELLANT BURNING GROUND GROUNDWATER PLUME CONCEPTUAL MODEL

ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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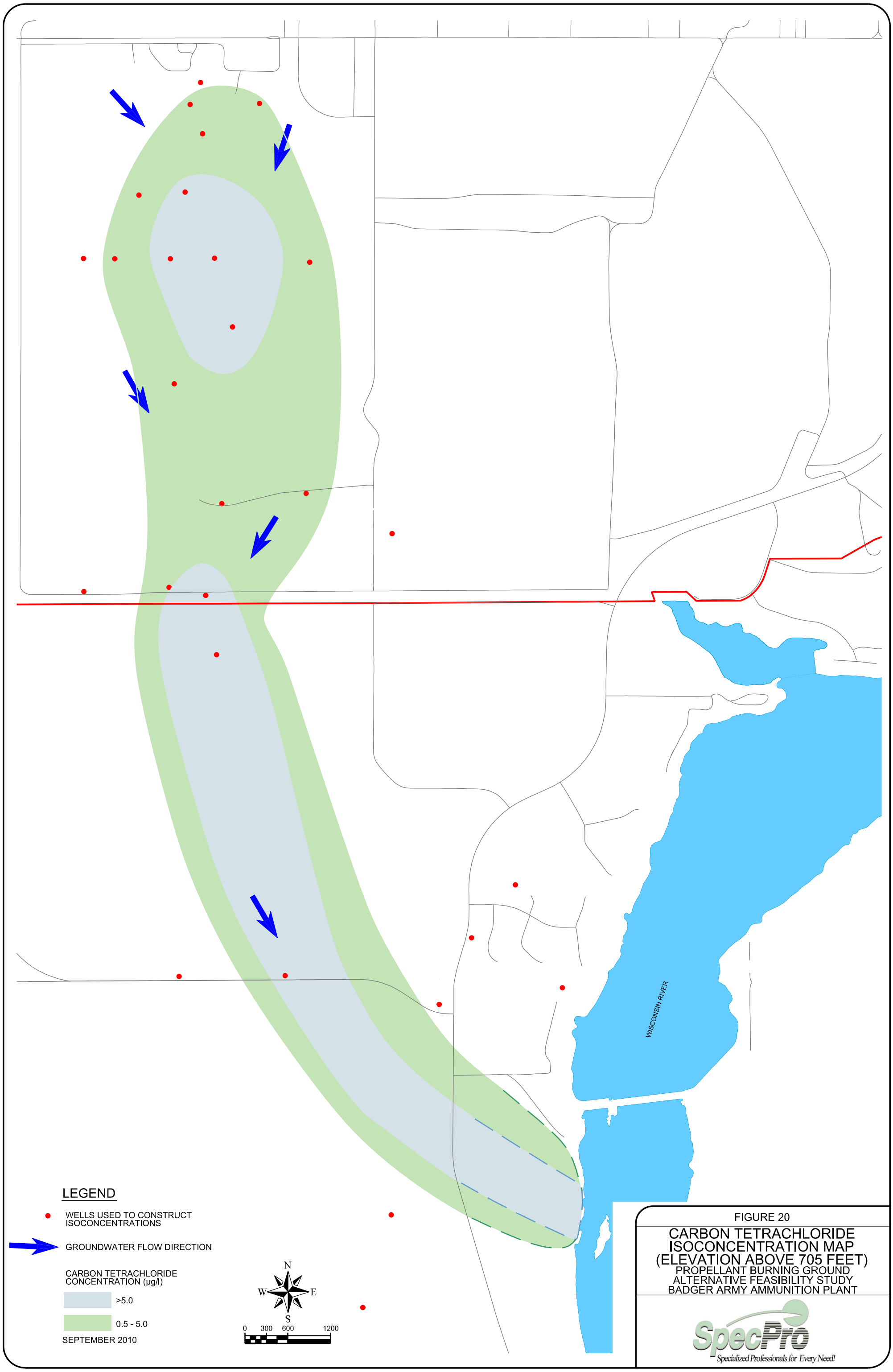
WISCONSIN RIVER
LEGEND
WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
GROUNDWATER FLOW DIRECTION
CARBON TETRACHLORIDE CONCENTRATION (µg/l)
>5.0
0.5 - 5.0
SEPTEMBER 2010
N
W
E
S
0
300
600
1200
FIGURE 20
CARBON TETRACHLORIDE ISOCONCENTRATION MAP (ELEVATION ABOVE 705 FEET)
PROPELLANT BURNING GROUND ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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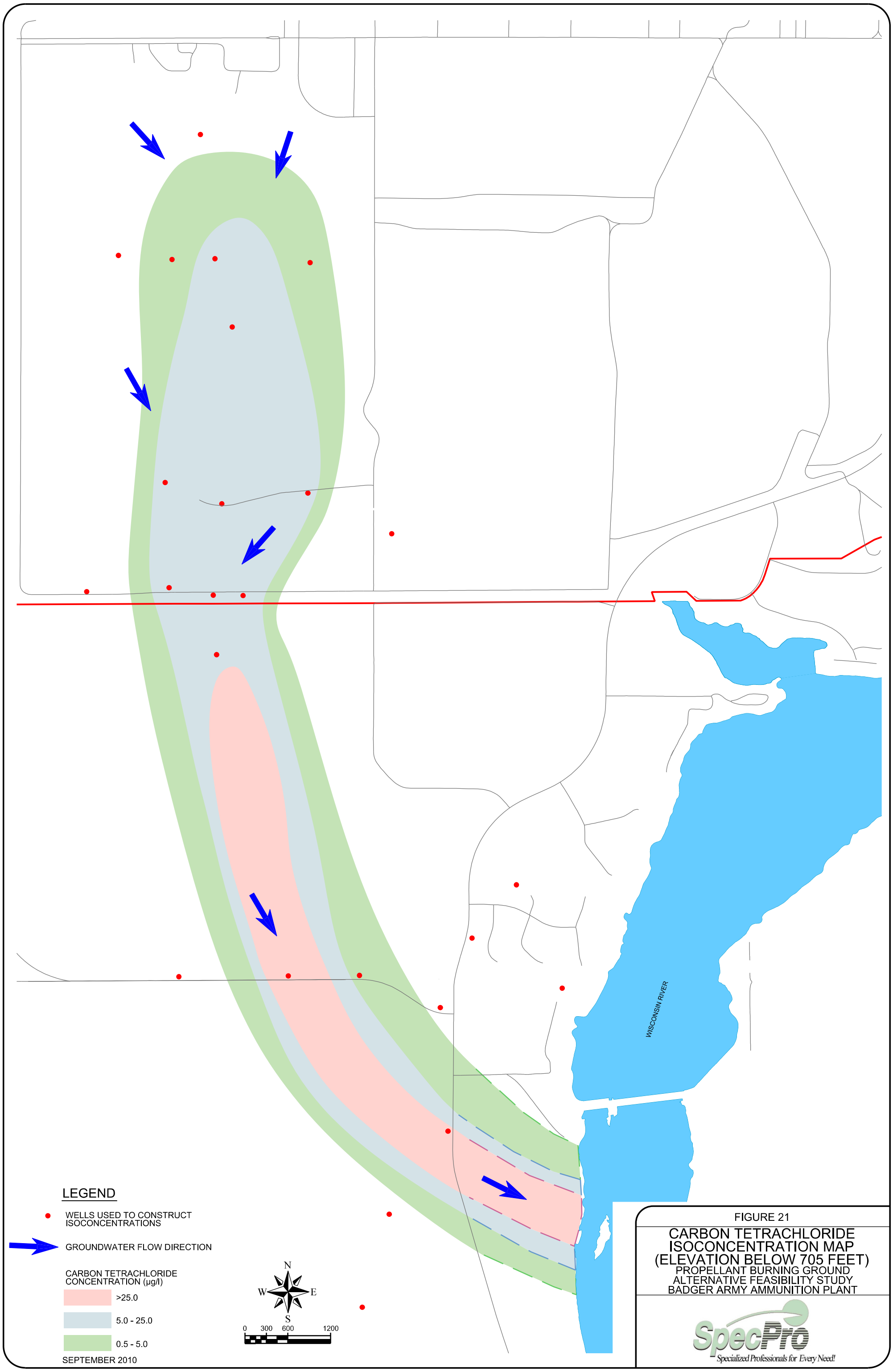
WISCONSIN RIVER
LEGEND
WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
GROUNDWATER FLOW DIRECTION
CARBON TETRACHLORIDE CONCENTRATION (µg/l)
>25.0
5.0 - 25.0
0.5 - 5.0
SEPTEMBER 2010
N
W
E
S
0
300
600
1200
FIGURE 21
CARBON TETRACHLORIDE ISOCONCENTRATION MAP (ELEVATION BELOW 705 FEET)
PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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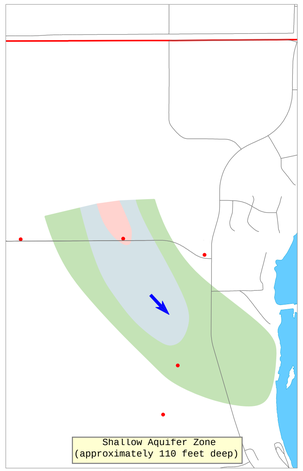
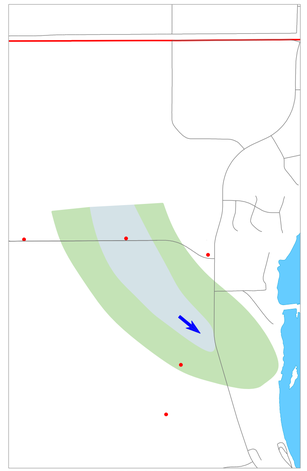


MARCH 1993 - B SERIES



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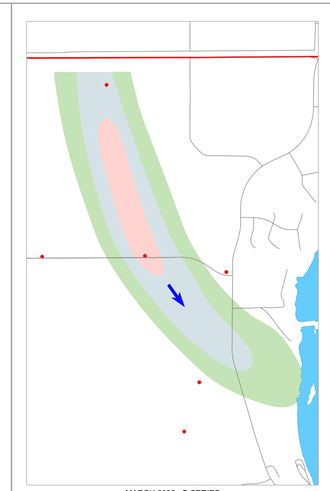
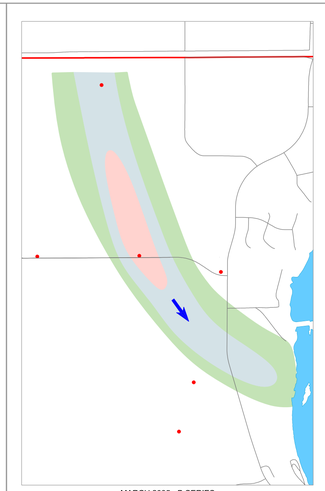


MARCH 2002 - B SERIES



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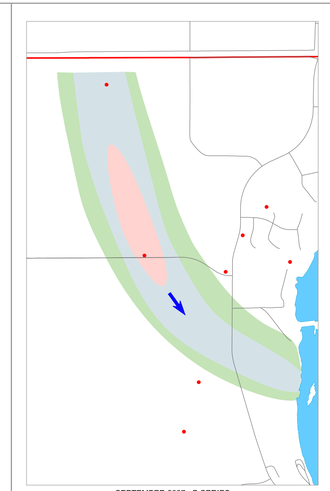
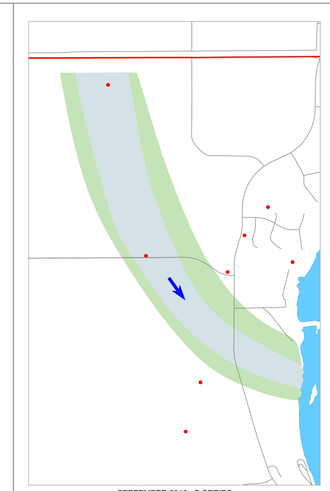
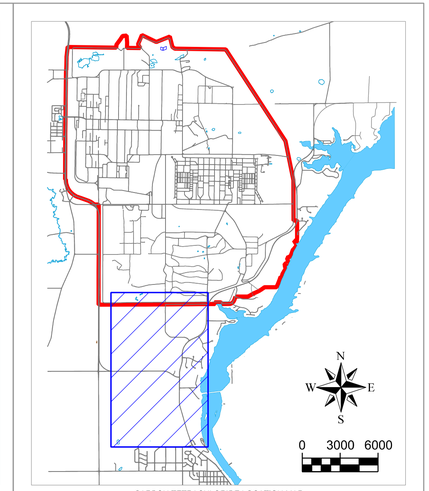


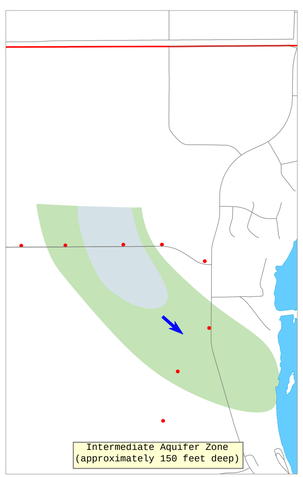
SEPTEMBER 2007 - B SERIES



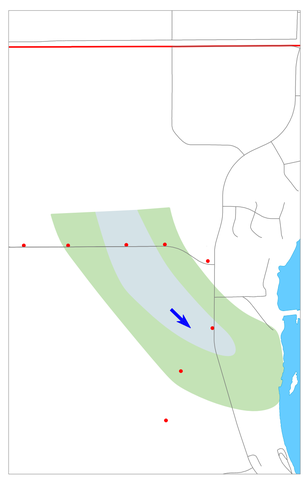
SEPTEMBER 2010 - B SERIES



CARBON TETRACHLORIDE LOCATION MAP



MARCH 1993 - C SERIES



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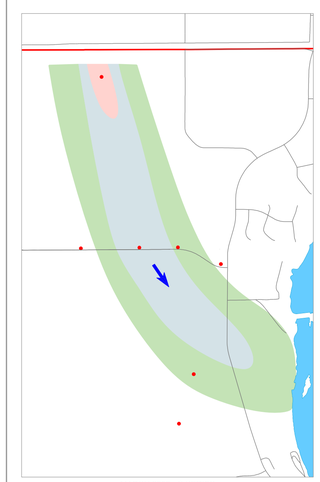
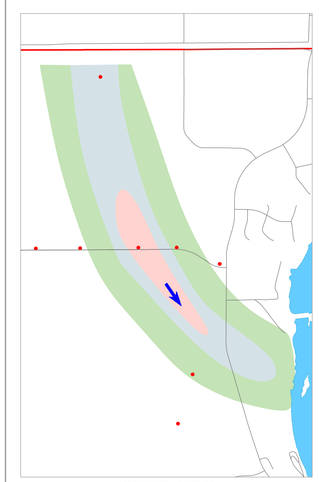
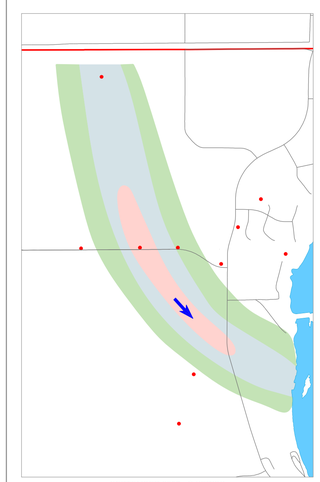


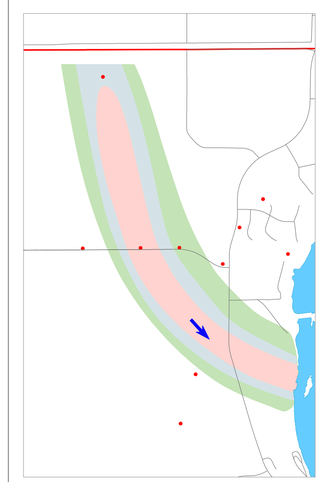
MARCH 2002 - C SERIES



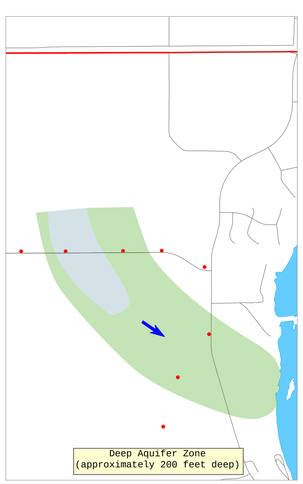
MARCH 2005 - C SERIES



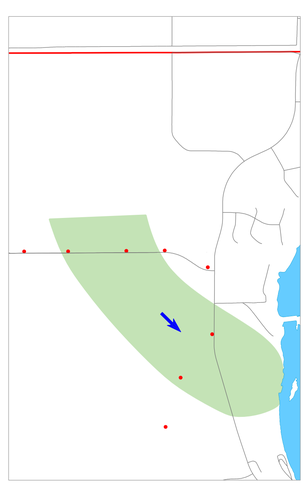
SEPTEMBER 2007 - C SERIES



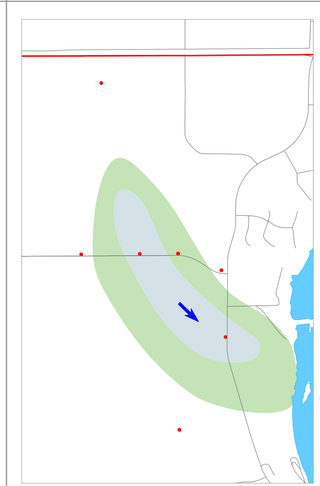
SEPTEMBER 2010 - C SERIES



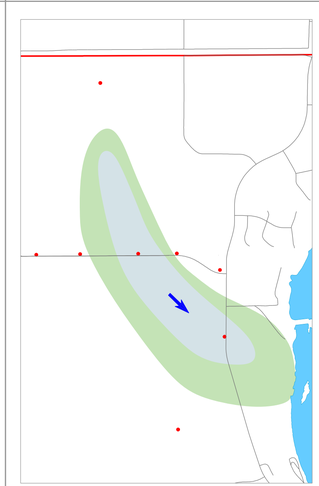
MARCH 1993 - D-E SERIES



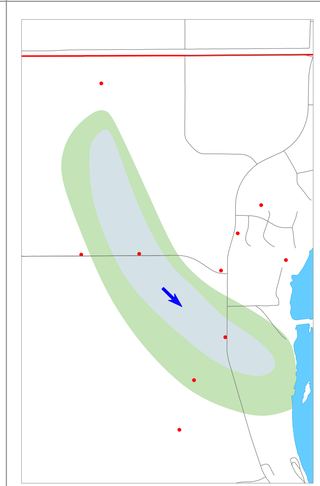
MARCH 1997 - D-E SERIES



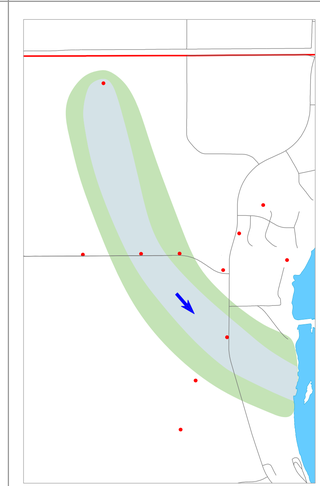
MARCH 2002 - D-E SERIES



MARCH 2005 - D-E SERIES



SEPTEMBER 2007 - D-E SERIES



SEPTEMBER 2010 - D-E SERIES

LEGEND

- WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
- GROUNDWATER FLOW DIRECTION

CARBON TETRACHLORIDE CONCENTRATION (µg/l)

- >25.0
- 5.0 - 25.0
- 0.5 - 5.0

N
W E
S

0 1000 2000 4000

Note: Groundwater in this area is approximately 80 feet deep

FIGURE 22

MARCH 1993 - SEPTEMBER 2010
CARBON TETRACHLORIDE
ISOCONCENTRATION MAP
PROPELLANT BURNING GROUND - OFF-SITE AREA
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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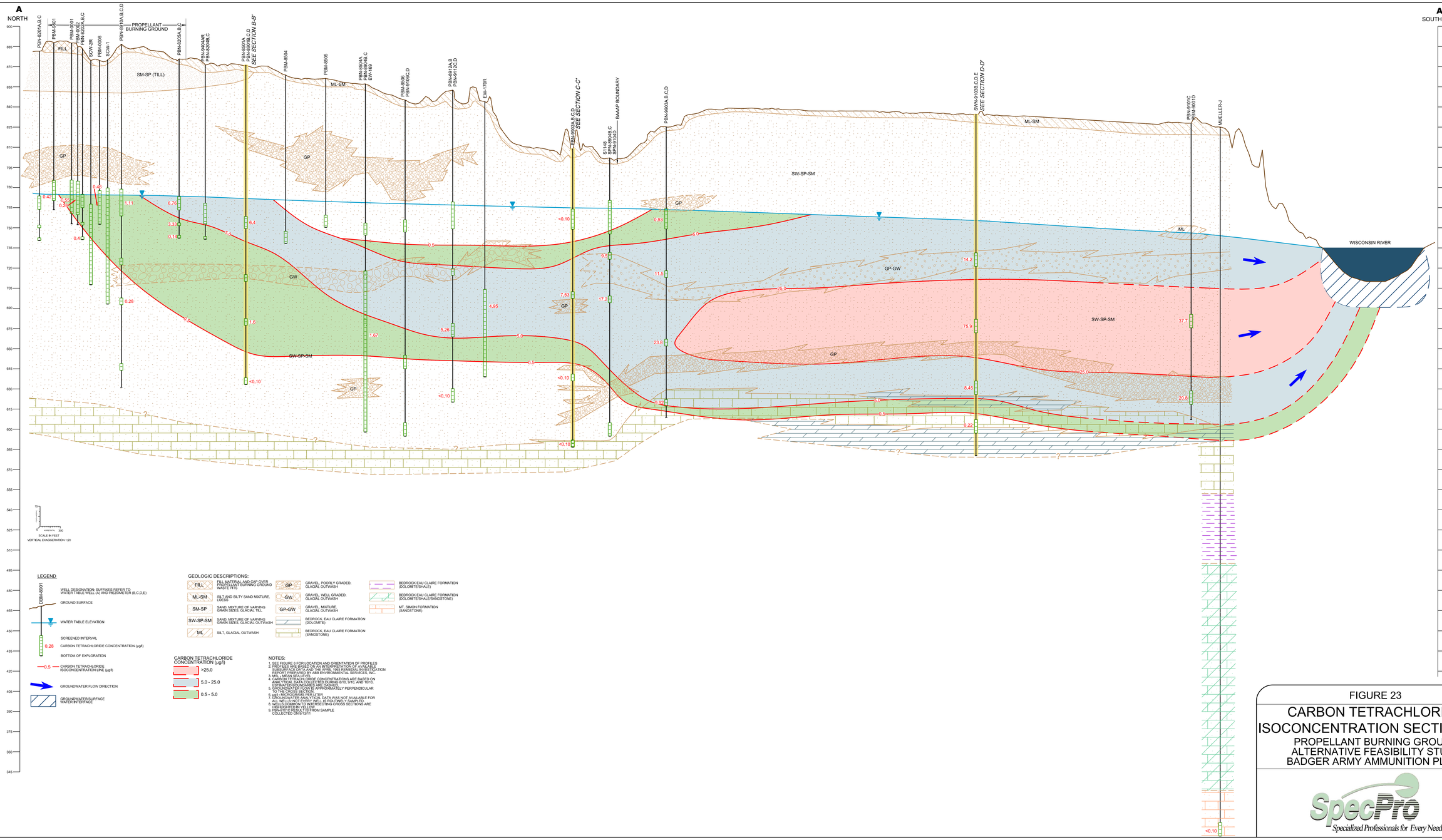
A
NORTH
A'
SOUTH
PROPELLANT BURNING GROUND
SEE SECTION B-B'
SEE SECTION C-C'
SEE SECTION D-D'
BAAAP BOUNDARY
WISCONSIN RIVER
FILL
SM-SP (TILL)
ML-SM
GP
GW
GP-GW
SW-SP-SM
ML
SCALE IN FEET
VERTICAL EXAGGERATION 120
LEGEND
WELL DESIGNATION: SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)
GROUND SURFACE
WATER TABLE ELEVATION
SCREENED INTERVAL
CARBON TETRACHLORIDE CONCENTRATION (µg/l)
BOTTOM OF EXPLORATION
CARBON TETRACHLORIDE ISOCONCENTRATION LINE (µg/l)
GROUNDWATER FLOW DIRECTION
GROUNDWATER/SURFACE WATER INTERFACE
GEOLOGIC DESCRIPTIONS:
FILL: F&L MATERIAL AND CAP OVER PROPELLANT BURNING GROUND WASTE PITS
ML-SM: SILT AND SILTY SAND MIXTURE, LOESS
SM-SP: SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-SP-SM: SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
ML: SILT, GLACIAL OUTWASH
GP: GRAVEL, POORLY GRADED, GLACIAL OUTWASH
GW: GRAVEL, WELL GRADED, GLACIAL OUTWASH
GP-GW: GRAVEL, MIXTURE, GLACIAL OUTWASH
BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)
BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)
BEDROCK EAU CLAIRE FORMATION (DOLOMITE/SHALE)
BEDROCK EAU CLAIRE FORMATION (DOLOMITE/SHALE/SANDSTONE)
MT. SIMON FORMATION (SANDSTONE)
CARBON TETRACHLORIDE CONCENTRATION (µg/l)
>25.0
5.0 - 25.0
0.5 - 5.0
NOTES:
1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. CARBON TETRACHLORIDE CONCENTRATIONS ARE BASED ON DATA FROM 1993 AND 1994 SAMPLING EVENTS 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTIONS.
6. (µG) = MICROGRAMS PER LITER
7. GROUNDWATER ANALYTICAL DATA WAS NOT AVAILABLE FOR ALL WELLS, NOT EVERY WELL IS ROUTINELY SAMPLED.
8. ALL WELLS NOT ON THE INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW.
9. PBN-8101C RESULT IS FROM SAMPLE COLLECTED ON 9/13/11
FIGURE 23
CARBON TETRACHLORIDE ISOCONCENTRATION SECTION A-A'
PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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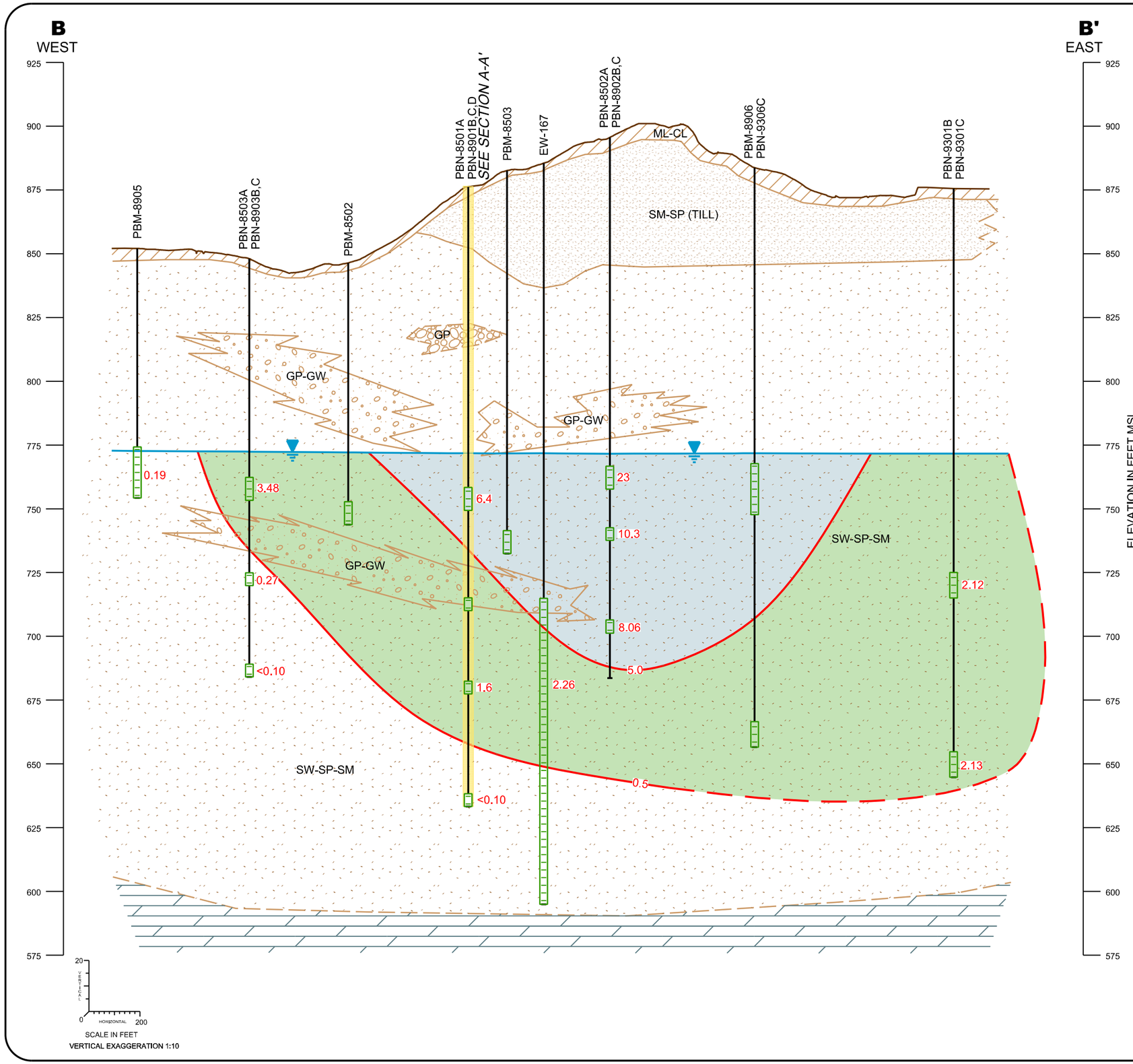

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

2.2 — CARBON TETRACHLORIDE CONCENTRATION (µg/l)

SCREENED INTERVAL

BOTTOM OF EXPLORATION

0.5 — CARBON TETRACHLORIDE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

- ML-CL — SILT AND CLAY MIXTURE, LOESS
- SM-SP — SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
- SW-SP-SM — SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
- GP — GRAVEL, POORLY GRADED, GLACIAL OUTWASH
- GP-GW — GRAVEL, MIXTURE, GLACIAL OUTWASH
- BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)

CARBON TETRACHLORIDE CONCENTRATION (µg/l)

- >5.0
- 0.5 - 5.0

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. CARBON TETRACHLORIDE CONCENTRATIONS ARE BASED ON ANALYTICAL DATA COLLECTED DURING 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. µg/l - MICROGRAMS PER LITER
7. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 24

CARBON TETRACHLORIDE ISOCONCENTRATION SECTION B-B'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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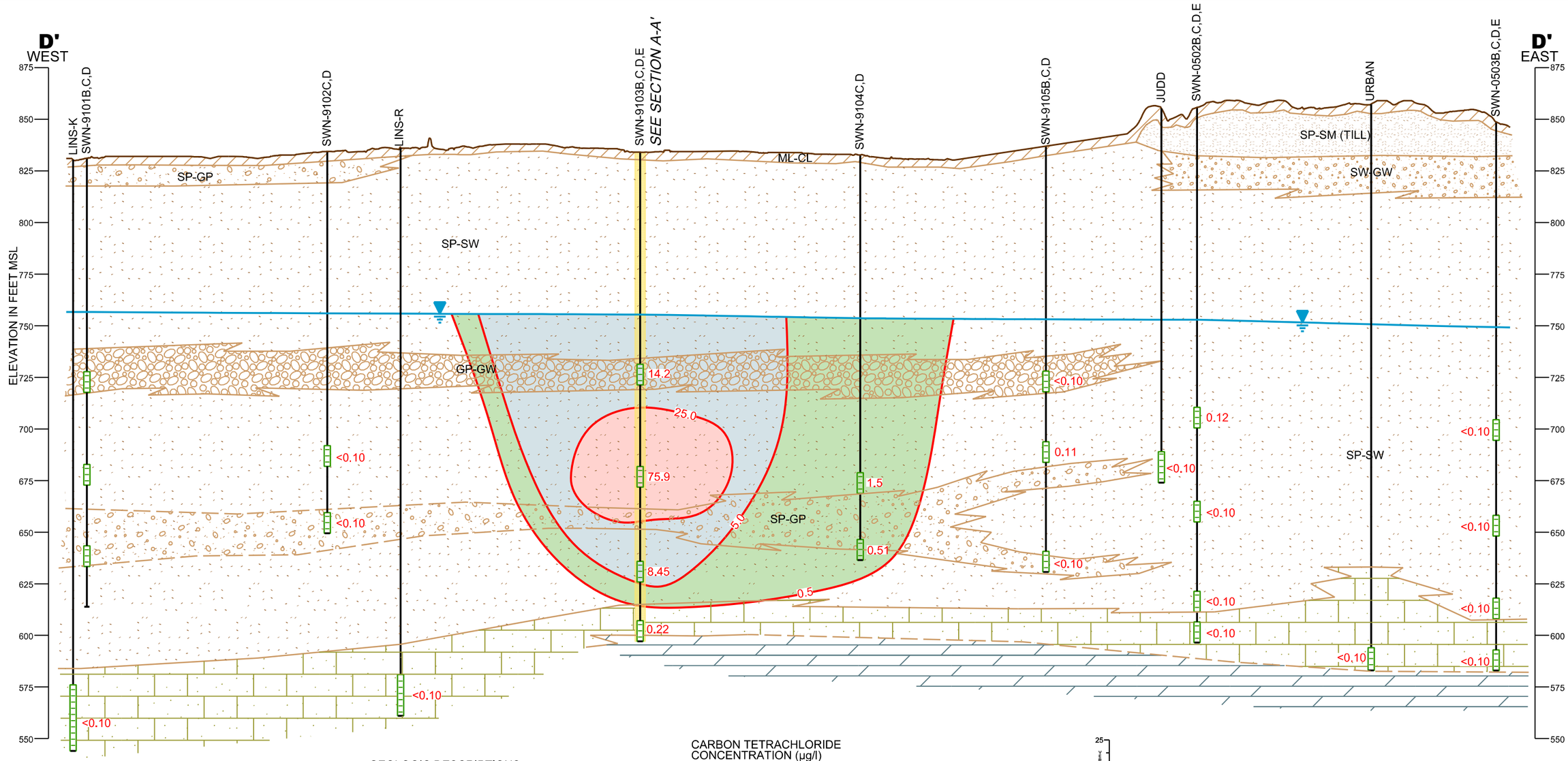

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

8.4 — CARBON TETRACHLORIDE CONCENTRATION (µg/l)

BOTTOM OF EXPLORATION

5.0 — CARBON TETRACHLORIDE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SP-GP	SAND AND GRAVEL, GLACIAL OUTWASH
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SP-SW	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
GP-GW	GRAVEL, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)

CARBON TETRACHLORIDE CONCENTRATION (µg/l)

- >25.0
- 5.0 - 25.0
- 0.5 - 5.0

VERTICAL 25 — 0 — HORIZONTAL 250

SCALE IN FEET

VERTICAL EXAGGERATION 1:10

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. CARBON TETRACHLORIDE CONCENTRATIONS ARE BASED ON ANALYTICAL DATA COLLECTED DURING 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. µg/l - MICROGRAMS PER LITER
7. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 25

CARBON TETRACHLORIDE ISOCONCENTRATION SECTION D-D'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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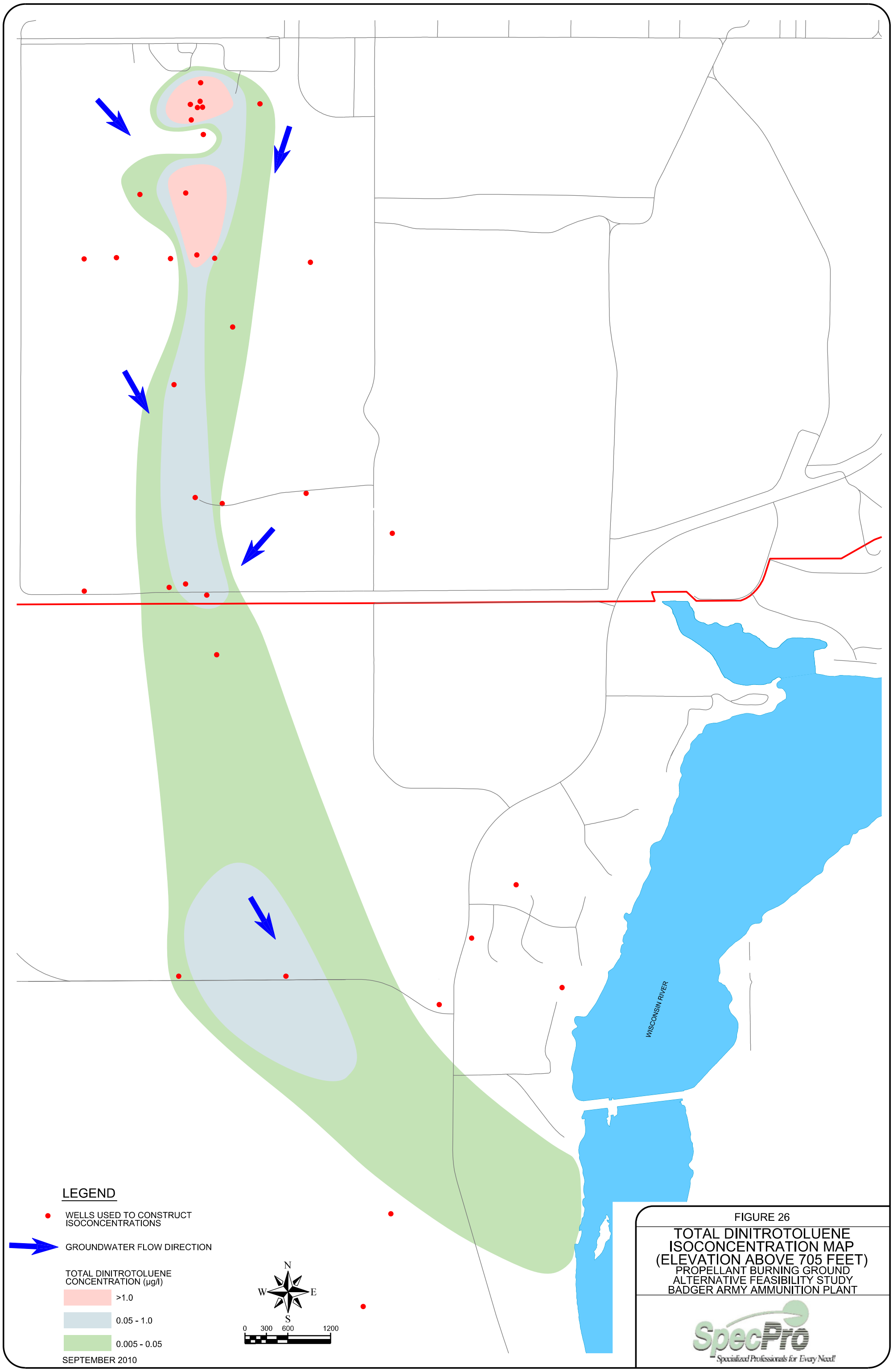
WISCONSIN RIVER
LEGEND
WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
GROUNDWATER FLOW DIRECTION
TOTAL DINITROTOLUENE CONCENTRATION (µg/l)
>1.0
0.05 - 1.0
0.005 - 0.05
SEPTEMBER 2010
N
W
E
S
0
300
600
1200
FIGURE 26
TOTAL DINITROTOLUENE ISOCONCENTRATION MAP (ELEVATION ABOVE 705 FEET)
PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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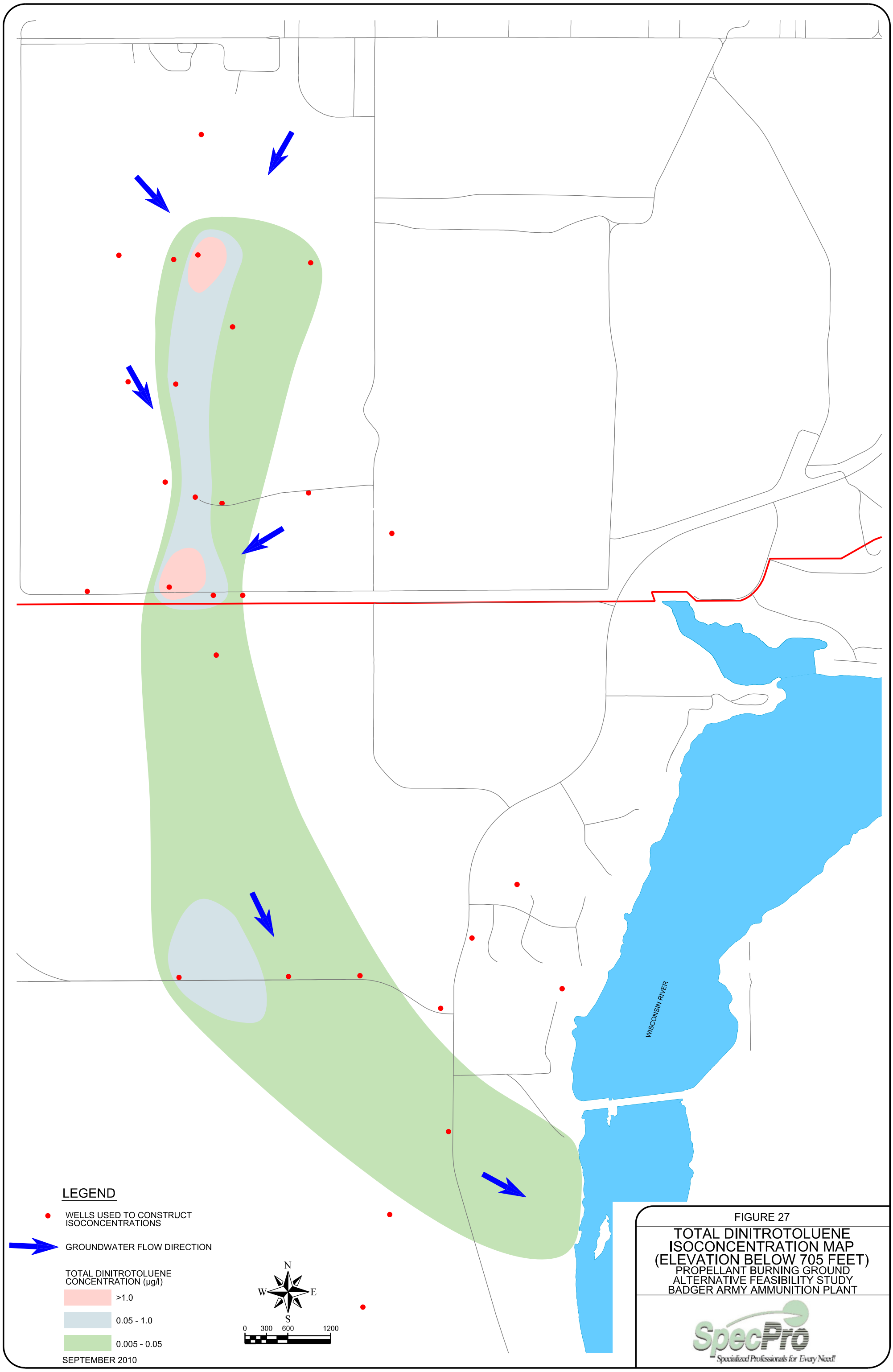
WISCONSIN RIVER
LEGEND
WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
GROUNDWATER FLOW DIRECTION
TOTAL DINITROTOLUENE CONCENTRATION (µg/l)
>1.0
0.05 - 1.0
0.005 - 0.05
SEPTEMBER 2010
N
W
E
S
0
300
600
1200
FIGURE 27
TOTAL DINITROTOLUENE ISOCONCENTRATION MAP (ELEVATION BELOW 705 FEET)
PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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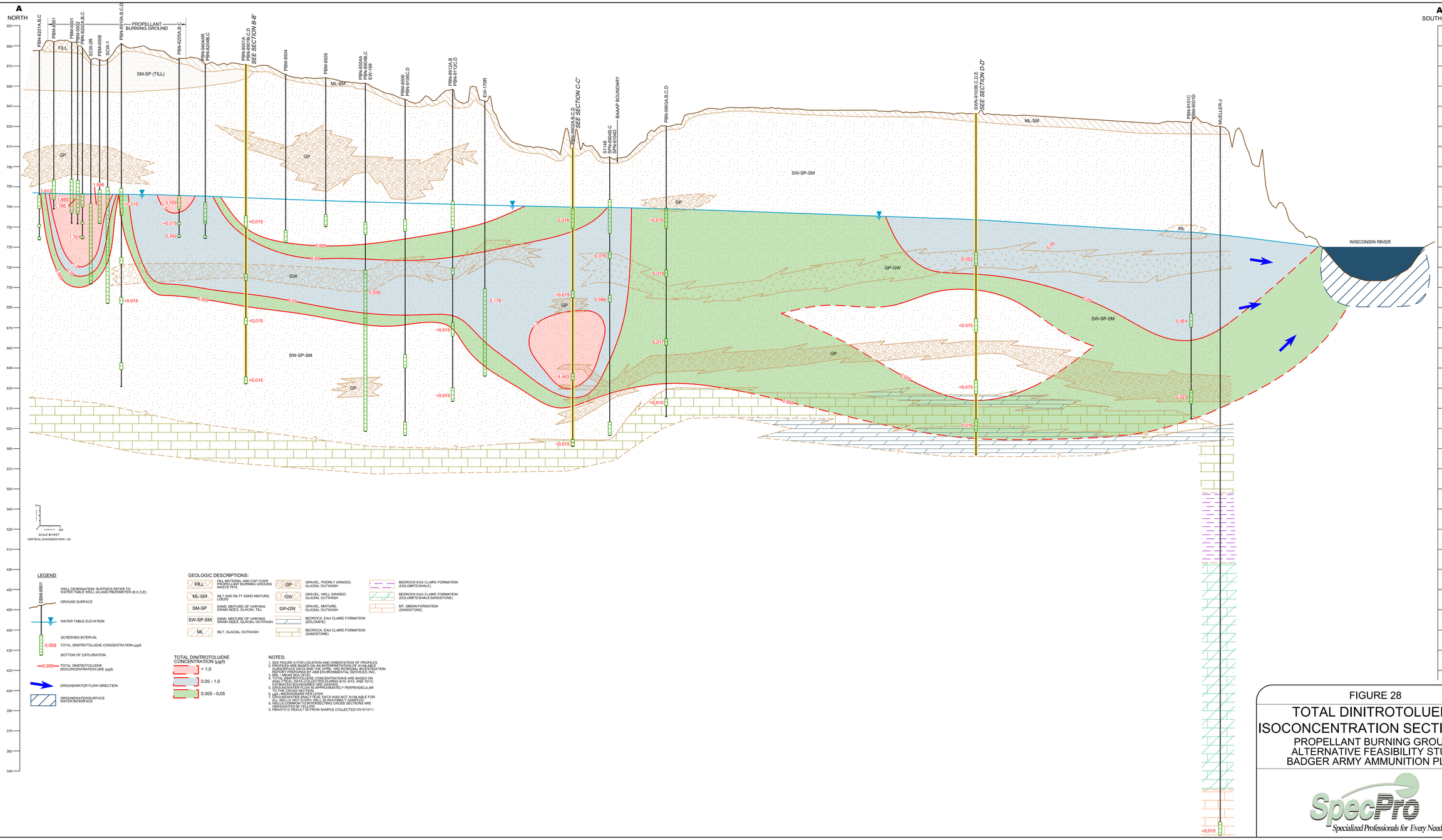

FIGURE 28

TOTAL DINITROTOLUENE ISOCONCENTRATION SECTION A-A'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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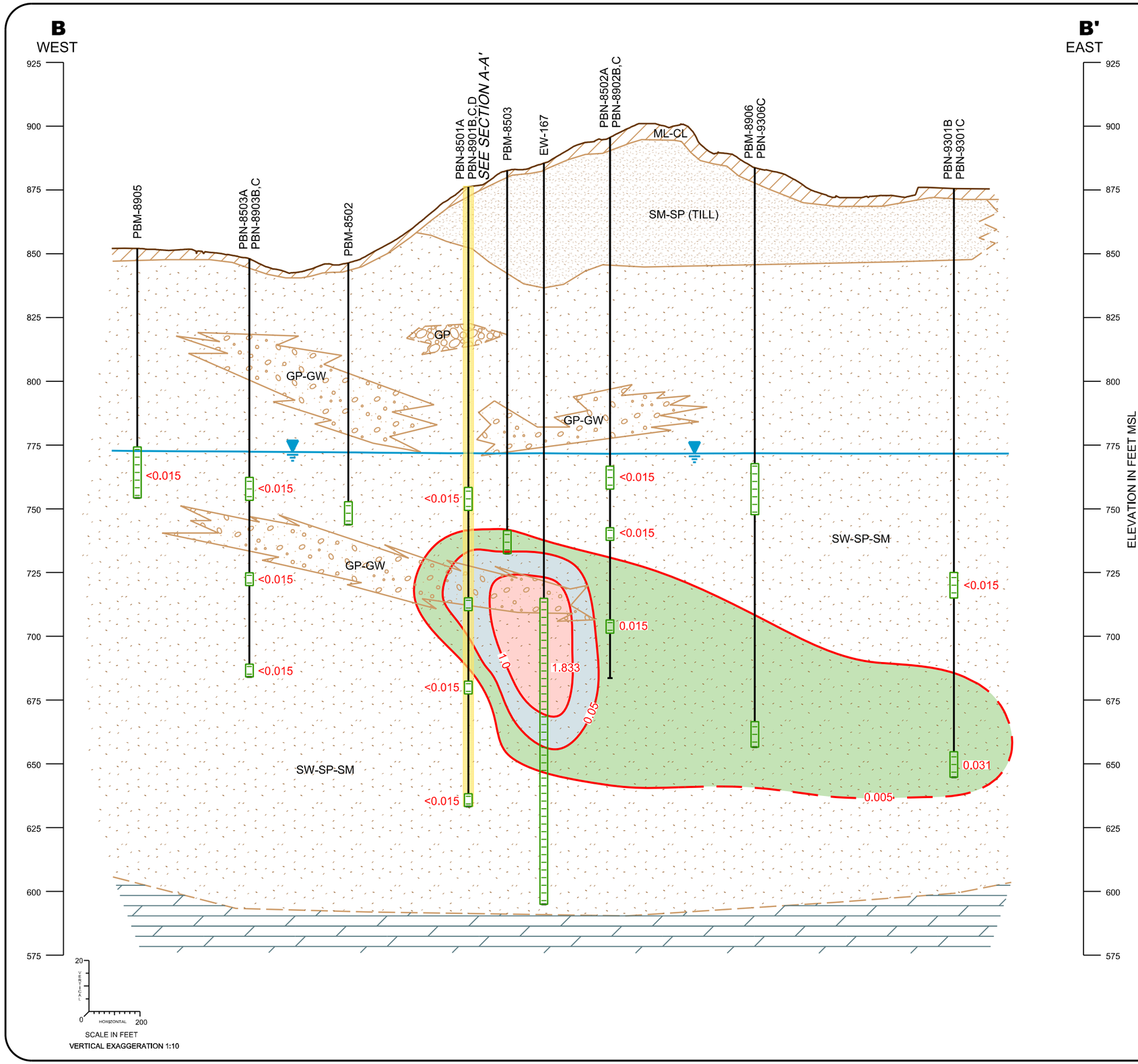

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

0.018 — TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

SCREENED INTERVAL

BOTTOM OF EXPLORATION

0.005 — TOTAL DINITROTOLUENE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

- ML-CL — SILT AND CLAY MIXTURE, LOESS
- SM-SP — SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
- SW-SP-SM — SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
- GP — GRAVEL, POORLY GRADED, GLACIAL OUTWASH
- GP-GW — GRAVEL, MIXTURE, GLACIAL OUTWASH
- BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)

TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

- >1.0
- 0.05 - 1.0
- 0.005 - 0.05

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. TOTAL DINITROTOLUENE CONCENTRATIONS ARE BASED ON ANALYTICAL DATA COLLECTED DURING 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. µg/l - MICROGRAMS PER LITER
7. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 29

TOTAL DINITROTOLUENE ISOCONCENTRATION SECTION B-B'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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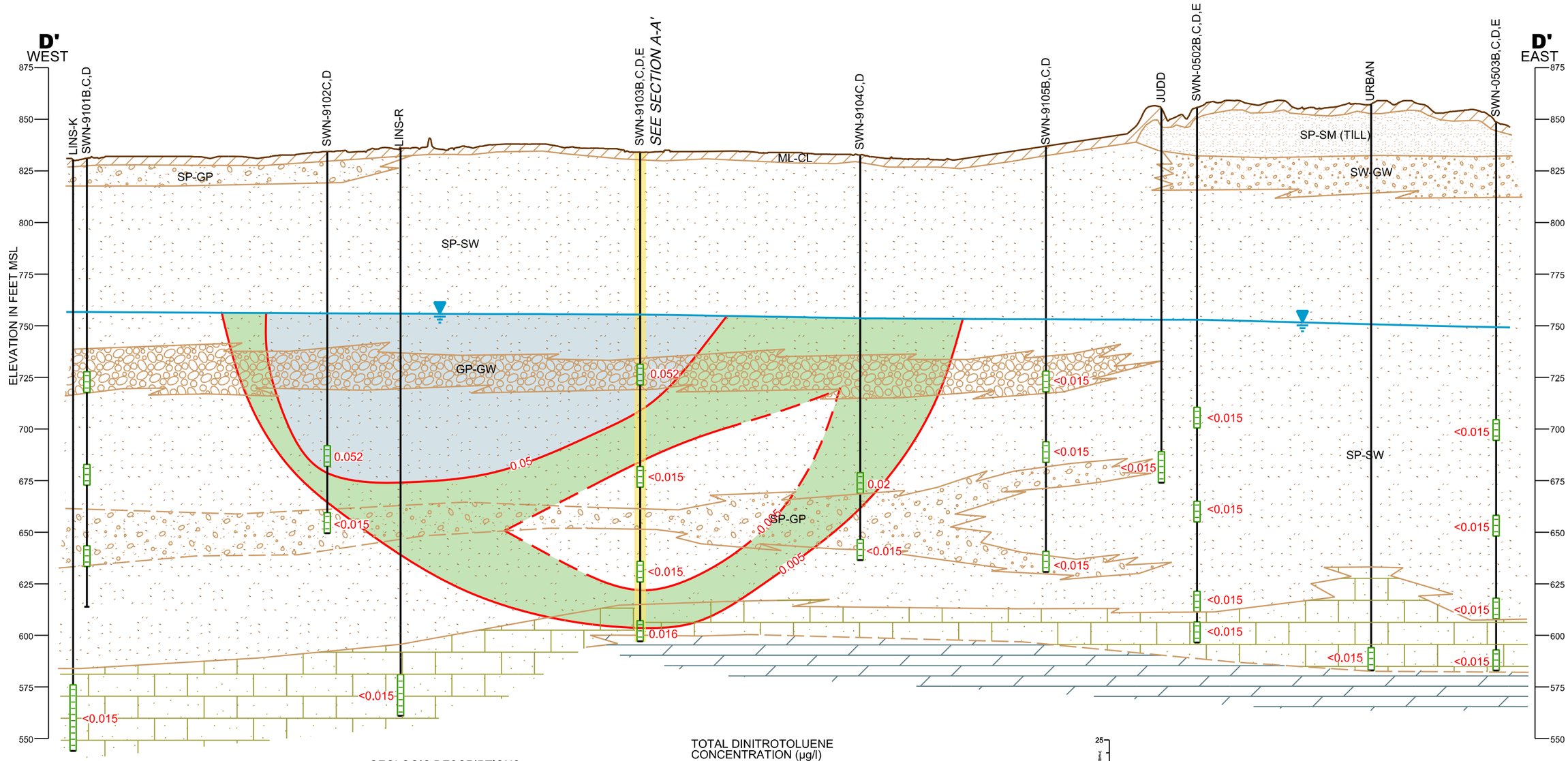

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

0.02 — TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

BOTTOM OF EXPLORATION

0.005 — TOTAL DINITROTOLUENE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SP-GP	SAND AND GRAVEL, GLACIAL OUTWASH
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SP-SW	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
GP-GW	GRAVEL, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (DOLOMITE)
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)

TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

>0.05

0.005 - 0.05

VERTICAL 25 — 0 — HORIZONTAL 250

SCALE IN FEET

VERTICAL EXAGGERATION 1:10

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. TOTAL DINITROTOLUENE CONCENTRATIONS ARE BASED ON ANALYTICAL DATA COLLECTED DURING 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. µg/l - MICROGRAMS PER LITER
7. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 30

TOTAL DINITROTOLUENE ISOCONCENTRATION SECTION D-D'

PROPELLANT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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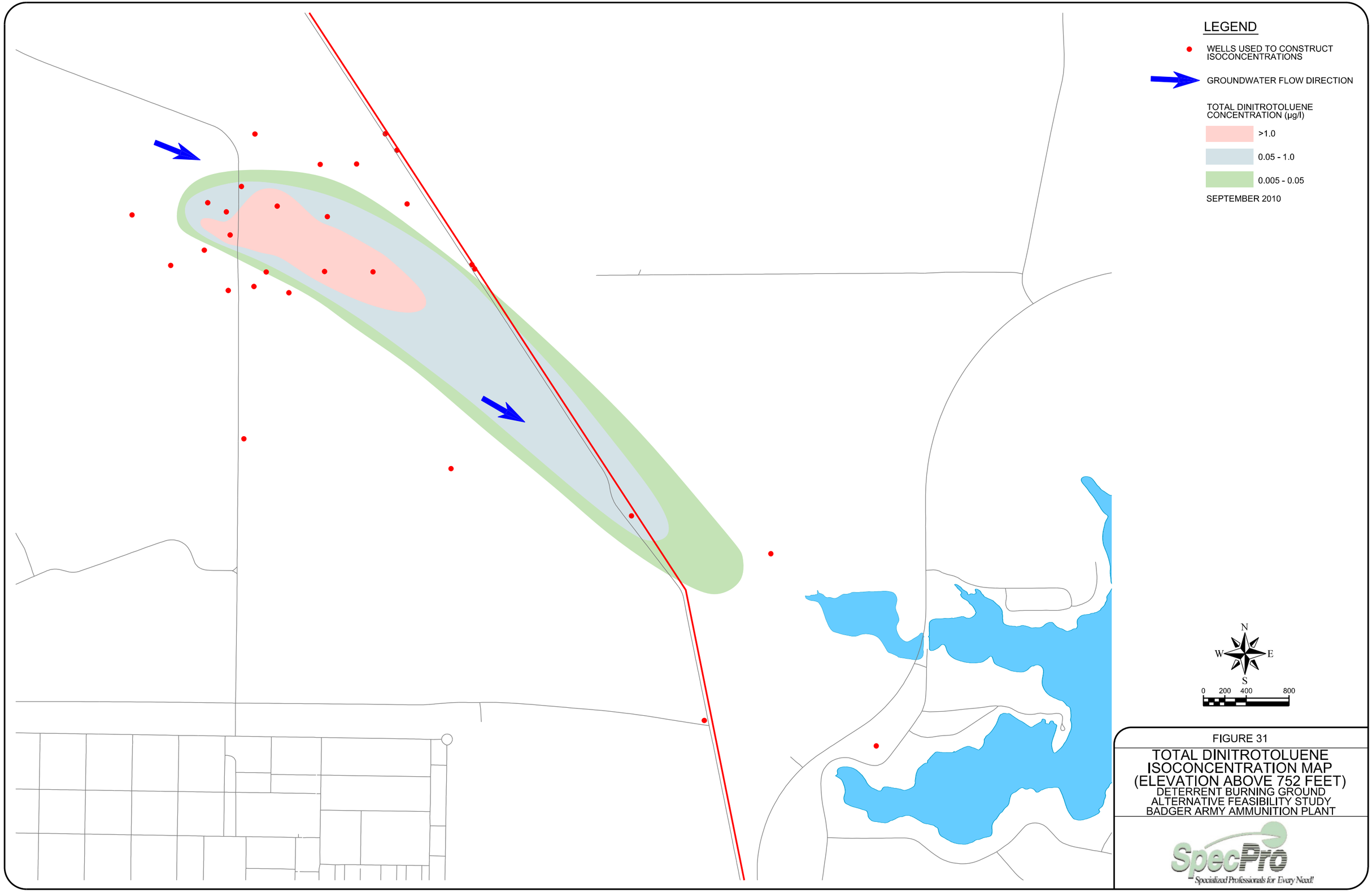

FIGURE 31

TOTAL DINITROTOLUENE ISOCONCENTRATION MAP (ELEVATION ABOVE 752 FEET)

DETERRENT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

LEGEND
WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
GROUNDWATER FLOW DIRECTION
TOTAL DINITROTOLUENE CONCENTRATION (µg/l)
>0.05
0.005 - 0.05
SEPTEMBER 2010
N
W
E
S
0
200
400
800
FIGURE 32
TOTAL DINITROTOLUENE ISOCONCENTRATION MAP (ELEVATION BELOW 752 FEET)
DETERRENT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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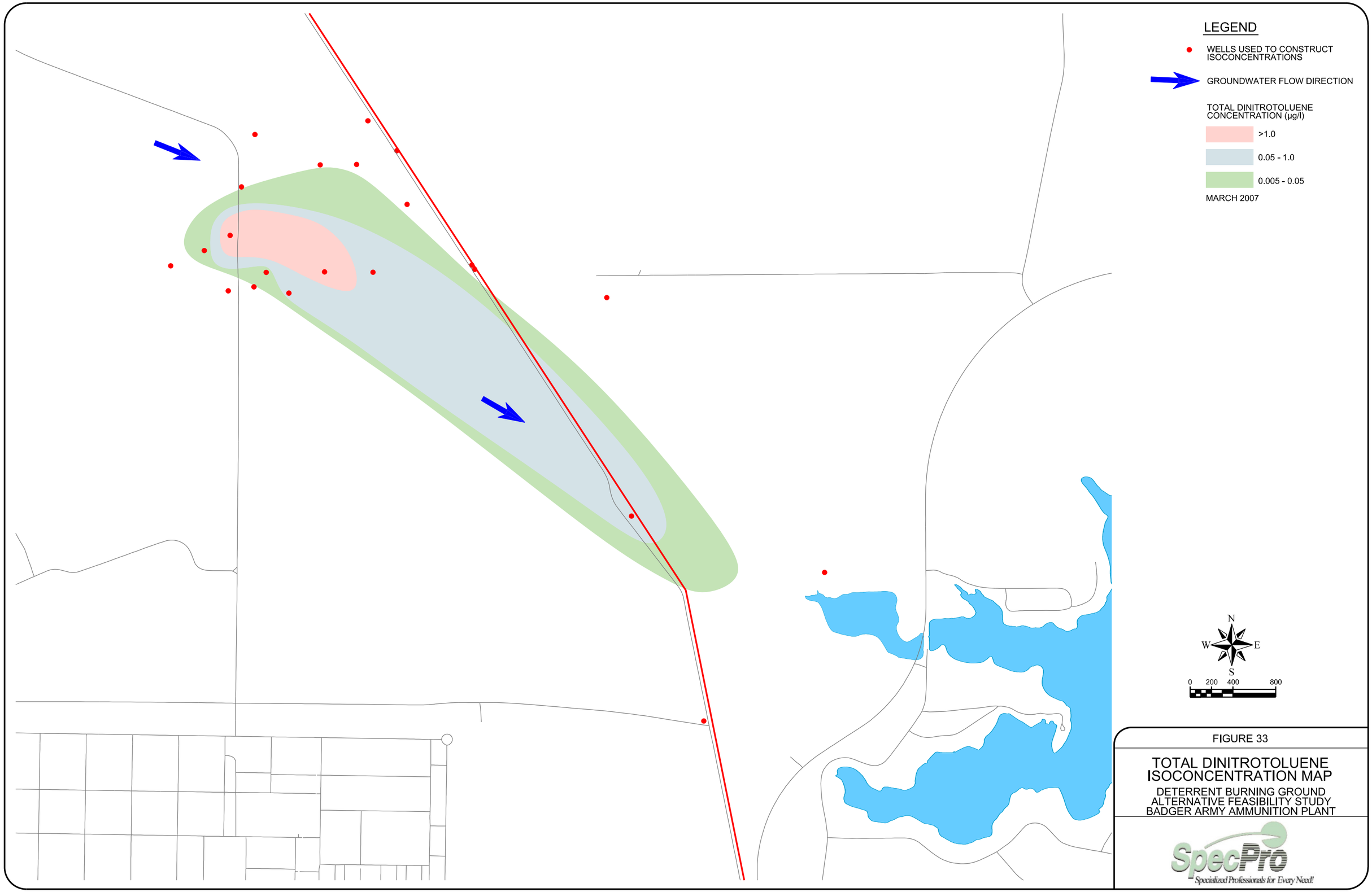
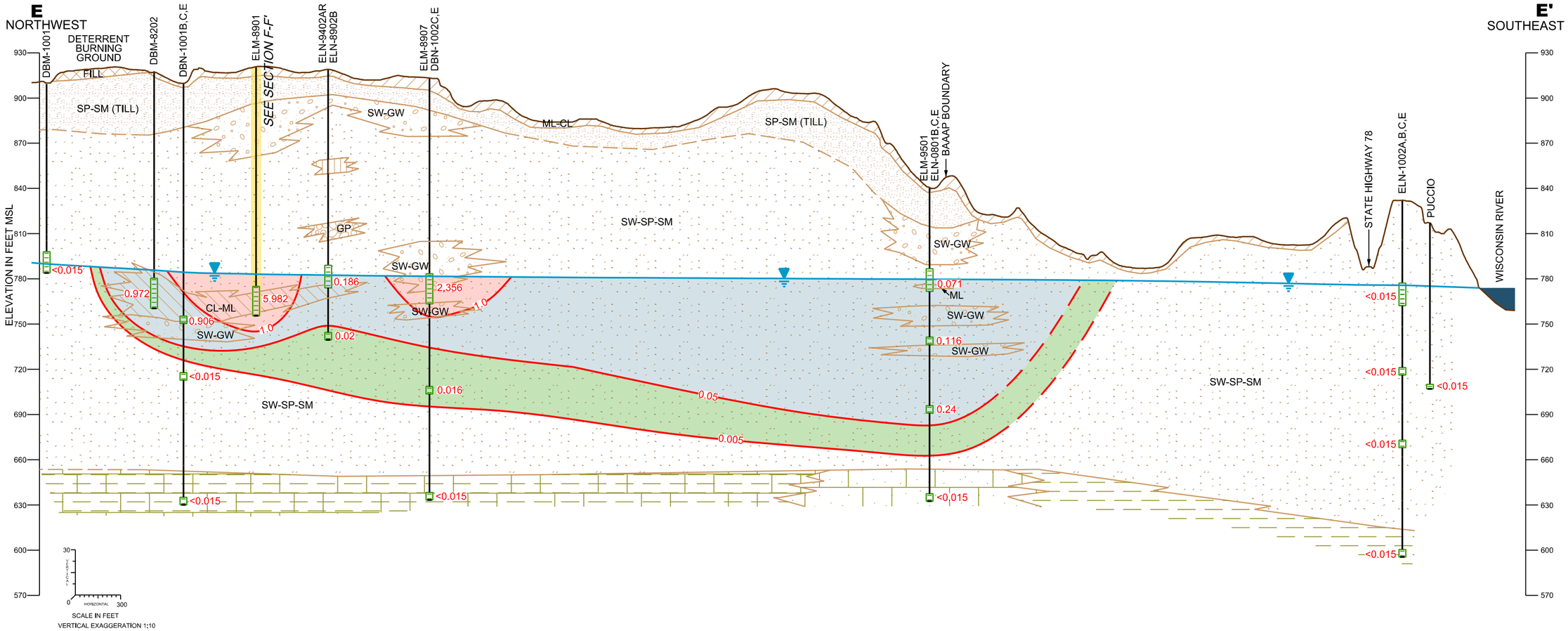


FIGURE 33

TOTAL DINITROTOLUENE ISOCONCENTRATION MAP

DETERRENT BURNING GROUND ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT



LEGEND

- DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)
- GROUND SURFACE
- WATER TABLE ELEVATION
- SCREENED INTERVAL
- 0.02 — TOTAL DINITROTOLUENE CONCENTRATION (µg/l)
- BOTTOM OF EXPLORATION
- 0.005 — TOTAL DINITROTOLUENE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

FILL	FILL MATERIAL AND CAP OVER DETERRENT BURNING GROUND WASTE PITS
ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SW-SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
ML	SILT, GLACIAL OUTWASH
CL-ML	LAYERED CLAY AND SILT, GLACIAL OUTWASH
GP	GRAVEL, GLACIAL OUTWASH
	BEDROCK, SHALE, EAU CLAIRE FORMATION (INTERBEDDED SANDSTONE)
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)
	BEDROCK, SHALE, EAU CLAIRE FORMATION (INTERBEDDED SILTSTONE)

TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

- > 1.0
- 0.05 - 1.0
- 0.005 - 0.05

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. TOTAL DINITROTOLUENE CONCENTRATIONS ARE BASED ON ANALYTICAL DATA COLLECTED DURING 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS HORIZONTAL FROM NORTHWEST TO SOUTHEAST.
6. µg/l - MICROGRAMS PER LITER
7. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 34

TOTAL DINITROTOLUENE ISOCONCENTRATION SECTION E-E'

DETERRENT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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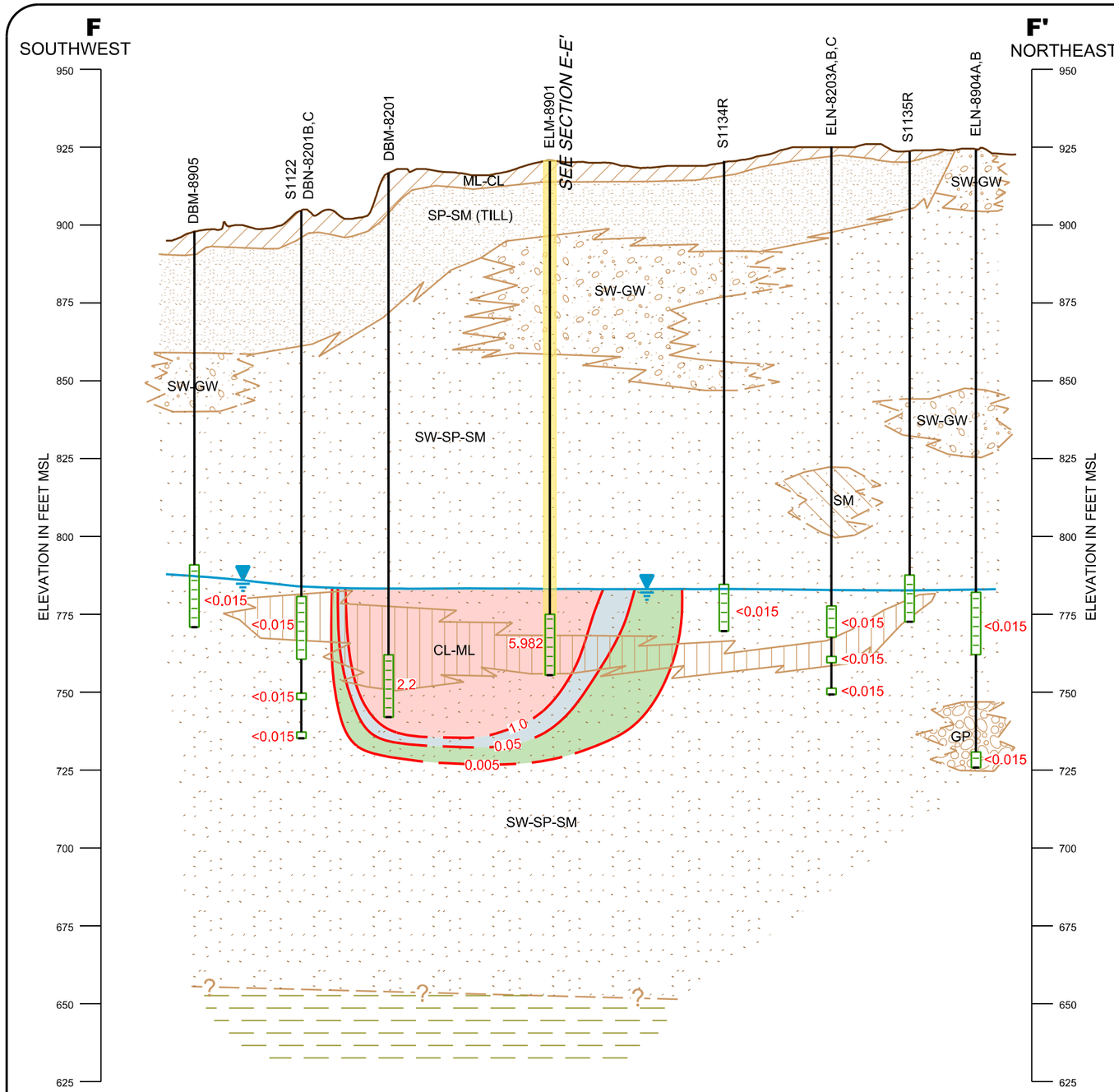

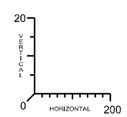

SCALE IN FEET
VERTICAL EXAGGERATION 1:10

LEGEND

DBM-8901 — WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

2.2 — TOTAL DINITROTOLUENE CONCENTRATION (µg/l) SCREENED INTERVAL

BOTTOM OF EXPLORATION

0.005 — TOTAL DINITROTOLUENE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

- ML-CL — SILT AND CLAY MIXTURE, LOESS
- SP-SM — SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
- SW-GW — SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
- SW-SP-SM — SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
- SM — SILTY SAND, GLACIAL OUTWASH
- CL-ML — LAYERED CLAY AND SILT, GLACIAL OUTWASH
- GP — GRAVEL, GLACIAL OUTWASH
- BEDROCK, EAU CLAIRE FORMATION (SHALE, INTERBEDDED SANDSTONE)

TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

- > 1.0
- 0.05 - 1.0
- 0.005 - 0.05

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. TOTAL DINITROTOLUENE CONCENTRATIONS ARE BASED ON ANALYTICAL DATA COLLECTED DURING 8/10, 9/10, AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
5. GROUNDWATER FLOW IS APPROXIMATELY PERPENDICULAR TO THE CROSS SECTION.
6. µg/l - MICROGRAMS PER LITER
7. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 35

TOTAL DINITROTOLUENE ISOCONCENTRATION SECTION F-F'

DETERRENT BURNING GROUND
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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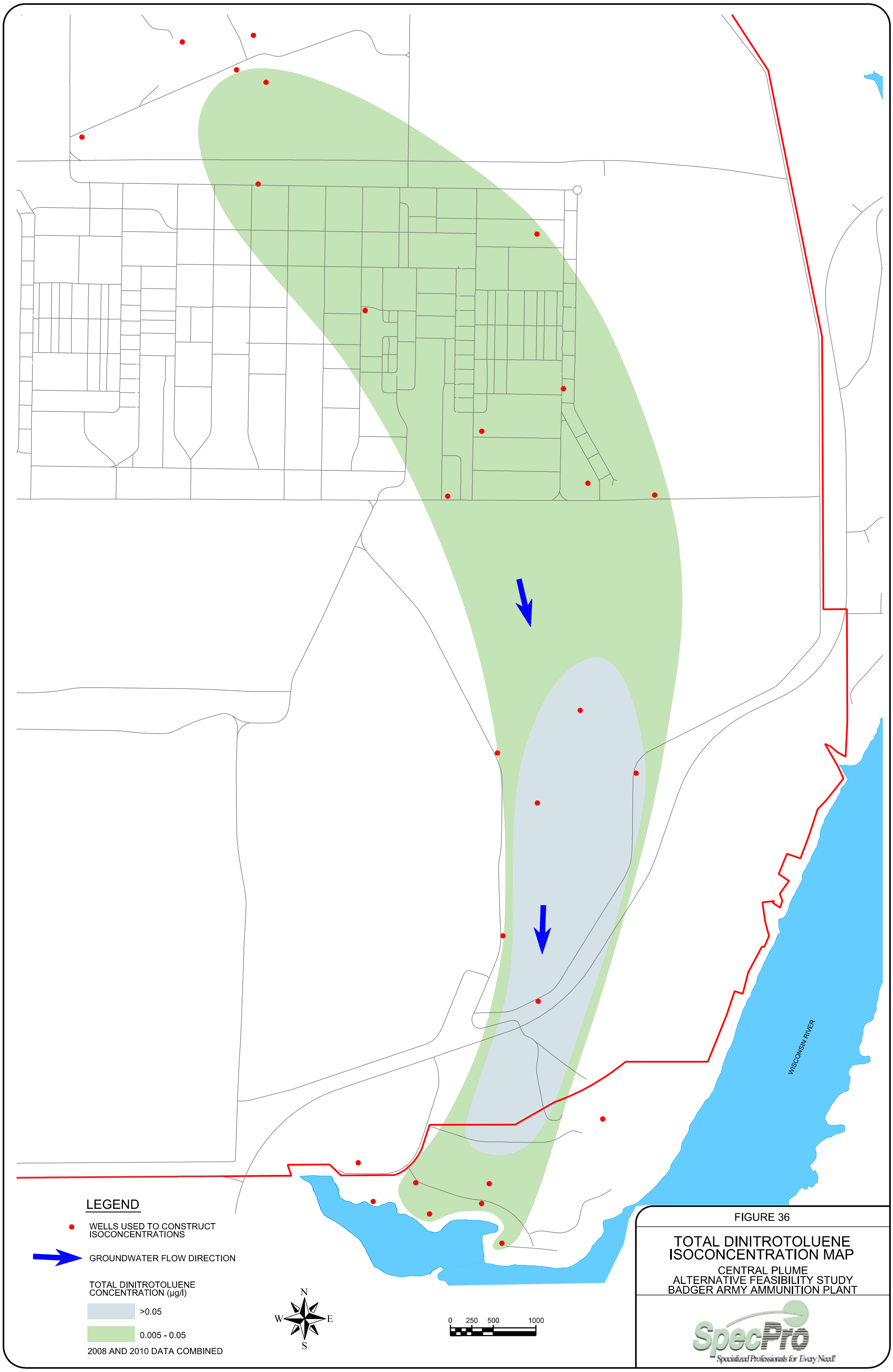
WISCONSIN RIVER
LEGEND
WELLS USED TO CONSTRUCT ISOCONCENTRATIONS
GROUNDWATER FLOW DIRECTION
TOTAL DINITROTOLUENE CONCENTRATION (µg/l)
>0.05
0.005 - 0.05
2008 AND 2010 DATA COMBINED
N
W
E
S
0 250 500 1000
FIGURE 36
TOTAL DINITROTOLUENE ISOCONCENTRATION MAP
CENTRAL PLUME
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT
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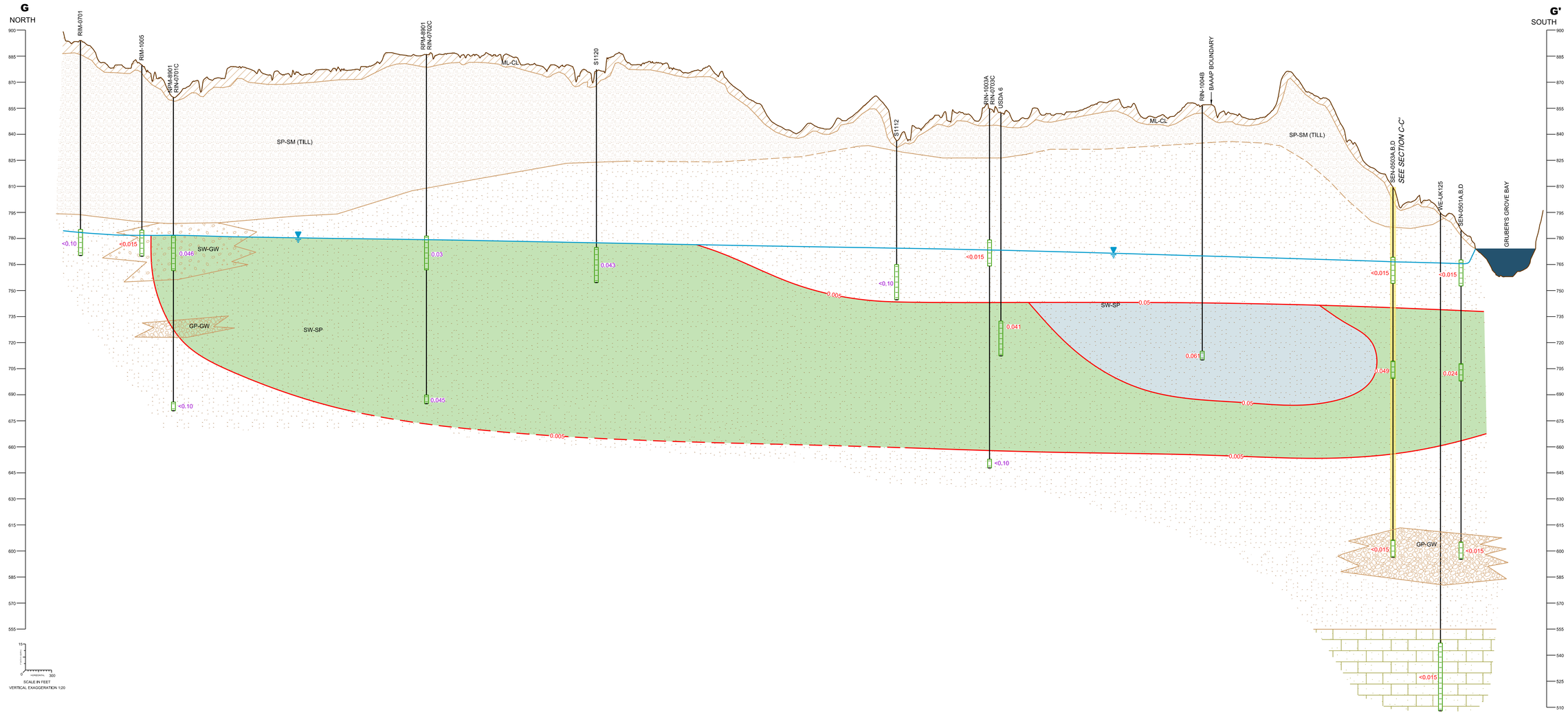

LEGEND

DBM-9901 — WELL DESIGNATION: SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B,C,D,E)

GROUND SURFACE

WATER TABLE ELEVATION

SCREENED INTERVAL

0.045 — TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

BOTTOM OF EXPLORATION

0.005 — TOTAL DINITROTOLUENE ISOCONCENTRATION LINE (µg/l)

GEOLOGIC DESCRIPTIONS:

ML-CL	SILT AND CLAY MIXTURE, LOESS
SP-SM	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL TILL
SW-GW	SAND, GRAVEL, AND COBBLES, GLACIAL OUTWASH
SW-SP	SAND, MIXTURE OF VARYING GRAIN SIZES, GLACIAL OUTWASH
GP-GW	GRAVEL, GLACIAL OUTWASH
	BEDROCK, EAU CLAIRE FORMATION (SANDSTONE)

TOTAL DINITROTOLUENE CONCENTRATION (µg/l)

- >0.05
- 0.005 - 0.05

NOTES:

1. SEE FIGURE 6 FOR LOCATION AND ORIENTATION OF PROFILES
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA AND THE APRIL 1993 REMEDIAL INVESTIGATION REPORT PREPARED BY ABB ENVIRONMENTAL SERVICES, INC.
3. MSL - MEAN SEA LEVEL
4. TOTAL DINITROTOLUENE CONCENTRATIONS SHOWN IN PURPLE ARE BASED ON ANALYTICAL DATA COLLECTED DURING 7/08.
5. ESTIMATED BOUNDARIES ARE DASHED.
5. TOTAL DINITROTOLUENE CONCENTRATIONS SHOWN IN RED ARE BASED ON ANALYTICAL DATA COLLECTED DURING 9/10 AND 10/10. ESTIMATED BOUNDARIES ARE DASHED.
6. GROUNDWATER FLOW IS HORIZONTAL FROM NORTH TO SOUTH.
7. µg/l - MICROGRAMS PER LITER
8. GROUNDWATER ANALYTICAL DATA WAS NOT AVAILABLE FOR WELLS SHOWN IN GREY, THEY WERE NOT PRESENTLY SAMPLED.
9. WELLS COMMON TO INTERSECTING CROSS SECTIONS ARE HIGHLIGHTED IN YELLOW

FIGURE 37

TOTAL DINITROTOLUENE ISOCONCENTRATION SECTION G-G'

CENTRAL PLUME
ALTERNATIVE FEASIBILITY STUDY
BADGER ARMY AMMUNITION PLANT

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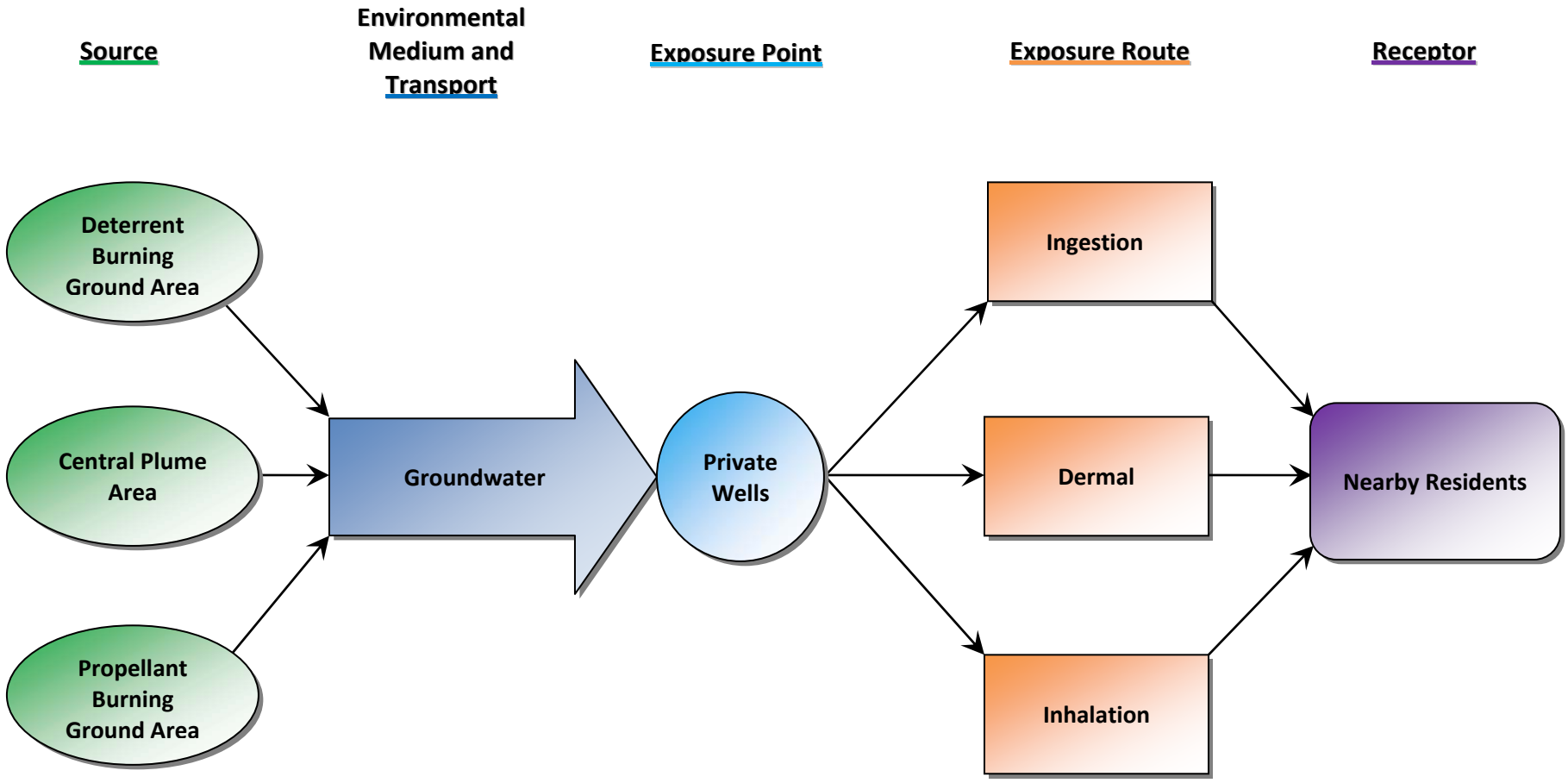
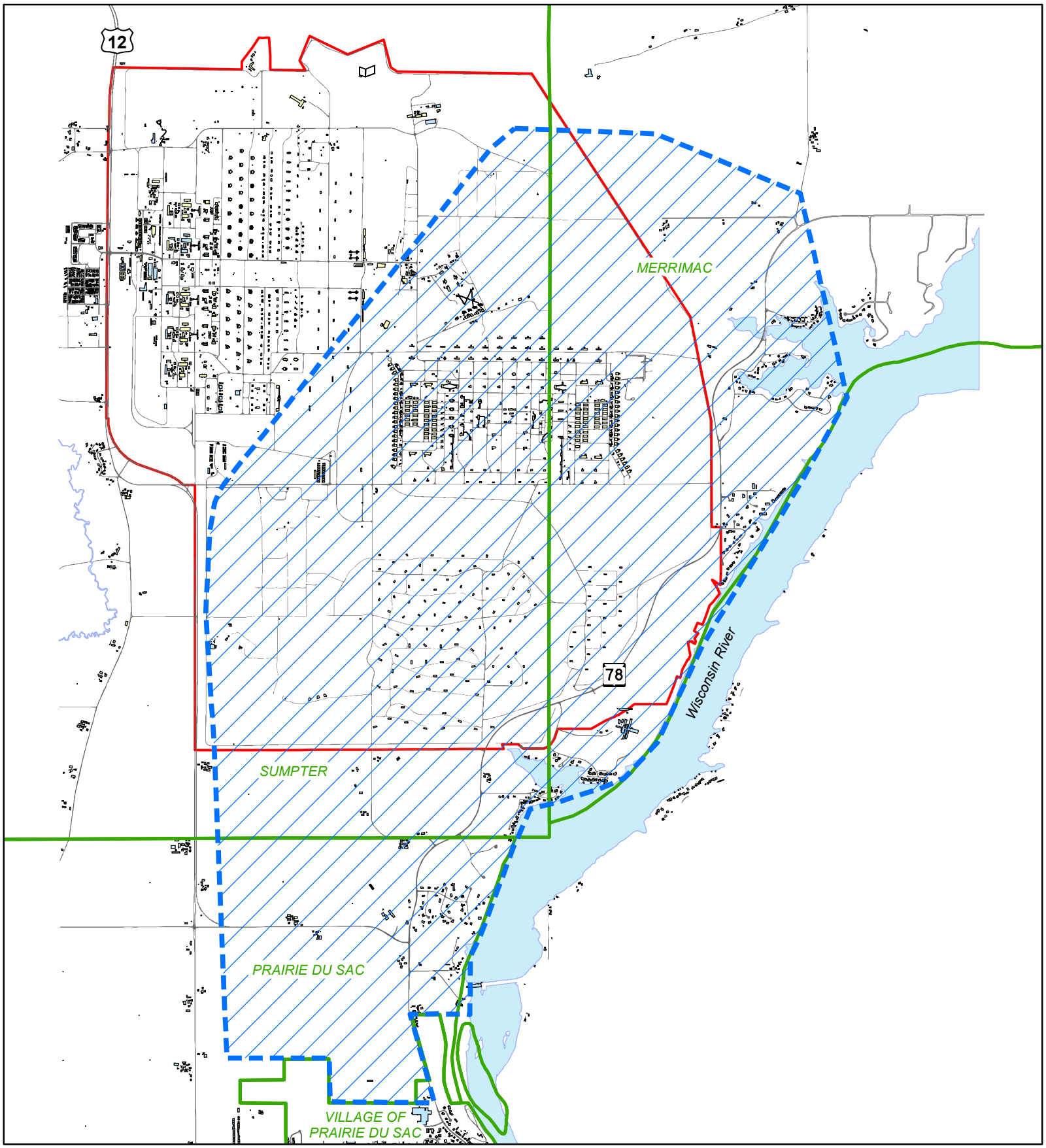
Figure 38
Conceptual Site Model
Alternative Feasibility Study
Groundwater Remedial Strategy





Legend

- Badger Army Ammunition Plant Boundary
- Proposed Remedy Area
- Township Boundary
- Paved Road
- Existing Building
- Former Building Footprint

Figure 39

Proposed Remedy Area
Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

1 inch = 3,750 feet

0 5,700 11,400 Feet

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D:\GIS_Projects\Groundwater_Projects\Municipal Well Planning\2011_AFS_GW\MXDs\ Fig_39_Proposed Remedy Area

Tables

Table 1
Propellant Burning Ground - Volatile Organic Compounds Soil Sample Results (2005)
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

		Volatile Organic Compounds		
Sample Number	**Sample Interval (ft bgs)**	**Carbon Tetrachloride**	**Trichloroethylene**	**Chloroform**
PBB 0501 010	20 - 30	<0.060	<0.060	<0.060
PBB 0501 022	21 - 22	<0.060	<0.060	<0.060
PBB 0501 026	25 - 26	<0.060	<0.060	<0.060
PBB 0501 030	20 - 30	<0.060	<0.060	<0.060
PBB 0501 031	30 - 31	<0.060	<0.060	<0.060
PBB 0501 040	30 - 40	<0.060	<0.060	<0.060
PBB 0501 041	40 - 41	<0.060	<0.060	<0.060
PBB 0501 050	40 - 50	<0.060	<0.060	<0.060
PBB 0501 051	50 - 51	<0.060	<0.060	<0.060
PBB 0501 060	50 - 60	<0.060	<0.060	<0.060
PBB 0501 061	60 - 61	<0.060	<0.060	<0.060
PBB 0501 070	60 - 70	<0.060	<0.060	<0.060
PBB 0501 071	70 - 71	<0.060	<0.060	<0.060
PBB 0501 080	70 - 80	<0.060	<0.060	<0.060
PBB 0501 080	90 - 91	<0.060	<0.060	<0.060
PBB 0501 090	80 - 90	<0.060	<0.060	<0.060
PBB 0501 091	90 - 91	<0.060	<0.060	<0.060
PBB 0501 100	90 - 100	<0.060	<0.060	<0.060
PBB 0502 010	104 - 105	<0.060	<0.060	<0.060
PBB 0502 023	22 - 23	<0.060	<0.060	<0.060
PBB 0502 029	28 - 29	<0.060	<0.060	<0.060
PBB 0502 030	20 - 30	<0.060	<0.060	<0.060
PBB 0502 035	34 - 35	<0.060	<0.060	<0.060
PBB 0502 040	30 - 40	<0.060	<0.060	<0.060
PBB 0502 050	40 - 50	<0.060	<0.060	<0.060
PBB 0502 053	52 - 53	<0.060	<0.060	<0.060
PBB 0502 060	50 - 60	<0.060	<0.060	<0.060

Table 1
Propellant Burning Ground - Volatile Organic Compounds Soil Sample Results (2005)
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Sample Number	Sample Interval (ft bgs)	Carbon Tetrachloride	Trichloroethylene	Chloroform
PBB 0502 070	60 - 70	<0.060	<0.060	<0.060
PBB 0502 080	70 - 80	<0.060	<0.060	<0.060
PBB 0502 080	80 - 90	<0.060	<0.060	<0.060
PBB 0502 090	80 - 90	<0.060	<0.060	<0.060
PBB 0502 100	90 - 100	<0.060	<0.060	<0.060
PBB 0502 105	104 - 105	<0.060	<0.060	<0.060
PBB 0503 010	60 - 70	<0.060	<0.060	<0.060
PBB 0503 013	12 - 13	<0.060	<0.060	<0.060
PBB 0503 020	10 - 20	<0.060	<0.060	<0.060
PBB 0503 030	20 - 30	<0.060	<0.060	<0.060
PBB 0503 040	30 - 40	<0.060	<0.060	<0.060
PBB 0503 050	40 - 50	<0.060	<0.060	<0.060
PBB 0503 055	54 - 55	<0.060	<0.060	<0.060
PBB 0503 060	50 - 60	<0.060	<0.060	<0.060
PBB 0503 070	60 - 70	<0.060	<0.060	<0.060
PBB 0503 080	70 - 80	<0.060	<0.060	<0.060
PBB 0503 090	80 - 90	<0.060	<0.060	<0.060
PBB 0503 100	90 - 100	<0.060	<0.060	<0.060
PBB 0503 105	100 - 105	<0.060	<0.060	<0.060

ft bgs - feet below ground surface
All results are expressed in milligrams per kilogram (mg/kg)
Samples collected by Shaw Environmental, Inc., in January 2005
Samples were analyzed by CT Laboratories using method SW8260B
Boring PBB 0501 was drilled beneath Propellant Burning Ground (PBG) Waste Pit 1.
Boring PBB 0502 was drilled beneath PBG Waste Pit 2.
Boring PBB 0503 was drilled beneath PBG Waste Pit 3.

Table 2
DNT-Impacted Soil Contaminant Mass Estimate
Propellant Burning Ground and Deterrent Burning Ground Source Areas
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Source Location	Average Concentration (mg/Kg)	Interval Depth (ft bgs)	Interval Thickness (ft)	Length (ft)	Width (ft)	Total Volume (ft3)	Mass Volume (lbs)
Propellant Burning Ground							
Waste Pit #1 (upper zone)	7,776	22 - 31	9	50	40	18,000	1,749
Waste Pit #1 (lower zone)	45.6	31 - 91	60	50	40	120,000	68
Waste Pit #2 (upper zone)	3,746	23 - 43	20	40	30	24,000	1,124
Waste Pit #2 (lower zone)	191	43 - 105	62	40	30	74,400	178
Waste Pit #3 (upper zone)	1,618	13 - 20	7	30	20	4,200	85
Waste Pit #3 (lower zone)	528	20 - 90	70	30	20	42,000	277
Total DNT Soil Contaminant Mass							**3,481**
Deterrent Burning Ground							
Waste Pit #1	1,950	10 - 30	20	70	35	49,000	1,194
Waste Pits #2 and #3	1,050	20 - 50	30	280	40	336,000	4,409
Total DNT Soil Contaminant Mass							**5,603**

cm - centimeters
cm3 - cubic centimeters
ft - feet
ft3 - cubic feet
lbs - pounds
mg/Kg - milligrams per kilogram
bgs - below ground surface
Deterrent Burning Ground estimate is based on data from 1991 to 1998.
Propellant Burning Ground estimate is based on data from 2005.
Soil bulk density = 125 lbs/ft3 = 0.002002 Kg/cm3
Mass volume = average concentration (mg/kg) x soil bulk density (kg/cm3) x 28,317 (cm3/ft3) x total volume (ft3) x 10E-6 (kg/mg) x 2.204586 (lb/kg)

Table 3
IRM and MIRM Pumping Well Information
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Well		Well Depth (feet)	Screened Interval (feet)	Casing Diameter (inches)	Flow Rate October 2011 (gpm)
IRM	SCW-1	182	95.5 - 182	8	150
	SCW-2R	167	107 - 167	8	210
MIRM	EW-163R	217	83 - 217	12	668
	EW-164	213	101.5 - 213	10.75	0
	EW-167	290	170 - 290	12	445
	EW-168	300	180 - 300	12	378
	EW-169	26	140 - 260	12	385
	EW-170R	205	140 - 205	12	525

EW - Extraction Well
SCW - Extraction Well
IRM - Interim Remedial Meausres
MIRM - Modified Interim Remedial Measures
gpm - gallons per minute

Table 4
Contaminant Mass Removal in Pounds
IRM and MIRM Systems
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

		2007		2008		2009		2010	
IRM	1,1,1-TCA	<0.06	<0.60	<0.09	<0.07	0.11	<0.12	<0.09	0.11
	Carbon tetrachloride	<0.06	<0.10	0.12	0.13	0.18	0.16	<0.09	0.14
	Chloroform	0.36	0.52	0.48	0.29	0.58	0.57	0.44	0.46
	TCE	0.11	0.14	0.18	0.14	0.27	0.32	0.23	0.27
	Total DNT	32.3	10.88	<3.03	<0.88	<2.58	<6.25	<5.46	<3.07
MIRM	1,1,1-TCA	1.16	2.3	<2.42	<3.35	2.19	<2.01	1.42	1.76
	Carbon tetrachloride	8.89	15	19.88	26.39	21.56	24.63	18.73	16.72
	Chloroform	2.1	3.6	3.79	4.89	3.9	4.87	3.47	3.79
	TCE	6.6	11.4	<6.50	<9.80	9.36	11.1	7.67	10.23
	Total DNT	<0.08	<1.08	<0.96	<1.65	<2.3	<1.49	<2.82	<3.05
Total Pounds (VOCs) Removed:		**<53.00**		**<78.52**		**<81.93**		**<65.62**	
Total Pounds (DNT) Removed:		**<44.34**		**<6.52**		**<12.62**		**<14.40**	
Average Pumping Rate:		1,131 gpm		2,329 gpm		2,438 gpm		2,414 gpm	

IRM - Interim Remedial Measures
MIRM - Modified Interim Remedial Measures
TCA - trichloroethane
TCE - trichloroethylene
DNT - dinitrotoluene
VOCs - volatile organic compounds
gpm - gallons per minute
Total DNT values are based on the addition of the six DNT isomers.
All mass values are expressed in pounds.

Table 5
Groundwater Analytical Results
December 2010
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

			VOCs - SW8260B			
Well	**Sample Date**	**Dinitrotoluene, Total**	**1,1,1-Trichloroethane**	**Carbon Tetrachloride**	**Chloroform**	**Trichloroethylene**
EW-163R	12/07/10	**0.113**	**0.31**	**4.28**	**0.88**	**3.16**
EW-167	12/07/10	**1.833**	**0.26**	**2.26**	**0.72**	**0.99**
EW-168	12/07/10	**0.025**	**0.16**	**2.95**	**0.70**	**0.94**
EW-169	12/07/10	**0.058**	**0.16**	**1.67**	**0.60**	**1.52**
EW-170R	12/07/10	**0.178**	**0.41**	**4.95**	**1.09**	**4.38**
IRM Influent	12/07/10	<0.5	<0.10	**0.23**	**0.62**	**0.35**
MIRM Influent	12/07/10	**0.475**	**0.28**	**3.36**	**0.79**	**2.15**
IRM/MIRM Effluent	12/07/10	<0.015	<0.10	<0.10	<0.10	<0.10
Chapter NR 140 PAL		0.005	40	0.5	0.6	0.5
Chapter NR 140 ES		0.05	200	5.0	6.0	5

All results are expressed in micrograms per liter (µg/l)
Bold values are detected results
Dinitrotoluene, Total results were analyzed by either SW8270C or SW8270CSIM
VOCs - Volatile Organic Compounds
EW - Extraction Well
IRM - Interim Remedial Meausres
MIRM - Modified Interim Remedial Measures
Chapter NR 140 PAL - Chapter NR 140, Wisconsin Administrative Code, Preventive Action Limit
Chapter NR 140 ES - Chapter NR 140, Wisconsin Administrative Code, Enforcement Standard

Table 6
Field Hydraulic Conductivity Test Results
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Well	Level Type	Hydraulic Conductivity (cm/sec)	Soil Type at Screen Interval	Reference
PBM-8911	A	$4x10^{-2}$	Sand	1993 RI
PBN-8203B	B	$1x10^{-3}$	Sand	1993 RI
PBN-8203C	C	$7x10^{-4}$	Sand	1993 RI
PBN-8901B	B	$3x10^{-2}$	Gravel with sand	1993 RI
PBN-8901C	C	$3x10^{-2}$	Sand	1993 RI
PBN-8901D	D	$5x10^{-2}$	Sand	1993 RI
PBN-8902B	B	$1x10^{-2}$	Sand	1993 RI
PBN-8902C	C	$2x10^{-2}$	Sand	1993 RI
PBN-8903B	B	$1x10^{-2}$	Sand	1993 RI
PBN-8903C	C	$4x10^{-2}$	Sand	1993 RI
PBN-8904C	C	$2x10^{-2}$	Sand	1993 RI
PBN-8910B	B	$2x10^{-1}$	Gravel with sand	1993 RI
PBN-8910C	C	$2x10^{-2}$	Sand	1993 RI
PBN-8910D	D	$5x10^{-2}$	Sand with gravel	1993 RI
PBN-9106C	C	$1.6x10^{-2}$	Sand	1993 RI
PBN-9112C	C	$8x10^{-3}$	Sand	1993 RI
PBN-9112D	D	$3x10^{-2}$	Sand	1993 RI
LON-8902B	B	$4x10^{-2}$	Gravel with cobbles	1993 RI
LON-8903B	B	$1x10^{-1}$	Sand and gravel	1993 RI
SPN-8901C	C	$4x10^{-2}$	Sand and gravel	1993 RI
SPN-8902B	B	$1x10^{-2}$	Sand	1993 RI
SPN-8902C	C	$3x10^{-2}$	Sand	1993 RI
SPN-8903B	B	$4x10^{-2}$	Sand and gravel	1993 RI
SPN-8904B	B	$2x10^{-2}$	Sand and gravel	1993 RI
SPN-8904C	C	$2x10^{-2}$	Sand	1993 RI
S1103	C	$8x10^{-3}$	Sand	1993 RI
S1106	C	$7x10^{-3}$	Sand	1993 RI
S1107	A	$3x10^{-3}$	Sand	1993 RI
S1114	C	$2x10^{-2}$	Sand	1993 RI
DBM-8901	A	$3x10^{-2}$	Sand	1993 RI
DBN-8902A	A	$8x10^{-2}$	Silt and clay	1993 RI
DBN-8902B	B	$1x10^{-1}$	Gravel with sand	1993 RI
DBM-8903	A	$1x10^{-1}$	Gravel with sand	1993 RI

Table 6
Field Hydraulic Conductivity Test Results
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Well	Level Type	Hydraulic Conductivity (cm/sec)	Soil Type at Screen Interval	Reference
DBN-8904A	A	$3x10^{-2}$	Sand	1993 RI
DBN-8904B	B	$5x10^{-2}$	Gravel with sand	1993 RI
DBM-8905	A	$6x10^{-3}$	Sand	1993 RI
DBM-8201	A	$7x10^{-3}$	Silty clay	1993 RI
ELN-9107A	A	$5x10^{-3}$	Sand	1993 RI
ELN-9107B	B	$2x10^{-2}$	Sand	1993 RI
ELM-9110	A	$2x10^{-2}$	Sand	1993 RI
ELM-8901	A	$8x10^{-3}$	Silty sand	1993 RI
ELN-8904A	A	$4x10^{-2}$	Sand	1993 RI
ELN-8904B	B	$1x10^{-1}$	Gravel	1993 RI
ELM-8905	A	$1x10^{-2}$	Sand with gravel	1993 RI
ELM-8906B	B	$5x10^{-2}$	Gravel and sand	1993 RI
ELM-8907	A	$1x10^{-1}$	Gravel	1993 RI
ELM-8908	A	$4x10^{-2}$	Sand with gravel	1993 RI
ELM-8909	A	$3x10^{-2}$	Sand	1993 RI
ELN-8203C	C	$6x10^{-3}$	Sand	1993 RI
ELN-8204A	A	$3x10^{-4}$	Silty sand	1993 RI
S1153	A	$5x10^{-3}$	Sand	1993 RI
RPM-8901	A	$2x10^{-1}$	Sand and gravel	1993 RI
RPM-8902	A	$1x10^{-1}$	Sand	1993 RI
OPM-8903	A	$1x10^{-1}$	Sand with gravel	1993 RI
Average		**$4x10^{-2}$**		

cm/sec - centimeters per second
1993 RI - Final Remedial Investigation Report (United States Army Environmental Center, April 1993)
Level Type - typical well depth configuration

Table 7
Horizontal Groundwater Gradient
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Plume Area	Well Pair	Well Distance (ft)	Mar 2010 Well Elevation (ft msl)	Mar 2010 Elevation Difference (ft)	Mar 2010 Gradient (ft/ft)	Sept 2010 Well Elevation (ft msl)	Sept 2010 Elevation Difference (ft)	Sept 2010 Gradient (ft/ft)	Mar 2011 Well Elevation (ft msl)	Mar 2011 Elevation Difference (ft)	Mar 2011 Gradient (ft/ft)	Average Gradient (ft/ft)	Average Hydraulic Conductivity (ft/day)	Effective Porosity	Average Groundwter Flow Velocity (ft/day)
PBG	PBN-8910A	6,360	775.41	11.12	0.00175	774.72	9.94	0.00156	776.20	10.6	0.00167	0.00165	113.4	0.26	0.72
	PBN-9902A		764.29			764.78			765.60						
	PBN-9902B	5,700	764.31	9.36	0.00164	764.78	9.2	0.00161	765.60	9.4	0.00165				
	SWN-9103B		754.95			755.58			756.20						
DBG	DBM-8202	4,930	786.40	6.7	0.00136	786.14	5.55	0.00113	787.20	6.5	0.00132	0.00127	113.4	0.26	0.55
	ELM-9501		779.70			780.59			780.70						
Central	RIN-1002A	8,260				776.92	10.31	0.00125				0.00103	113.4	0.26	0.45
	SEN-0503A					766.61									
	RIM-1005	7,000				782.58	5.66	0.00081							
	RIN-1002A					776.92									

ft - Feet
ft msl - Feet Mean Sea Level
ft/ft - Feet per Foot
Groundwater flow velocity = (hydraulic conductivity)(hydraulic gradient)/effective porosity
Hydraulic conductivity conversion: 4.0 x 10 ^-2 cm/sec = 113.4 ft/day

Table 8
Vertical Groundwater Gradient
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

	Well Pair	Well ID	Layer	Groundwater Elevation (ft msl)			Groundwater Vertical Gradient (ft/ft)			
				Mar-10	Sep-10	Mar-11	Mar-10	Sep-10	Mar-11	Average
Propellant Burning Ground	PBN-8910A	650	A	775.41	774.72	776.22				
	PBN-8910C	652	C	775.66	774.84	776.48	0.25	0.12	0.26	0.21
	PBN-8205A	622	A	774.30	773.56	775.03				
	PBN-8205B	623	B	774.38	773.73	775.12				
	PBN-8205C	624	C	774.42	773.69	775.15	0.12	0.13	0.12	0.12
	PBN-8501A	631	A	772.57	771.76	773.17				
	PBN-8901C	642	C	772.68	771.82	773.24				
	PBN-8901D	643	D	772.74	771.90	773.32	0.17	0.14	0.15	0.15
	PBN-9902A	688	A	764.29	764.78	765.58				
	PBN-9902B	689	B	764.31	764.78	765.55				
	PBN-9902C	690	C	764.26	764.97	765.51				
	PBN-9902D	691	D	764.36	764.75	765.52	0.07	-0.03	-0.06	-0.01
	PBN-9903A	692	A	763.03	763.65	764.21				
	PBN-9903B	693	B	763.45	764.09	764.64				
	PBN-9903C	694	C	763.52	764.14	764.70				
	PBN-9903D	695	D	763.49	764.13	764.70	0.46	0.48	0.49	0.48
	SWN-9103B	571	B	754.95	755.58	756.20				
	SWN-9103C	572	C	755.08	755.70	756.32				
	SWN-9103D	573	D	754.89	755.57	756.17				
	SWN-9103E	574	E	755.02	755.61	756.30	0.07	0.03	0.10	0.07
	PBN-9102B	562	B	743.36	743.95	744.41				
	PBN-9102C	563	C	743.50	744.11	744.60				
	PBM-9002D	982	D	743.73	744.37	744.86	0.37	0.42	0.45	0.41
	SWN-0501B	237	B	754.42	754.92	755.48				
	SWN-0501C	238	C	754.40	754.90	755.34				
	SWN-0501D	239	D	754.24	754.67	755.32				
	SWN-0501E	240	E	754.04	754.38	755.27	-0.38	-0.54	-0.21	-0.38
	SWN-0503B	245	B	748.78	749.07	749.35				
	SWN-0503C	246	C	748.74	749.04	749.38				
	SWN-0503D	247	D	748.80	749.11	749.44				
	SWN-0503E	248	E	752.07	750.71	749.53	3.29	1.64	0.18	1.70
Deterrent Burning Ground	S1122	300	A	782.35	783.23	783.90				
	DBN-8201B	303	B	782.26	783.13	783.82				
	DBN-8201C	304	C	782.29	783.18	783.85	-0.06	-0.05	-0.05	-0.05
	DBN-9502A	318	A	782.19	783.22	783.85				
	DBN-9502B	319	B	781.87	782.90	783.56				
	DBN-9502C	320	C	781.94	782.97	783.63	-0.25	-0.25	-0.22	-0.24
	DBN-9501A	314	A	781.68	782.72	783.26				
	DBN-9501B	315	B	781.74	782.76	783.29				
	DBN-9501C	316	C	781.73	782.78	783.31				
	DBN-9501E	317	E	781.69	782.66	783.18	0.01	-0.06	-0.08	-0.04
	ELN-8203A	210	A	782.19	782.93	783.66				
	ELN-8203B	211	B	781.63	782.62	783.17				
	ELN-8203C	212	C	781.67	782.60	783.17	-0.52	-0.33	-0.49	-0.45
	ELM-9501	234	A	779.70	780.59	780.73				
	ELN-0801B	455	B	779.80	782.65	780.89				
	ELN-0801C	456	C	779.85	780.68	780.89				
	ELN-0801E	457	E	779.75	780.59	780.78	0.05	0.00	0.05	0.03
	ELN-1003A	467	A		779.50	779.43				
	ELN-1003B	468	B		778.90	779.45				
	ELN-1003C	469	C		779.03	779.59				
	ELN-1003E	470	E		778.59	779.16		-0.91	-0.27	-0.59

Table 8
Vertical Groundwater Gradient
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

	Well Pair	Well ID	Layer	Groundwater Elevation (ft msl)			Groundwater Vertical Gradient (ft/ft)			
				Mar-10	Sep-10	Mar-11	Mar-10	Sep-10	Mar-11	Average
Central Plume	RIN-1002A	492	A		776.92					
	RIN-1002C	493	C		776.84			-0.08		-0.08
	RIN-1005A	496	A		775.27					
	RIN-1005C	497	C		774.33			-0.94		-0.94
	SEN-0501A	580	A	764.96	765.51	765.50				
	SEN-0501B	581	B	765.03	765.56	765.58				
	SEN-0501D	582	D	765.29	765.83	765.83	0.33	0.32	0.33	0.33
	SEN-0503A	585	A	766.07	766.61	766.59				
	SEN-0503B	586	B	766.07	766.62	766.58				
	SEN-0503D	587	D	766.14	766.70	766.63	0.07	0.09	0.04	0.07

Layer designation
A = shallow zone in sand and gravel aquifer
B = intermediate zone in sand and gravel aquifer
C = deep zone in sand and gravel aquifer
D = bottom zone in sand and gravel aquifer
E = top of bedrock aquifer
ft msl - Feet Mean Sea Level
ft/ft - Feet per Foot
Gradient determined between shallow and deep well for each well cluster

Table 9
Groundwater Analytical Results
Northeast Boundary Monitoring Well Installation - August 2010
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

					Dinitrotoluenes - SW8270CSIM						VOCs - SW8260B	
Well	**Well ID**	**Sample Level**	**Sample Depth (feet)**	**Sampled Date**	**2,3-Dinitrotoluene**	**2,4-Dinitrotoluene**	**2,5-Dinitrotoluene**	**2,6-Dinitrotoluene**	**3,4-Dinitrotoluene**	**3,5-Dinitrotoluene**	**1,1,1-Trichloroethane**	**Methylene Chloride**
ELN-1001B	460	B	91 - 96	08/04/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1001C	461	C	155 - 160	08/04/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1001E	462	E	240.5 - 245.5	08/04/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1002A	463	A	60 - 70	08/03/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1002B	464	B	111 - 116	08/03/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1002C	465	C	159 - 164	08/03/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1002E	466	E	231.5 - 236.5	08/04/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
ELN-1003A	467	A	21 - 31	08/04/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	**0.12 (J)**
ELN-1003B	468	B	91.5 - 96.5	08/03/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	**0.12 (J)**	<0.10
ELN-1003B (dup)	468	B	91.5 - 96.5	08/03/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	**0.15 (J)**	<0.10
ELN-1003C	469	C	155 - 160	08/03/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	**0.15 (J)**	<0.10
ELN-1003E	470	E	225.5 - 230.5	08/04/10	<0.012	<0.014	<0.013	<0.018	<0.031	<0.015	<0.10	<0.10
Chapter NR 140 PAL					NE	0.005	NE	0.005	NE	NE	40	0.5
Chapter NR 140 ES					NE	0.05	NE	0.05	NE	NE	200	5

Notes:
The Sample Level references the typical well depth configuration
All results are expressed in micrograms per liter (µg/l)
Bold values are detected results
Sample ELN-1003B (dup) was a duplicate sample
J = Analytical result is between the Limit of Detection (LOD) and Limit of Quantitation (LOQ)
NE = Not Established
VOCs = Volatile Organic Compounds
Chapter NR 140 PAL - Chapter NR 140, Wisconsin Administrative Code, Preventive Action Limit
Chapter NR 140 ES - Chapter NR 140, Wisconsin Administrative Code, Enforcement Standard

Table 10
Groundwater Analytical Results
September 2010 Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

						VOCs - SW8260B								
Well	**Well ID**	**Sample Level**	**Sample Depth (feet)**	**Sample Date**	**Dinitrotoluene, Total**	**1,1-Dichloroethylene**	**1,2-Dichloropropane**	**1,1,1-Trichloroethane**	**1,1,2-Trichloroethane**	**Bromodichloromethane**	**Carbon Tetrachloride**	**Chloroform**	**Ethyl Ether**	**Trichloroethylene**
BGM-9101	350	A	68-78	09/16/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
BGM-9102	351	A	77-87	09/16/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
BGM-9103	352	A	90-100	09/16/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**7.4**
BGM-9103 (dup)	352	A	90-100	09/16/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**7.94**
DBM-8201	301	A	154.6-174.6	09/21/10	**2.2**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBM-8202	302	A	137.3-157.3	09/21/10	**0.972**	<0.10	<0.10	**2.11**	**0.27**	<0.10	<0.10	<0.10	<0.10	<0.10
DBM-8903	306	A	113-133	09/30/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBM-8905	307	A	107-127	09/30/10	<0.015	<0.10	<0.10	**0.83**	<0.10	<0.10	**0.22**	<0.10	<0.10	<0.10
DBM-8905 (dup)	307	A	107-127	09/30/10	<0.015	<0.10	<0.10	**0.82**	<0.10	<0.10	**0.22**	<0.10	<0.10	<0.10
DBM-9501	313	A	92-107	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-8201B	303	B	157.5-159.5	09/30/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-8201C	304	C	167.5-169.5	09/30/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-8902A	308	A	99.5-119.5	09/30/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-8902B	309	B	145-150	09/30/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9501A	314	A	110-120	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9501B	315	B	162.5-172.5	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9501C	316	C	218.5-228.5	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9501E	317	E	245.2-255.5	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9502A	318	A	103-113	10/05/10	<0.015	<0.10	<0.10	**0.17**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9502B	319	B	155.2-165.5	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-9502C	320	C	210-220.3	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.19**	<0.10	<0.10
DBN-9502C (dup)	320	C	210-220.3	10/05/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.16**	<0.10	<0.10
ELM-8901	216	A	145.5-165	09/22/10	**5.982**	**0.17**	<0.10	**2.46**	**0.3**	<0.10	<0.10	<0.10	<0.10	<0.10
ELM-8903	217	A	130-150	09/16/10	<0.015	<0.10	<0.10	<0.10	**0.11**	<0.10	<0.10	<0.10	<0.10	<0.10
ELM-8907	220	A	130.3-150.3	09/16/10	**2.356**	<0.10	<0.10	**0.16**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELM-8908	221	A	125-145	09/23/10	**1.466**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELM-8909	222	A	135-155	09/16/10	<0.015	<0.10	<0.10	**1.61**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELM-9110	229	A	139-154	09/22/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELM-9501	234	A	54-69	09/22/10	**0.071**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-0801B	455	B	100-105	09/22/10	**0.116**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-0801C	456	C	145.5-150.5	09/22/10	**0.24**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-0801E	457	E	202.6-207.6	09/22/10	<0.015	<0.10	<0.10	**0.18**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-0801E (dup)	457	E	202.6-207.6	09/22/10	<0.015	<0.10	<0.10	**0.15**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-0802A	458	A	122.4-107.4	09/22/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-0802C	459	C	185.7-180.7	09/22/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8203A	210	A	147.5-157.5	09/23/10	<0.015	<0.10	**0.49**	<0.10	**0.62**	<0.10	<0.10	<0.10	**2.29**	<0.10
ELN-8203B	211	B	164-166	09/23/10	<0.015	<0.10	**0.42**	<0.10	**1.11**	<0.10	<0.10	<0.10	**0.14**	<0.10
ELN-8203B (dup)	211	B	164-166	09/23/10	<0.015	<0.10	**0.46**	<0.10	**1.12**	<0.10	<0.10	<0.10	**0.12**	<0.10
ELN-8203C	212	C	174-176	09/23/10	<0.015	<0.10	<0.10	<0.10	**0.58**	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8204A	213	A	141-151	09/23/10	<0.015	<0.10	<0.10	**0.26**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8204B	214	B	163-165	09/23/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8204C	215	C	171-173	09/23/10	<0.015	<0.10	<0.10	**0.2**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8902B	224	B	173.5-178.5	09/22/10	**0.02**	<0.10	<0.10	**0.26**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8904A	225	A	142-162	09/23/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-8904B	226	B	194-199	09/23/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table 10
Groundwater Analytical Results
September 2010 Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

						VOCs - SW8260B								
Well	**Well ID**	**Sample Level**	**Sample Depth (feet)**	**Sample Date**	**Dinitrotoluene, Total**	**1,1-Dichloroethylene**	**1,2-Dichloropropane**	**1,1,1-Trichloroethane**	**1,1,2-Trichloroethane**	**Bromodichloromethane**	**Carbon Tetrachloride**	**Chloroform**	**Ethyl Ether**	**Trichloroethylene**
ELN-9107A	227	A	116-126	09/16/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-9107B	228	B	135-145	09/16/10	<0.015	<0.10	<0.10	<0.10	**0.29**	<0.10	<0.10	<0.10	<0.10	<0.10
ELN-9402AR	231	A	130-145	09/22/10	**0.186**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
LON-8903A	659	A	138-158	09/28/10	<0.015	<0.10	<0.10	**0.19**	<0.10	**0.11**	**1.76**	**0.9**	<0.10	**0.87**
LON-8903B	660	B	193-198	09/28/10	**0.048**	<0.10	<0.10	**0.23**	<0.10	**0.19**	**0.34**	**1.32**	<0.10	**0.21**
NLM-0302R	272	A	112-127	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBM-0001	367	A	102-127	09/21/10	**1.561**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.55**	**0.39**	<0.10	**1.32**
PBM-0001 (dup)	367	A	102-127	09/21/10	**1.885**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.52**	**0.39**	<0.10	**1.38**
PBM-0002	368	A	100-125	09/21/10	**1166.1**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.26**	**0.19**	<0.10	**1.26**
PBM-0005	371	A	95-120	09/21/10	**1.806**	<0.10	<0.10	**0.11**	<0.10	<0.10	**0.37**	**0.26**	<0.10	**0.91**
PBM-0008	374	A	97-122	09/21/10	**1.546**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.46**	<0.10	<0.10	**2.73**
PBM-8905	635	A	78.05-98.05	10/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.19**	<0.10	<0.10	<0.10
PBM-9001D	981	D	200.5-210.5	09/14/10	**0.019**	<0.10	<0.10	<0.10	<0.10	<0.10	**20.8**	**3.08**	<0.10	**3.96**
PBM-9001D (dup)	981	D	200.5-210.5	09/14/10	**0.023**	<0.10	<0.10	<0.10	<0.10	<0.10	**17.7**	**2.78**	<0.10	**3.46**
PBM-9002D	982	D	194.5-204.5	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.43**	**0.38**	<0.10	<0.10
PBM-9003D	983	D	189.5-199.5	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBM-9801	360	A	102.5-117.5	09/21/10	**1.613**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.42**	**0.28**	<0.10	**0.44**
PBN-8202C	615	C	139.2-141.2	09/21/10	**1.701**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.4**	**0.49**	<0.10	**1.13**
PBN-8203A	616	A	86.5-96.5	10/04/10	**0.017**	<0.10	<0.10	**0.53**	<0.10	<0.10	**3.86**	**0.13**	<0.10	**0.31**
PBN-8203C	618	C	115.5-117.5	10/04/10	<0.015	<0.10	<0.10	**0.25**	<0.10	<0.10	**1.98**	**0.13**	<0.10	**0.2**
PBN-8205A	622	A	102.5-112.5	10/04/10	**3.018**	<0.10	<0.10	**1.19**	<0.10	<0.10	**6.76**	**0.76**	<0.10	**1.69**
PBN-8205A (dup)	622	A	102.5-112.5	10/04/10	**3.559**	<0.10	<0.10	**1.18**	<0.10	<0.10	**6.39**	**0.71**	<0.10	**1.67**
PBN-8205B	623	B	122.2-124.2	10/06/10	<0.015	<0.10	<0.10	**0.55**	<0.10	<0.10	**3.33**	**0.71**	<0.10	**1.73**
PBN-8205C	624	C	131.5-133.5	10/04/10	**0.342**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.14**	**0.12**	<0.10	**0.8**
PBN-8501A	631	A	112.9-121.9	10/07/10	<0.015	<0.10	<0.10	**1.12**	<0.10	<0.10	**6.4**	**0.62**	<0.10	**1.92**
PBN-8501A (dup)	631	A	112.9-121.9	10/07/10	<0.015	<0.10	<0.10	**1.08**	<0.10	<0.10	**5.95**	**0.6**	<0.10	**1.82**
PBN-8502A	632	A	129-138	10/07/10	<0.015	<0.10	<0.10	**1.07**	<0.10	<0.10	**23**	**0.3**	<0.10	**1.33**
PBN-8503A	633	A	85.82-94.82	10/07/10	<0.015	<0.10	<0.10	**0.29**	<0.10	<0.10	**3.48**	<0.10	<0.10	<0.10
PBN-8901C	642	C	193.1-198.1	10/07/10	<0.015	<0.10	<0.10	**0.3**	<0.10	<0.10	**1.6**	**0.7**	<0.10	**0.68**
PBN-8901D	643	D	233.2-238.2	10/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**1.21**	<0.10	<0.10
PBN-8902B	644	B	155-160	10/07/10	<0.015	<0.10	<0.10	**0.75**	<0.10	**0.11**	**10.3**	**0.9**	<0.10	**5.46**
PBN-8902C	645	C	188.1-193.3	10/07/10	**0.015**	<0.10	<0.10	**0.85**	<0.10	**0.15**	**8.06**	**1.1**	<0.10	**3.29**
PBN-8903B	646	B	120-125	10/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	**0.16**	**0.27**	**0.76**	<0.10	<0.10
PBN-8903C	647	C	155-160	10/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	**0.14**	<0.10	**0.61**	<0.10	<0.10
PBN-8910A	650	A	108-128	10/04/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**1.11**	**0.6**	<0.10	**2**
PBN-8910C	652	C	187-192	10/04/10	<0.015	<0.10	<0.10	**0.31**	<0.10	**0.14**	**0.28**	**1.29**	<0.10	<0.10
PBN-9102B	562	B	105-115	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9102C	563	C	151.3-161.3	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.14**	**0.21**	<0.10	<0.10
PBN-9102C (dup)	563	C	151.3-161.3	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.14**	**0.17**	<0.10	<0.10
PBN-9103B	564	B	96.1-106.1	09/15/10	**0.018**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9103C	565	C	142.3-152.3	09/15/10	**0.025**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9112C	665	C	173.4-183.4	09/28/10	<0.015	<0.10	<0.10	**0.6**	<0.10	**0.24**	**5.26**	**1.41**	<0.10	**7.36**
PBN-9112D	666	D	221-231	09/28/10	<0.015	**0.27**	<0.10	**0.16**	<0.10	<0.10	<0.10	<0.10	**0.23**	<0.10
PBN-9301B	668	B	150.5-160.5	10/06/10	<0.015	<0.10	<0.10	**0.88**	<0.10	<0.10	**2.12**	**0.43**	<0.10	**0.18**
PBN-9301C	669	C	217.5-227.5	10/06/10	**0.031**	**0.16**	<0.10	**1.69**	<0.10	<0.10	**2.13**	**0.87**	<0.10	**0.24**

Table 10
Groundwater Analytical Results
September 2010 Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

						VOCs - SW8260B								
Well	**Well ID**	**Sample Level**	**Sample Depth (feet)**	**Sample Date**	**Dinitrotoluene, Total**	**1,1-Dichloroethylene**	**1,2-Dichloropropane**	**1,1,1-Trichloroethane**	**1,1,2-Trichloroethane**	**Bromodichloromethane**	**Carbon Tetrachloride**	**Chloroform**	**Ethyl Ether**	**Trichloroethylene**
PBN-9303B	673	B	83.5-93.5	10/06/10	<0.015	**0.1**	<0.10	**0.94**	<0.10	<0.10	**3.04**	**0.67**	<0.10	<0.10
PBN-9303C	674	C	154.5-164.5	10/06/10	<0.015	<0.10	<0.10	**0.46**	<0.10	<0.10	**6.12**	**1.62**	<0.10	<0.10
PBN-9303D	675	D	214.5-224.5	10/06/10	<0.015	**0.14**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9402B	680	B	85.5-95.5	10/06/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.22**	<0.10	<0.10
PBN-9402C	681	C	125-135	10/06/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.13**	**0.23**	<0.10	<0.10
PBN-9402C (dup)	681	C	125-135	10/06/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.14**	**0.27**	<0.10	<0.10
PBN-9402D	682	D	215-225	10/06/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9902A	688	A	45-60	10/06/10	**0.018**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9902B	689	B	106-111	10/06/10	<0.015	<0.10	<0.10	**0.57**	<0.10	<0.10	**7.53**	**0.74**	<0.10	**1.28**
PBN-9902C	691	C	217.5-222.5	10/06/10	**4.443**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-9902D	690	D	217.5-222.5	09/28/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**13.3**	<0.10
PBN-9902D (dup)	690	D	217.5-222.5	09/28/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**13.4**	<0.10
PBN-9903A	692	A	61-76	09/28/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.93**	<0.10	<0.10	**0.1**
PBN-9903B	693	B	107-112	09/28/10	**0.019**	<0.10	<0.10	**0.5**	<0.10	<0.10	**11.5**	**1.18**	<0.10	**5.8**
PBN-9903C	694	C	158-163	09/28/10	**0.017**	<0.10	<0.10	**0.26**	<0.10	<0.10	**23.8**	**2.07**	<0.10	**6.82**
PBN-9903D	695	D	203-208	09/28/10	<0.015	<0.10	<0.10	**0.12**	<0.10	<0.10	**9.92**	**1.48**	**11.4**	**3.98**
S1103	702	C	115.0-120.1	09/09/10	<0.015	<0.10	<0.10	**0.25**	<0.10	<0.10	**6.99**	**0.8**	<0.10	<0.10
S1103 (dup)	702	C	115.0-120.1	09/09/10	<0.015	<0.10	<0.10	**0.29**	<0.10	<0.10	**7.31**	**0.85**	<0.10	<0.10
S1104	703	A	73.28-93.5	09/09/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
S1105	704	B	104.4-109.5	09/09/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
S1106	705	C	130.7-135.7	09/09/10	**0.026**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.34**	**0.24**	<0.10	<0.10
S1121	755	A	39.11-59.3	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
S1122	300	A	123.8-144	09/30/10	<0.015	<0.10	<0.10	**0.38**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
S1134R	236	A	136-151	09/23/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SEN-0501A	580	A	17-32	09/08/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.27**	<0.10	<0.10
SEN-0501B	581	B	77-87	09/08/10	**0.024**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.68**	<0.10	<0.10
SEN-0501D	582	D	180-190	09/08/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.82**	<0.10	<0.10
SEN-0502A	583	A	18-33	09/08/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SEN-0502B	588	B	592-692	09/08/10	**0.035**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.47**	<0.10	<0.10
SEN-0502B (dup)	588	B	592-692	09/08/10	**0.039**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.47**	<0.10	<0.10
SEN-0502D	584	D	177-187	09/08/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.5**	<0.10	<0.10
SEN-0503A	585	A	40.5-55.5	09/08/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SEN-0503B	586	B	100-110	09/08/10	**0.049**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.41**	<0.10	<0.10
SEN-0503D	587	D	203-213	09/08/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.35**	<0.10	<0.10
SPN-0401A	728	A	77-92	09/09/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SPN-0402A	729	A	30-45	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SPN-0402C	730	C	143.7-148.7	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.76**	**0.83**	<0.10	<0.10
SPN-0403A	731	A	40.8-55.8	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SPN-0403C	732	C	160-165	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.6**	**0.81**	<0.10	<0.10
SPN-0404D	733	D	237-242	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SPN-0406A	736	A	28.4-43.4	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SPN-0406B	737	B	93.5-98.5	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.48**	<0.10	<0.10
SPN-0406B (dup)	737	B	93.5-98.5	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.48**	<0.10	<0.10
SPN-0406C	738	C	144.4-149.4	09/13/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.19**	**1.54**	<0.10	<0.10
SPN-8902B	716	B	93.8-98.8	09/09/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table 10
Groundwater Analytical Results
September 2010 Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

						VOCs - SW8260B								
Well	**Well ID**	**Sample Level**	**Sample Depth (feet)**	**Sample Date**	**Dinitrotoluene, Total**	**1,1-Dichloroethylene**	**1,2-Dichloropropane**	**1,1,1-Trichloroethane**	**1,1,2-Trichloroethane**	**Bromodichloromethane**	**Carbon Tetrachloride**	**Chloroform**	**Ethyl Ether**	**Trichloroethylene**
SPN-8902C	717	C	124-129	09/09/10	<0.015	<0.10	<0.10	**0.22**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SPN-8904B	720	B	70-75	09/09/10	**0.078**	<0.10	<0.10	**0.45**	<0.10	<0.10	**9.5**	**0.97**	<0.10	**6.1**
SPN-8904C	721	C	101.5-106.5	09/09/10	**0.096**	**0.12**	<0.10	**1.03**	<0.10	**0.17**	**17.2**	**1.94**	<0.10	**13.1**
SWN-0501B	237	B	145.6-155.6	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.2**	**0.43**	<0.10	<0.10
SWN-0501C	238	C	196.6-206.6	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.46**	**1.43**	<0.10	<0.10
SWN-0501D	239	D	252.9-262.9	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.25**	<0.10
SWN-0501E	240	E	280.3-290.3	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**10.5**	<0.10
SWN-0502B	241	B	145.8-155.8	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.87**	<0.10	<0.10
SWN-0502B (dup)	241	B	145.8-155.8	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.12**	**0.94**	<0.10	<0.10
SWN-0502C	242	C	191.5-201.5	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**1**	<0.10	<0.10
SWN-0502D	243	D	234.9-244.9	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SWN-0502E	244	E	250-260	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SWN-0503B	245	B	144.3-154.3	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.54**	<0.10	<0.10
SWN-0503C	246	C	190.6-200.6	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.94**	<0.10	<0.10
SWN-0503D	247	D	230.5-240.5	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SWN-0503E	248	E	255.2-265.2	09/07/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**4.59**	<0.10
SWN-9102C	569	C	142.5-152.5	09/14/10	**0.052**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
SWN-9102D	570	D	175-185	09/14/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.23**	<0.10	<0.10
SWN-9103B	571	B	103.4-113.4	09/14/10	**0.052**	<0.10	<0.10	<0.10	<0.10	<0.10	**14.1**	**1.65**	<0.10	**1.38**
SWN-9103B (dup)	571	B	103.4-113.4	09/14/10	**0.044**	<0.10	<0.10	<0.10	<0.10	<0.10	**14.2**	**1.58**	<0.10	**1.48**
SWN-9103C	572	C	152.8-162.8	09/14/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**75.9**	**5.82**	<0.10	**0.98**
SWN-9103D	573	D	199.1-209.1	09/14/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**8.45**	**1.76**	<0.10	**0.29**
SWN-9103E	574	E	227.9-237.9	09/14/10	**0.016**	<0.10	<0.10	<0.10	<0.10	<0.10	**0.22**	<0.10	<0.10	<0.10
SWN-9104C	575	C	154-164	09/14/10	**0.02**	<0.10	<0.10	<0.10	<0.10	<0.10	**1.5**	**0.44**	<0.10	<0.10
SWN-9104D	576	D	187-197	09/14/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.51**	**0.42**	<0.10	<0.10
SWN-9105B	577	B	102.5-112.5	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.52**	<0.10	<0.10
SWN-9105C	578	C	137-147	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.11**	**2.74**	<0.10	<0.10
SWN-9105D	579	D	190.5-200.5	09/15/10	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.61**	<0.10	<0.10
Chapter NR 140 PAL					0.005	0.7	0.5	40	0.5	0.06	0.5	0.6	100	0.5
Chapter NR 140 ES					0.05	7	5.0	200	5.0	0.6	5.0	6.0	1000	5

Notes:
The Sample Level references the typical well depth configuration
All results are expressed in micrograms per liter (µg/l)
Bold values are detected results
Wells listed with (dup) after the name were duplicate samples
Dinitrotoluene, Total results were analyzed by either SW8270C or SW8270CSIM
VOCs = Volatile Organic Compounds
Chapter NR 140 PAL - Chapter NR 140, Wisconsin Administrative Code, Preventive Action Limit
Chapter NR 140 ES - Chapter NR 140, Wisconsin Administrative Code, Enforcement Standard

Table 11
Groundwater Analytical Results
2010 Site-wide Monitoring Well Installation
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

					Dinitrotoluenes - SW8270CSIM							VOCs - SW8260B					
Well	**Well ID**	**Sample Level**	**Sample Depth (feet)**	**Sampled Date**	**2,3-Dinitrotoluene**	**2,4-Dinitrotoluene**	**2,5-Dinitrotoluene**	**2,6-Dinitrotoluene**	**3,4-Dinitrotoluene**	**3,5-Dinitrotoluene**	**Dinitrotoluene, Total**	**1,1,1-Trichloroethane**	**Carbon Tetrachloride**	**Chloroform**	**Ethyl Ether**	**Toluene**	**Trichloroethylene**
DBM-1001	471	A	115-125	10/26/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	**1.75**	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-1001B	472	B	154.5-159.5	10/26/10	**0.269 (J)**	<0.015	<0.015	<0.015	**0.611**	**0.026 (J)**	**0.906**	**2.44**	**0.44**	<0.10	<0.10	**0.14 (J)**	<0.10
DBN-1001B (dup)	472	B	154.5-159.5	10/26/10	**0.253 (J)**	<0.015	<0.015	<0.015	**0.607**	**0.026 (J)**	**0.886**	**2.46**	**0.43**	<0.10	<0.10	**0.14 (J)**	<0.10
DBN-1001C	473	C	192-197	10/26/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	**0.14 (J)**	<0.10
DBN-1001E	474	E	275-280	11/08/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
DBN-1002C	476	C	205-210	10/26/10	<0.015	<0.015	<0.015	<0.015	**0.016 (J)**	<0.015	**0.016**	**0.52**	**0.12 (J)**	<0.10	<0.10	**0.1 (J)**	<0.10
DBN-1002E	477	E	275-280	11/08/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PBN-1001A	593	A	69-79	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	**0.82**	<0.10	<0.10	<0.10	<0.10
PBN-1001B	594	B	135-140	10/27/10	<0.015	<0.015	<0.015	**0.018 (J)**	<0.015	<0.015	**0.018**	**0.37**	**13.1**	**1.24**	<0.10	<0.10	**5.32**
PBN-1001C	595	C	195-200	10/27/10	<0.015	<0.015	<0.015	**0.04 (J)**	<0.015	<0.015	**0.04**	**0.15 (J)**	**5.06**	**3.85**	**4,610**	**0.16 (J)**	**0.12 (J)**
PBN-1002A	589	A	121-131	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	**0.21 (J)**	<0.10	<0.10	<0.10	<0.10
PBN-1002B	590	B	171.5-176.5	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	**0.32**	**6.88**	**0.50**	<0.10	<0.10	**1.23**
PBN-1002C	591	C	212-217	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	**0.65**	**11.5**	**0.8**	<0.10	**0.38**	**3.23**
PBN-1003C	592	C	184.5-189.5	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	**0.39**	**0.3 (J)**	<0.10	**0.16 (J)**	**0.26 (J)**
RIM-1001	482	A	89-99	10/26/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIM-1002	478	A	100-110	10/26/10	<0.015	**0.026 (J)**	<0.015	**0.019 (J)**	<0.015	<0.015	**0.045**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIM-1003	491	A	104-114	10/26/10	<0.015	**0.029 (J)**	<0.015	<0.015	<0.015	<0.015	**0.029**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIM-1004	494	A	60-70	10/28/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIM-1005	490	A	100-110	10/26/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1001A	480	A	97-107	10/27/10	<0.015	**0.027 (J)**	<0.015	**0.035 (J)**	<0.015	<0.015	**0.062**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1001A (dup)	480	A	97-107	10/27/10	<0.015	**0.042 (J)**	<0.015	**0.052**	<0.015	<0.015	**0.094**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1001C	481	C	176-181	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	**0.25 (J)**	<0.10	**0.3 (J)**	<0.10	<0.10	<0.10
RIN-1002A	492	A	82-92	10/26/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1002C	493	C	175-180	10/26/10	<0.015	<0.015	<0.015	**0.023 (J)**	<0.015	<0.015	**0.023**	<0.10	<0.10	**0.26 (J)**	<0.10	<0.10	<0.10
RIN-1003A	495	A	80-90	10/28/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1004B	498	B	141.5-146.5	10/28/10	<0.015	**0.022 (J)**	<0.015	**0.039 (J)**	<0.015	<0.015	**0.061**	<0.10	<0.10	**0.44**	<0.10	<0.10	<0.10
RIN-1004B (dup)	498	B	141.5-146.5	10/28/10	<0.015	**0.024 (J)**	<0.015	**0.037 (J)**	<0.015	<0.015	**0.061**	<0.10	<0.10	**0.42**	<0.10	<0.10	<0.10
RIN-1005A	496	A	50-60	10/28/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1005C	497	C	142-147	10/28/10	<0.015	<0.015	<0.015	**0.06**	<0.015	<0.015	**0.06**	<0.10	<0.10	**0.76**	<0.10	<0.10	<0.10
RIN-1006A	483	A	90-100	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	**0.46**
RIN-1006C	484	C	175-180	10/28/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
RIN-1007C	479	C	170-175	10/27/10	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	**0.56**	**0.24 (J)**	**0.31**	<0.10	<0.10	**0.26 (J)**
Chapter NR 140 PAL					NE	0.005	NE	0.005	NE	NE	0.005	40	0.5	0.6	100	160	0.5
Chapter NR 140 ES					NE	0.05	NE	0.05	NE	NE	0.05	200	5.0	6.0	1000	800	5

Notes:
The Sample Level references the typical well depth configuration
All results are expressed in micrograms per liter (µg/l)
Bold values are detected results
Samples DBN-1001B (dup), RIN-1001A (dup), and RIN-1004B (dup) were duplicate samples
J = Analytical result is between the Limit of Detection (LOD) and Limit of Quantitation (LOQ)
NE = Not Established
VOCs = Volatile Organic Compounds
Chapter NR 140 PAL - Chapter NR 140, Wisconsin Administrative Code, Preventive Action Limit
Chapter NR 140 ES - Chapter NR 140, Wisconsin Administrative Code, Enforcement Standard

Table 12
Private Well Groundwater Analytical Results
August 2010 Annual Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

August '10 Round	Limit of Detection	Limit of Quantitation
2,3-DNT	0.014	0.046
2,4-DNT	0.014	0.046
2,5-DNT	0.014	0.046
2,6-DNT	0.014	0.046
3,4-DNT	0.014	0.046
3,5-DNT	0.014	0.046

*Limit of detection and Limit of quantitation may change each round.

☐ = Under PAL and ES
☐ = Over Preventive Action Limit (PAL)
☐ = Over Enforcement Standard (ES)
☐ = No PAL or ES established
☐ = Not Tested
ND = Compound was not detected

All results are expressed as µg/l (micrograms per liter)

Well Name	Well No.	Well Depth (feet)	Aquifer	Sample Analyzed By:	Date of Sample	Dichlorodifluoromethane	Chloroform	Carbon Tetrachloride	Dibromochloromethane	Bromodichloromethane	Methylene Chloride	Tetrachloroethene	Trichloroethene	Toluene	Xylenes	Ethyl Ether	1,2,4-Trimethylbenzene	1,2,3-Trichlorobenzene	2,6-Dinitrotoluene	2,4-Dinitrotoluene	2,3-Dinitrotoluene	3,4-Dinitrotoluene	2,5-Dinitrotoluene	3,5-Dinitrotoluene	Dinitrotoluene, Total
Anderson-R	411	26	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	0.36	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Brey	817	100	Sand	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Deppe	413	unknown	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gibbs	839	unknown	unknown	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Grosse	415	110	Sand	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				SPECPRO(D)	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gruber-D	417	unknown	Sand	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hendershot	418	20	Sand	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Howery	419	unknown	unknown	SPECPRO	August 2010	Sampling declined																			
Jones-A	860	unknown	unknown	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kopras	874	260	Bedrock	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lee	420	100	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nimmow-J	421	unknown	unknown	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	0.25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Olah	904	30	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Osterland	422	unknown	unknown	SPECPRO	August 2010	Water shut off; well not sampled																			
Puccio	423	100	Sand	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Raschein	424	unknown	unknown	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Revers	425	80	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Roll	426	unknown	unknown	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Statz	427	unknown	unknown	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wenger	414	unknown	unknown	SPECPRO	8/24/2010	ND	ND	ND	ND	ND	ND	ND	0.43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wilkinson	428	unknown	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Woods	429	86	Sand	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				SPECPRO(D)	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zurbachen-A	967	176	Bedrock	SPECPRO	8/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

(D) = Duplicate

Table 13
Private Well Groundwater Analytical Results
September 2010 Quarterly Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Sept '10 Round	Limit of Detection	Limit of Quantitation
2,3-DNT	0.015	0.05
2,4-DNT	0.015	0.05
2,5-DNT	0.015	0.05
2,6-DNT	0.015	0.05
3,4-DNT	0.015	0.05
3,5-DNT	0.015	0.05

*Limit of detection and Limit of quantitation may change each round.

☐ = Under PAL and ES
☐ = Over Preventive Action Limit (PAL)
☐ = Over Enforcement Standard (ES)
☐ = No PAL or ES established
☐ = Not Tested
ND = Compound was not detected

All results are expressed as µg/l (micrograms per liter)

Well Name	Well No.	Well Depth (feet)	Aquifer	Sample Analyzed By:	Date of Sample	Dichlorodifluoromethane	Chloroform	Carbon Tetrachloride	Dibromochloromethane	Bromodichloromethane	Methylene Chloride	Tetrachloroethene	Trichloroethene	Toluene	Xylenes	Ethyl Ether	1,1,1-Trichloroethane	1,1,2-Trichloroethane	2,6-Dinitrotoluene	2,4-Dinitrotoluene	2,3-Dinitrotoluene	3,4-Dinitrotoluene	2,5-Dinitrotoluene	3,5-Dinitrotoluene	Dinitrotoluene, Total
Brabender	171	unknown	unknown	SPECPRO	8/31/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chamberlain	172	unknown	unknown	SPECPRO	8/31/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cramer	825	unknown	unknown	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Crow	160	unknown	unknown	SPECPRO	9/1/2010	ND	0.72	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Curto	412	unknown	unknown	SPECPRO	8/31/2010	0.33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Delaney	152	301	Bedrock	SPECPRO	8/30/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ellingson	162	265	Bedrock	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.30	ND	ND	ND	ND	ND	ND	ND	ND	ND
Goelz	173	unknown	unknown	SPECPRO	8/31/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Groth	842	219	Bedrock	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gruber-North	970	240	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hankins	847	221	Bedrock	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hanson	963	307	Sand	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.37	ND	ND	ND	ND	ND	ND	ND	ND	ND
Judd	862	180	Sand	SPECPRO	9/1/2010	ND	1.21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				SPECPRO(D)	9/1/2010	ND	1.22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kindschi-V	870	unknown	unknown	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kirner	843	534	Bedrock	SPECPRO	9/2/2010	0.36	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Krumenauer	875	156	Sand	SPECPRO	9/1/2010	ND	0.4	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
				SPECPRO(D)	9/1/2010	ND	0.39	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lins-K	878	288	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lins-R	879	275	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mittenzwei	800	131	Sand	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mueller-J	899	523	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nimmow	998	178	Sand	SPECPRO	9/1/2010	ND	0.53	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nowotarski	891	88	Sand	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Orbitec	324	160	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PDS-3	911	554	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Priebe	913	76	Sand	SPECPRO	9/2/2010	ND	0.78	0.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.017	ND	ND	ND	ND	0.017
Purcell-Dan	163	112	Sand	SPECPRO	8/31/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND
				SPECPRO(D)	8/31/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Purcell-Gladys	916	unknown	unknown	SPECPRO	9/1/2010	ND	2.34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ramaker	917	310	Bedrock	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Roth-G	924	298	Bedrock	SPECPRO	9/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.26	ND	ND	ND	ND	ND	ND	ND	ND	ND
Schlender	931	280	Bedrock	SPECPRO	9/2/2010	ND	1.26	0.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.017	ND	ND	ND	ND	0.017
				SPECPRO(D)	9/2/2010	ND	1.22	0.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.019	ND	ND	ND	ND	0.019
Spear	803	159	Sand	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.22	ND	ND	ND	ND	ND	ND	ND
Urban	161	275	Bedrock	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.67	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 13
Private Well Groundwater Analytical Results
September 2010 Quarterly Round
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Sept '10 Round	Limit of Detection	Limit of Quantitation
2,3-DNT	0.015	0.05
2,4-DNT	0.015	0.05
2,5-DNT	0.015	0.05
2,6-DNT	0.015	0.05
3,4-DNT	0.015	0.05
3,5-DNT	0.015	0.05

*Limit of detection and Limit of quantitation may change each round.

☐ = Under PAL and ES
☐ = Over Preventive Action Limit (PAL)
☐ = Over Enforcement Standard (ES)
☐ = No PAL or ES established
☐ = Not Tested
ND = Compound was not detected

All results are expressed as µg/l (micrograms per liter)

Well Name	Well No.	Well Depth (feet)	Aquifer	Sample Analyzed By:	Date of Sample	Dichlorodifluoromethane	Chloroform	Carbon Tetrachloride	Dibromochloromethane	Bromodichloromethane	Methylene Chloride	Tetrachloroethene	Trichloroethene	Toluene	Xylenes	Ethyl Ether	1,1,1-Trichloroethane	1,1,2-Trichloroethane	2,6-Dinitrotoluene	2,4-Dinitrotoluene	2,3-Dinitrotoluene	3,4-Dinitrotoluene	2,5-Dinitrotoluene	3,5-Dinitrotoluene	Dinitrotoluene, Total
WE-QN039	158	100	Sand	SPECPRO	8/30/2010	ND	1.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-QR441	157	118	Sand	SPECPRO	8/30/2010	ND	0.95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-RD430	159	80	Sand	SPECPRO	8/30/2010	ND	0.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-RM383	153	81	Sand	SPECPRO	8/30/2010	ND	0.43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-SQ017	164	180	Sand	SPECPRO	8/31/2010	ND	1.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-SQ001	165	179	Sand	SPECPRO	8/31/2010	ND	0.52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-RR542	156	100	Sand	SPECPRO	8/31/2010	ND	0.43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-RR598	169	106	Sand	SPECPRO	8/31/2010	ND	0.58	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-SQ002	170	100	Sand	SPECPRO	8/31/2010	ND	0.58	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-TF023	174	178	Sand	SPECPRO	9/1/2010	ND	0.48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-TM599	129	120	Sand	SPECPRO	8/31/2010	ND	0.97	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-UK125	431	283	Bedrock	SPECPRO	8/30/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WE-UK124	432	100	Sand	SPECPRO	8/30/2010	ND	0.58	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.016	ND	ND	ND	ND	ND	0.016
				SPECPRO(D)	8/30/2010	ND	0.54	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Weum	802	158	Sand	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zander	849	229	Sand	SPECPRO	9/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.46	ND	ND	ND	ND	ND	ND	ND	ND	ND
USDA 6	128	140	Sand	SPECPRO	9/2/2010	ND	0.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.041	ND	ND	ND	ND	ND	0.041
				SPECPRO(F)	9/2/2010	ND	0.25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

(D) = Duplicate
(F) = Filtered

Table 14

Groundwater Plume Contaminant Mass Estimate

Propellant Burning Ground

Alternative Feasibility Study - Groundwater Remedial Strategy

Badger Army Ammunition Plant

Location	Plume Interval (µg/l)	Average Concentration (µg/l)	Interval Thickness (ft)	Length (ft)	Width (ft)	Porosity	Total Pore Space Volume (ft3)	Conversion Factor (lbs/ft3)	Mass Volume (lbs)
Carbon Tetrachloride									
On-site	>5.0	8.0	45	6,000	1,800	0.26	126,360,000	62.4	631
	0.5 to 5.0	1.5	45	7,200	3,000	0.26	252,720,000	62.4	237
Off-site	>25.0	60.0	60	6,000	750	0.26	70,200,000	62.4	2,628
	>5.0 to 25	8.0	75	8,400	1,125	0.26	184,275,000	62.4	920
	0.5 to 5.0	1.5	125	10,200	750	0.26	248,625,000	62.4	233
Carbon Tetrachloride Contaminant Mass									**4,648**
Dinitrotoluene									
On-site	>1.0	196	50	750	500	0.26	4,875,000	62.4	596.23
	>1.0	1.9	45	450	300	0.26	1,579,500	62.4	1.87
	>1.0	4.4	50	1,000	500	0.26	6,500,000	62.4	17.85
	0.05 - 1.0	0.15	45	7,200	400	0.26	33,696,000	62.4	3.15
	0.005 - 0.05	0.02	30	8,400	600	0.26	39,312,000	62.4	0.49
Off-site	0.05 - 1.0	0.05	70	6,000	2,000	0.26	218,400,000	62.4	6.81
	0.005 - 0.05	0.02	120	10,200	1,800	0.26	572,832,000	62.4	7.15
Total DNT Contaminant Mass									**634**

µg/l - micrograms per liter
ft - Feet
ft3 - Cubic Feet
lbs - Pounds
Total DNT values are based on the addition of the six DNT isomers.
Carbon tetrachloride and total DNT estimates are based on data from 2010.

Table 15
Dinitrotoluene Groundwater Plume Contaminant Mass Estimate
Deterrent Burning Ground and Central Plumes
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Location	Average Concentration (µg/l)	Elevation (ft above MSL)	Interval Thickness (ft)	Length (ft)	Width (ft)	Porosity	Total Pore Space Volume (ft3)	Conversion Factor (lbs/ft3)	Mass Volume (lbs)
Deterrent Burning Ground									
Hot Zone	4.09	735-780	45	900	800	0.26	8,424,000	62.4	21.50
Remainder	0.768	720-780	60	6,000	1,200	0.26	112,320,000	62.4	53.80
Total DNT Contaminant Mass									**75.3**
Central Plume									
Plume	0.042	660-760	100	18,000	2,000	0.26	936,000,000	62.4	24.5
Total DNT Contaminant Mass									**24.5**

µg/l - micrograms per liter
ft - Feet
ft3 - Cubic Feet
lbs - Pounds
Total DNT values are based on the addition of the six DNT isomers.
Deterrent Burning Ground estimate is based on data from 2010.
Central Plume estimate is based on data from 2008 to 2010.
MSL - mean sea level

Table 16
Regulatory Requirements: VOCs and SVOCs
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

Regulated Media	Groundwater		Surface Water	
Chemical	**Wisconsin - NR 140**		**Wisconsin - NR 105**	
Regulation	**Groundwater Standards**		**WWSF Water Quality Criteria**	
Standard	**ES**	**PAL**	**HTC-NPWS**	**HCC-NPWS**
Unit	**µg/l**	**µg/l**	**µg/l**	**µg/l**
Bromodichloromethane	0.6	0.06	-----	-----
Carbon Tetrachloride	5	0.5	-----	29
Chloroform	6	0.6	-----	1,960
2,4-Dinitrotoluene	0.05	0.005	13	13
2,6-Dinitrotoluene	0.05	0.005	-----	-----
Dinitrotoluene, Total *	0.05	0.005	-----	-----
1,1,1-Trichloroethane	200	40	270,000	-----
1,1,2-Trichloroethane	5	0.5	-----	195
Trichloroethylene	5	0.5	-----	539

VOC - Volatile Organic Compound
SVOC - Semi-volatile Organic Compound
NR - Natural Resources (Wisconsin Administrative Code)
WWSF - Surface Water Designated Use - Warm Water Sport Fish (Lake Wisconsin) - NR 102
ES - Enforcement Standard - Public Health Groundwater Standard - NR 140.10
PAL - Preventive Action Limit - Public Health Groundwater Quality Guideline - NR 140.10
HTC-NPWS - Human Threshold Criteria - Non Public Water System - NR 105.08
HCC-NPWS - Human Cancer Criteria - Non Public Water System - NR 105.09
µg/l- micrograms per liter
*Total DNT Isomers (2,3 DNT; 2,4 DNT; 2,5 DNT ; 2,6 DNT; 3,4 DNT; 3,5 DNT) - NR 140.10

Table 17
Comparison of Alternatives
Alternative Feasibility Study - Groundwater Remedial Strategy
Badger Army Ammunition Plant

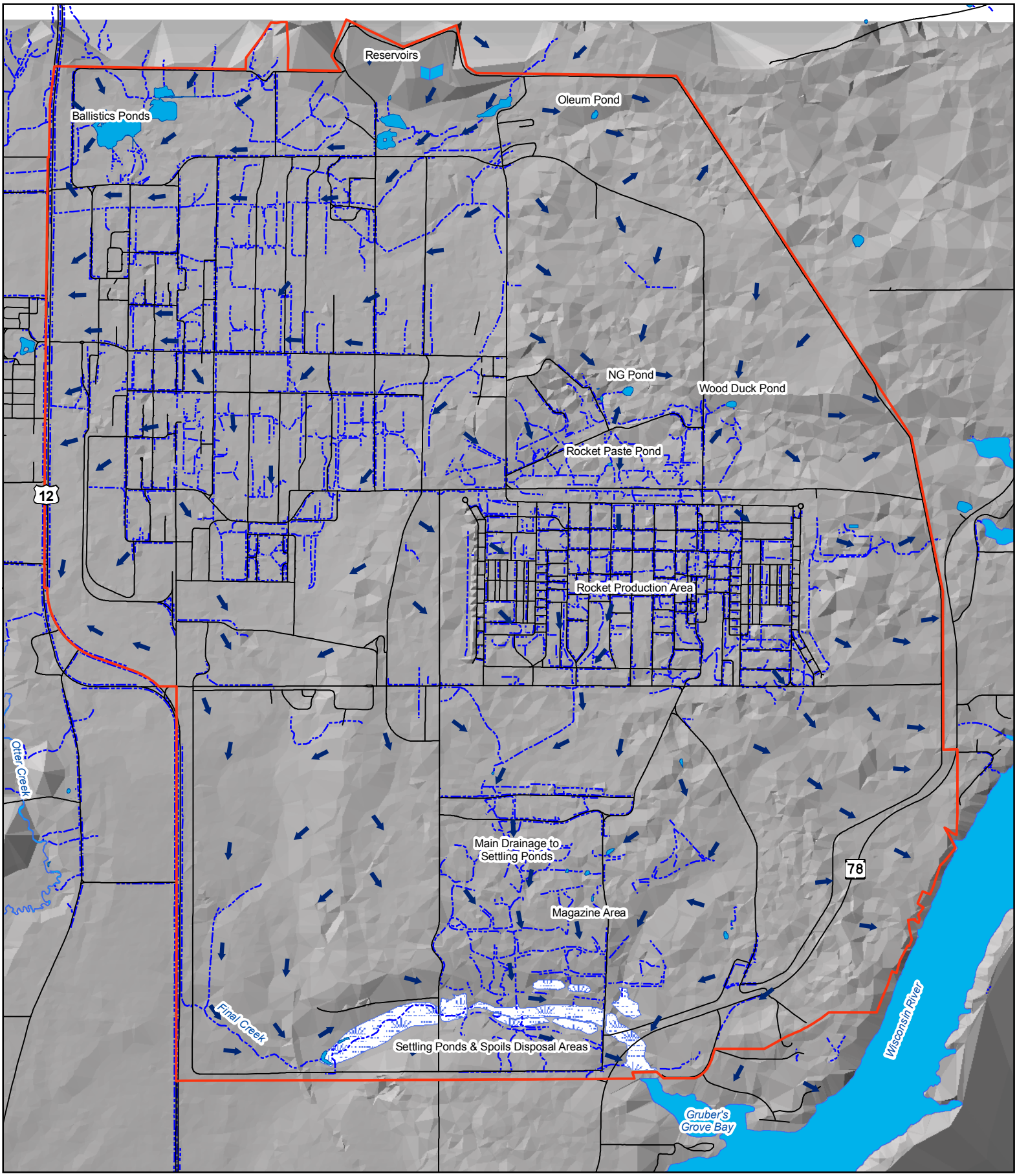
Criteria	**Alternative 1 – IRM/MIRM Treatment and Monitored Natural Attenuation**	**Alternative 2 – In-Situ Biochemical Treatment and Monitored Natural Attenuation**	**Alternative 3 – Public Water System and Monitored Natural Attenuation**
Overall Protection of Human Health and the Environment	This alternative would control and limit the migration of the on-site Propellant Burning Ground (PBG) plume only. There is no capture/treatment planned for the off-site portion of the PBG plume. There is also no capture/treatment planned for the Deterrent Burning Ground (DBG) plume or the Central Plume. Monitoring of private wells would continue, and private wells would be replaced if a persistent exceedance of a Chapter NR 140, Wisconsin Administrative Code, Enforcement Standard (ES) is confirmed. Contaminant concentrations are predicted to decrease through natural attenuation processes. Based on the applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors.	This alternative meets the requirements of the remedial action objective because it would effectively degrade the contaminants in groundwater on the installation, thereby minimizing the risk of future contaminant migration to human receptors and the environment. Groundwater monitoring at private wells would continue to provide assurance to the residents that their water is safe to drink. Based on the applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors.	This alternative would be the most protective of human health because it completely eliminates the exposure pathway to humans by providing an alternative source of water. Based on the applicable scientific and regulatory information, there is no evidence that the residual contaminant plumes are adversely affecting environmental receptors.
Compliance with Applicable Regulations	This alternative currently complies with applicable regulations.	This alternative would be designed to comply with applicable regulations.	This alternative would comply with applicable regulations.
Long-Term Effectiveness and Permanence	In this alternative, contaminant concentrations would continue to decrease below regulatory standards through recovery and treatment of the portion of the PBG plume on the installation, and natural processes (dilution, dispersion, and sorption). Monitoring of the plumes would continue for several years after the plumes attenuate to ensure that all areas remain below regulatory standards. Monitoring of residential wells would continue until Wisconsin Department of Natural Resources (WDNR) agrees that residential well monitoring is no longer required.	Both active treatment and natural attenuation components of the alternative would be permanent. If effective, groundwater treatment would permanently remove the majority of dinitrotoluene (DNT) and the chlorinated solvents from the groundwater. The remaining contamination would continue to decrease due to natural attenuation processes. However, this alternative may require supplemental post-treatment applications, at considerable cost, and would require a groundwater monitoring program to verify the efficacy of the remedial action. This alternative is expected to be effective over the long-term.	This alternative provides a permanent, long-term solution to the groundwater threat from Badger Army Ammunition Plant (BAAAP). The groundwater contamination would continue to decrease due to natural attenuation processes and no receptors would be at a significant risk.
Reduction of Toxicity, Mobility, and Volume through Treatment	Limited reductions in toxicity, mobility, and volume would occur through treatment of the PBG plume on the installation. The groundwater contamination would continue to decrease due to natural attenuation processes.	In-situ bioremediation of groundwater would reduce the toxicity, mobility, and volume of DNT and chlorinated solvents in the treated area more quickly than natural processes alone. The groundwater contamination would also continue to decrease due to natural attenuation processes and no receptors would be at a significant risk.	This alternative reduces the toxicity, mobility, and volume of the contamination in the groundwater through natural attenuation and eliminates the human exposure pathway by closing the private water wells.

Criteria	**Alternative 1 – IRM/MIRM Treatment and Monitored Natural Attenuation**	**Alternative 2 – In-Situ Biochemical Treatment and Monitored Natural Attenuation**	**Alternative 3 – Public Water System and Monitored Natural Attenuation**
Short-Term Effectiveness	The short-term impacts of alternatives shall be assessed considering the following: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved. For this alternative, short-term risks to the community and workers could include those due to potential human or ecological exposure to contaminants. However, there would be no additional short-term risk as this WDNR-approved alternative is already in place and operating on-site.	The short-term impacts of alternatives shall be assessed considering the following: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved. For this alternative, short-term risks to the community and workers could include those due to potential human or ecological exposure to contaminants. Because monitoring well and private well sampling would continue, no significant increase in risk is anticipated for potential receptors with the implementation of this alternative. In addition, there would be little effect on the community as most of the field activity associated with the injection would be conducted by qualified personnel on-site. As observed in the treatability study, the bioremediation occurs very quickly upon introduction of the CL-Out® and no worker safety issues have been identified.	The short-term impacts of this alternative considers the following: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and time until protection is achieved. For this alternative, short-term risks to the community and workers would not include those due to potential human or ecological exposure to contaminants, as all of the proposed work does not come in contact with impacted groundwater. There would be some effect (road/lane closures, increased worker traffic, equipment noise, etc.) on the community due to construction of the wells, water tower, and underground piping. The construction of the public water system is estimated to take approximately three years.
Implementability	This alternative has already been implemented.	CL-Out® has been demonstrated in a drum test to be effective in treating DNT and chlorinated solvents without the production of lasting intermediates or daughter products.	This alternative would be feasible, with the consent and approval of the community and community leaders. The towns of Sumpter, Merrimac, and Prairie du Sac must all work effectively together and coordinate efforts for the public water supply alternative to move forward.
Cost (Total present worth)	$76,966,000	$61,347,000	$40,048,400
State Acceptance	This alternative is a continuation of the current interim groundwater remedy accepted by the WDNR; therefore, it is likely that the WDNR would continue to accept this remedy. However, this criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the WDNR.	This criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the WDNR.	This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the WDNR.
Community Acceptance	This alternative is a continuation of the current interim groundwater remedy; therefore, it is likely that the community would continue to accept it. However, this criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the public.	This criterion would be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from the public.	This criterion will be evaluated throughout the development, screening, and analysis of alternatives based on comments and input received from local governments and the public.

Appendices

Appendix A

Surface Water Runoff Map



Legend

- Surface Water Flow
- Badger Army Ammunition Plant Boundary
- Drainage
- Pond/Lake/River
- Settling Ponds

Surface Water Runoff Map

Alternative Feasibility Study
Groundwater Remedial Strategy
Badger Army Ammunition Plant

0 1,450 2,900 5,800 Feet

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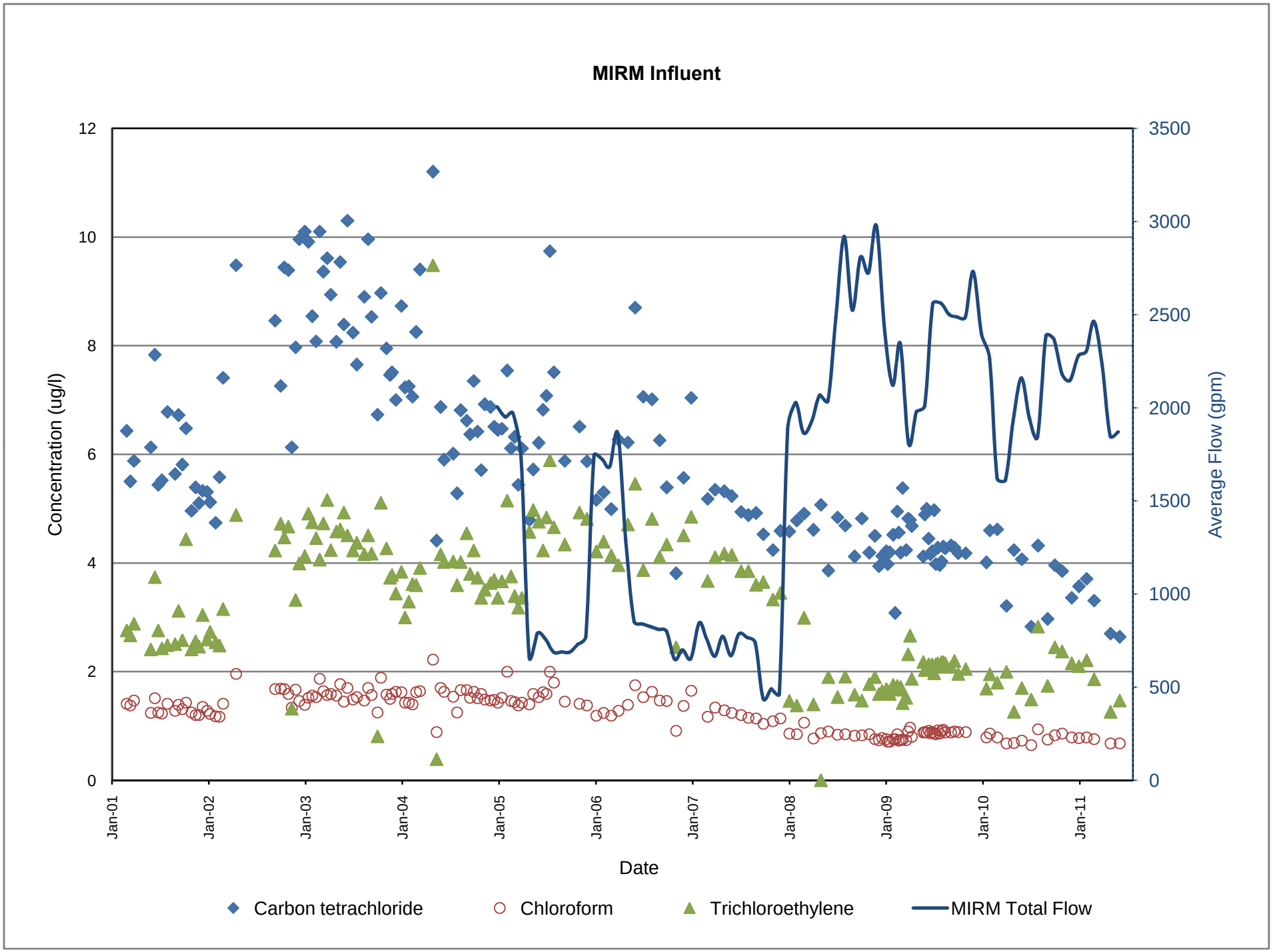
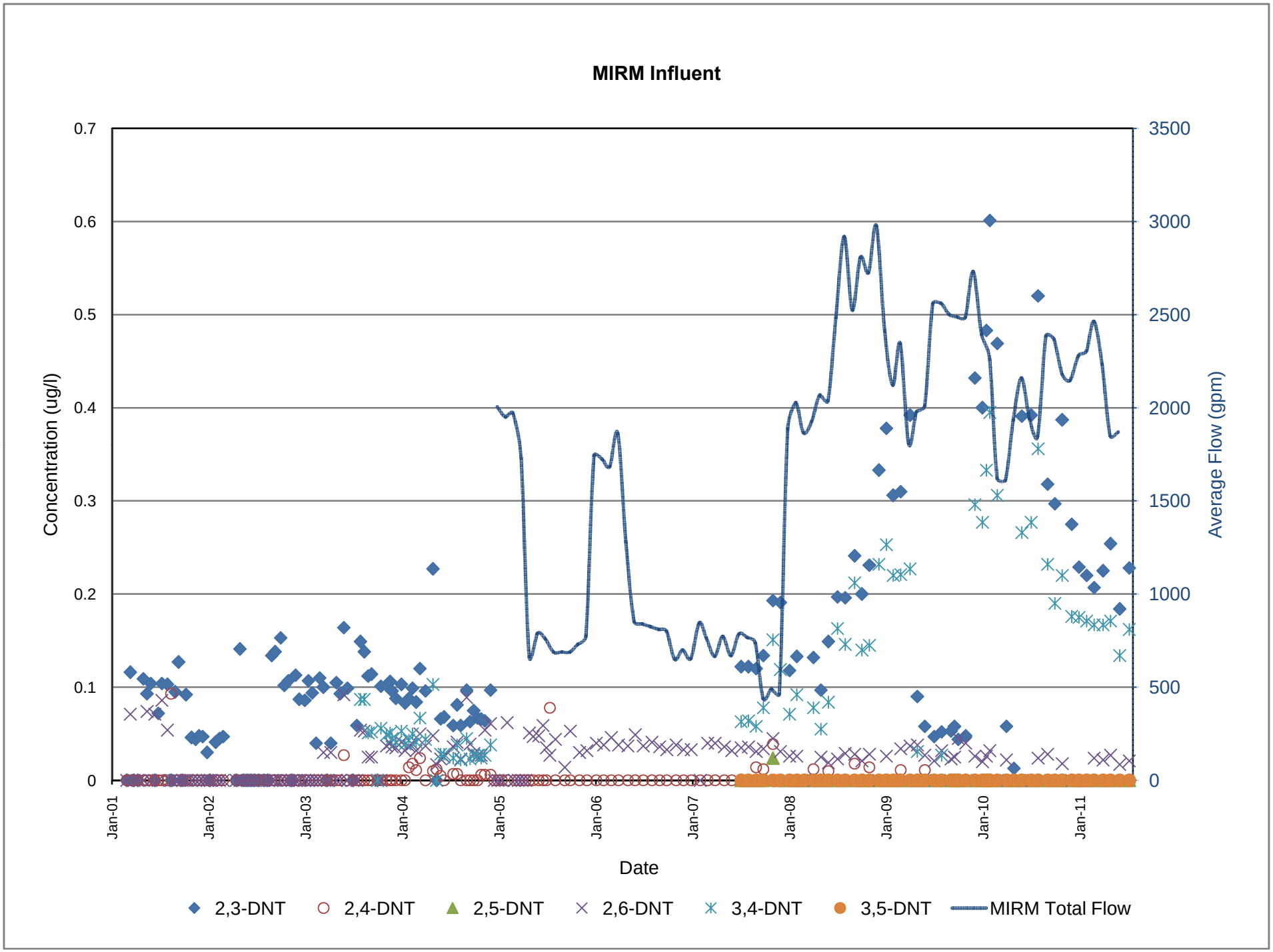
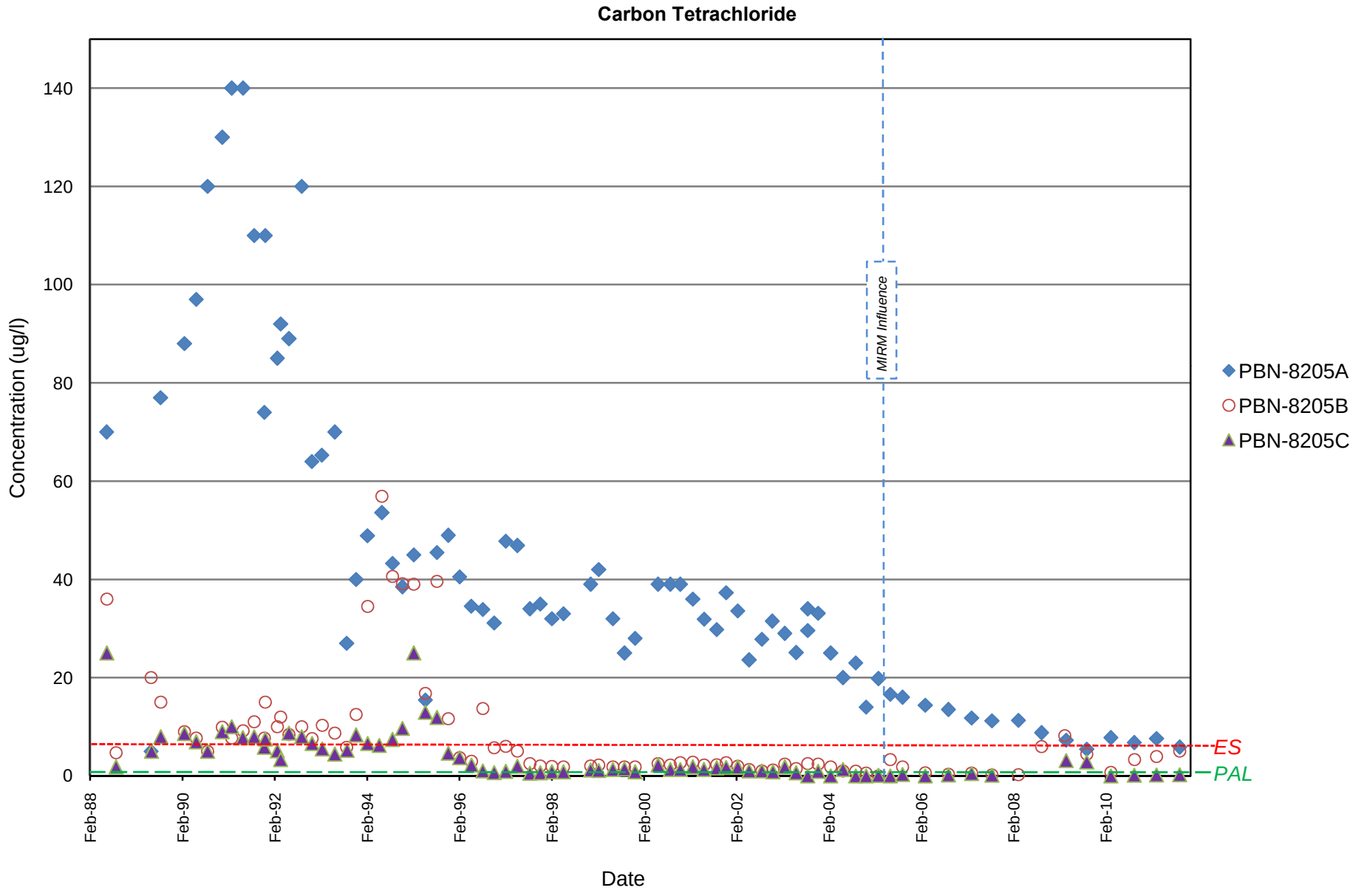
Appendix B

Plume Concentration Over Time Graphs

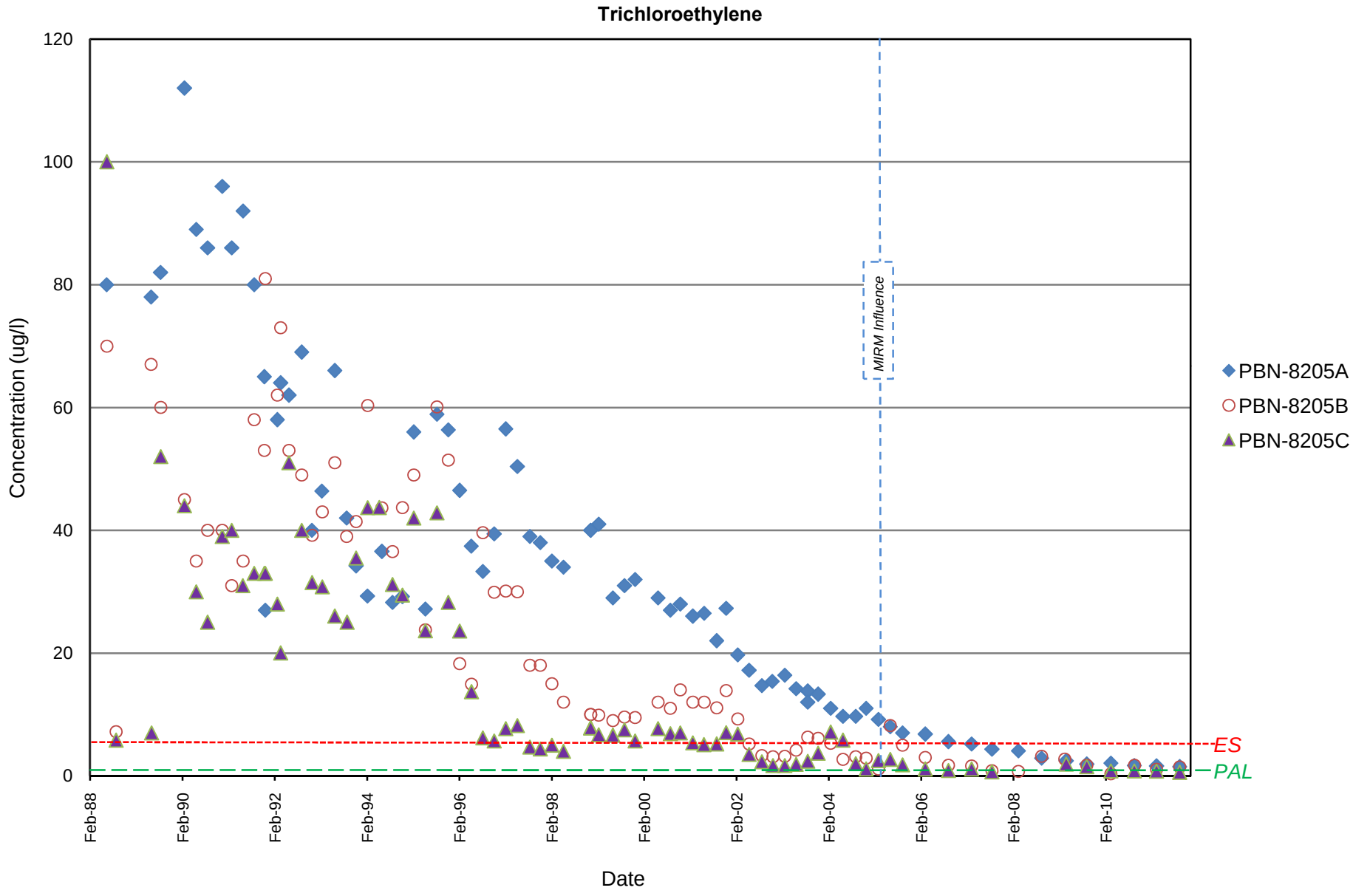

MIRM Influent
Concentration (ug/l)
Average Flow (gpm)
Date
0
2
4
6
8
10
12
0
500
1000
1500
2000
2500
3000
3500
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Carbon tetrachloride
Chloroform
Trichloroethylene
MIRM Total Flow

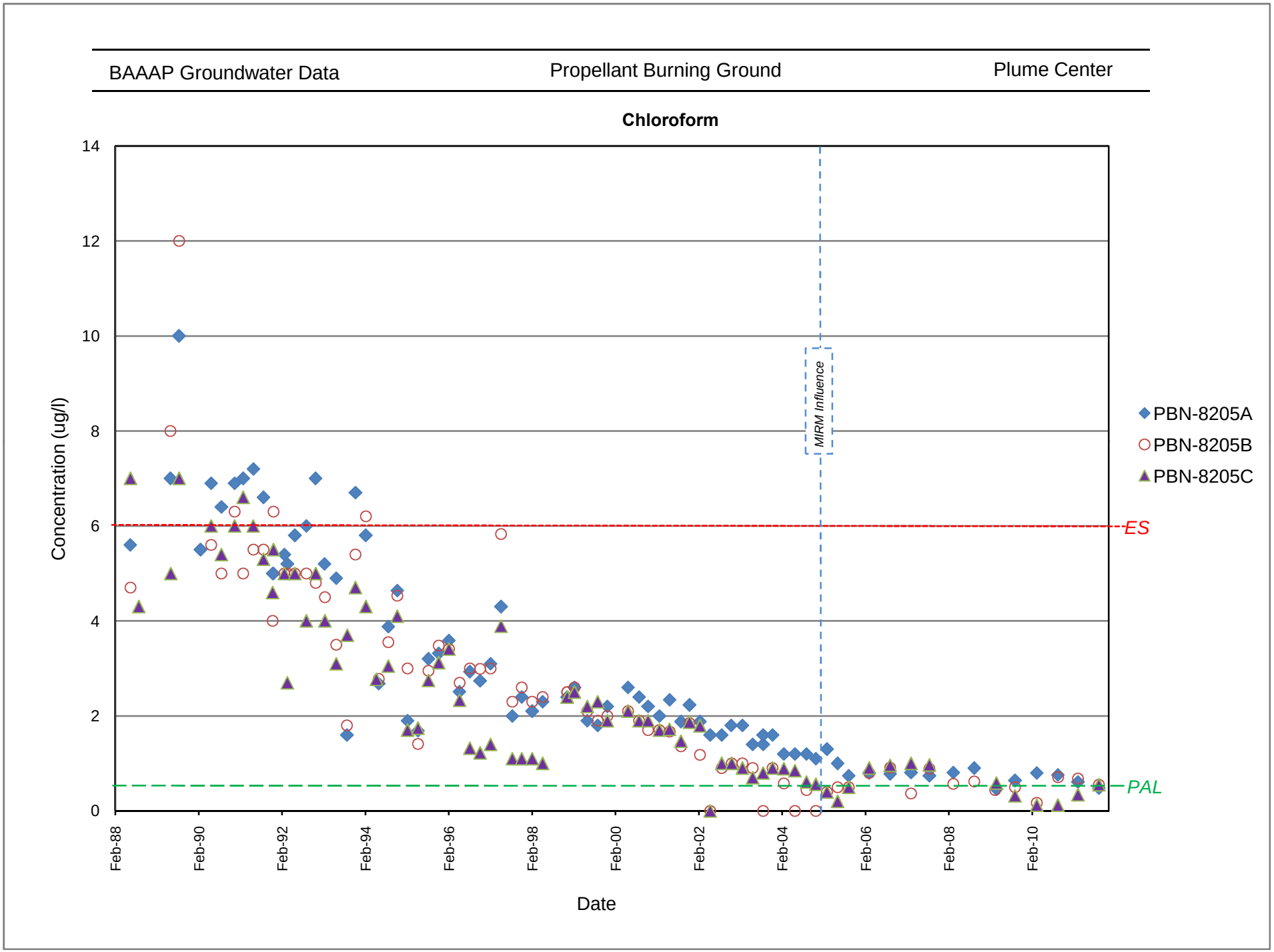

MIRM Influent
Concentration (ug/l)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Average Flow (gpm)
3500
3000
2500
2000
1500
1000
500
0
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Date
2,3-DNT
2,4-DNT
2,5-DNT
2,6-DNT
3,4-DNT
3,5-DNT
MIRM Total Flow

BAAAP Groundwater Data | Propellant Burning Ground | Plume Center

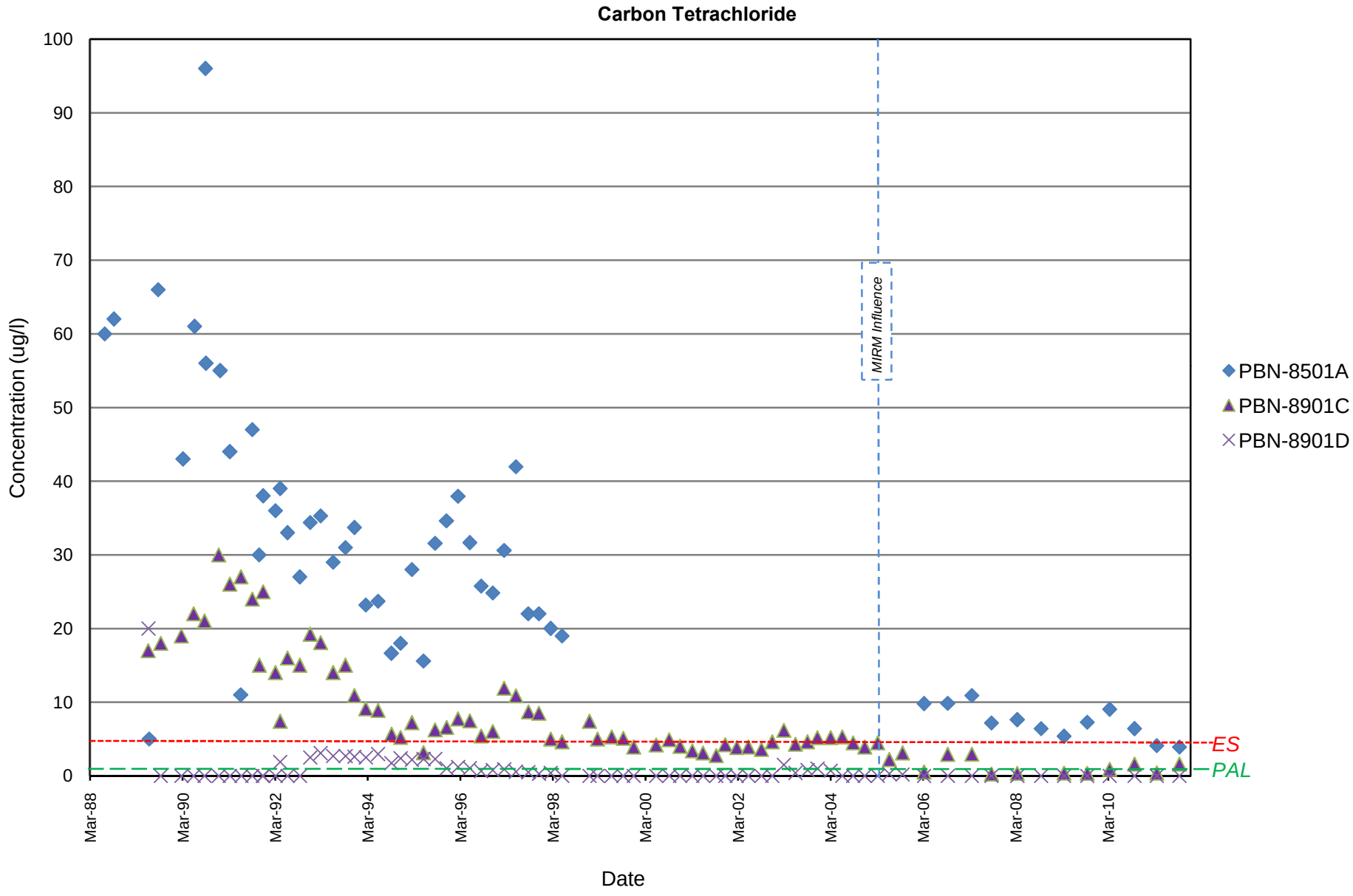


BAAAP Groundwater Data | Propellant Burning Ground | Plume Center

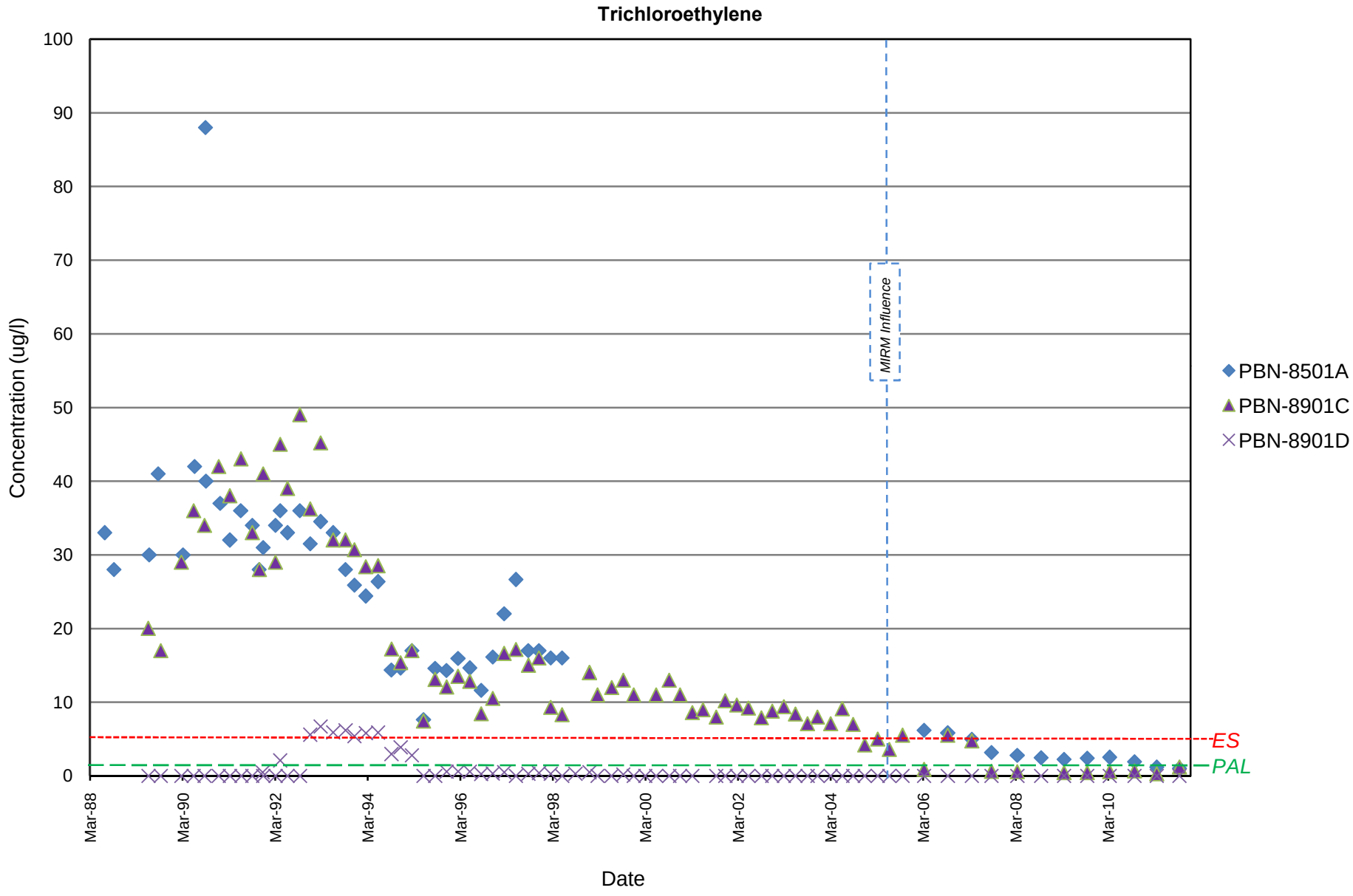


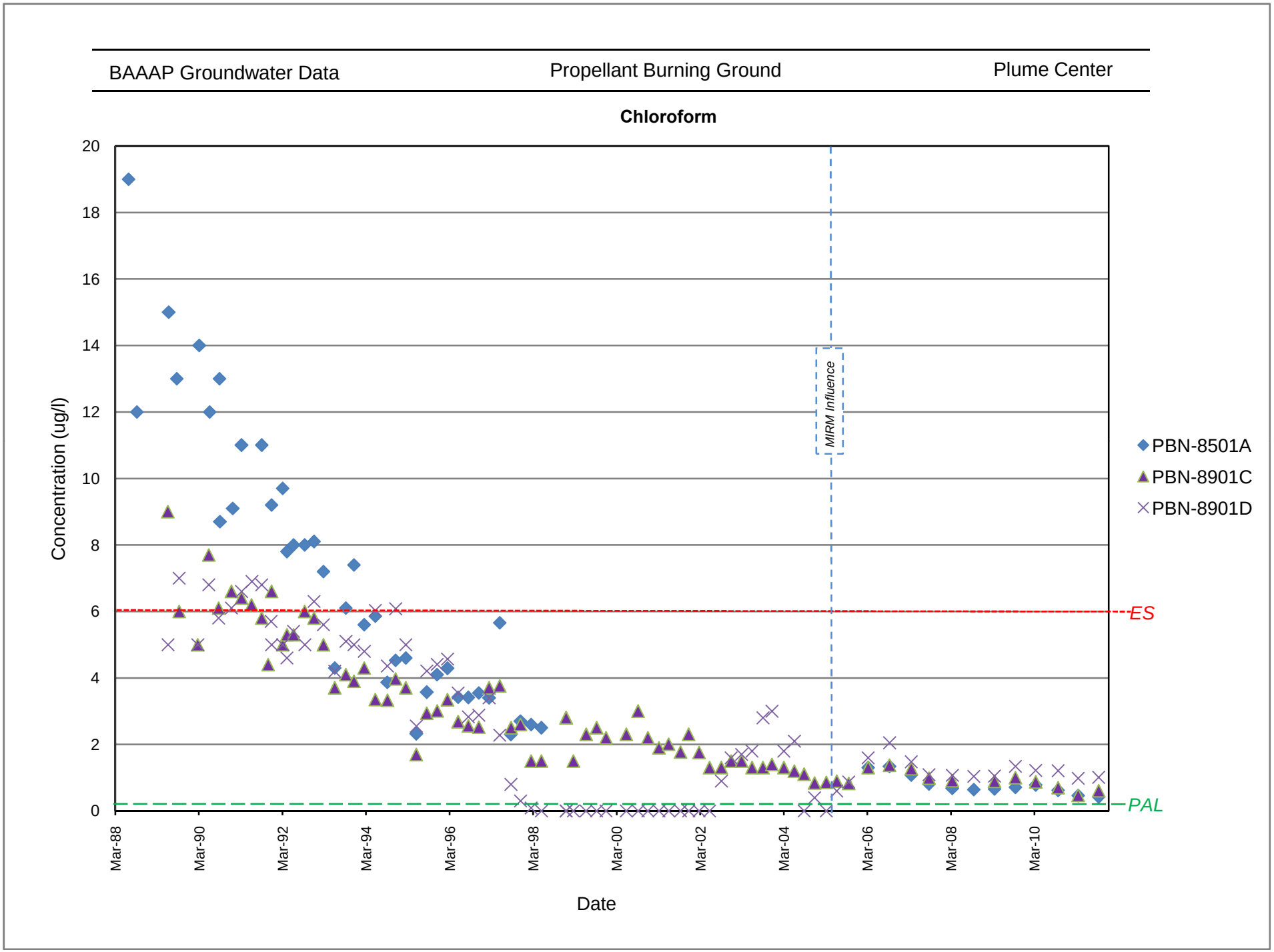

BAAAP Groundwater Data
Propellant Burning Ground
Plume Center
Chloroform
Concentration (ug/l)
14
12
10
8
6
4
2
0
Feb-88
Feb-90
Feb-92
Feb-94
Feb-96
Feb-98
Feb-00
Feb-02
Feb-04
Feb-06
Feb-08
Feb-10
Date
MIRM Influence
ES
PAL
PBN-8205A
PBN-8205B
PBN-8205C

BAAAP Groundwater Data | Propellant Burning Ground | Plume Center

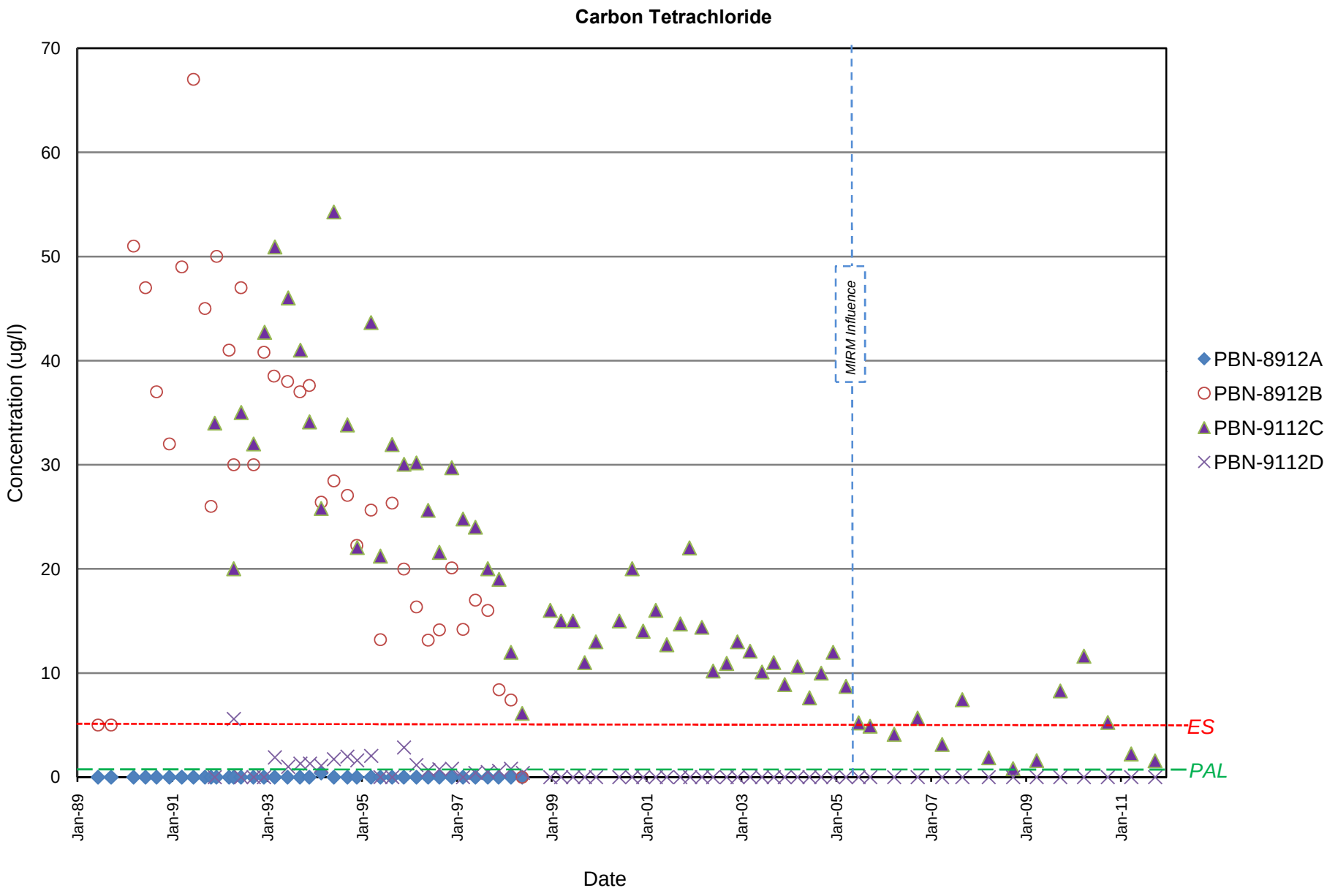


BAAAP Groundwater Data | Propellant Burning Ground | Plume Center

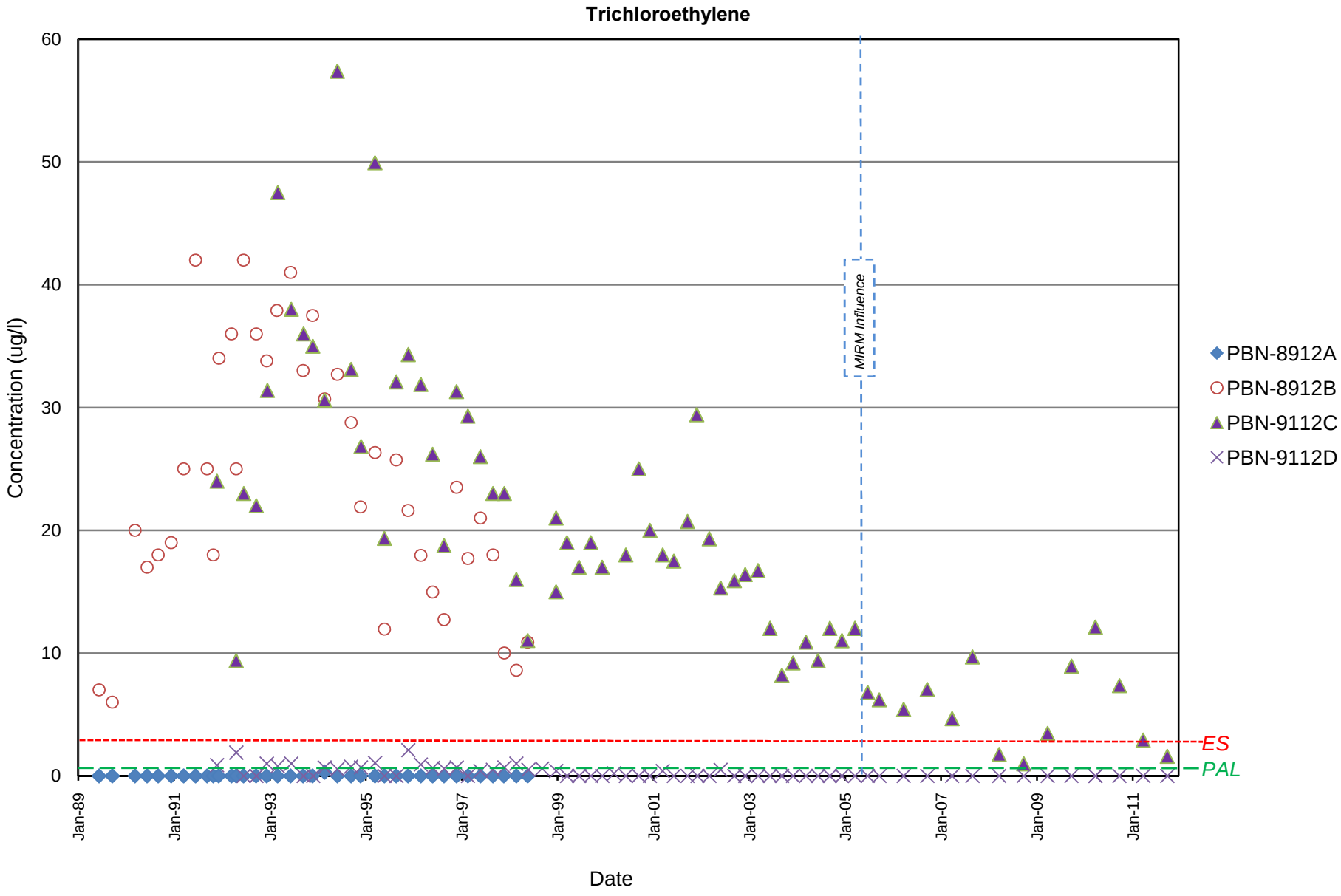


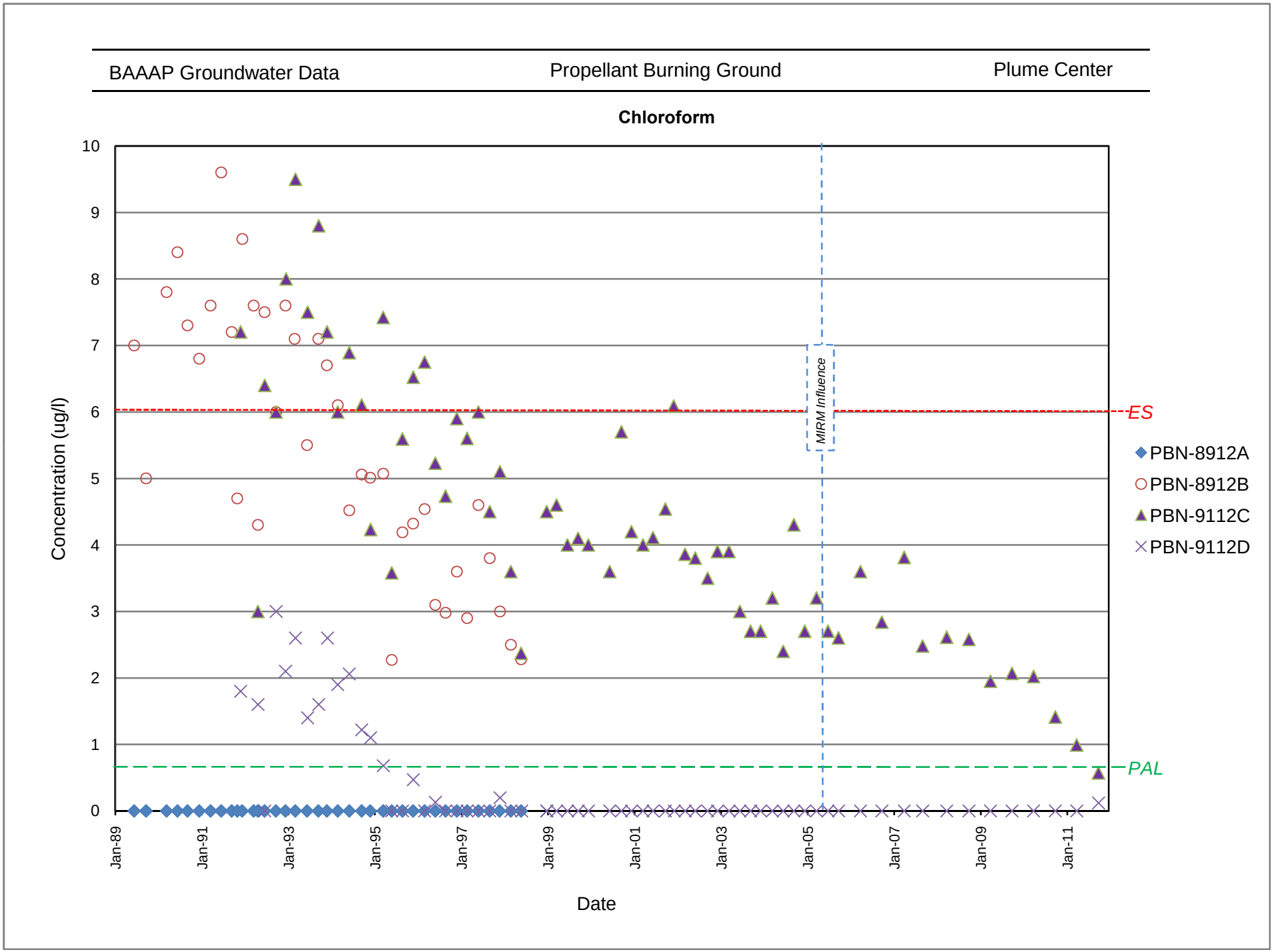

BAAAP Groundwater Data
Propellant Burning Ground
Plume Center
Chloroform
Concentration (ug/l)
20
18
16
14
12
10
8
6
4
2
0
MIRM Influence
ES
PAL
PBN-8501A
PBN-8901C
PBN-8901D
Mar-88
Mar-90
Mar-92
Mar-94
Mar-96
Mar-98
Mar-00
Mar-02
Mar-04
Mar-06
Mar-08
Mar-10
Date

BAAAP Groundwater Data | Propellant Burning Ground | Plume Center

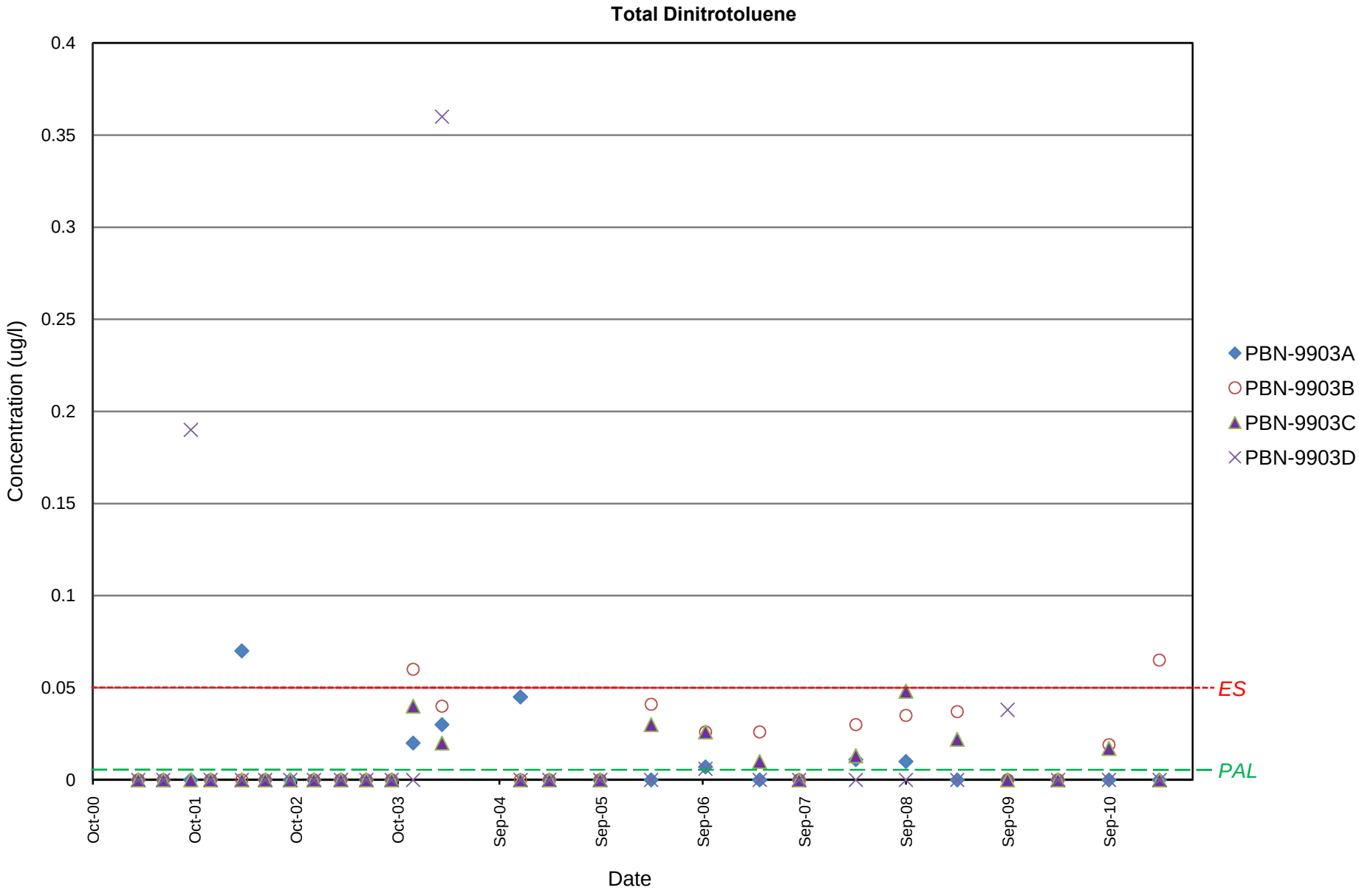


BAAAP Groundwater Data | Propellant Burning Ground | Plume Center

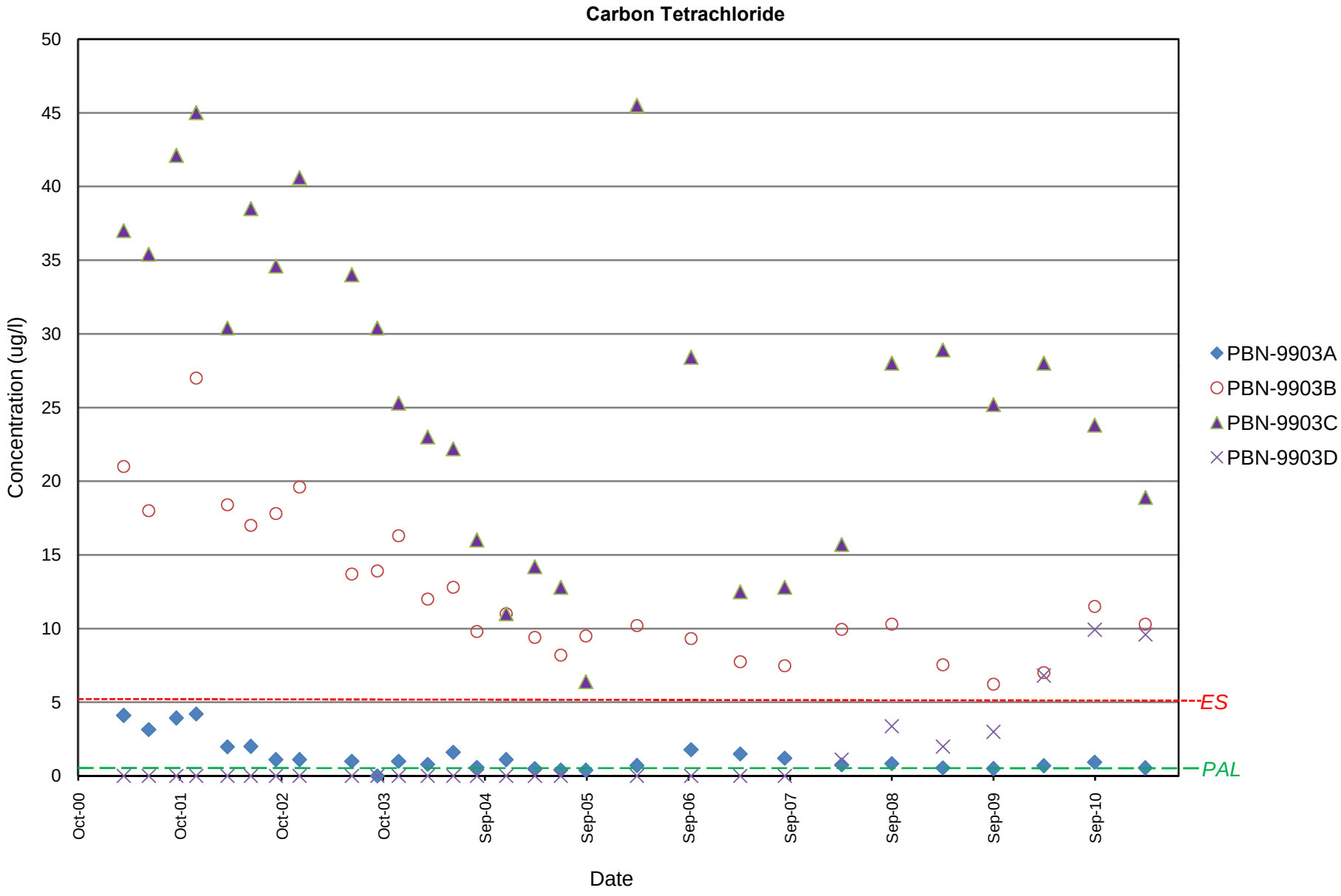



BAAAP Groundwater Data
Propellant Burning Ground
Plume Center
Chloroform
Concentration (ug/l)
10
9
8
7
6
5
4
3
2
1
0
MIRM Influence
ES
PAL
PBN-8912A
PBN-8912B
PBN-9112C
PBN-9112D
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11
Date

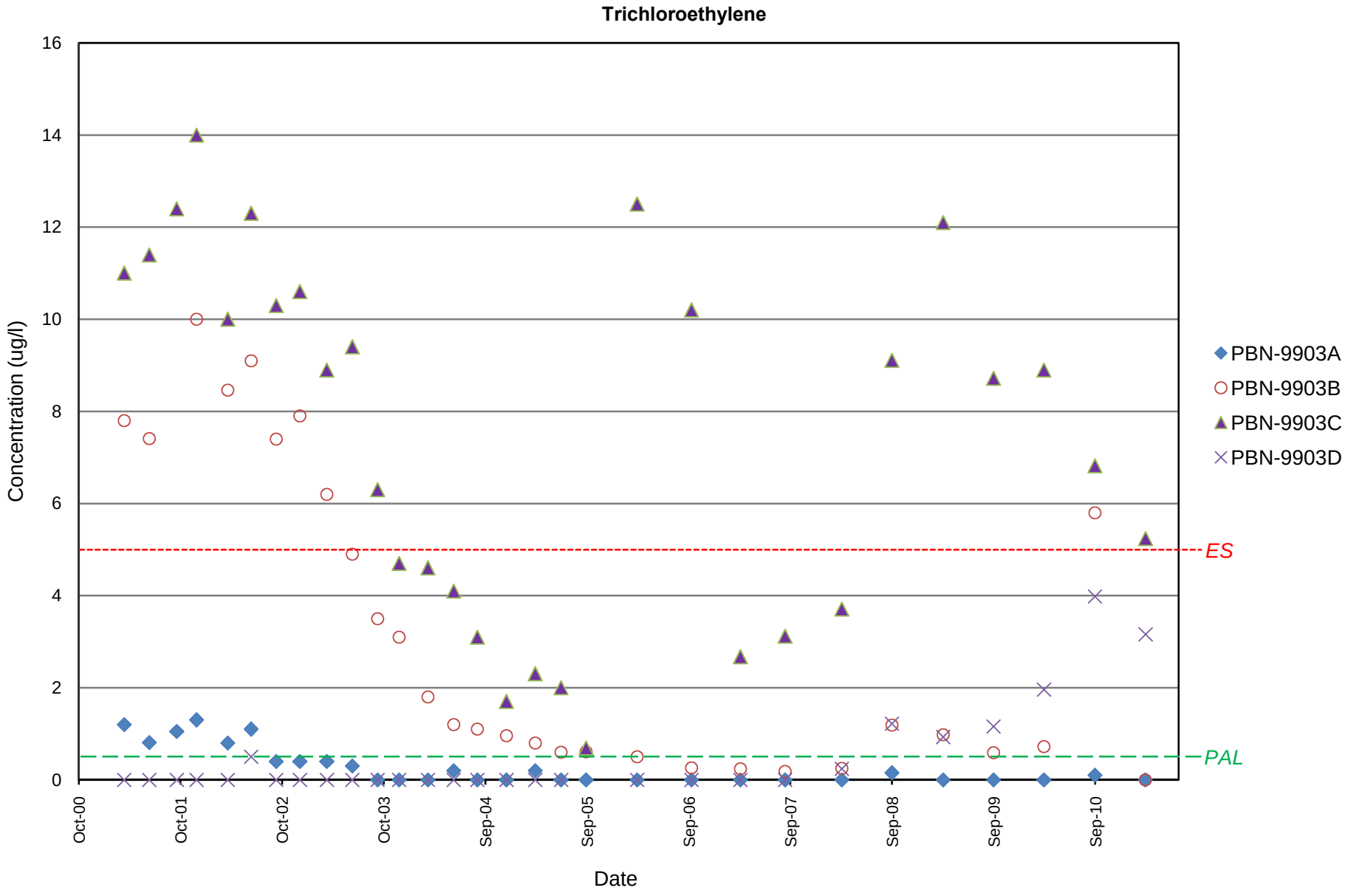
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



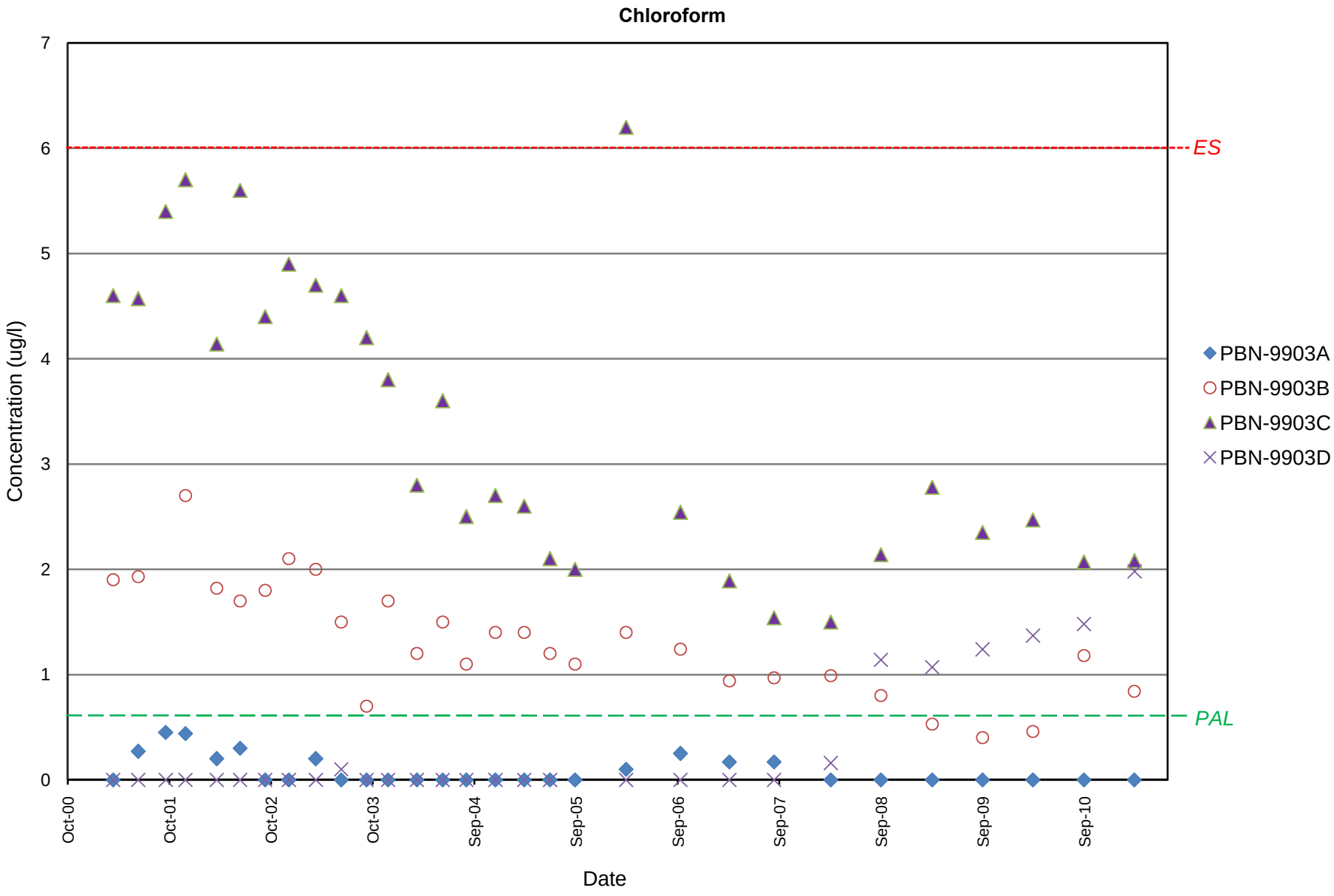
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



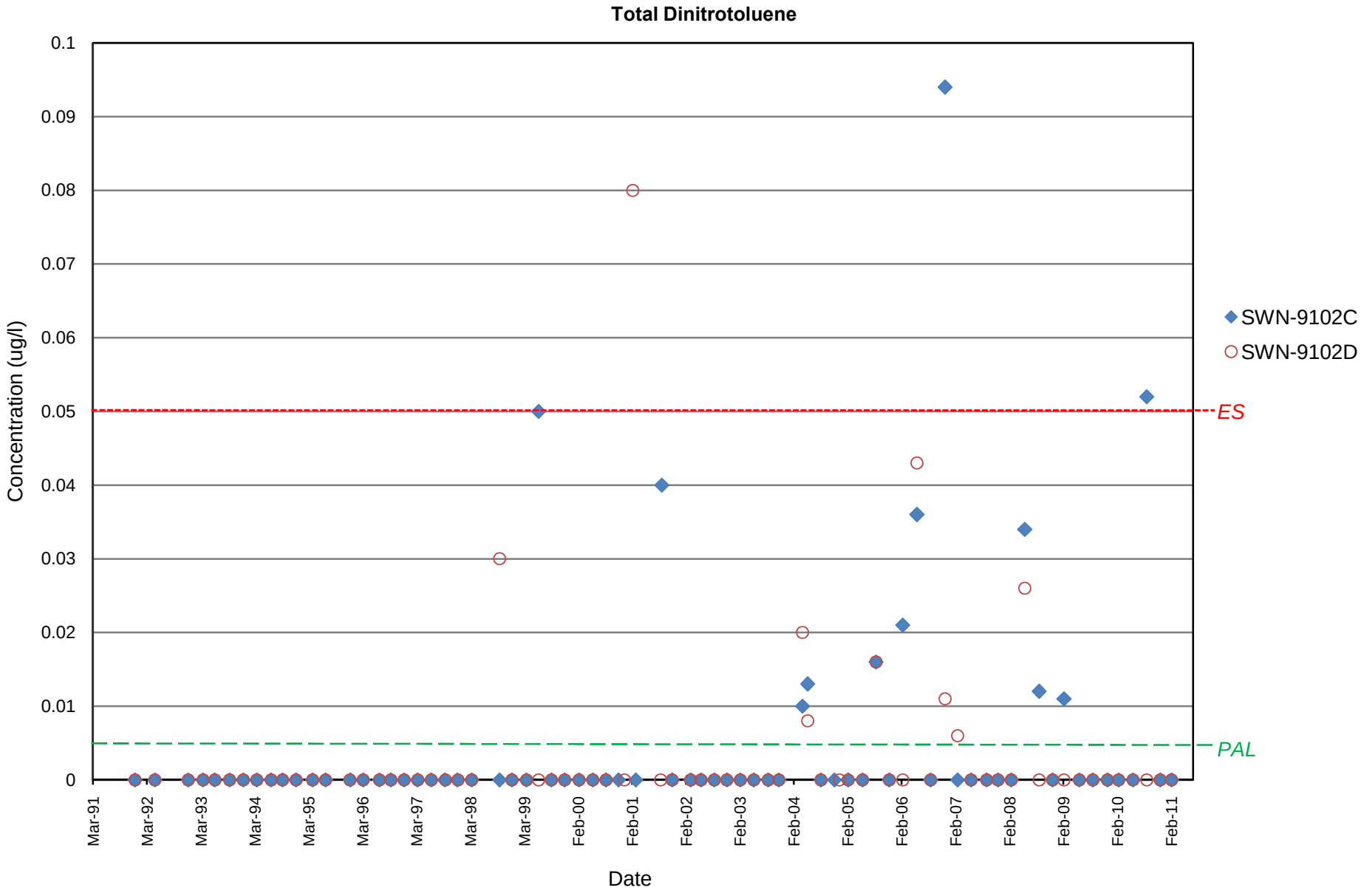
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



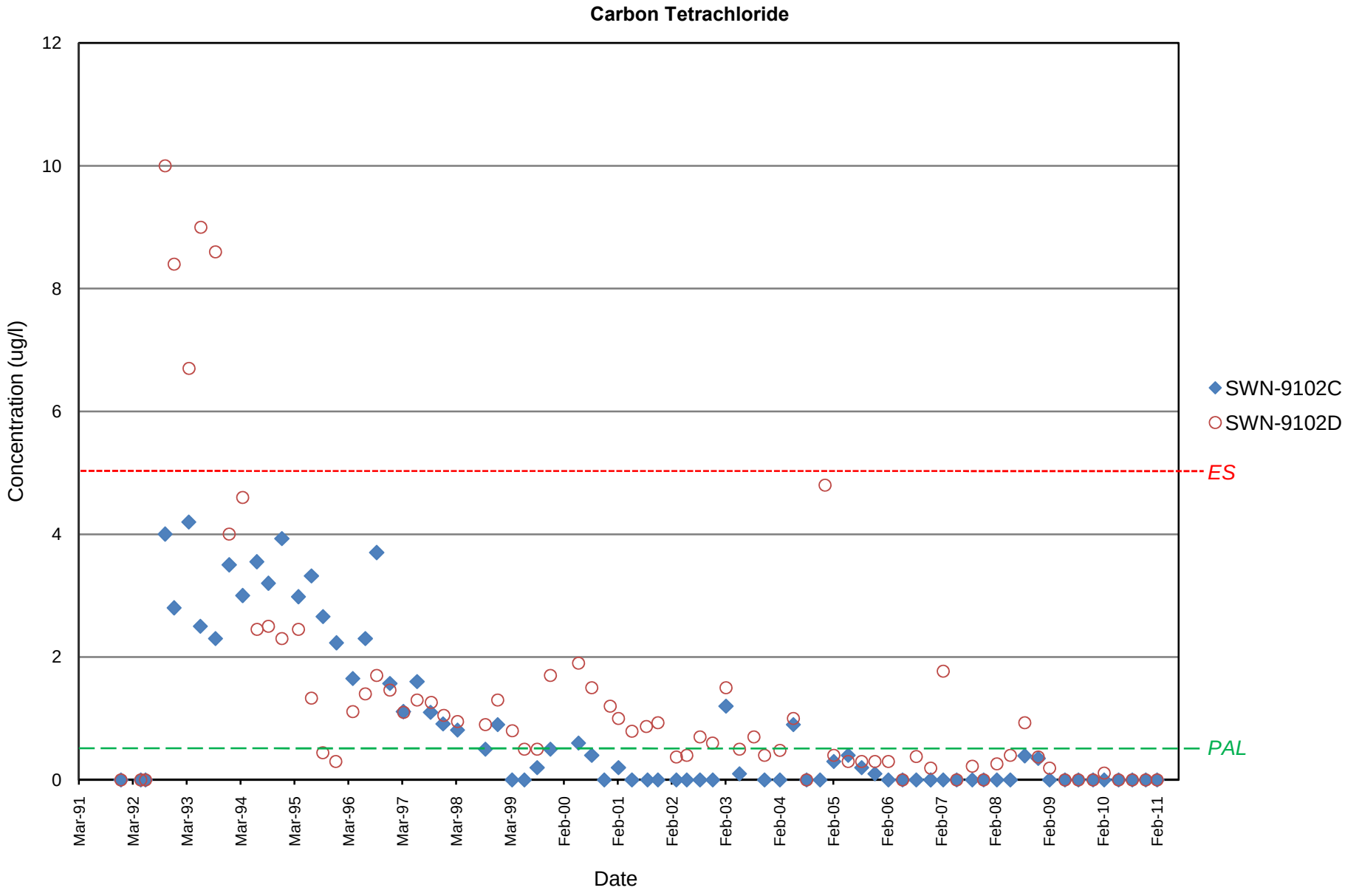
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



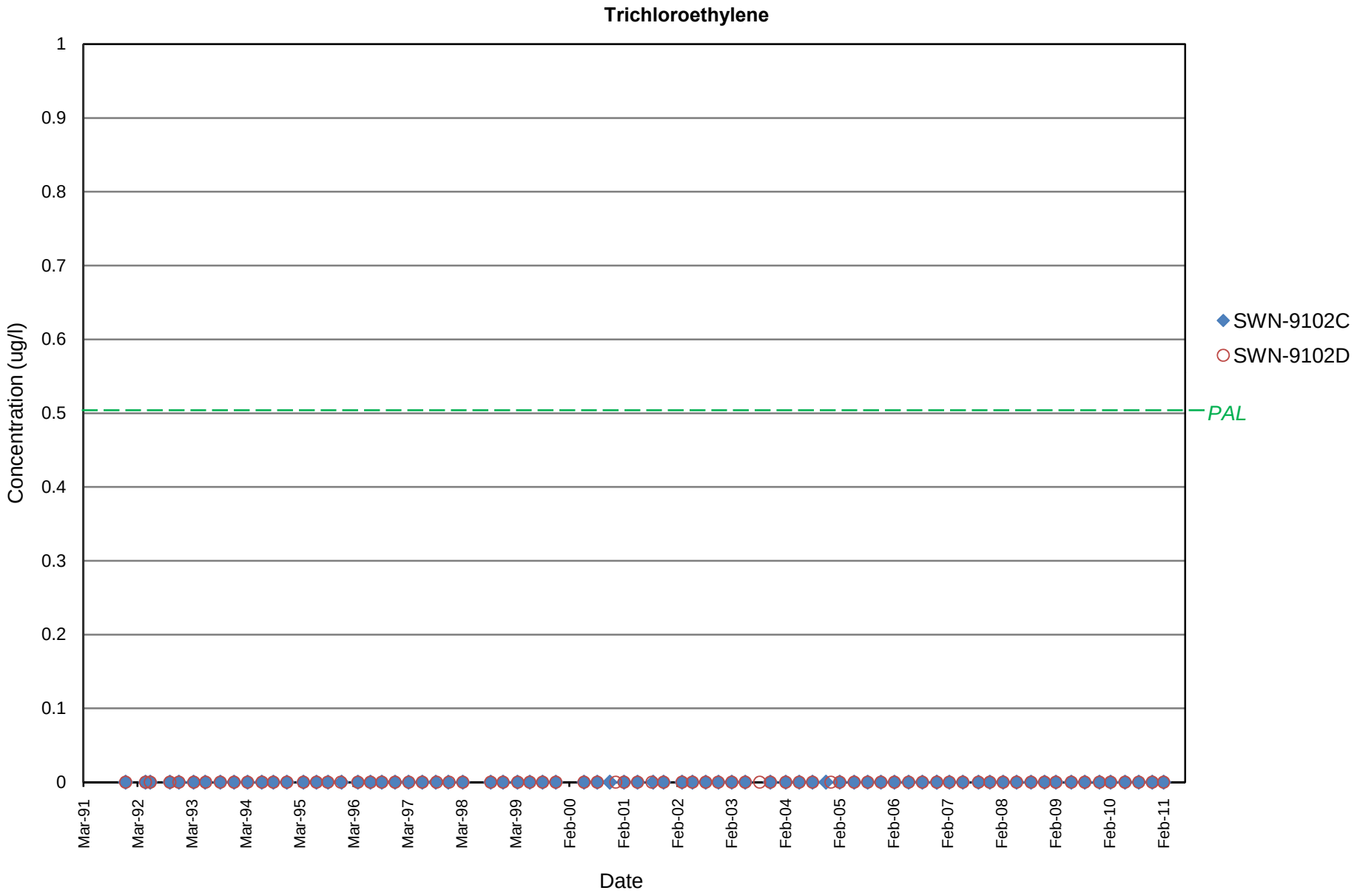
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



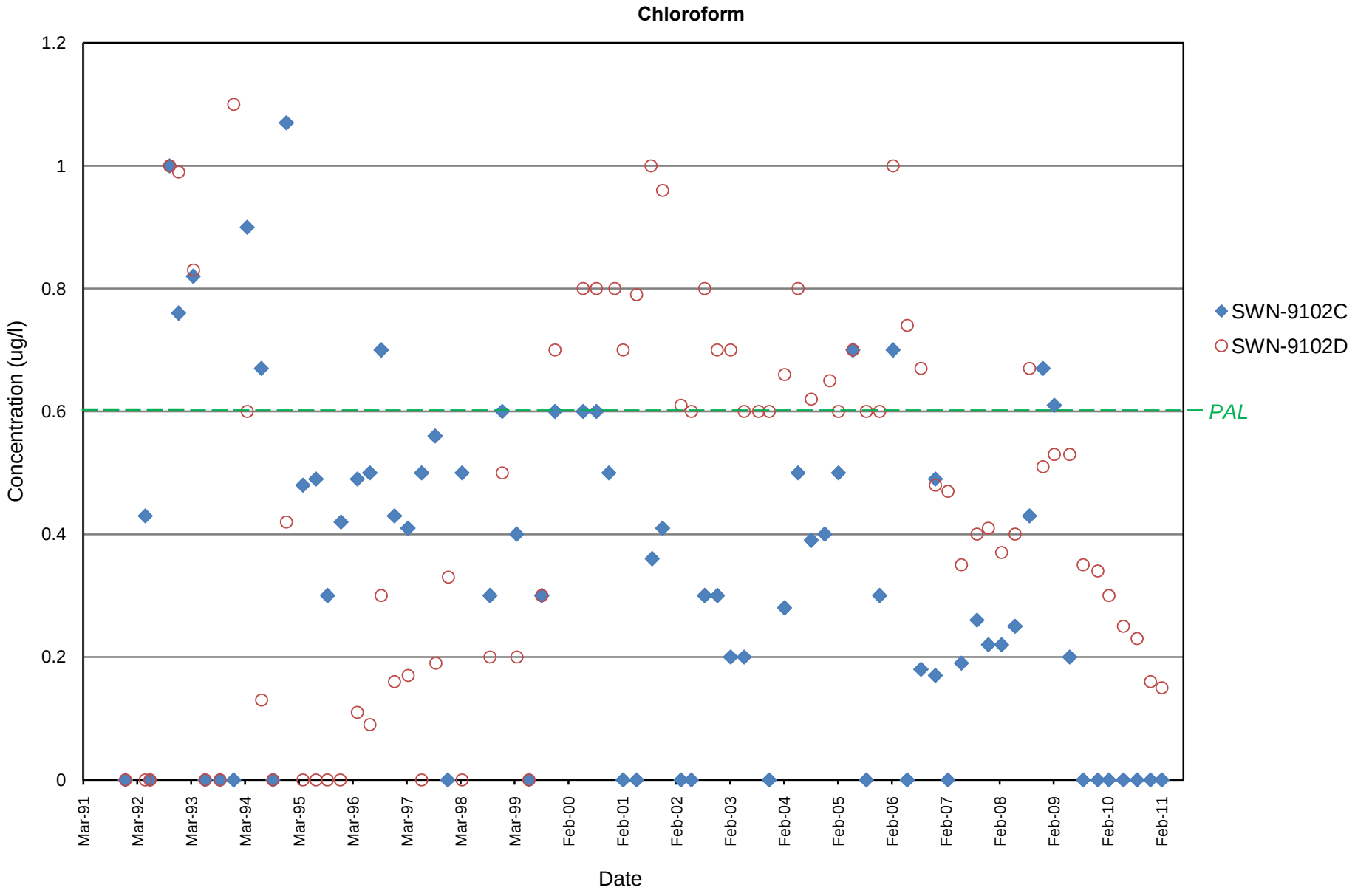
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



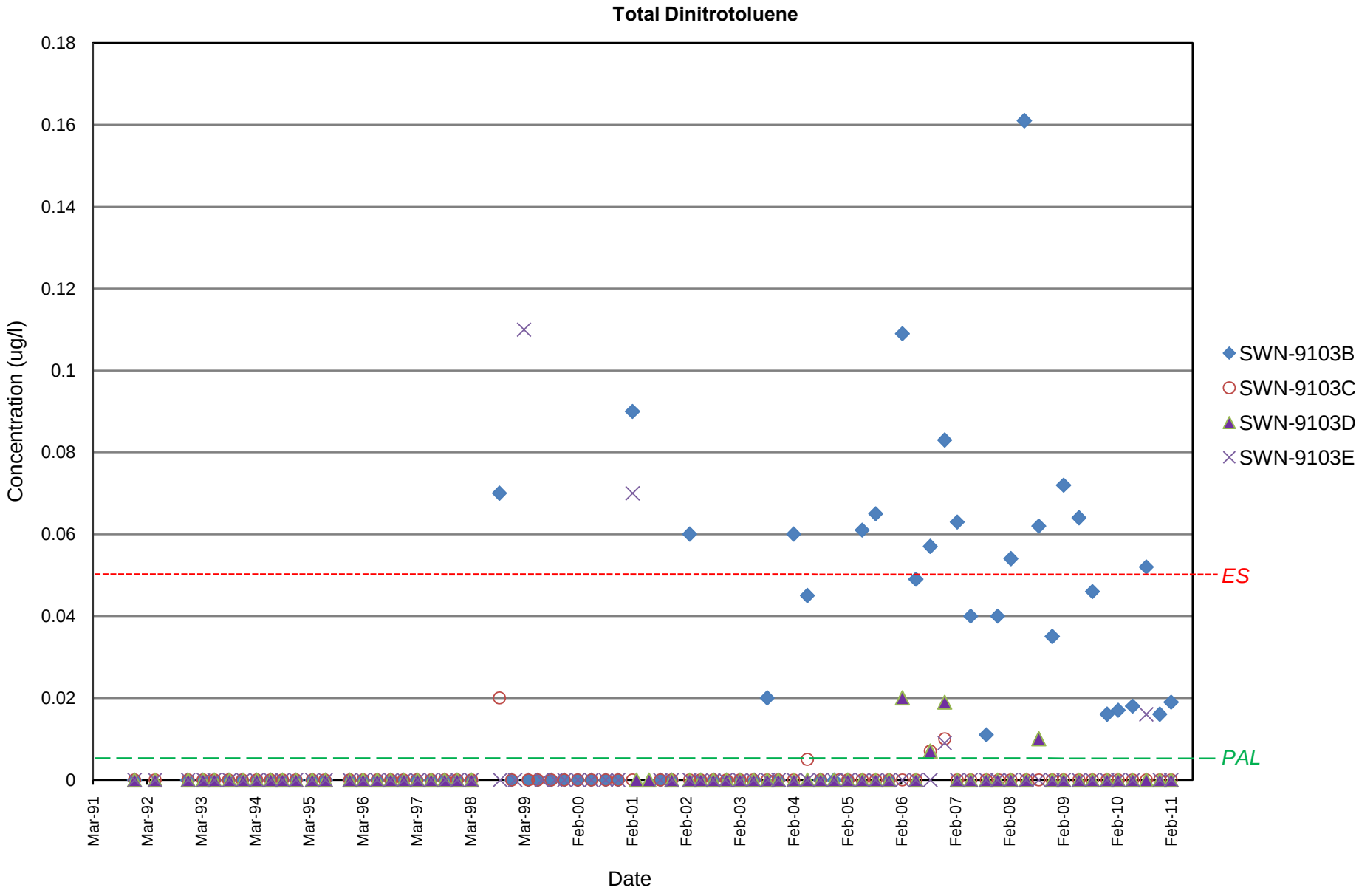
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



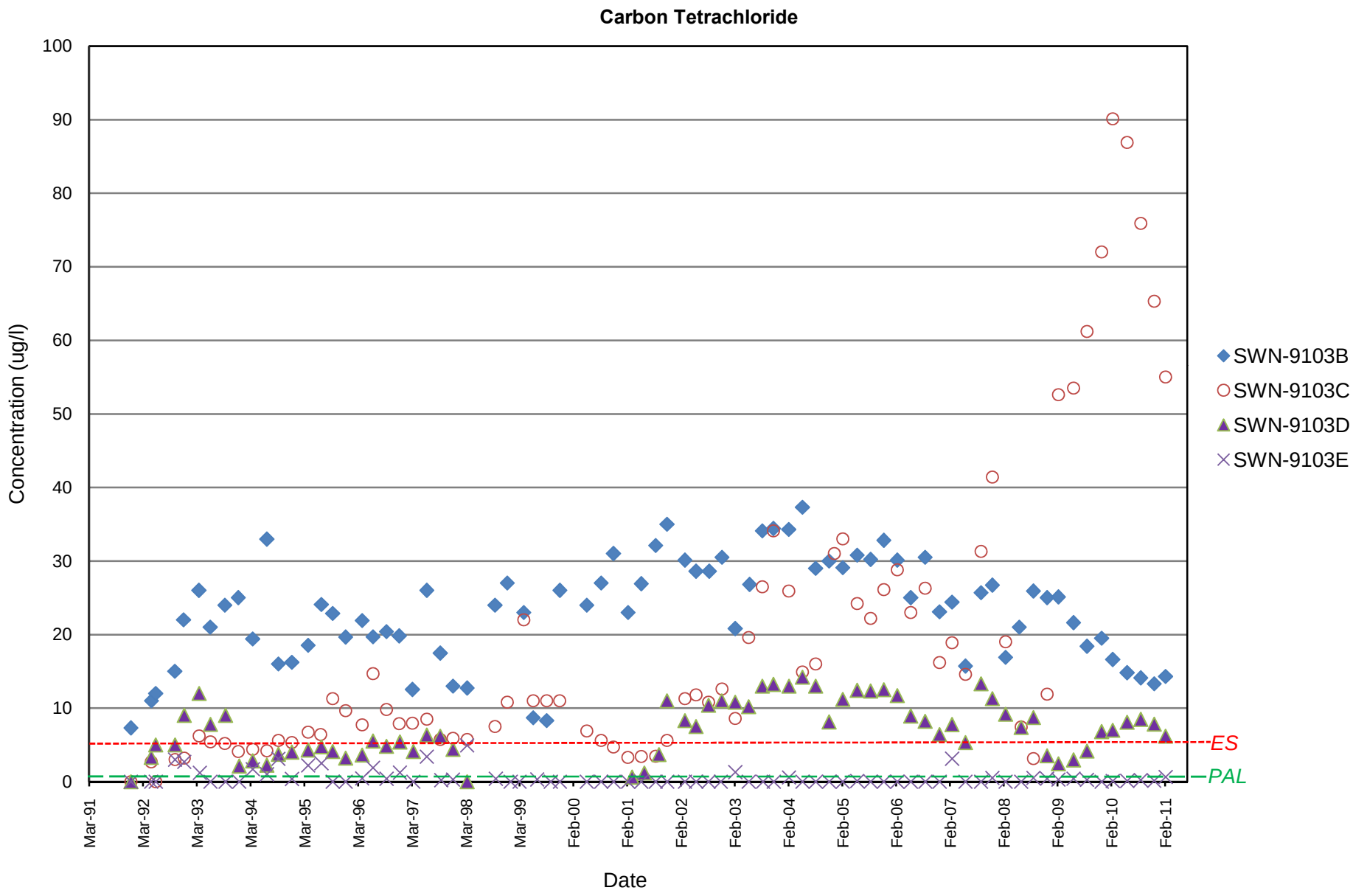
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



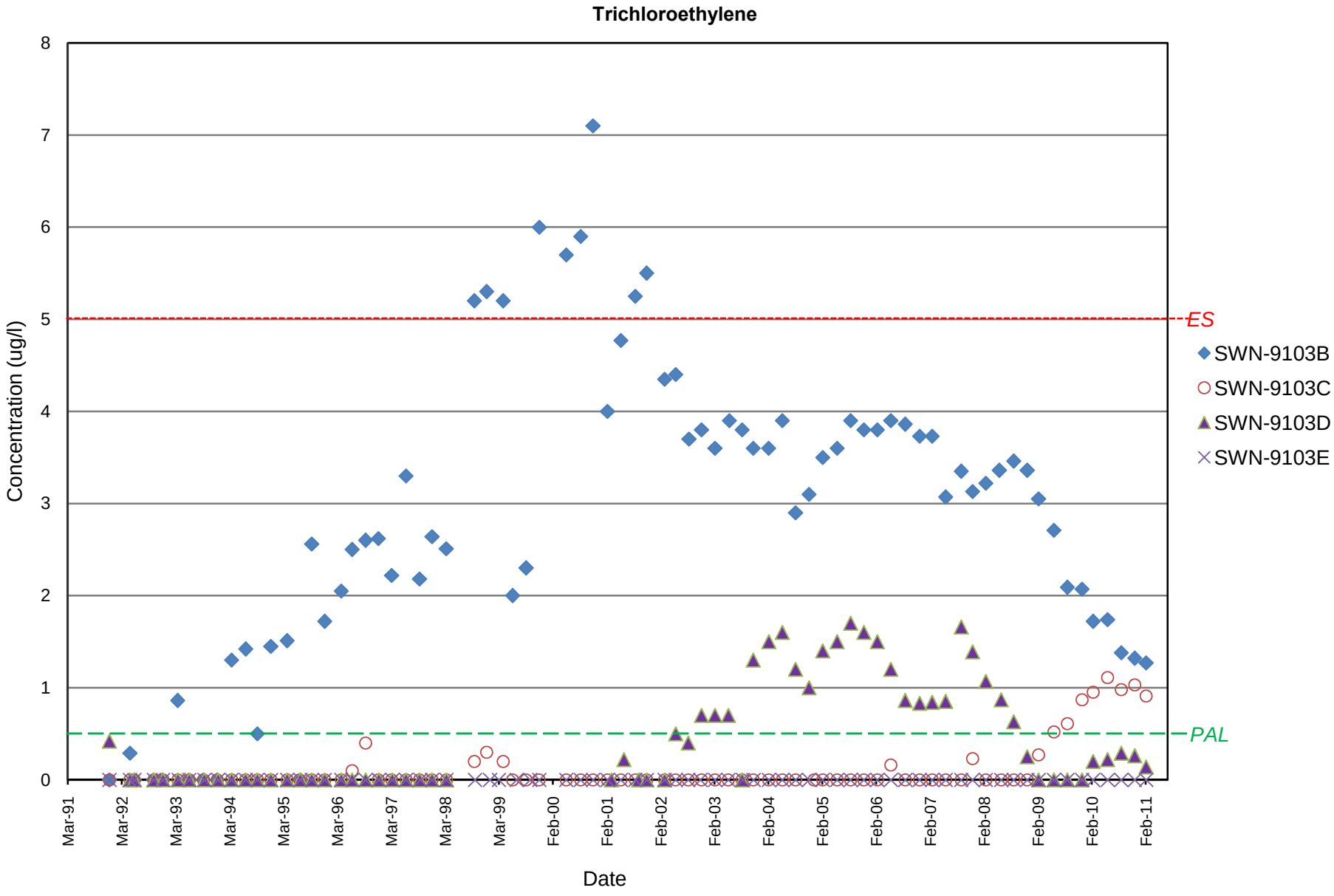
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



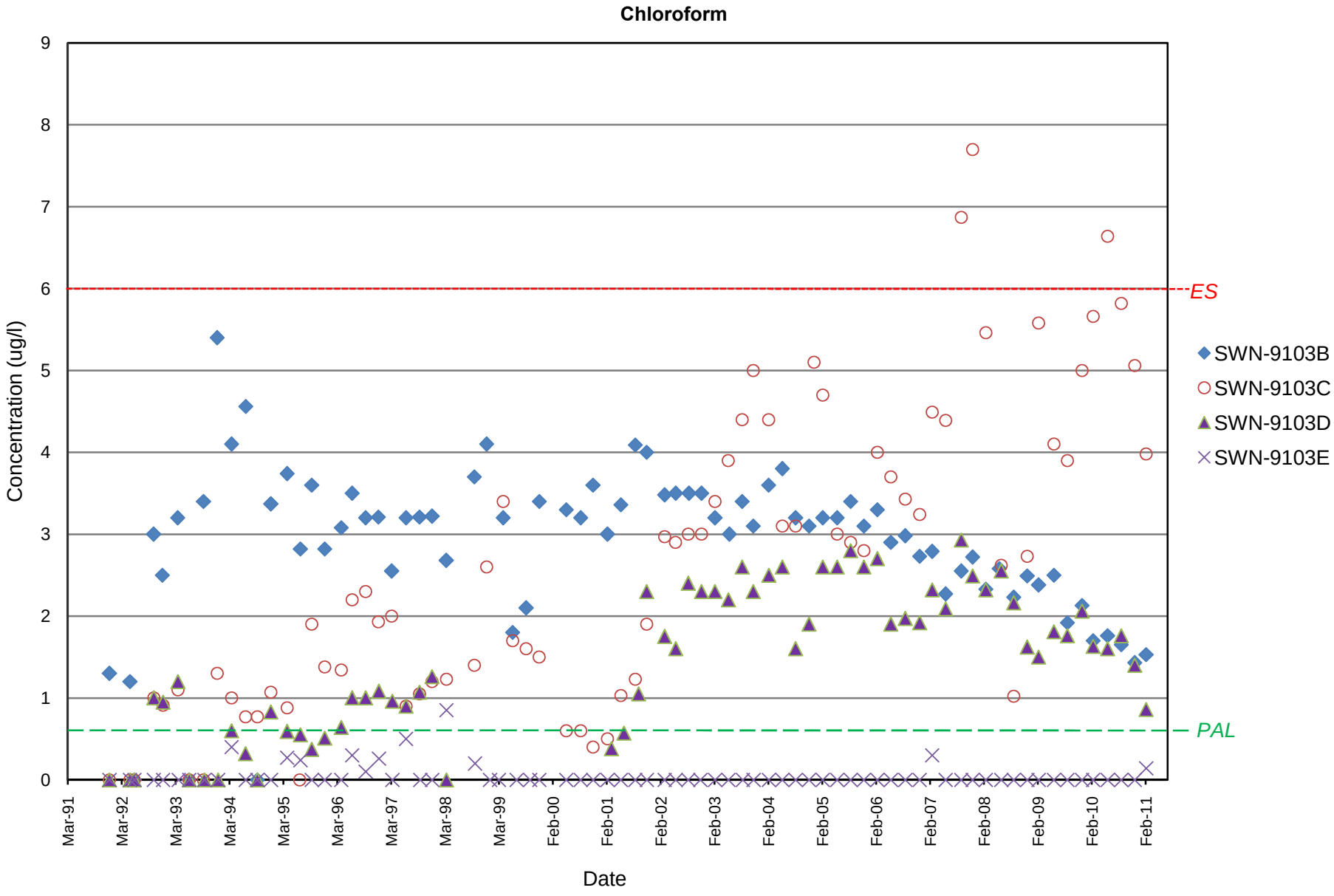
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



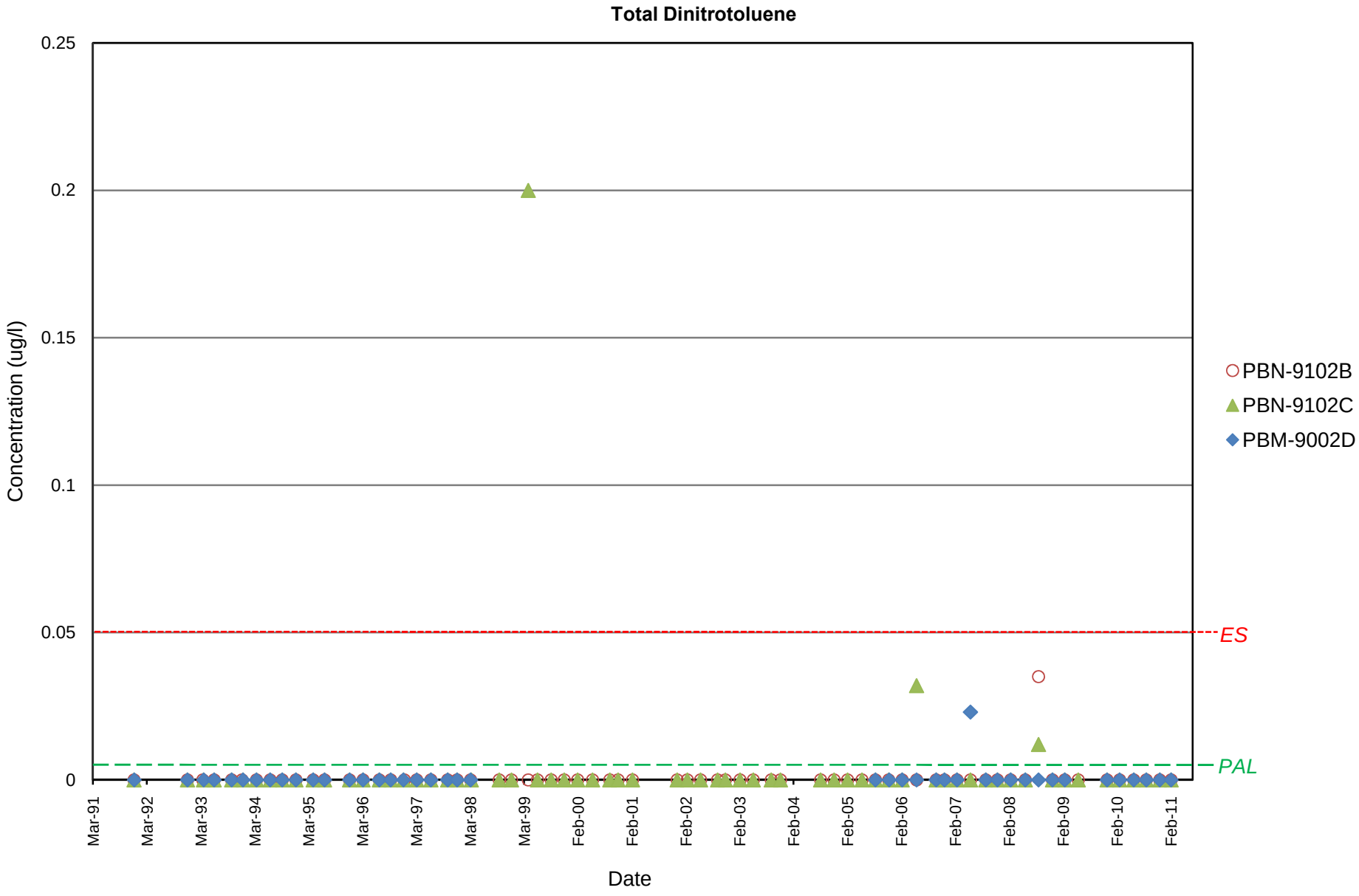
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



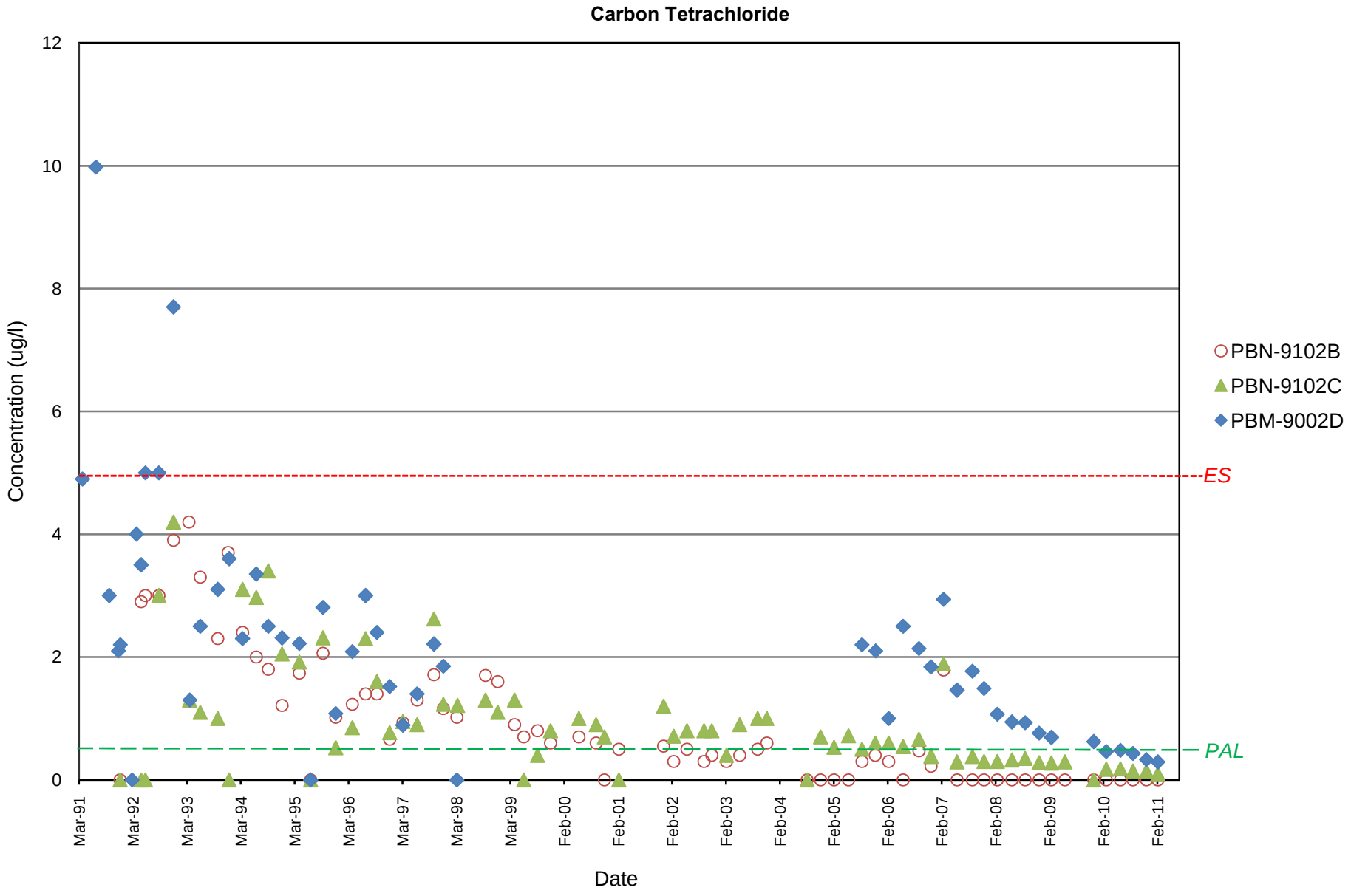
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



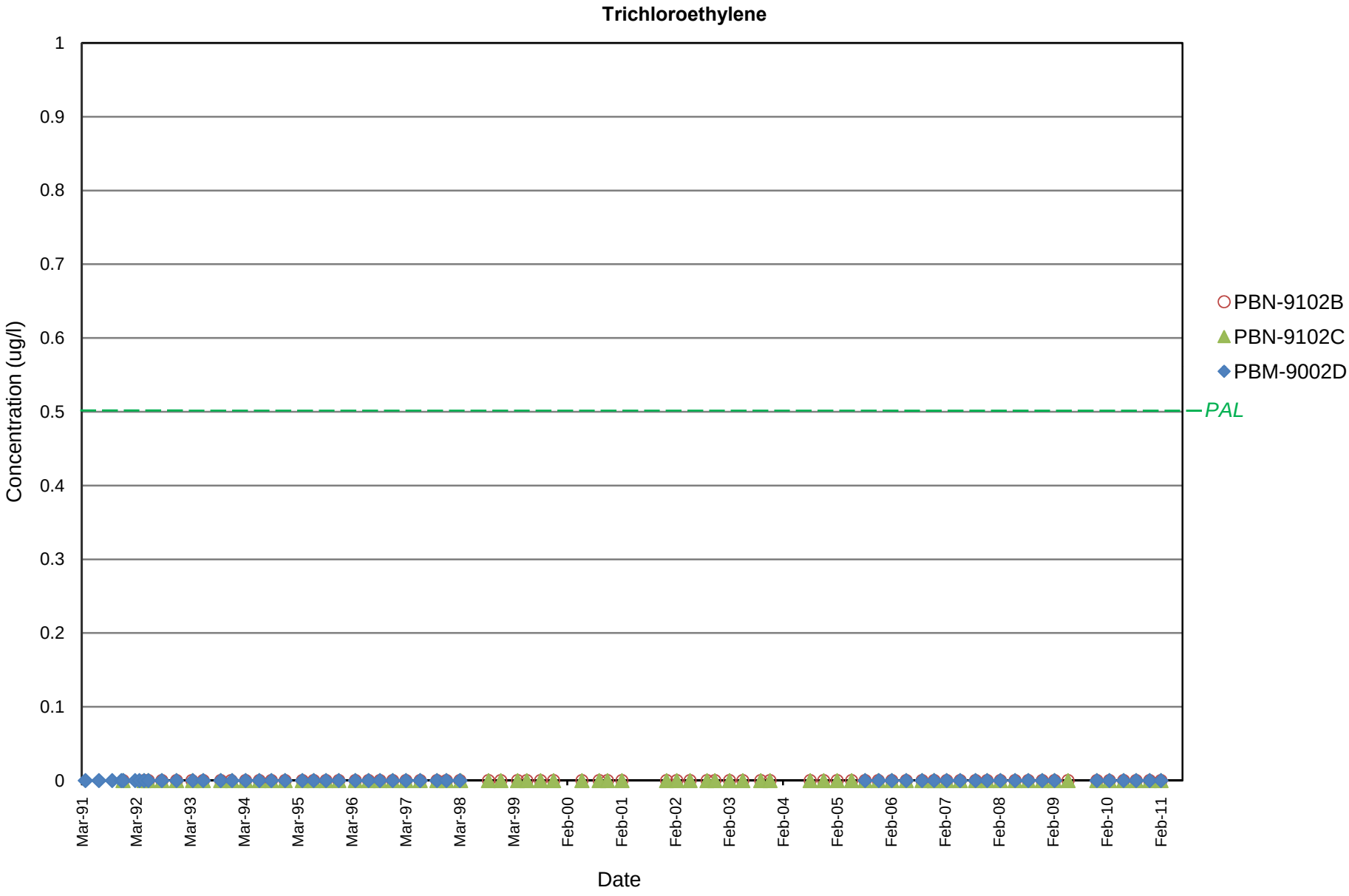
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



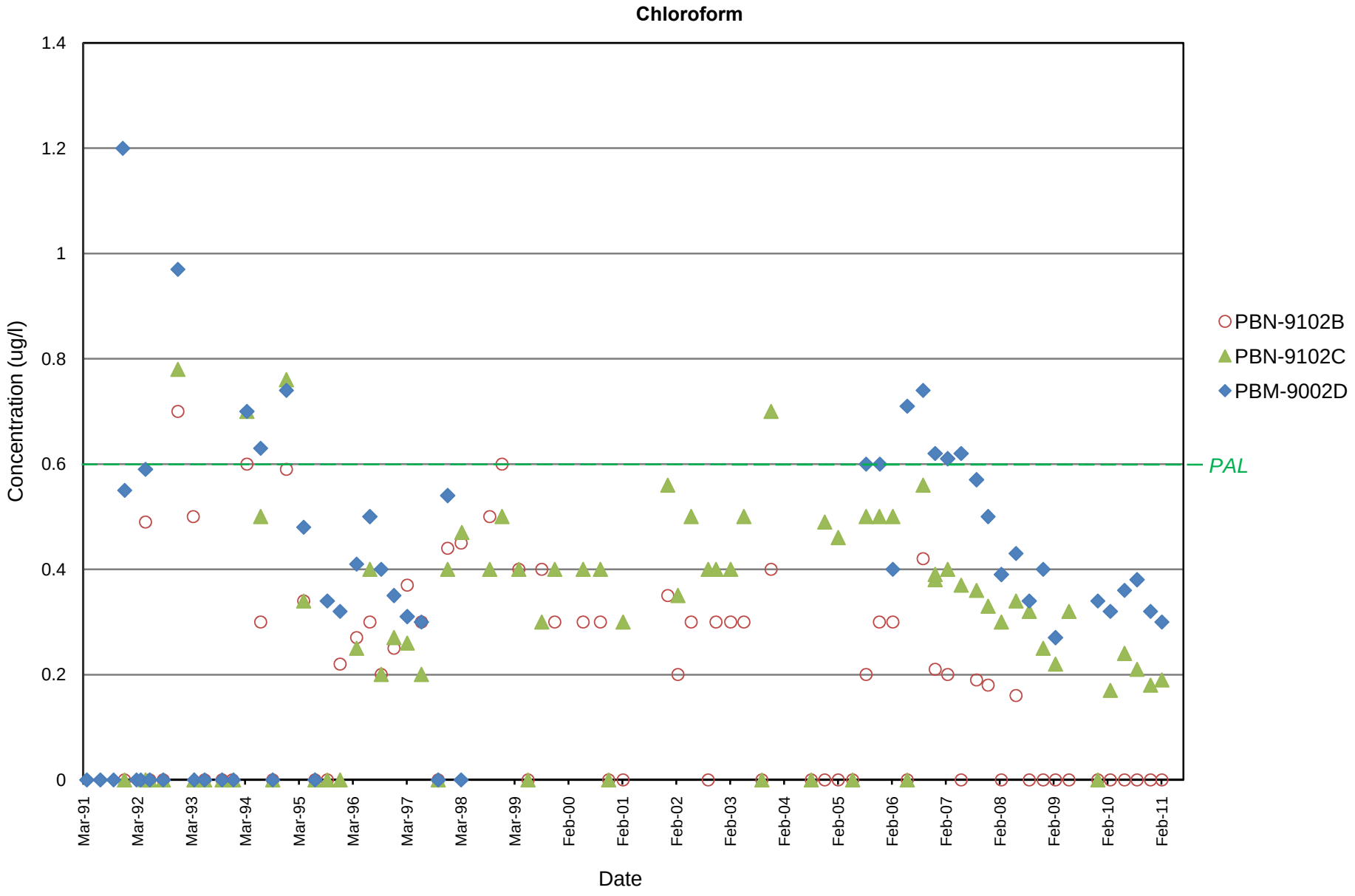
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



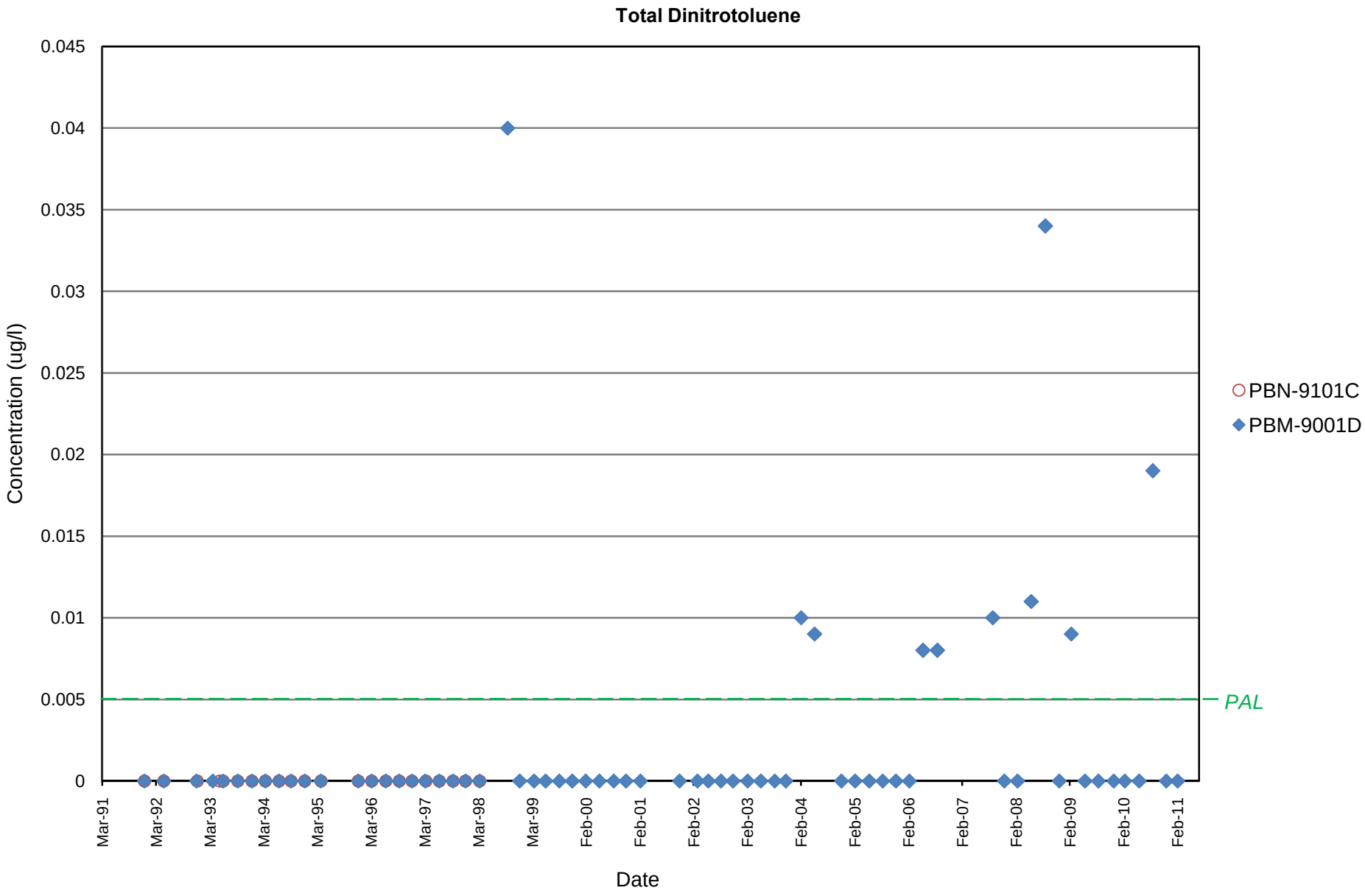
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



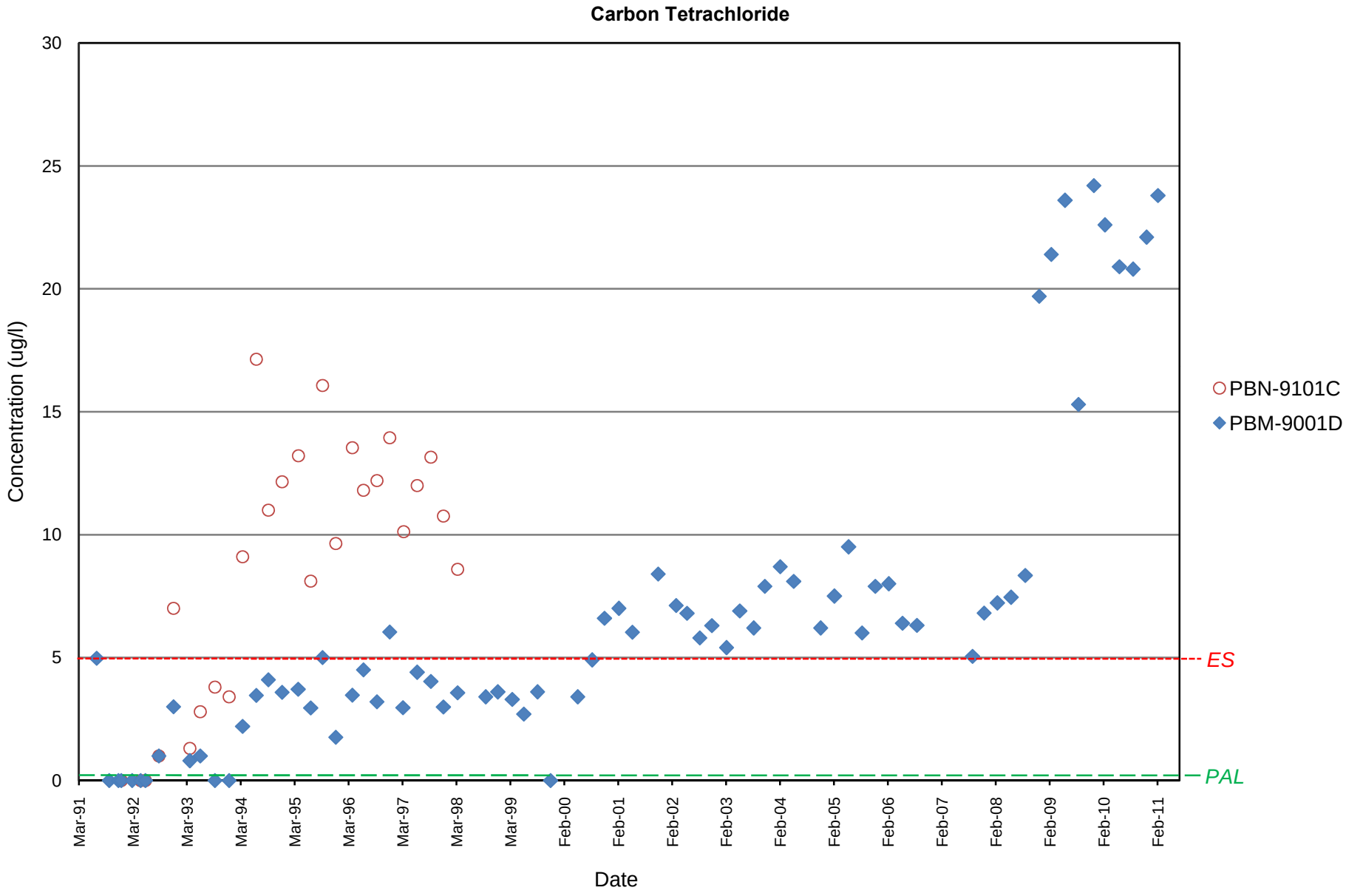
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



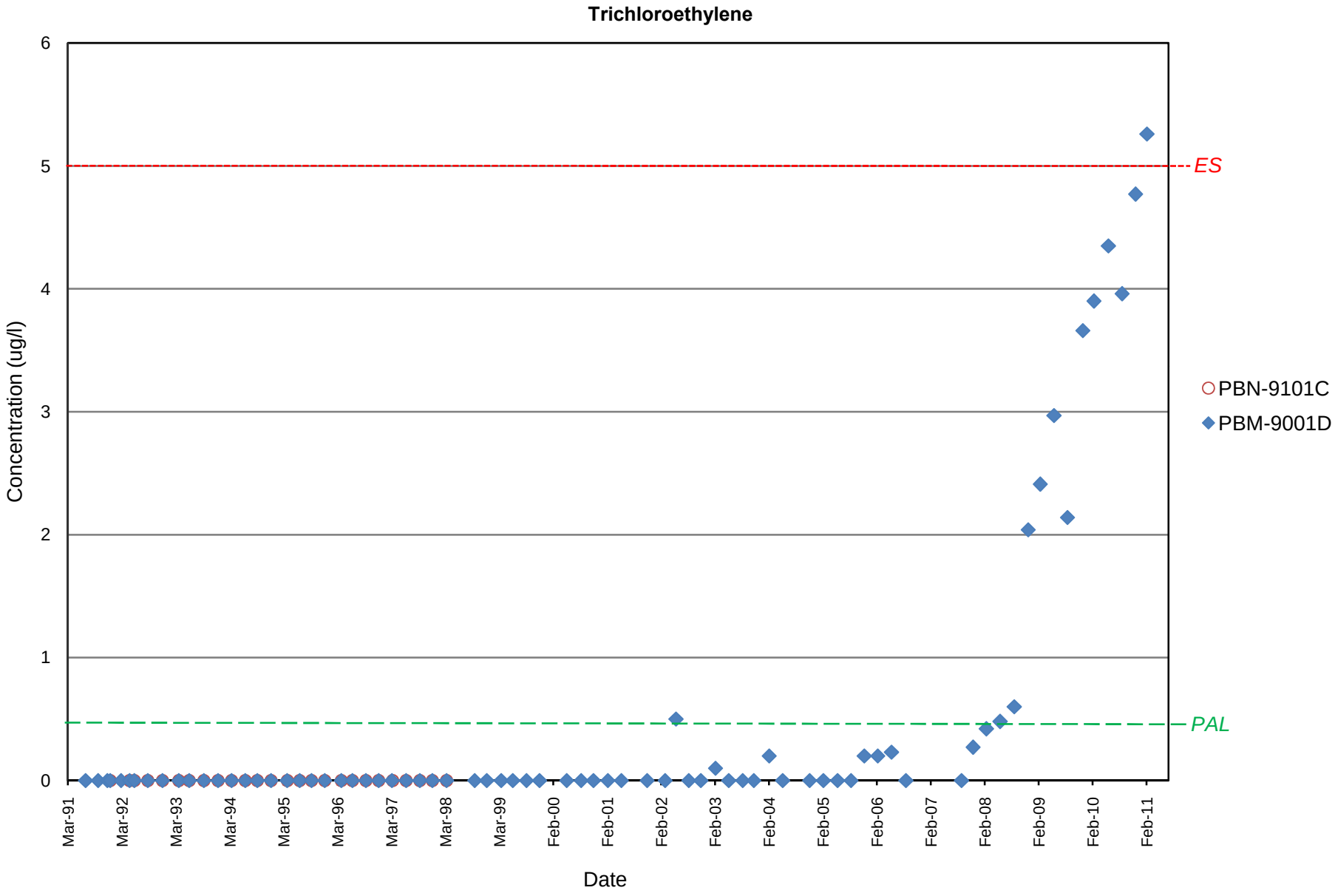
BAAAP Groundwater Data | Propellant Burning Ground | Plume Leading Edge - Offsite



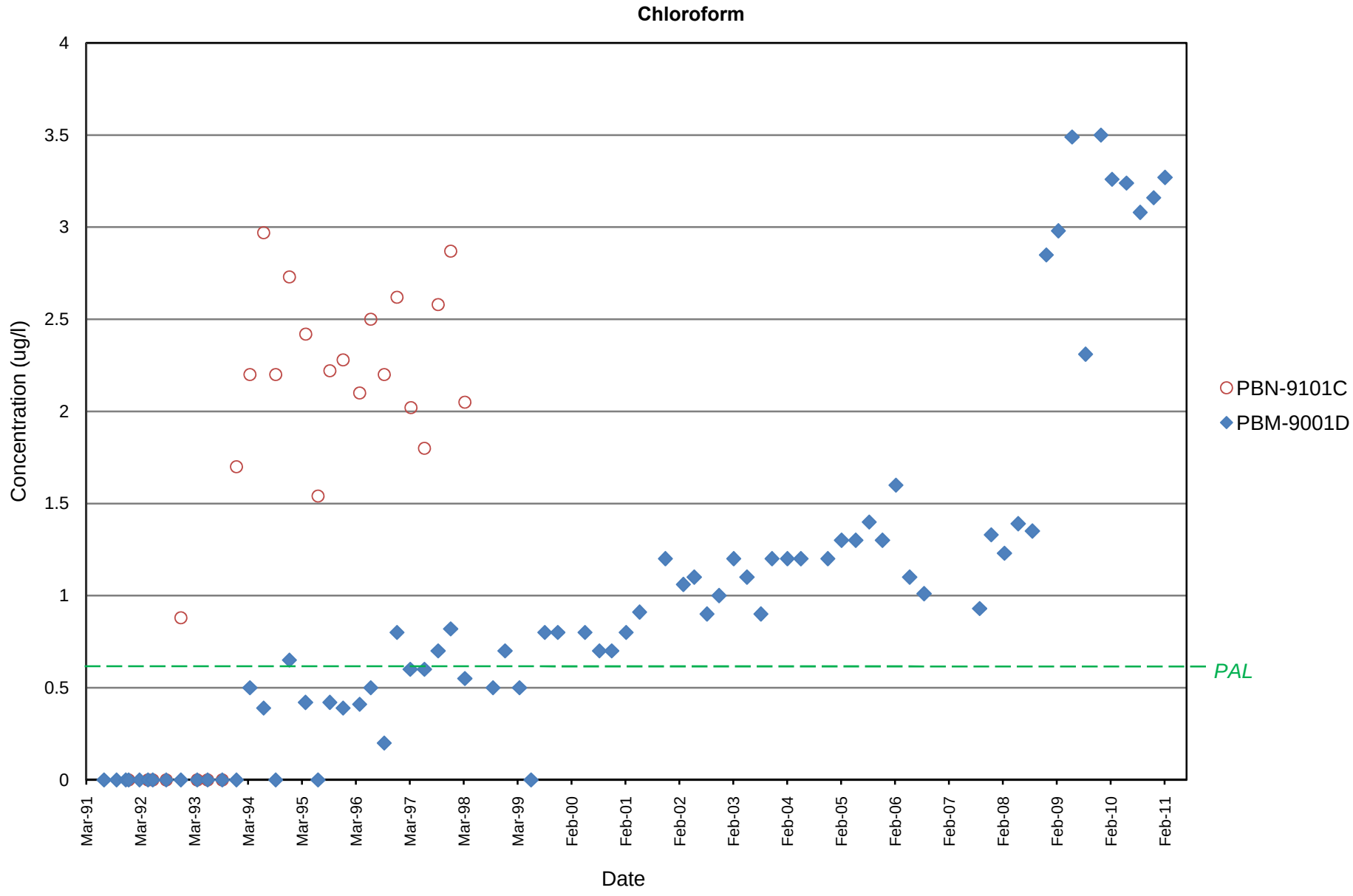
BAAAP Groundwater Data | Propellant Burning Ground | Plume Leading Edge - Offsite



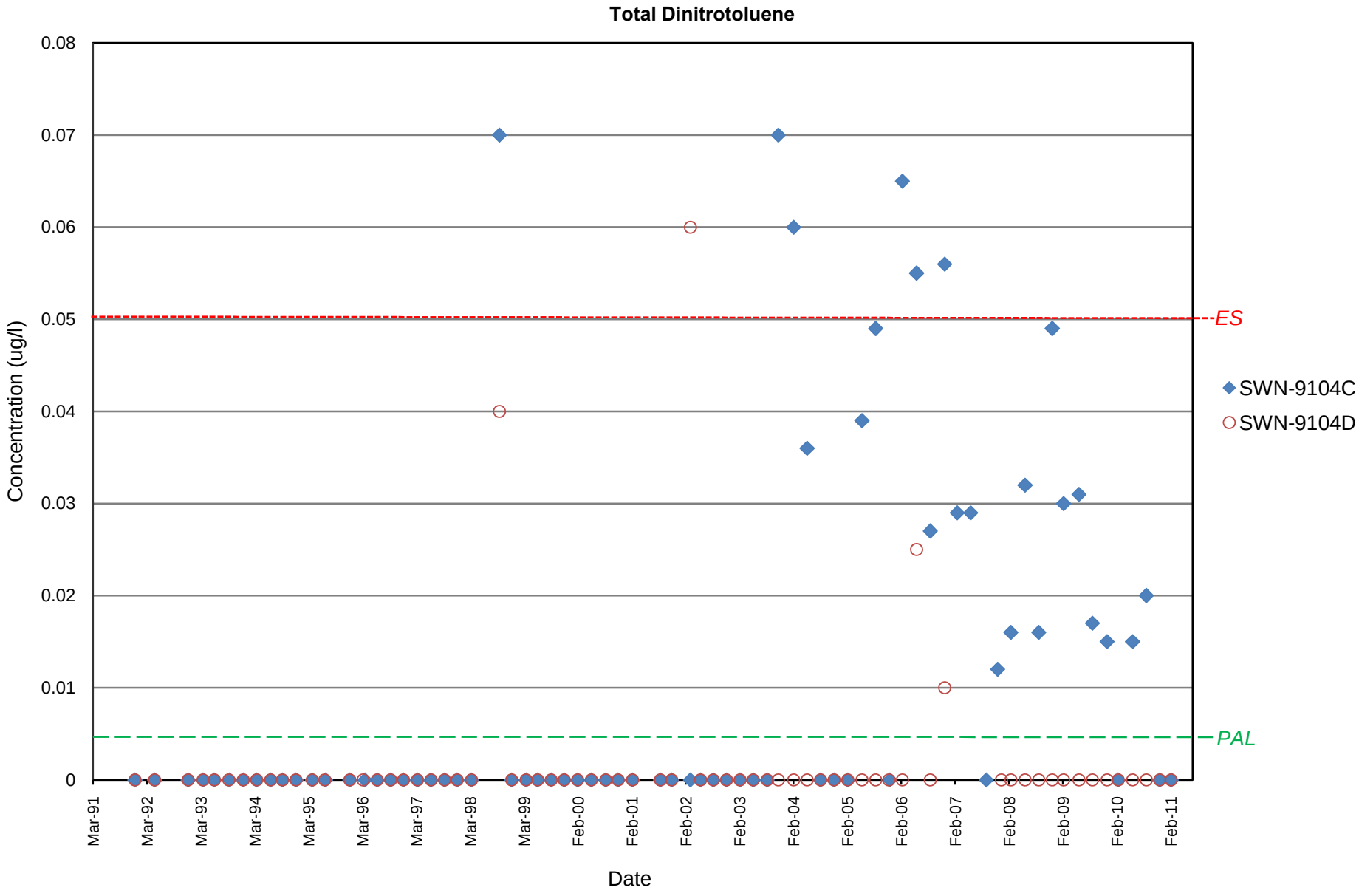
BAAAP Groundwater Data | Propellant Burning Ground | Plume Leading Edge



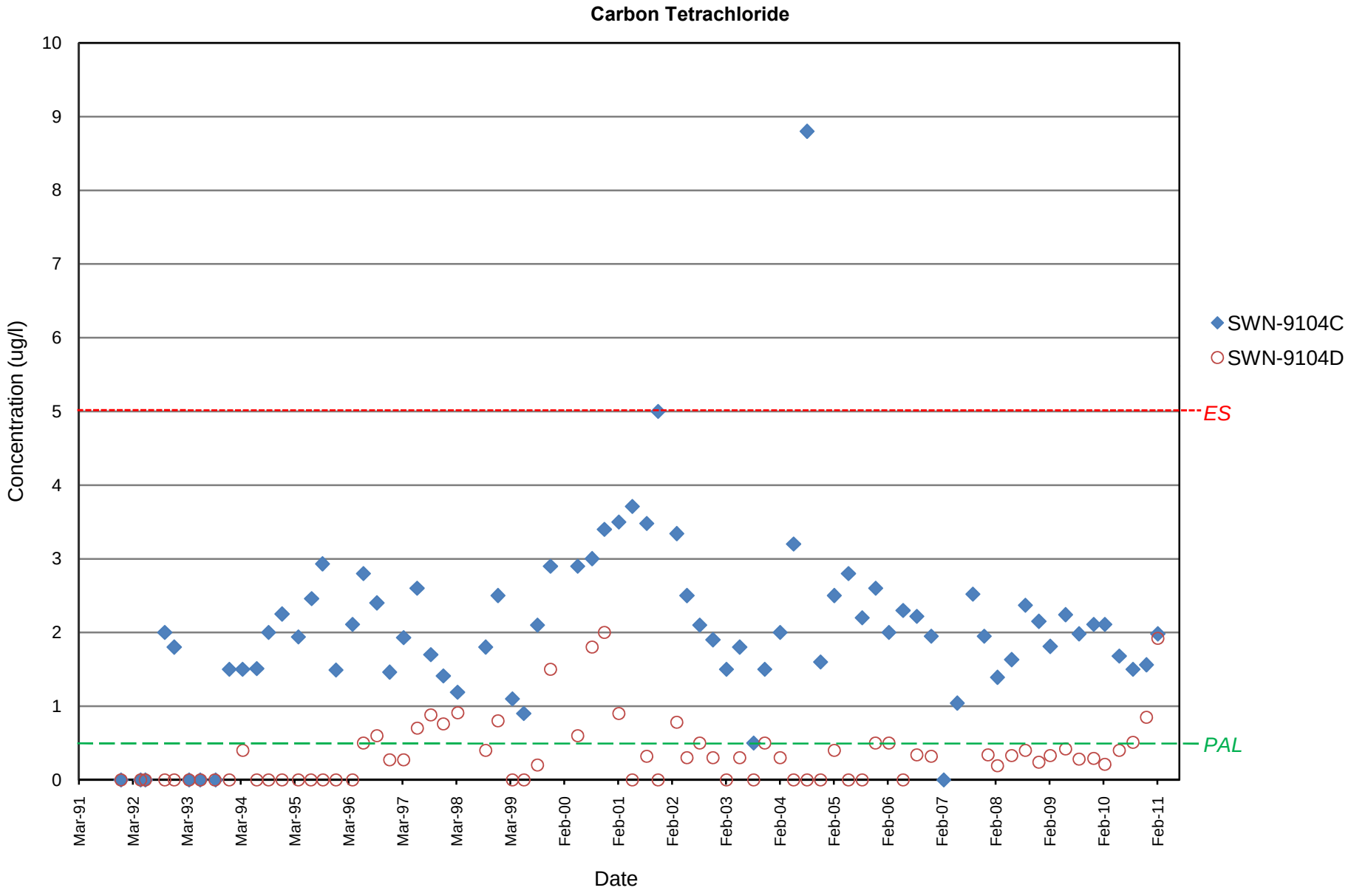
BAAAP Groundwater Data | Propellant Burning Ground | Plume Leading Edge - Offsite



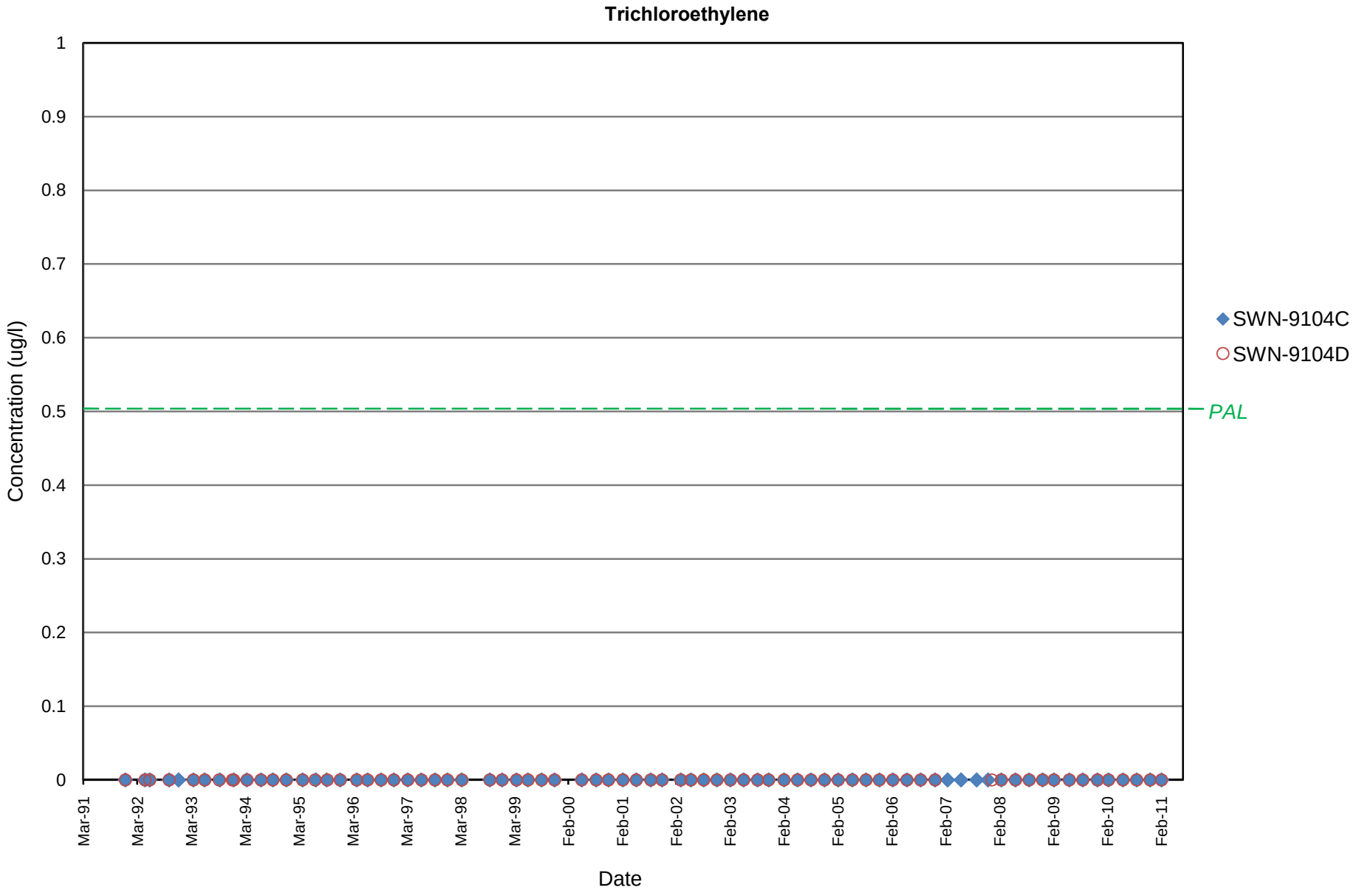
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



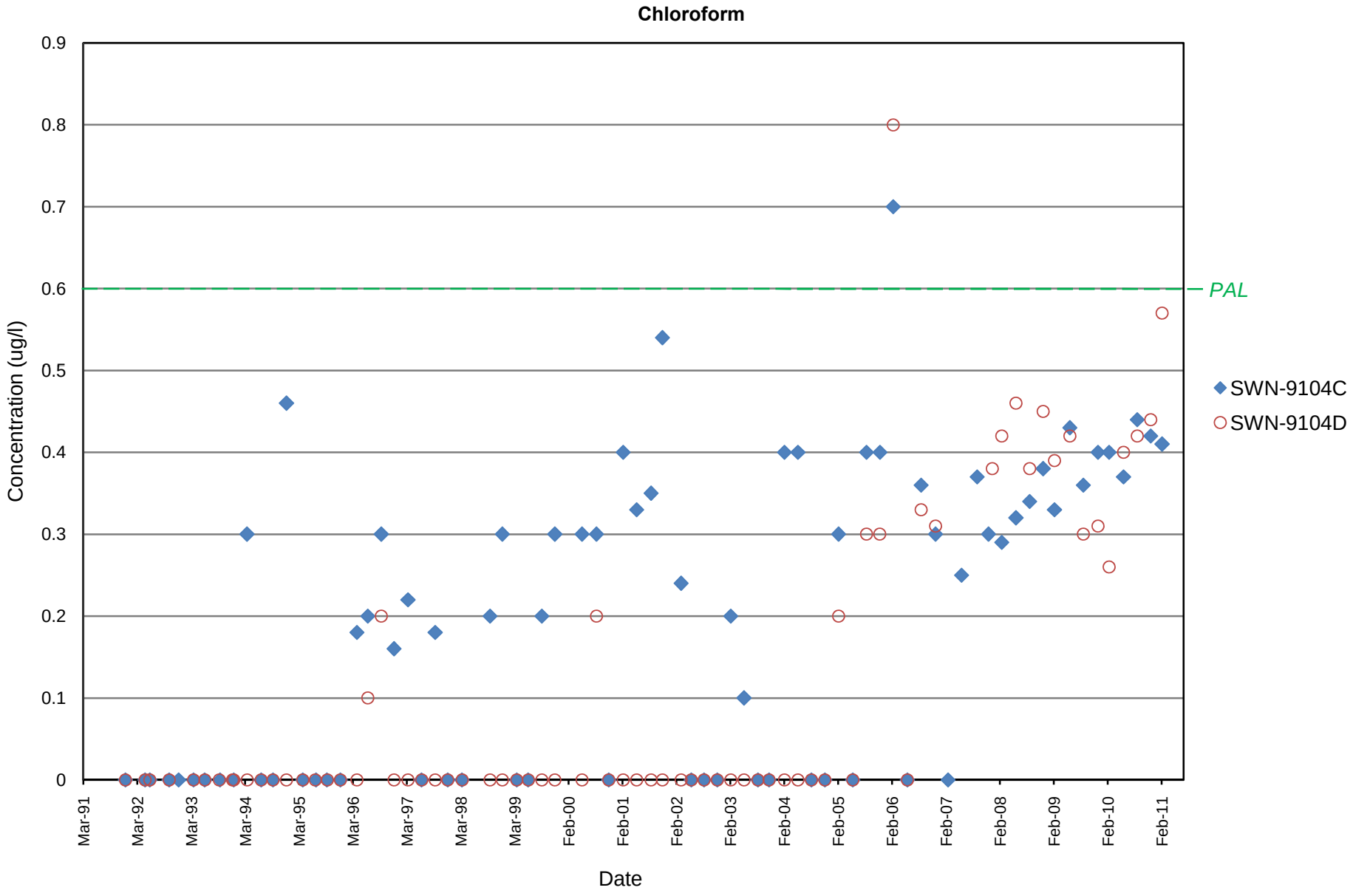
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



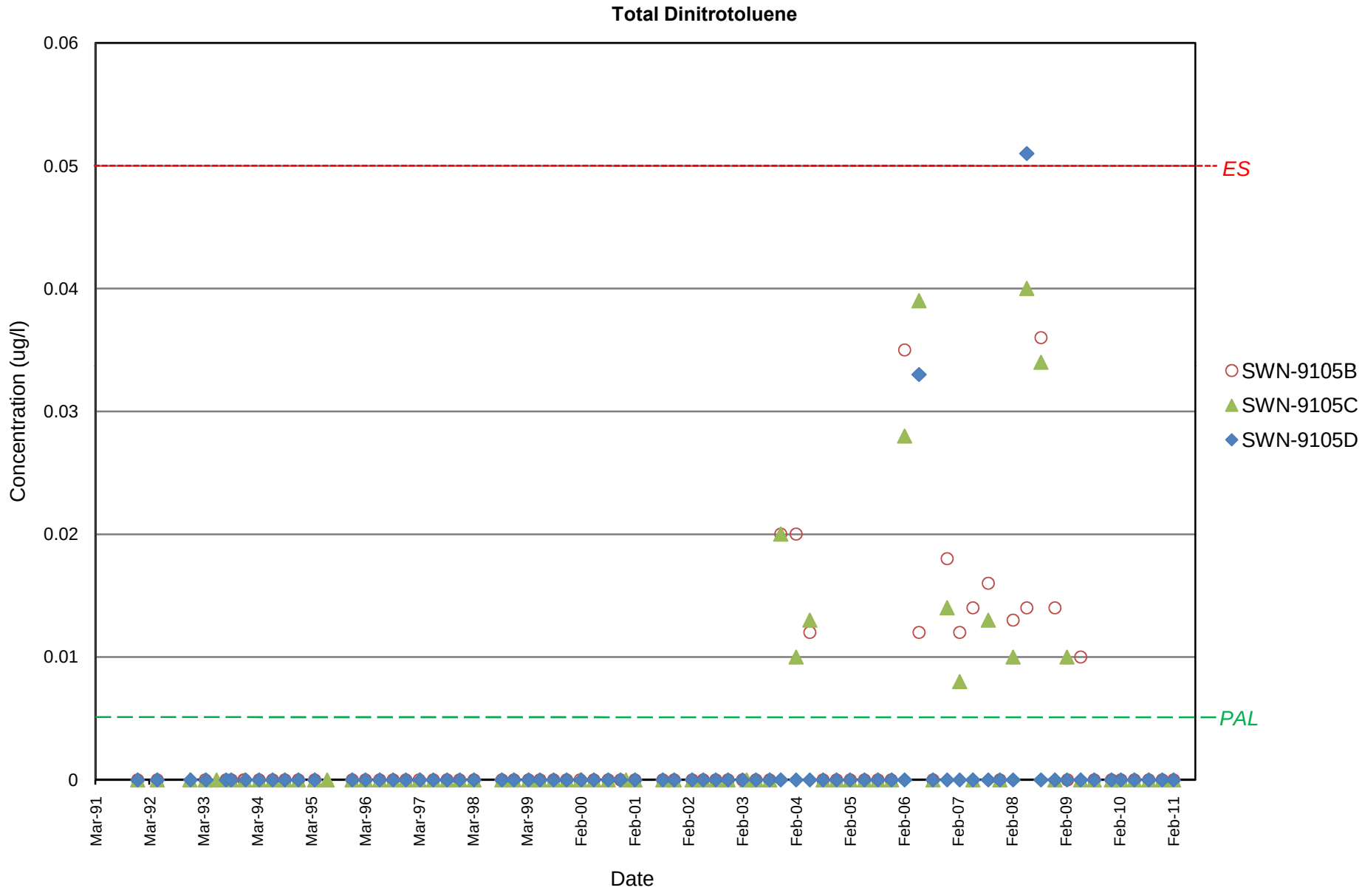
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite



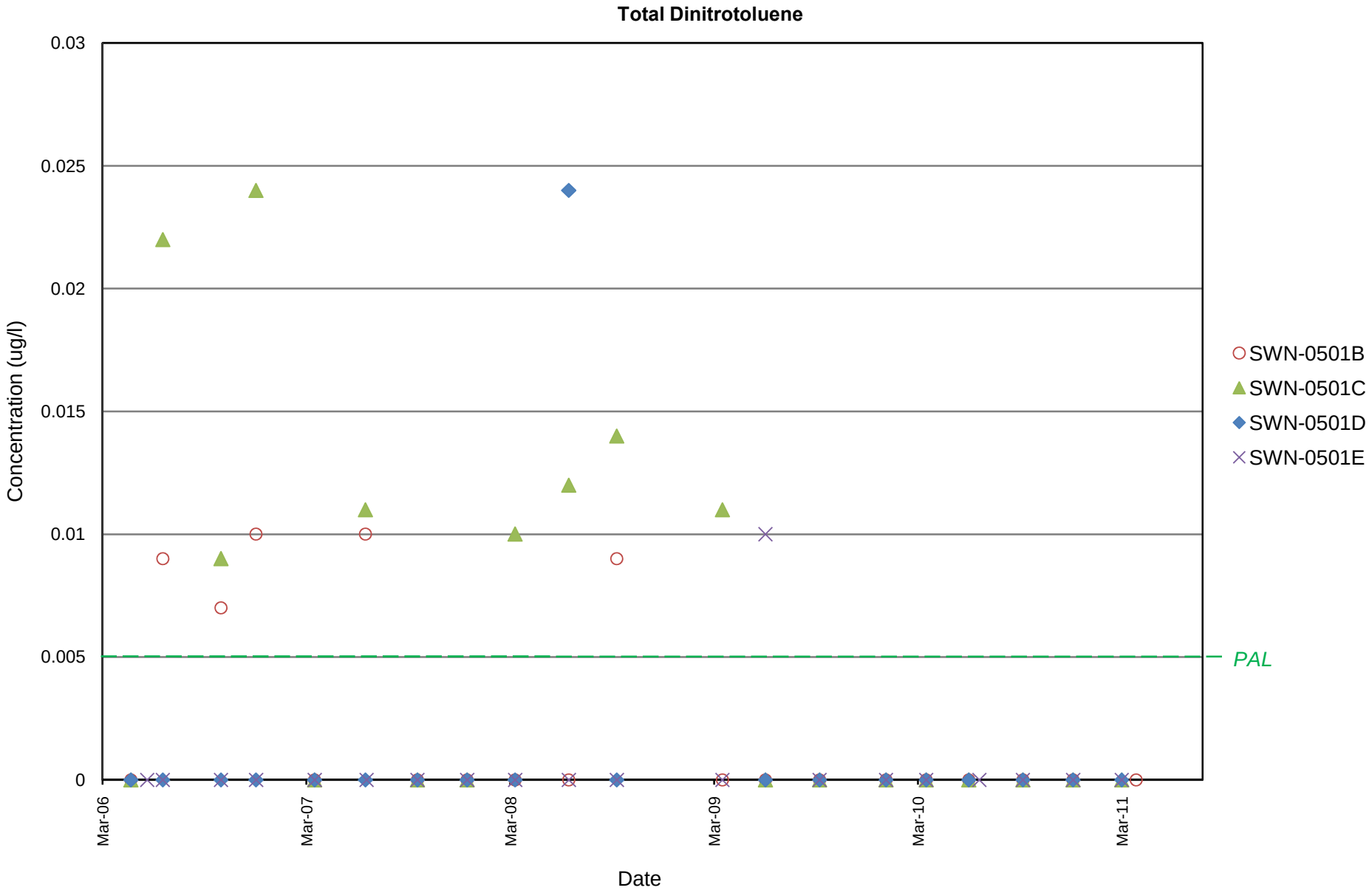
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



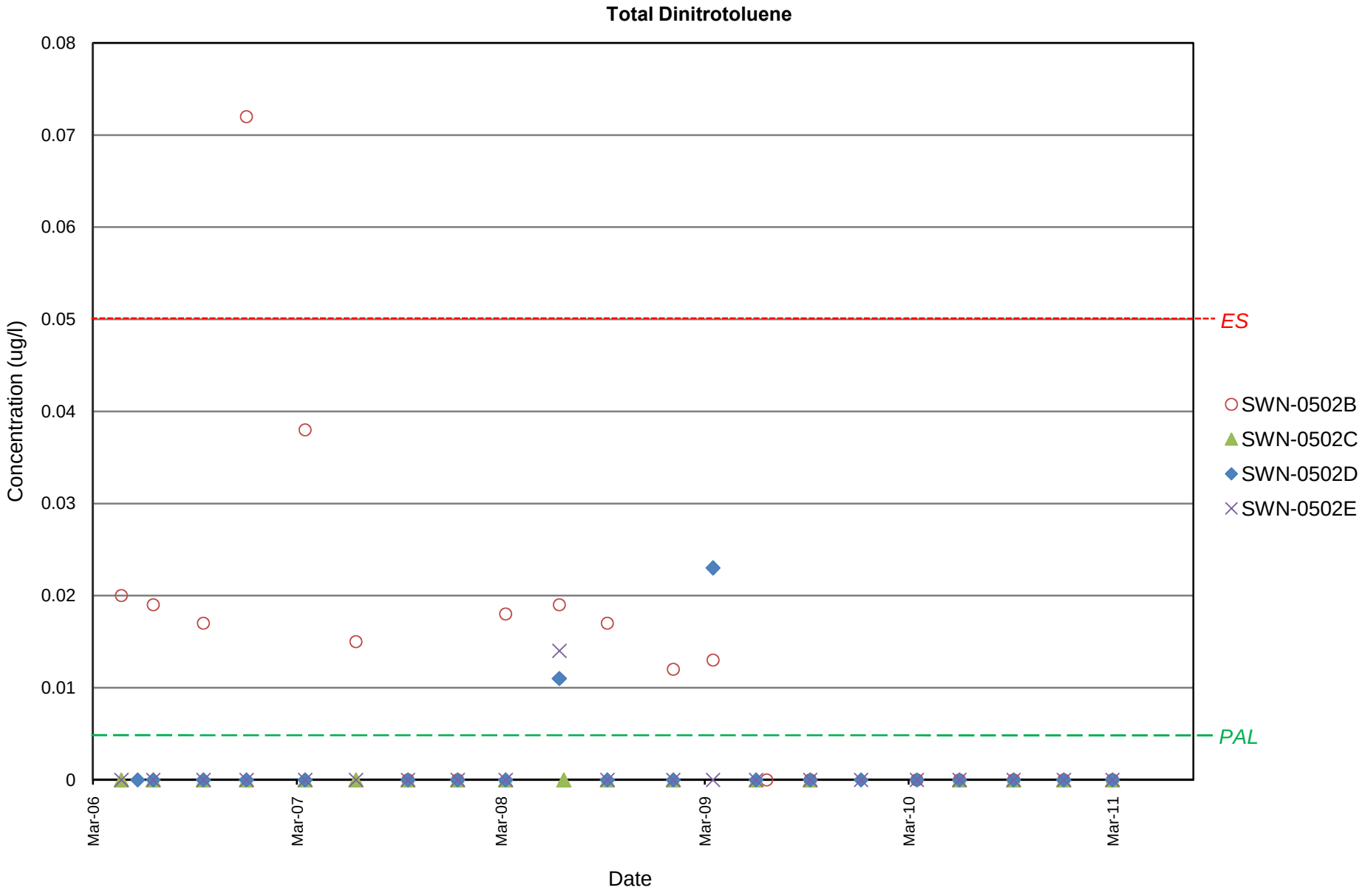
BAAAP Groundwater Data | Propellant Burning Ground | Plume Center - Offsite



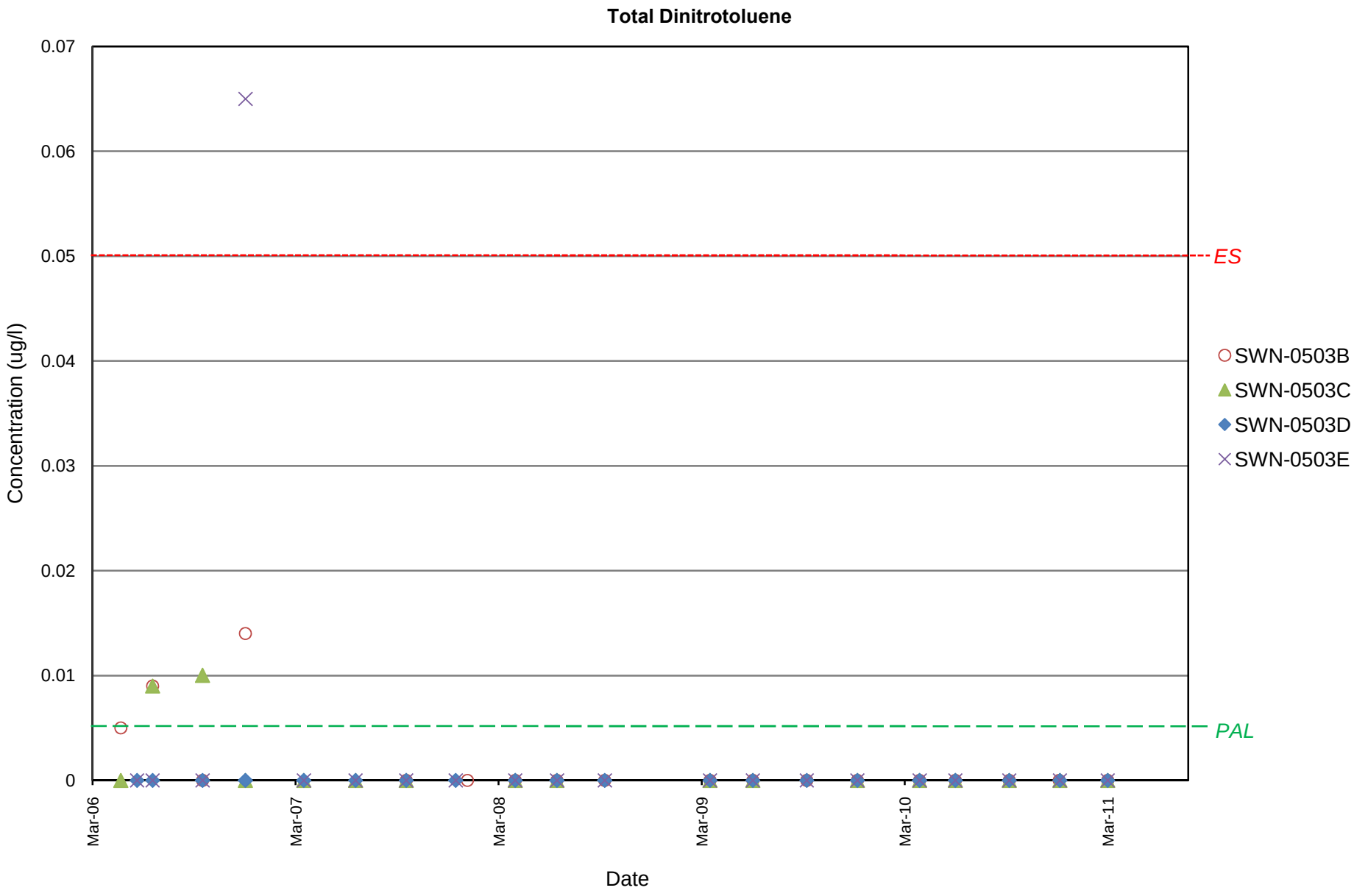
BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite

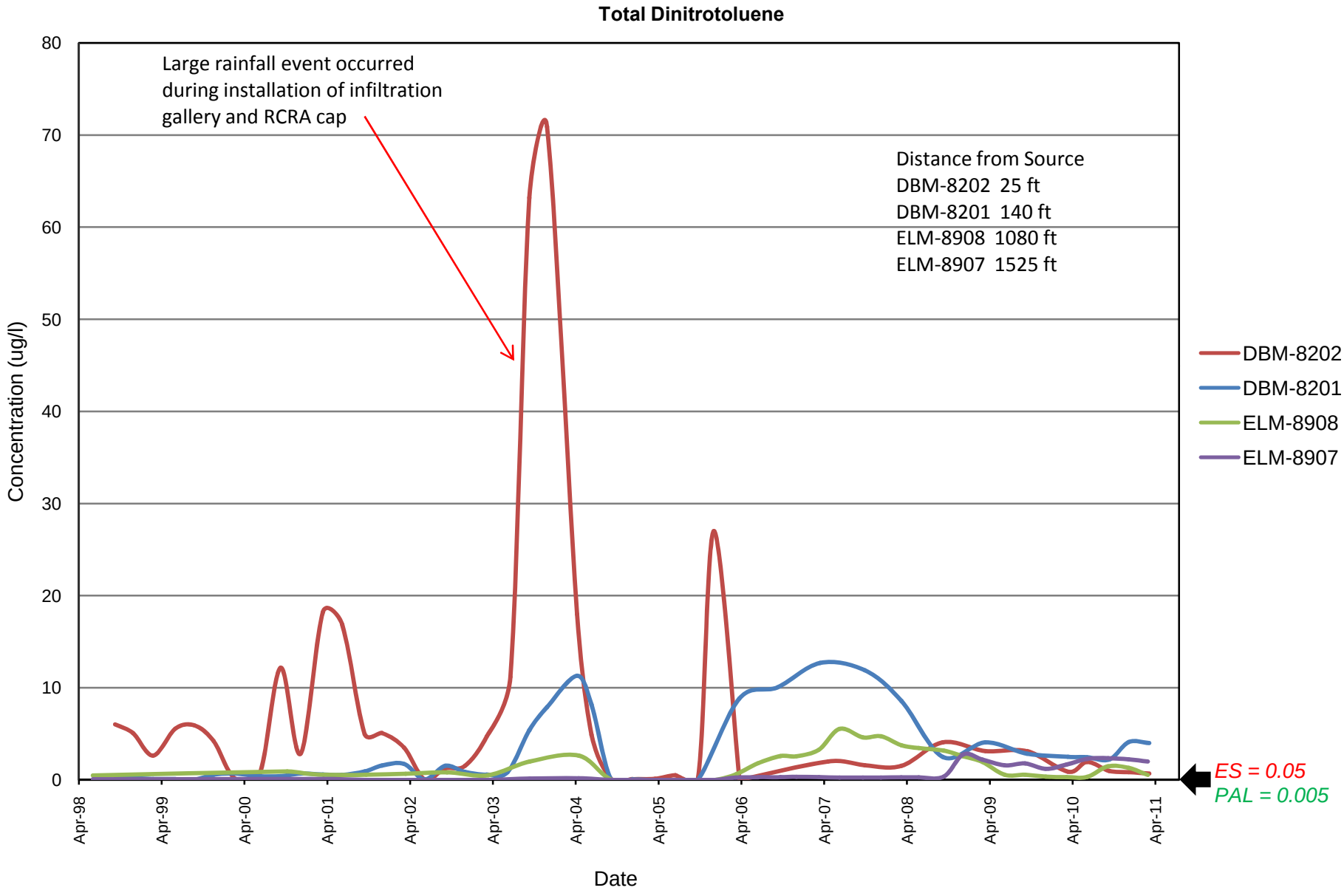


BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite

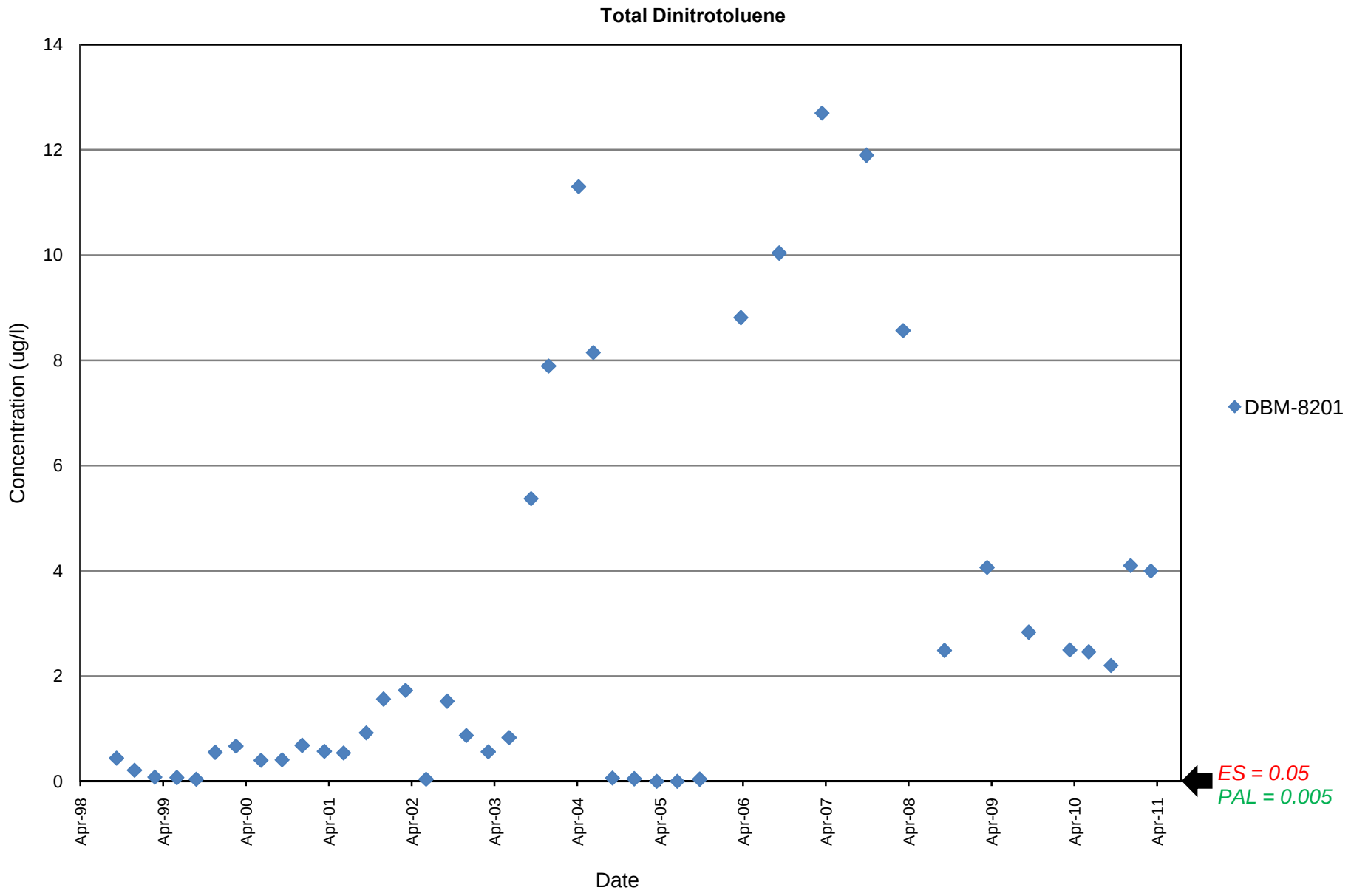


BAAAP Groundwater Data | Propellant Burning Ground | Plume Edge - Offsite

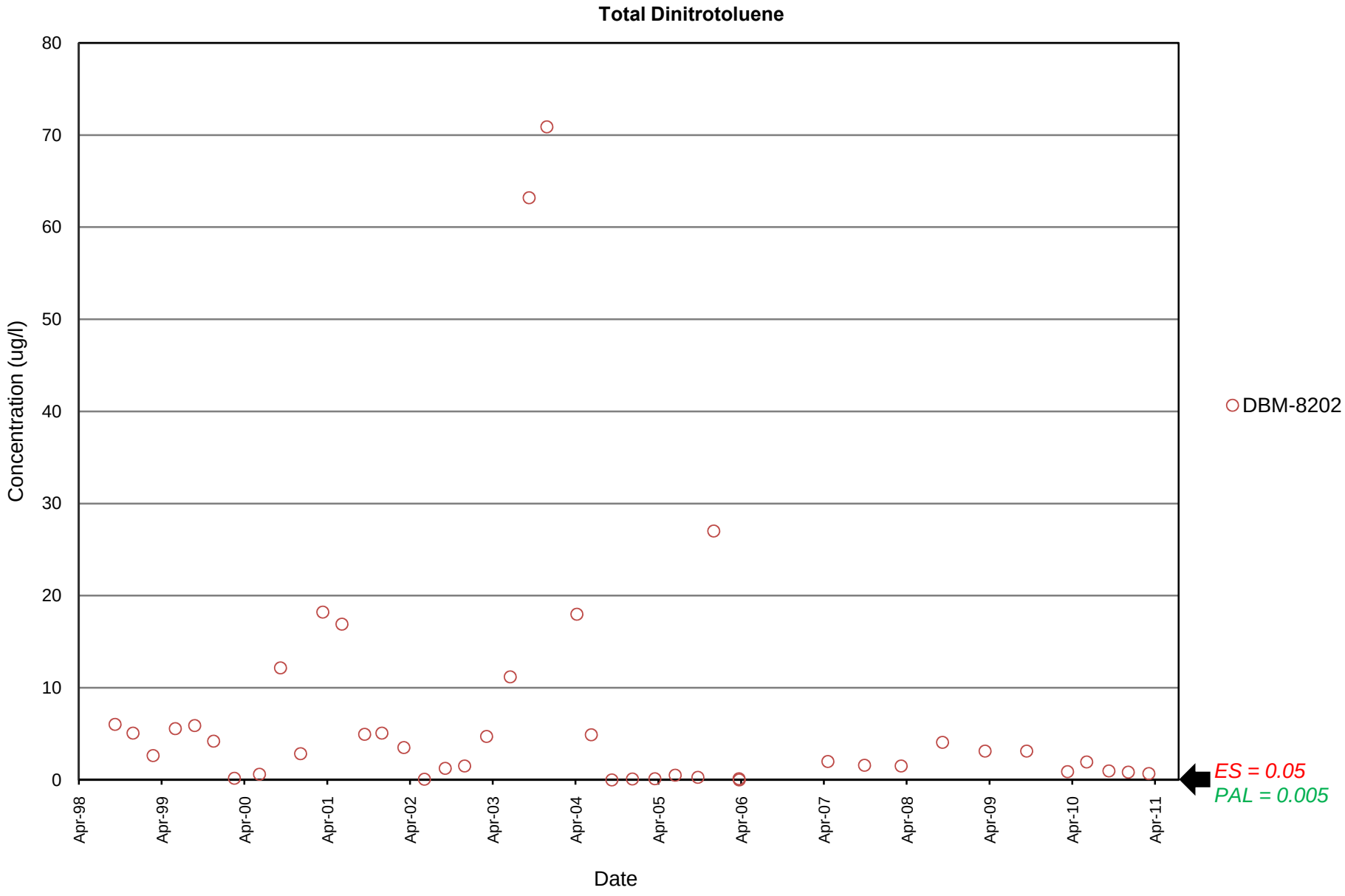



Total Dinitrotoluene
Large rainfall event occurred during installation of infiltration gallery and RCRA cap
Distance from Source
DBM-8202 25 ft
DBM-8201 140 ft
ELM-8908 1080 ft
ELM-8907 1525 ft
DBM-8202
DBM-8201
ELM-8908
ELM-8907
ES = 0.05
PAL = 0.005
Concentration (ug/l)
0
10
20
30
40
50
60
70
80
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Apr-05
Apr-06
Apr-07
Apr-08
Apr-09
Apr-10
Apr-11
Date

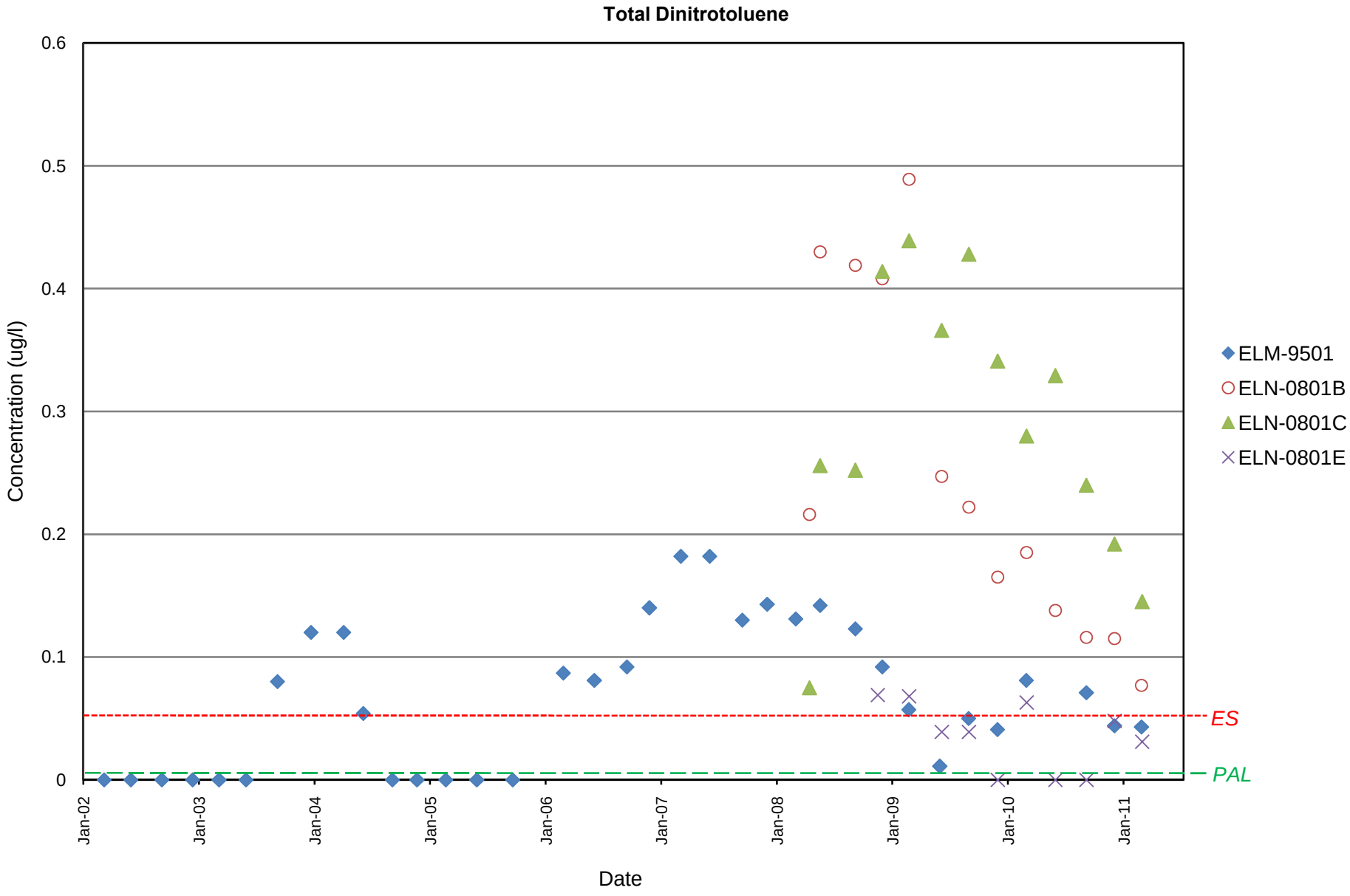
BAAAP Groundwater Data | Deterrent Burning Ground | Source Area



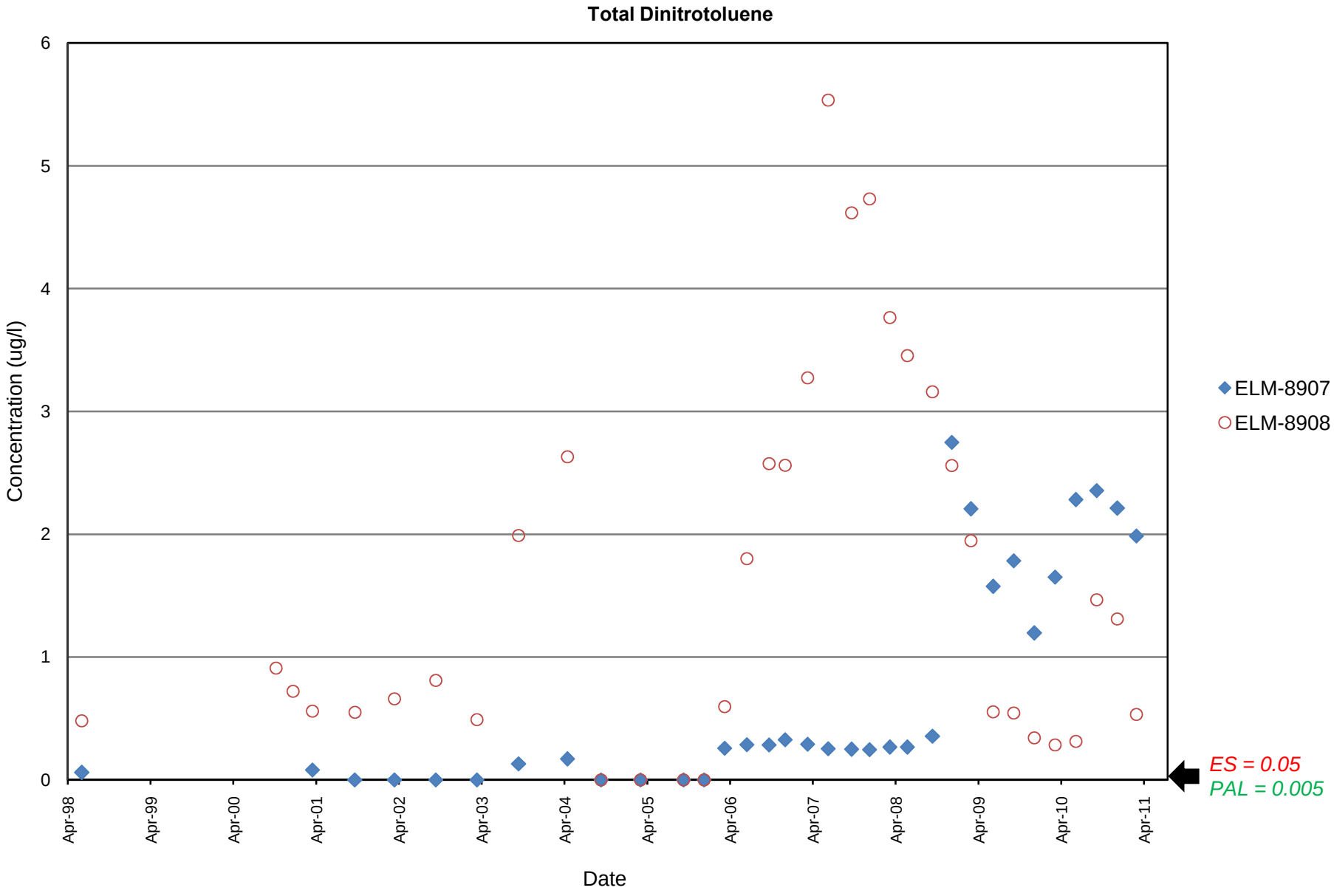
BAAAP Groundwater Data | Deterrent Burning Ground | Source Area

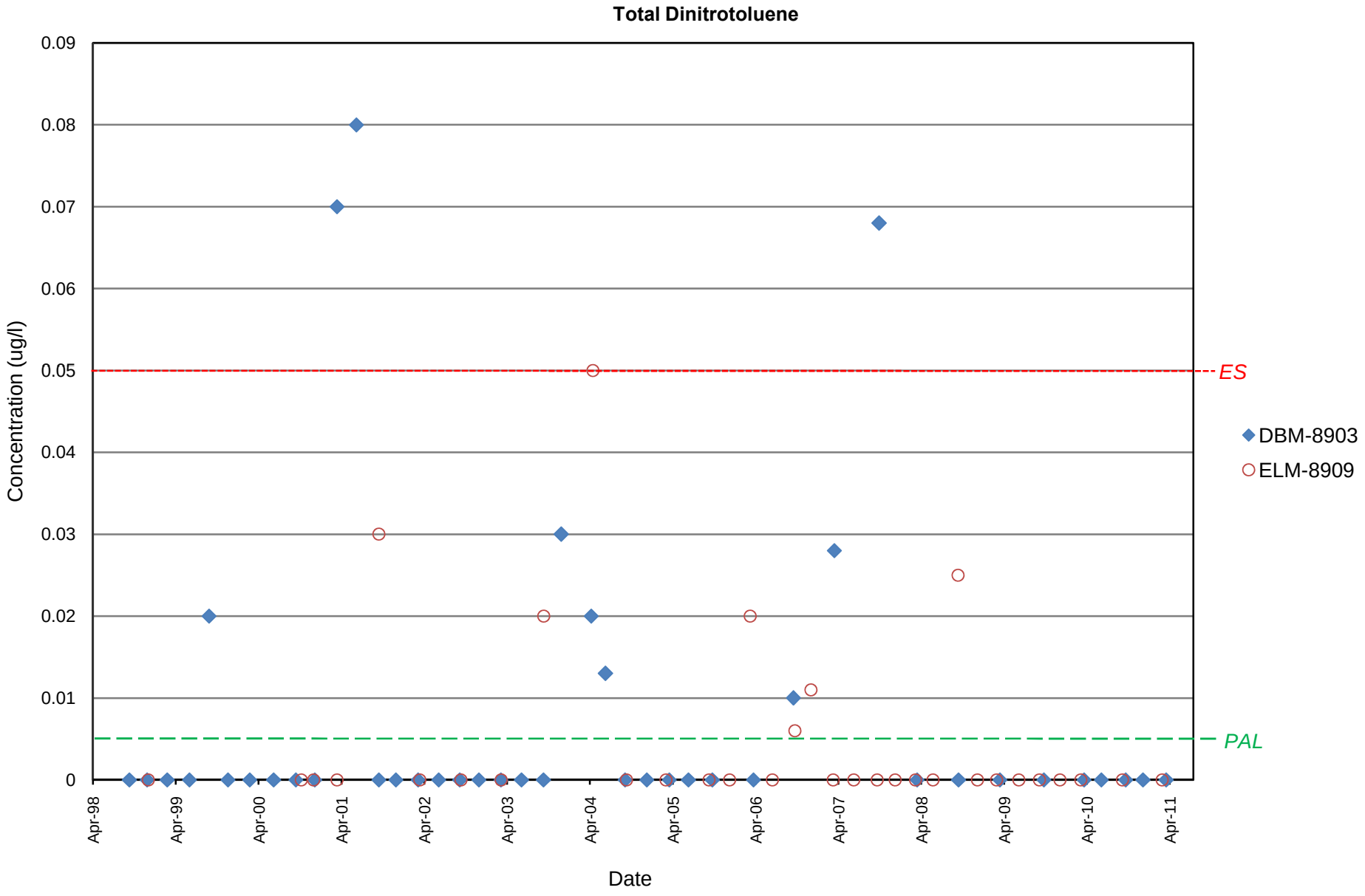


BAAAP Groundwater Data | Deterrent Burning Ground | Plume Center - Downgradient

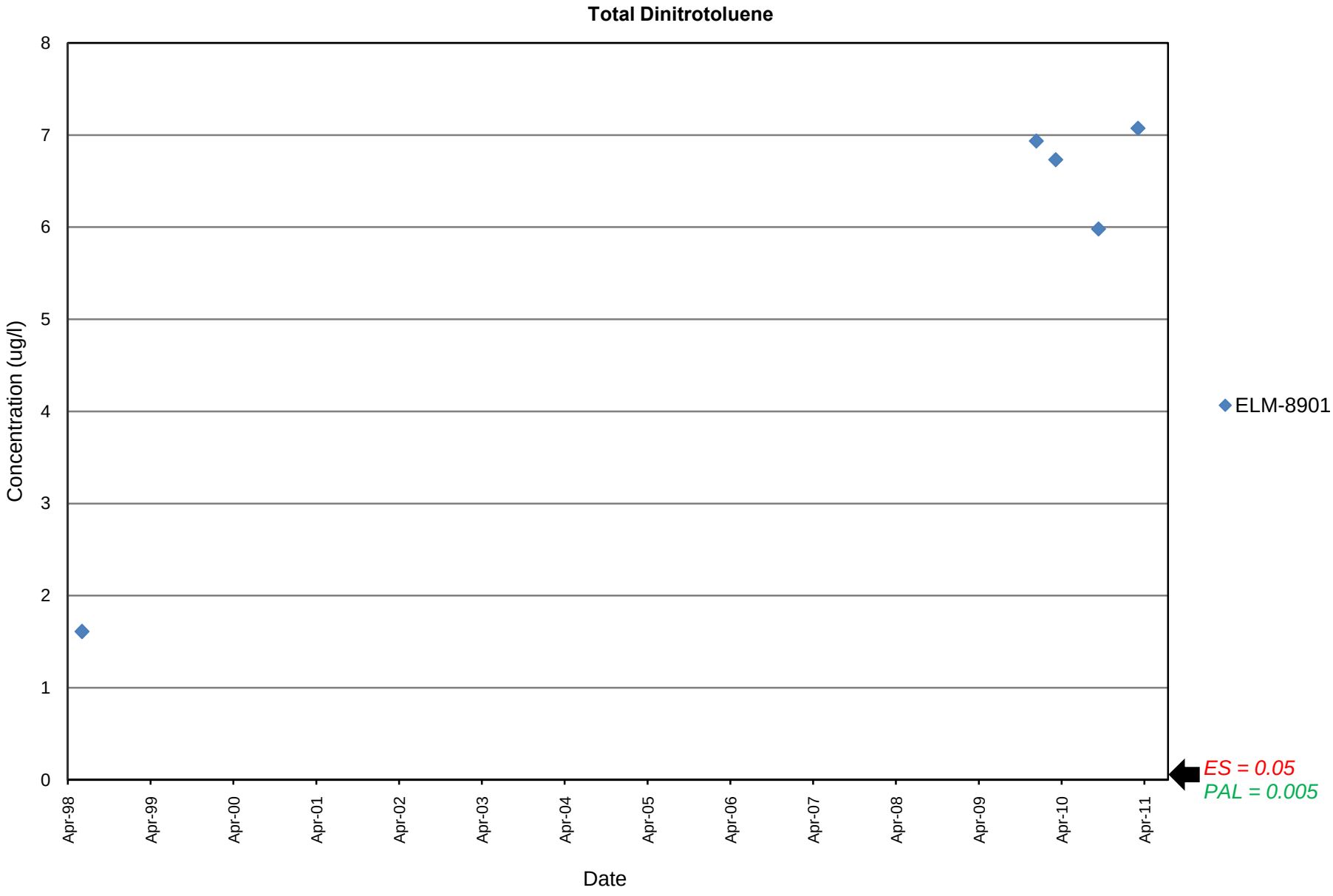


BAAAP Groundwater Data | Deterrent Burning Ground | Plume Center

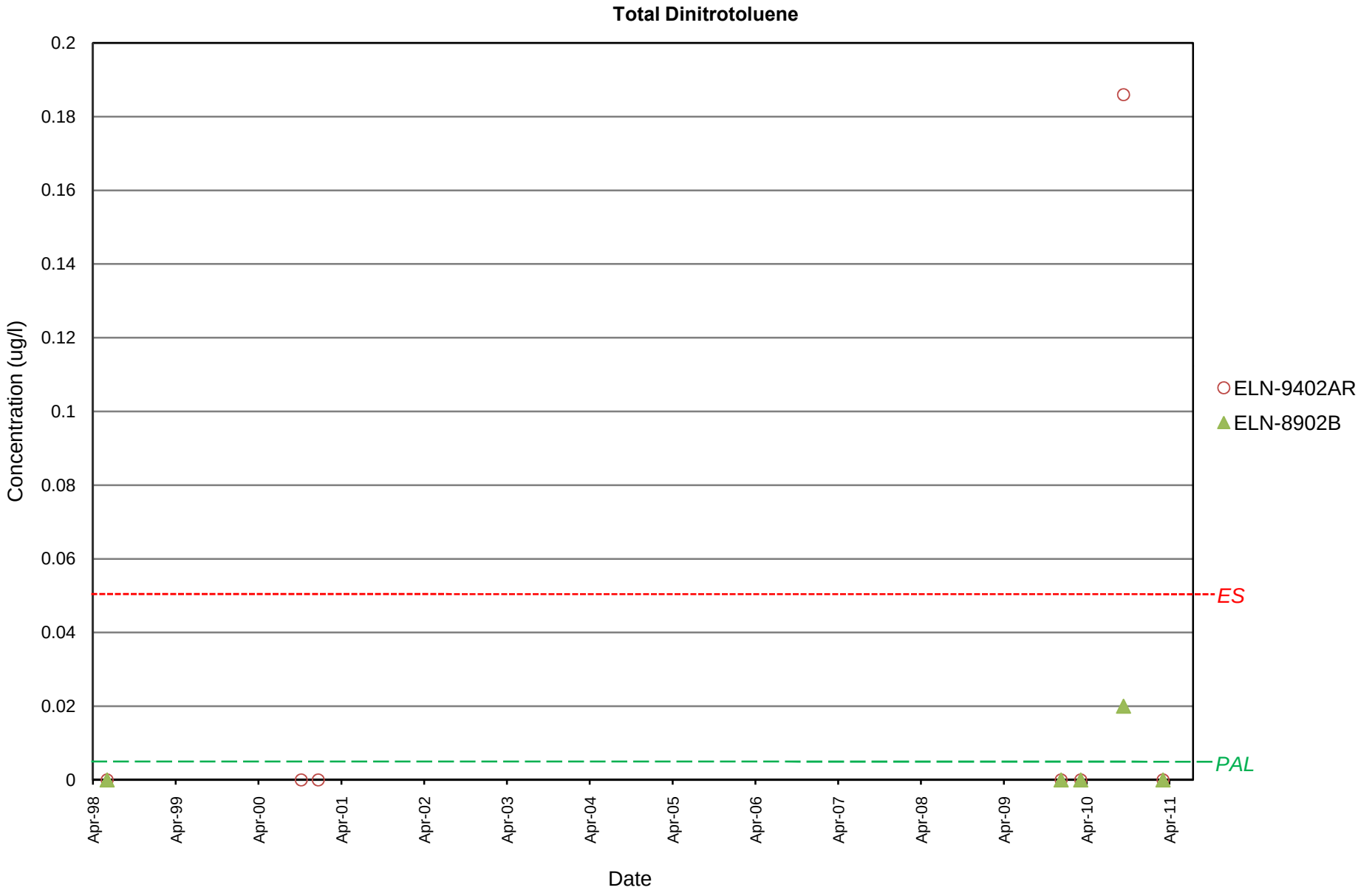



Total Dinitrotoluene
Concentration (ug/l)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
ES
PAL
DBM-8903
ELM-8909
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Apr-05
Apr-06
Apr-07
Apr-08
Apr-09
Apr-10
Apr-11
Date

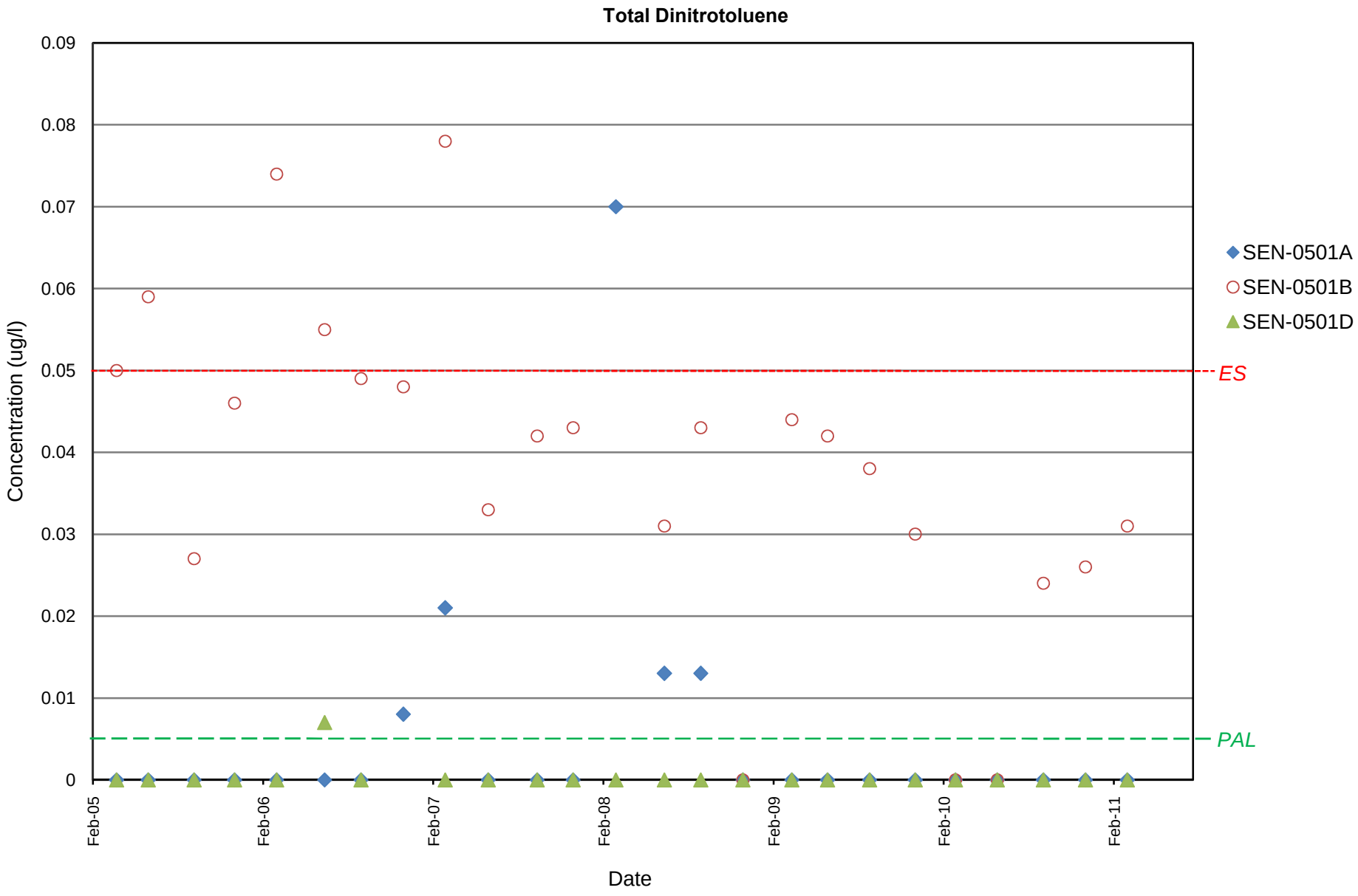
BAAAP Groundwater Data | Deterrent Burning Ground | Plume Center



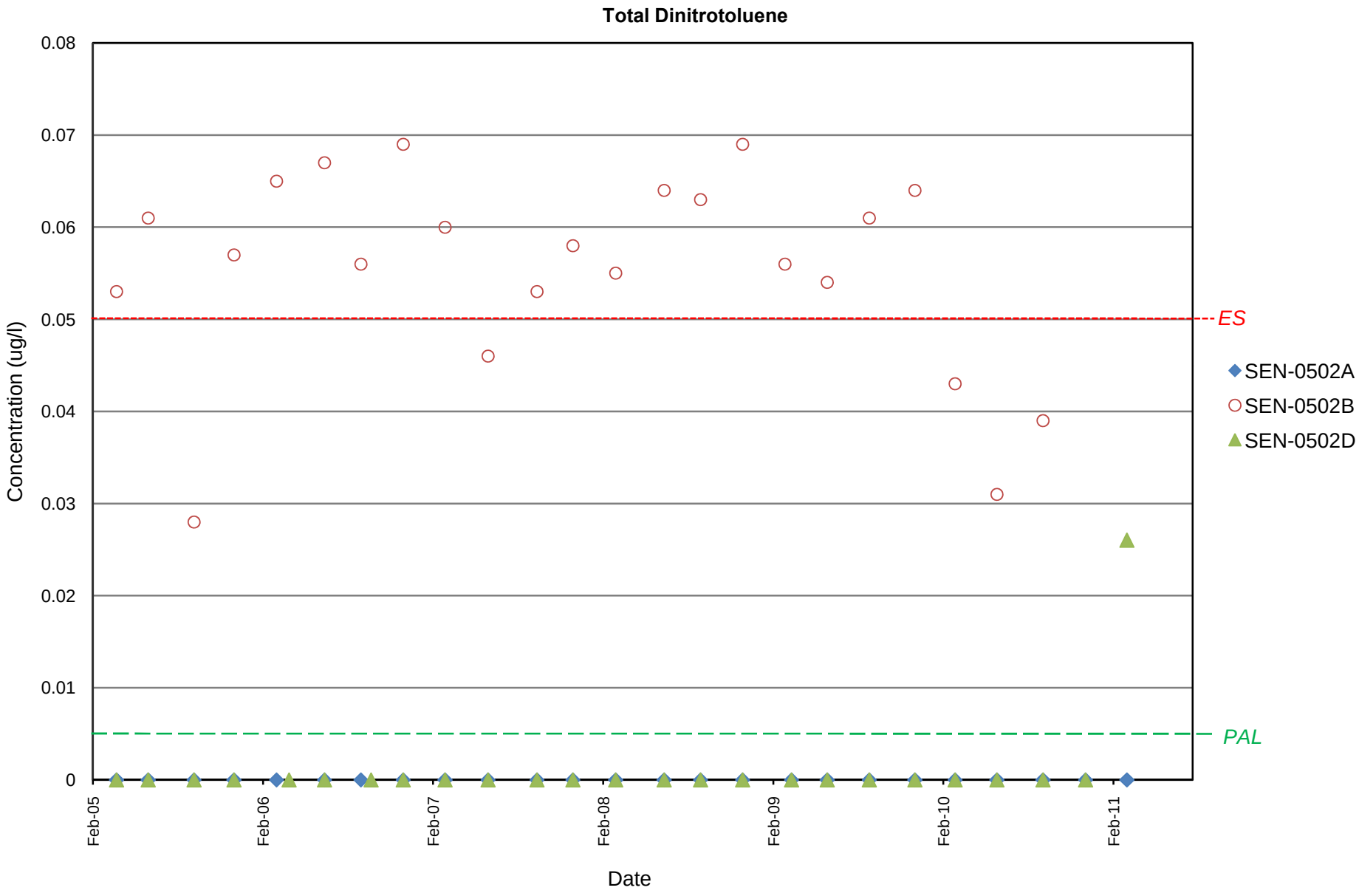
BAAAP Groundwater Data | Deterrent Burning Ground | Plume Center



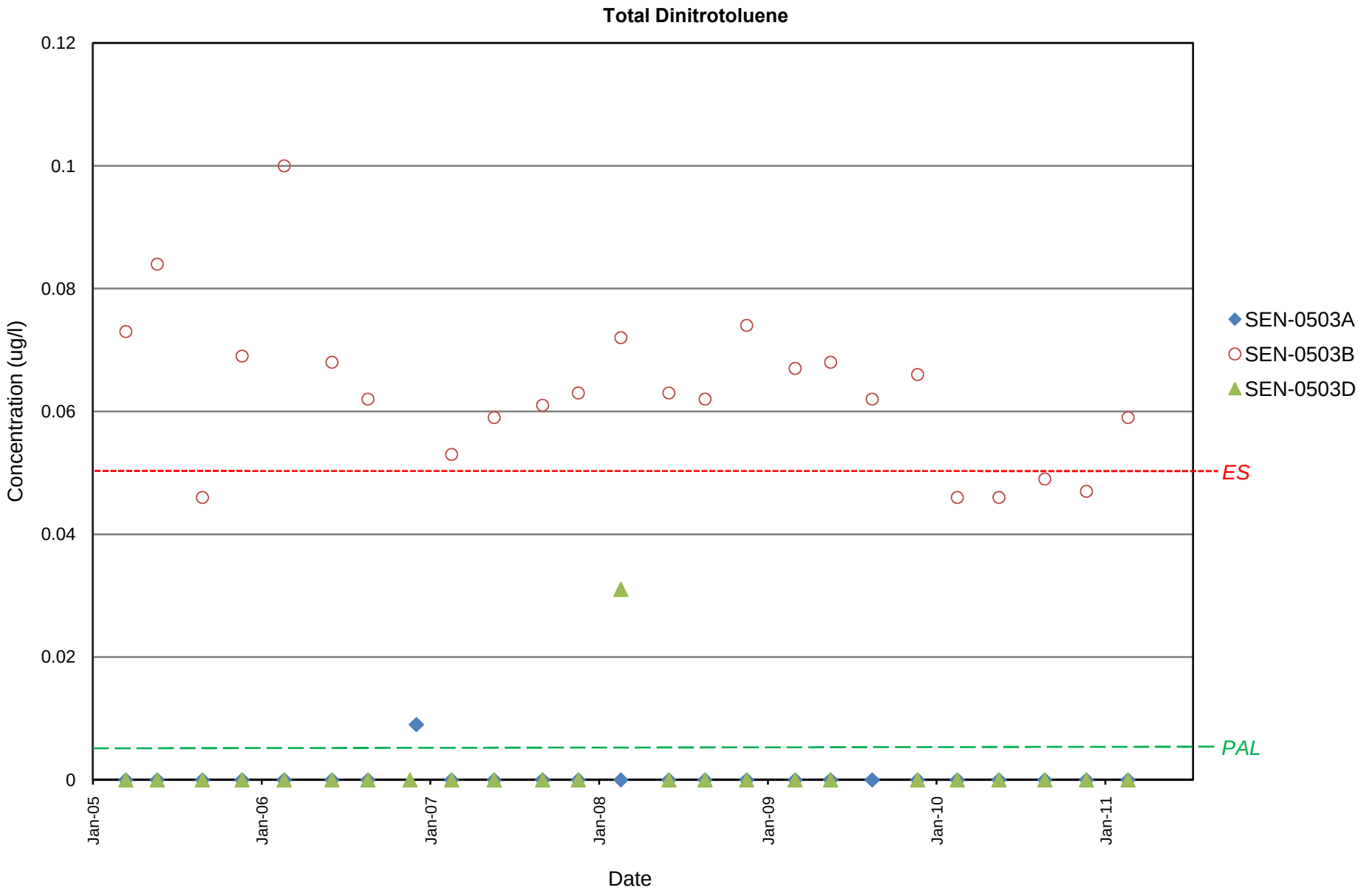
BAAAP Groundwater Data | Central Plume | Plume Leading Edge



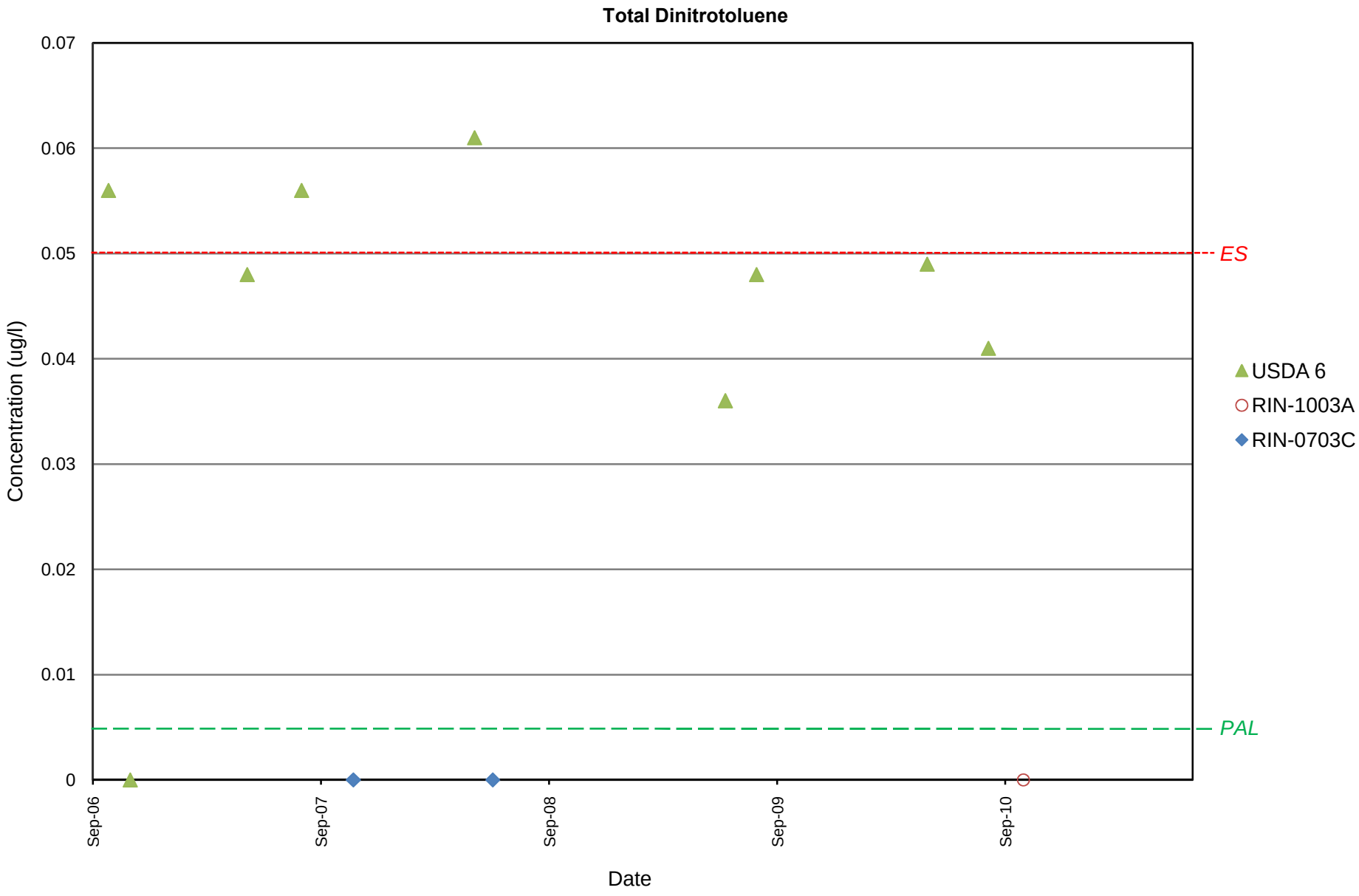
BAAAP Groundwater Data | Central Plume | Plume Leading Edge

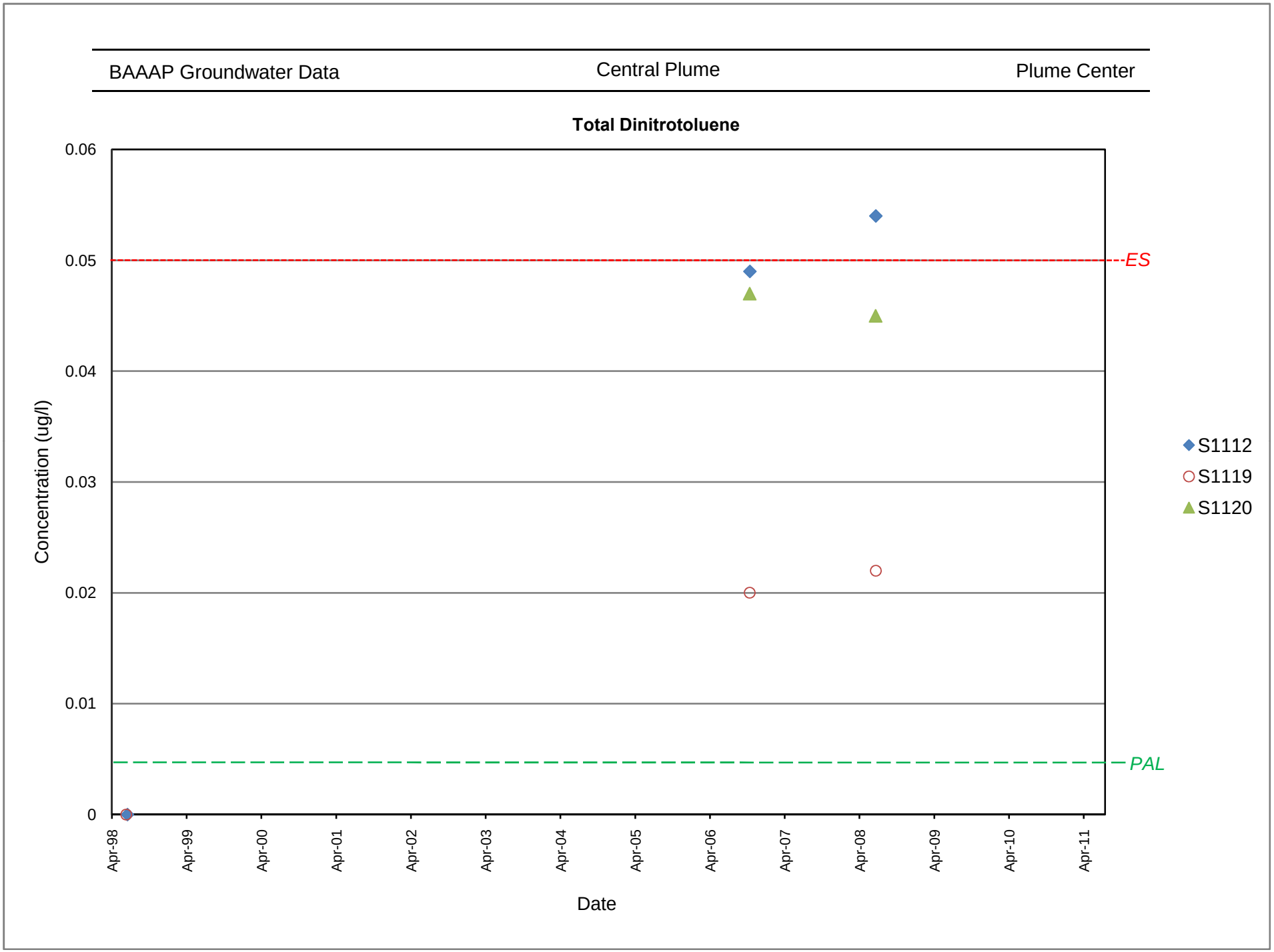


BAAAP Groundwater Data | Central Plume | Plume Leading Edge

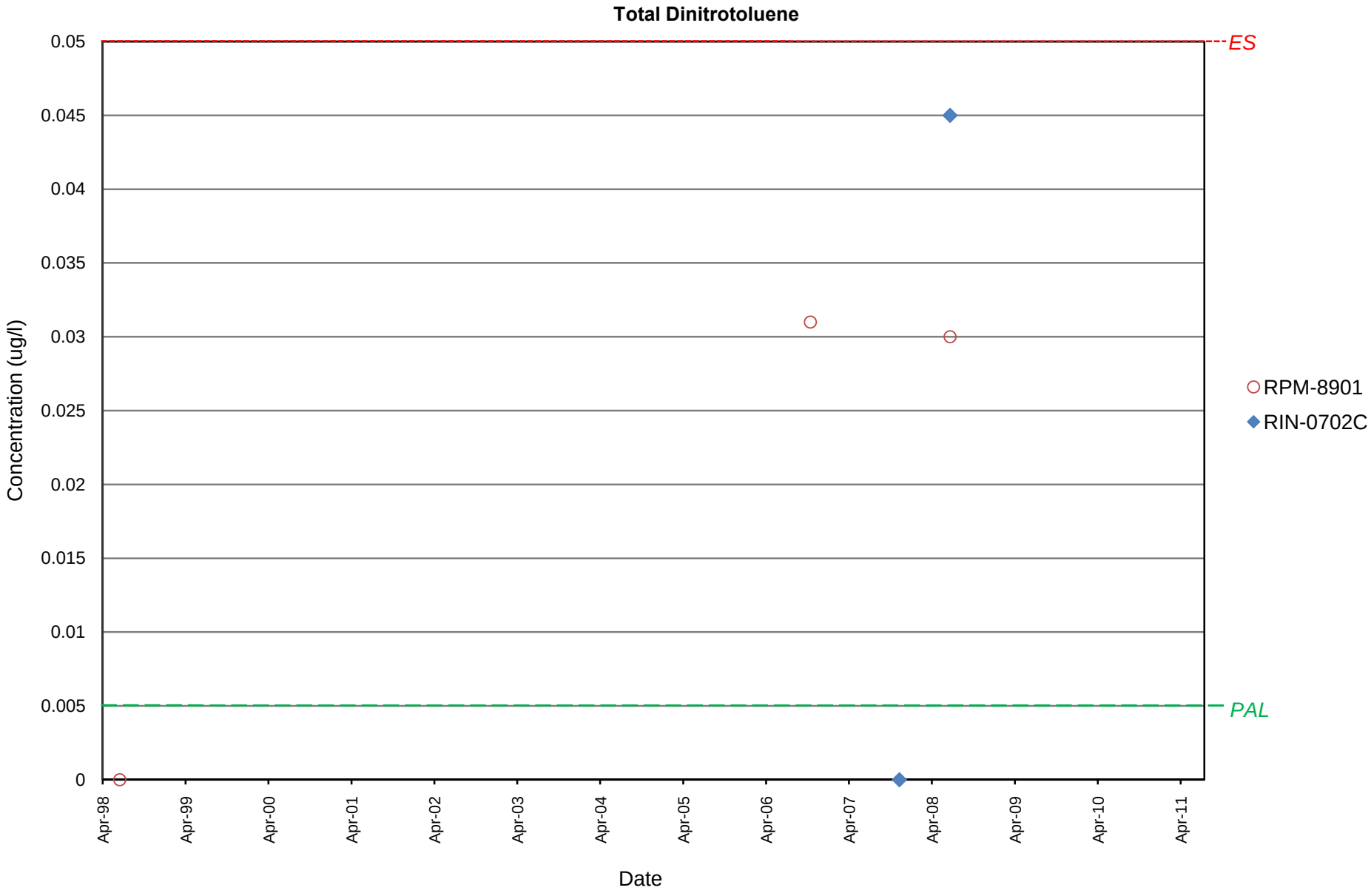


BAAAP Groundwater Data	Central Plume	Plume Center - Downgradient

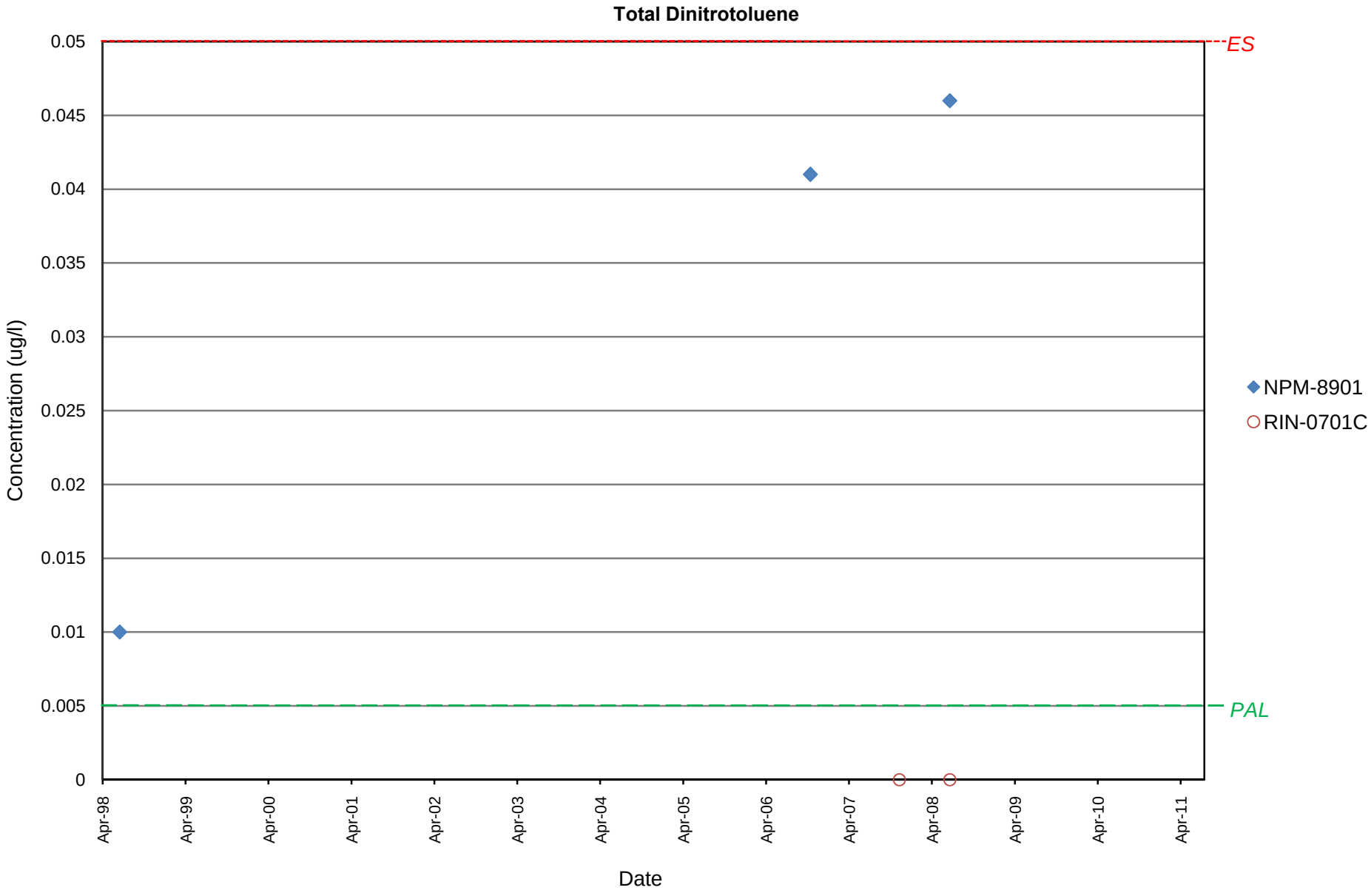



BAAAP Groundwater Data
Central Plume
Plume Center
Total Dinitrotoluene
Concentration (ug/l)
0.06
0.05
0.04
0.03
0.02
0.01
0
ES
PAL
S1112
S1119
S1120
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Apr-05
Apr-06
Apr-07
Apr-08
Apr-09
Apr-10
Apr-11
Date

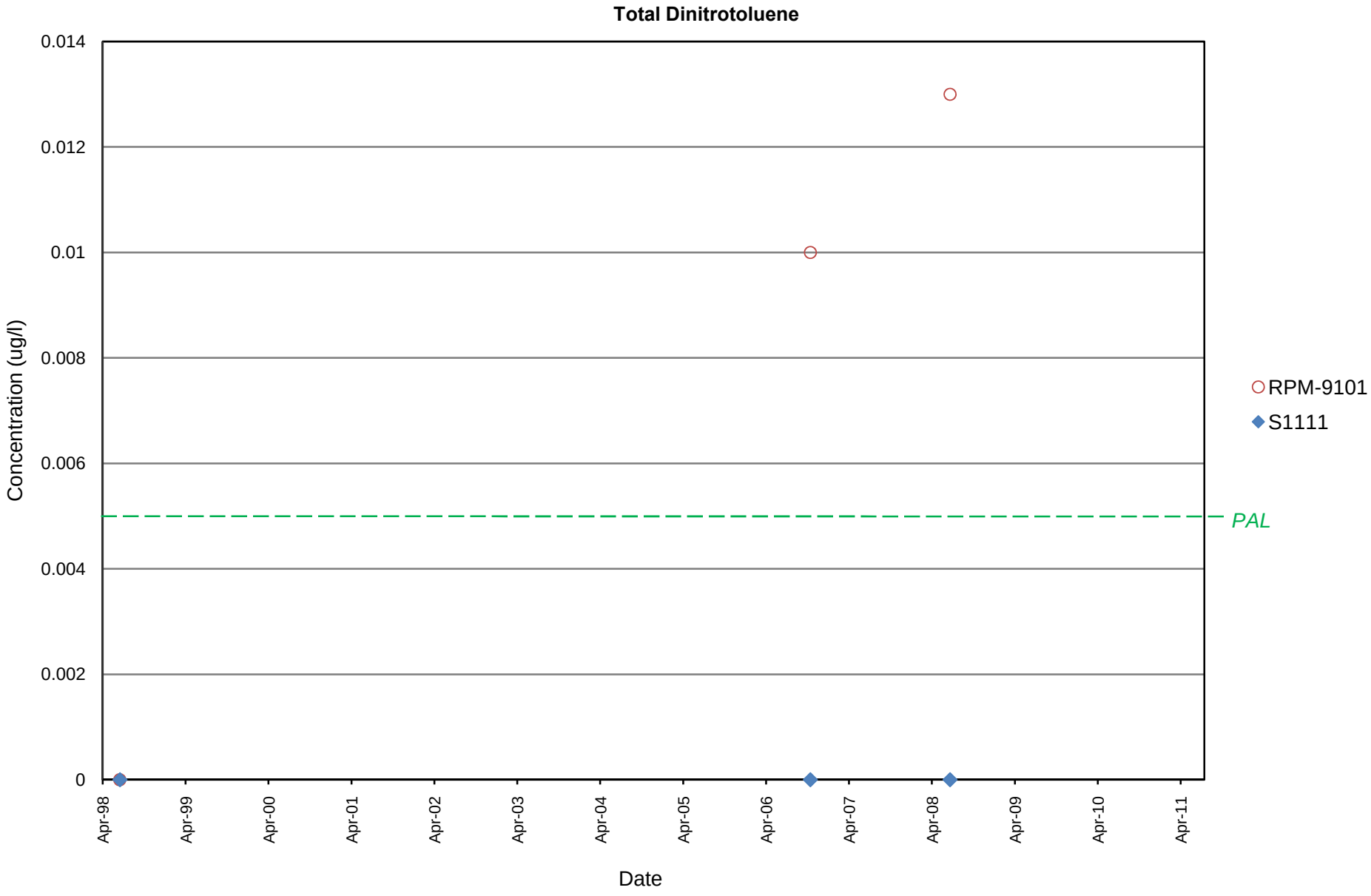
BAAAP Groundwater Data | Central Plume | Plume Center



BAAAP Groundwater Data | Central Plume | Plume Center

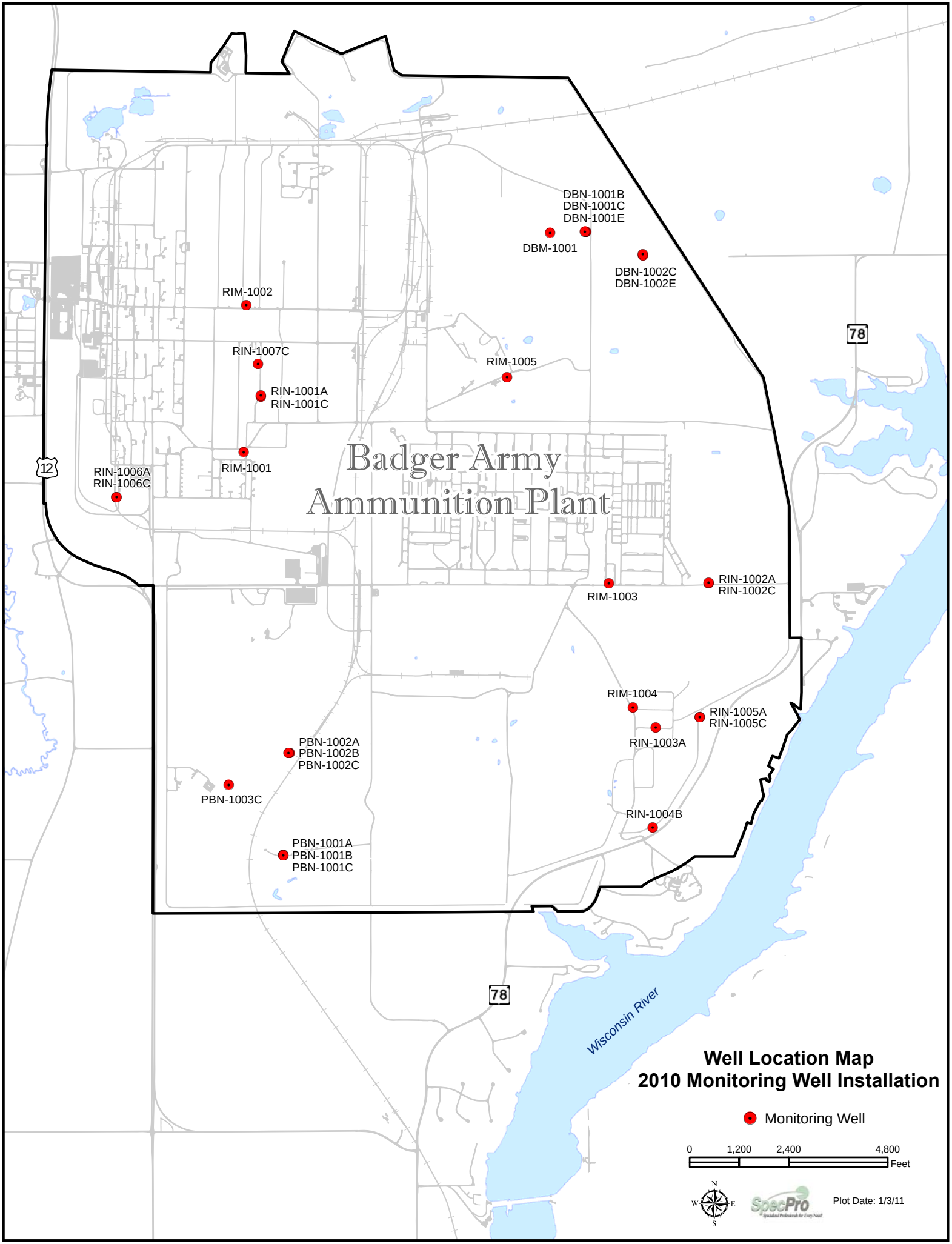


BAAAP Groundwater Data | Central Plume | Plume Edge



Appendix C

Groundwater Monitoring Well Installation Documentation


Badger Army
Ammunition Plant
DBN-1001B
DBN-1001C
DBN-1001E
DBM-1001
DBN-1002C
DBN-1002E
RIM-1002
RIN-1007C
RIN-1001A
RIN-1001C
RIM-1005
RIM-1001
RIN-1006A
RIN-1006C
RIM-1003
RIN-1002A
RIN-1002C
RIM-1004
RIN-1005A
RIN-1005C
RIN-1003A
PBN-1002A
PBN-1002B
PBN-1002C
PBN-1003C
RIN-1004B
PBN-1001A
PBN-1001B
PBN-1001C
12
78
78
Wisconsin River
Well Location Map
2010 Monitoring Well Installation
Monitoring Well
0
1,200
2,400
4,800
Feet
N
W
E
S
SpecPro
Plot Date: 1/3/11

Monitoring Well Information
2010 Monitoring Well Installation

Well Name	Well ID	License	WI Unique Well ID	Date Installed	Northing	Easting	Well Depth	Top of Casing Elevation	Ground Elevation	Static Water Level (10/26 - 11/8/10) (top of casing)	Groundwater Elevation (10/26 - 11/8/10)	Well Diameter (inches)	Screen Length	Bedrock Depth	Well Type
DBM-1001	471	3037	VM161	05/10/10	501035.03	2042233.38	125.3	911.97	909.21	122.33	789.64	2.5	15	NA	MW
DBN-1001B	472	3037	VM162	05/25/10	501062.19	2043112.65	159.5	912.07	909.77	126.28	785.79	2.5	5	NA	PZ
DBN-1001C	473	3037	VM163	05/27/10	501062.97	2043094.50	197	912.00	909.78	128.34	783.66	2.5	5	NA	PZ
DBN-1001E	474	3037	VM164	06/30/10	501064.75	2043076.32	279.9	912.50	909.95	128.29	784.21	2.5	5	258	PZ
DBN-1002C	476	3037	VM165	06/17/10	500487.21	2044487.97	210.1	916.12	913.72	133.28	782.84	2.5	5	NA	PZ
DBN-1002E	477	3037	VM166	07/12/10	500510.82	2044484.94	280.55	916.24	913.84	133.71	782.53	2.5	5	265	PZ
RIM-1002	478	3487	VM167	04/29/10	499282.00	2034868.80	110.2	891.01	888.51	103.29	787.72	2.5	15	NA	MW
RIN-1007C	479	3487	VM168	06/15/10	497857.57	2035155.19	175.3	883.81	881.41	97.63	786.18	2.5	5	NA	PZ
RIN-1001A	480	3487	VM169	04/28/10	497066.20	2035220.81	106.8	884.38	882.05	99.11	785.27	2.5	15	NA	MW
RIN-1001C	481	3487	VM170	05/24/10	497096.68	2035224.60	181.41	884.02	882.01	98.72	785.3	2.5	5	NA	PZ
RIM-1001	482	3487	VM171	04/27/10	495730.04	2034806.71	98.75	874.90	872.51	90.49	784.41	2.5	15	NA	MW
RIN-1006A	483	3487	VM172	05/18/10	494635.26	2031718.11	100.38	873.48	870.94	87.49	785.99	2.5	15	NA	MW
RIN-1006C	484	3487	VM173	05/18/10	494632.57	2031731.00	180.35	873.39	870.89	87.45	785.45	2.5	5	NA	PZ
RIM-1005	490	3487	VM174	05/06/10	497534.67	2041193.13	110.24	882.69	880.06	100.11	782.58	2.5	15	NA	MW
RIM-1003	491	3487	VM175	05/03/10	492554.74	2043660.80	114.3	885.06	882.78	107.29	777.77	2.5	15	NA	MW
RIN-1002A	492	3487	VM176	05/04/10	492556.37	2046081.69	92.2	862.81	860.46	85.89	776.92	2.5	15	NA	MW
RIN-1002C	493	3487	VM177	06/01/10	492568.67	2046078.50	179.8	862.95	860.86	86.11	776.84	2.5	5	NA	PZ
RIM-1004	494	3487	VM178	05/05/10	489552.08	2044244.43	70.52	836.40	833.60	61.85	774.55	2.5	15	NA	MW
RIN-1003A	495	3487	VM179	05/05/10	489061.45	2044797.07	90.5	857.10	854.66	83.23	773.87	2.5	15	NA	MW
RIN-1005A	496	3487	VM180	05/17/10	489310.71	2045864.38	60.5	828.61	826.74	53.34	775.27	2.5	15	NA	MW
RIN-1005C	497	3487	VM181	05/17/10	489316.84	2045864.92	147	828.75	826.49	54.42	774.33	2.5	5	NA	PZ
RIN-1004B	498	3487	VM182	05/13/10	486645.01	2044721.14	146.7	859.31	856.74	88.76	770.55	2.5	5	NA	PZ
PBN-1002A	589	2814	VM189	05/20/10	488450.52	2035896.71	130.8	893.90	891.70	123.35	770.55	2.5	15	NA	MW
PBN-1002B	590	2814	VM183	05/19/10	488447.03	2035926.71	176.5	894.27	892.27	123.69	770.58	2.5	5	NA	PZ
PBN-1002C	591	2814	VM184	06/09/10	488449.71	2035908.47	216.8	893.48	891.48	122.93	770.55	2.5	5	NA	PZ
PBN-1003C	592	2814	VM185	06/03/10	487681.33	2034447.60	189.6	848.21	846.51	74.47	773.74	2.5	5	NA	PZ
PBN-1001A	593	2814	VM186	05/03/10	485983.78	2035769.90	79.3	840.37	838.17	73.99	766.38	2.5	15	NA	MW
PBN-1001B	594	2814	VM187	06/02/10	485975.99	2035767.53	139.9	839.93	838.23	73.41	766.52	2.5	5	NA	PZ
PBN-1001C	595	2814	VM188	06/08/10	485968.12	2035767.23	199.7	840.01	837.71	73.65	766.36	2.5	5	NA	PZ

Notes:
NA = Bedrock not encountered
PZ = Piezometer
MW = Groundwater Monitoring Well
All measurements are in feet and measured from the ground surface unless otherwise noted.
Northing and Easting coordinates are associated with the State Plane System North American Datum 1983 (NAD83).

WDNR Monitoring Well Construction Forms

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: PBN-1002A
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM189 / DNR Well ID No.: 589
Facility ID: 157053930	St. Plane 488450.52 ft. N, 2035896.71 ft. E. (S)C/N	Date Well Installed: 05 / 20 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number:

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 893.90 ft. MSL

C. Land surface elevation 891.70 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 105.8 ft.

F. Fine sand, top _____ ft. MSL or 110.8 ft.

G. Filter pack, top _____ ft. MSL or 112.8 ft.

H. Screen joint, top _____ ft. MSL or 115.8 ft.

I. Well bottom _____ ft. MSL or 130.8 ft.

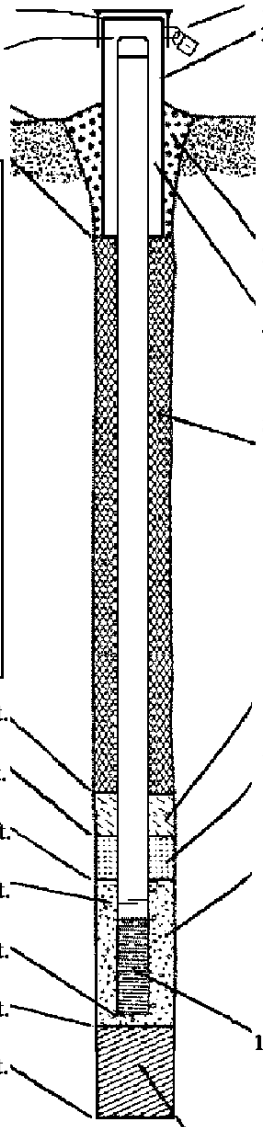
J. Filter pack, bottom _____ ft. MSL or 130.8 ft.

K. Borehole, bottom _____ ft. MSL or 130.8 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

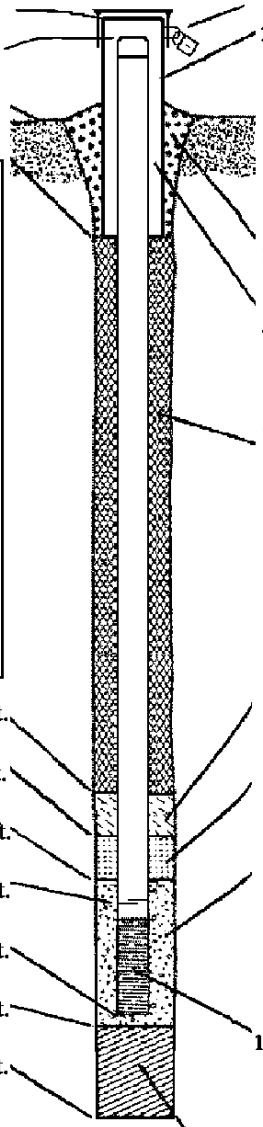
Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: PBN-1001C
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM188 / DNR Well ID No.: 595
Facility ID: 157053930	St. Plane 485968.12 ft. N, 2035767.23 ft. E. (S)C/N	Date Well Installed: 06 / 08 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	



A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 840.01 ft. MSL

C. Land surface elevation 837.71 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 184.7 ft.

F. Fine sand, top _____ ft. MSL or 189.7 ft.

G. Filter pack, top _____ ft. MSL or 191.7 ft.

H. Screen joint, top _____ ft. MSL or 194.7 ft.

I. Well bottom _____ ft. MSL or 199.7 ft.

J. Filter pack, bottom _____ ft. MSL or 199.7 ft.

K. Borehole, bottom _____ ft. MSL or 199.7 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.

1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 250 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: PBN-1001B
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM187 / DNR Well ID No.: 594
Facility ID: 157053930	St. Plane 485975.99 ft. N, 2035767.53 ft. E. (S)/C/N	Date Well Installed: 06 / 02 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 839.93 ft. MSL

C. Land surface elevation 838.23 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 124.9 ft.

F. Fine sand, top _____ ft. MSL or 129.9 ft.

G. Filter pack, top _____ ft. MSL or 131.9 ft.

H. Screen joint, top _____ ft. MSL or 134.9 ft.

I. Well bottom _____ ft. MSL or 139.9 ft.

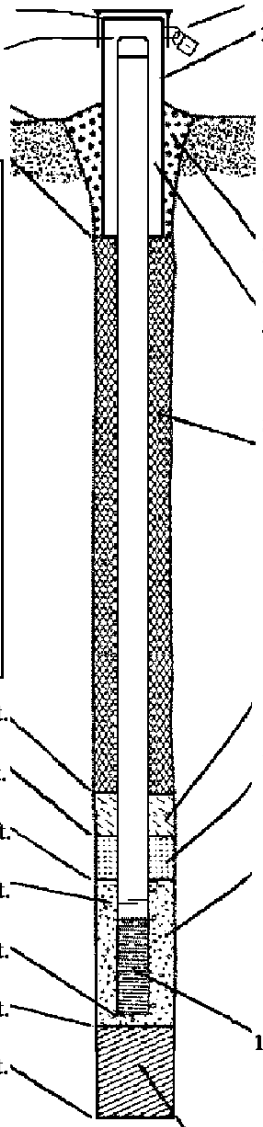
J. Filter pack, bottom _____ ft. MSL or 139.9 ft.

K. Borehole, bottom _____ ft. MSL or 139.9 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 175 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: PBN-1001A
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM186 / DNR Well ID No.: 593
Facility ID: 157053930	St. Plane 485983.78 ft. N, 2035769.90 ft. E. (S)/C/N	Date Well Installed: 05 / 03 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 840.37 ft. MSL

C. Land surface elevation 838.17 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 54.3 ft.

F. Fine sand, top _____ ft. MSL or 59.3 ft.

G. Filter pack, top _____ ft. MSL or 61.3 ft.

H. Screen joint, top _____ ft. MSL or 64.3 ft.

I. Well bottom _____ ft. MSL or 79.3 ft.

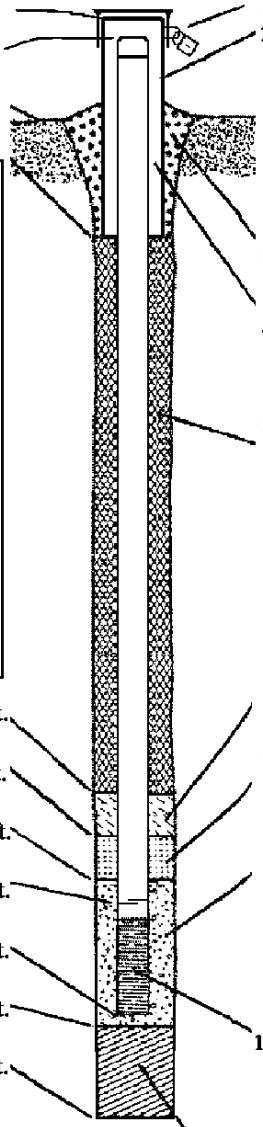
J. Filter pack, bottom _____ ft. MSL or 79.3 ft.

K. Borehole, bottom _____ ft. MSL or 79.3 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 80 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: DBN-1002E
Facility License, Permit or Monitoring No.: 3037	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM166 / DNR Well ID No.: 477
Facility ID: 157053930	St. Plane 500510.82 ft. N, 2044484.94 ft. E. (S)/C/N	Date Well Installed: 07 / 12 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Vince Meindel; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 916.24 ft. MSL

C. Land surface elevation 913.84 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ DWRC

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 265.55 ft.

F. Fine sand, top _____ ft. MSL or 270.55 ft.

G. Filter pack, top _____ ft. MSL or 272.55 ft.

H. Screen joint, top _____ ft. MSL or 275.55 ft.

I. Well bottom _____ ft. MSL or 280.55 ft.

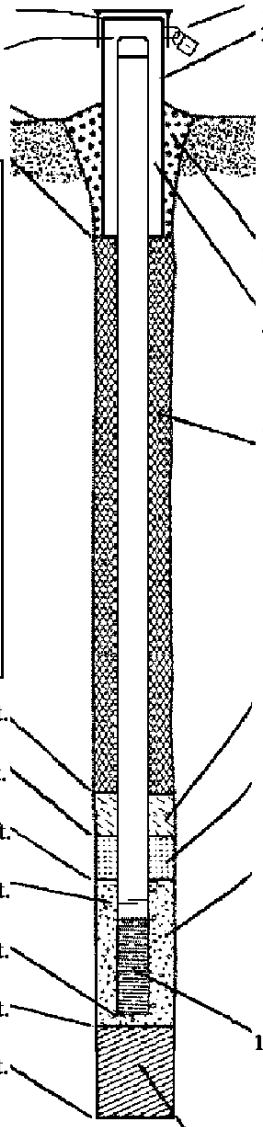
J. Filter pack, bottom _____ ft. MSL or 280.55 ft.

K. Borehole, bottom _____ ft. MSL or 280.55 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 400 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: DBN-1002C
Facility License, Permit or Monitoring No.: 3037	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM165 / DNR Well ID No.: 476
Facility ID: 157053930	St. Plane 500487.21 ft. N, 2044487.97 ft. E. (S)/C/N	Date Well Installed: 06 / 17 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 916.12 ft. MSL

C. Land surface elevation 913.72 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 195.1 ft.

F. Fine sand, top ____ ft. MSL or 200.1 ft.

G. Filter pack, top ____ ft. MSL or 202.1 ft.

H. Screen joint, top ____ ft. MSL or 205.1 ft.

I. Well bottom ____ ft. MSL or 210.1 ft.

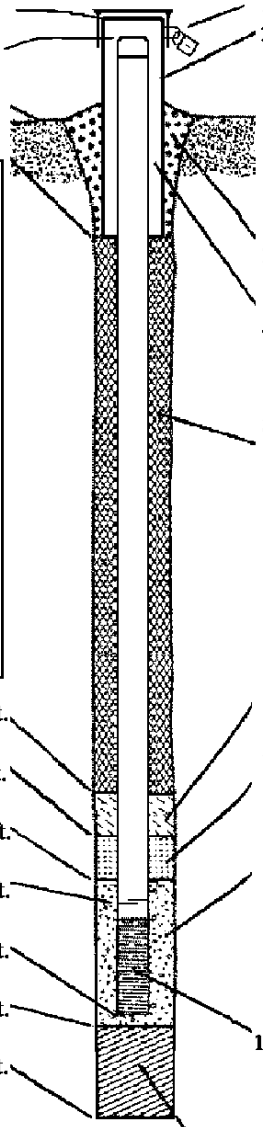
J. Filter pack, bottom ____ ft. MSL or 210.1 ft.

K. Borehole, bottom ____ ft. MSL or 210.1 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 250 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: DBN-1001E
Facility License, Permit or Monitoring No.: 3037	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM164 / DNR Well ID No.: 474
Facility ID: 157053930	St. Plane 501064.75 ft. N, 2043076.32 ft. E. (S)C/N	Date Well Installed: 06 / 30 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Vince Meindel; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known / Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 912.49 ft. MSL

C. Land surface elevation 910.09 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50 Hollow Stem Auger ☐ 41 Other ☑ DWRC

15. Drilling fluid used: Water ☑ 02 Air ☐ 01 Drilling Mud ☐ 03 None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 264.9 ft.

F. Fine sand, top _____ ft. MSL or 269.9 ft.

G. Filter pack, top _____ ft. MSL or 271.9 ft.

H. Screen joint, top _____ ft. MSL or 274.9 ft.

I. Well bottom _____ ft. MSL or 279.9 ft.

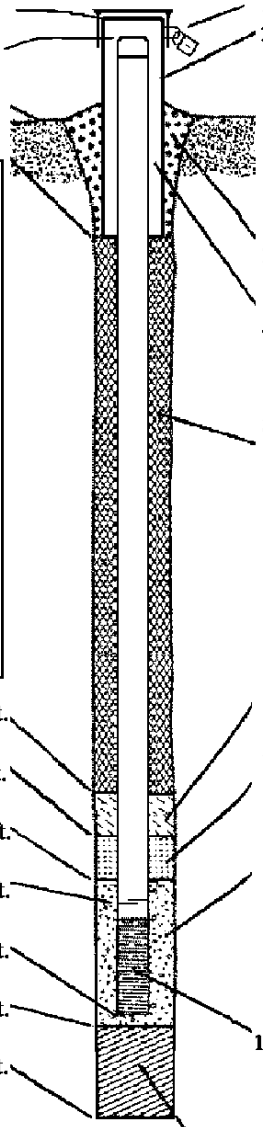
J. Filter pack, bottom _____ ft. MSL or 279.9 ft.

K. Borehole, bottom _____ ft. MSL or 279.9 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04 Other ☐ _____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30 Concrete ☐ 01 Other ☐ _____

4. Material between well casing and protective pipe: Bentonite ☑ 30 Other ☐ _____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 400 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01 Tremie pumped ☐ 02 Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐1/4 in. ☑3/8 in. ☐1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐ _____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23 Flush threaded PVC schedule 80 ☑ 24 Other ☐ _____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11 Continuous slot ☐ 01 Other ☐ _____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14 Other ☐ _____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: DBN-1001C
Facility License, Permit or Monitoring No.: 3037	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM163 / DNR Well ID No.: 473
Facility ID: 157053930	St. Plane 501062.97 ft. N, 2043094.50 ft. E. (S)C/N	Date Well Installed: 05 / 27 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number:

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 912.00 ft. MSL

C. Land surface elevation 909.78 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50 Hollow Stem Auger ☐ 41 Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02 Air ☐ 01 Drilling Mud ☐ 03 None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 182 ft.

F. Fine sand, top _____ ft. MSL or 187 ft.

G. Filter pack, top _____ ft. MSL or 189 ft.

H. Screen joint, top _____ ft. MSL or 192 ft.

I. Well bottom _____ ft. MSL or 197 ft.

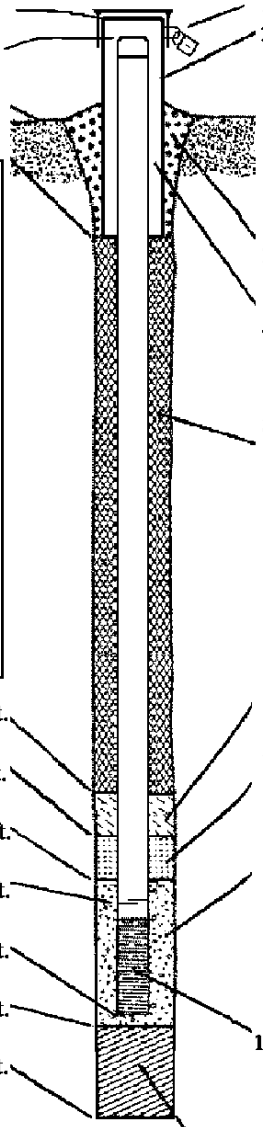
J. Filter pack, bottom _____ ft. MSL or 197 ft.

K. Borehole, bottom _____ ft. MSL or 197 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04 Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30 Concrete ☐ 01 Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30 Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 250 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01 Tremie pumped ☐ 02 Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23 Flush threaded PVC schedule 80 ☑ 24 Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11 Continuous slot ☐ 01 Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14 Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

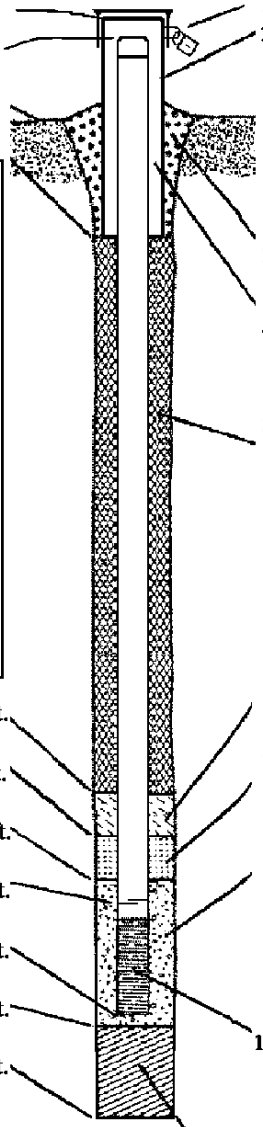
Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: DBN-1001B
Facility License, Permit or Monitoring No.: 3037	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM162 / DNR Well ID No.: 472
Facility ID: 157053930	St. Plane 501062.19 ft. N, 2043112.65 ft. E. (S)/C/N	Date Well Installed: 05 / 25 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____



A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 912.07 ft. MSL

C. Land surface elevation 909.77 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe ____

17. Source of water (attach analysis, if required): ____

E. Bentonite seal, top ____ ft. MSL or 144.5 ft.

F. Fine sand, top ____ ft. MSL or 149.5 ft.

G. Filter pack, top ____ ft. MSL or 151.5 ft.

H. Screen joint, top ____ ft. MSL or 154.5 ft.

I. Well bottom ____ ft. MSL or 159.5 ft.

J. Filter pack, bottom ____ ft. MSL or 159.5 ft.

K. Borehole, bottom ____ ft. MSL or 159.5 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.

1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 200 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: DBM-1001
Facility License, Permit or Monitoring No.: 3037	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM161 / DNR Well ID No.: 471
Facility ID: 157053930	St. Plane 501035.03 ft. N, 2042233.38 ft. E. (S)C/N	Date Well Installed: 05 / 10 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 911.97 ft. MSL

C. Land surface elevation 909.21 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 100.3 ft.

F. Fine sand, top ____ ft. MSL or 105.3 ft.

G. Filter pack, top ____ ft. MSL or 107.3 ft.

H. Screen joint, top ____ ft. MSL or 110.3 ft.

I. Well bottom ____ ft. MSL or 125.3 ft.

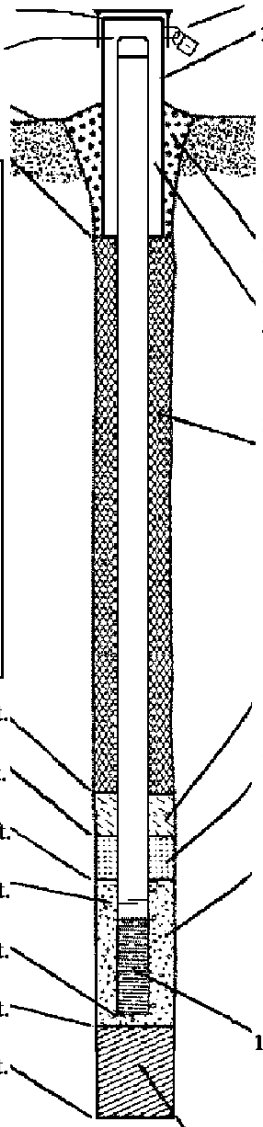
J. Filter pack, bottom ____ ft. MSL or 125.3 ft.

K. Borehole, bottom ____ ft. MSL or 125.3 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

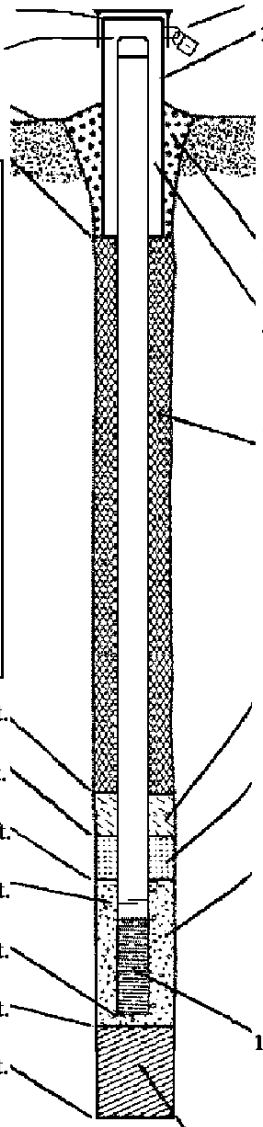
Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1007C
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM168 / DNR Well ID No.: 479
Facility ID: 157053930	St. Plane 497857.57 ft. N, 2035155.19 ft. E. (S)/C/N	Date Well Installed: 06 / 15 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____



A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 883.81 ft. MSL

C. Land surface elevation 881.41 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50 / Hollow Stem Auger ☐ 41 / Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02 / Air ☐ 01 / Drilling Mud ☐ 03 / None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 160.3 ft.

F. Fine sand, top ____ ft. MSL or 165.3 ft.

G. Filter pack, top ____ ft. MSL or 167.3 ft.

H. Screen joint, top ____ ft. MSL or 170.3 ft.

I. Well bottom ____ ft. MSL or 175.3 ft.

J. Filter pack, bottom ____ ft. MSL or 175.3 ft.

K. Borehole, bottom ____ ft. MSL or 175.3 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.

1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04 / Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30 / Concrete ☐ 01 / Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30 / Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 225 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01 / Tremie pumped ☐ 02 / Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23 / Flush threaded PVC schedule 80 ☑ 24 / Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11 / Continuous slot ☐ 01 / Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14 / Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP - NE Boundary	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1006C
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM173 / DNR Well ID No.: 484
Facility ID: 157053930	St. Plane 494632.57 ft. N, 2031731.00 ft. E. (S)/C/N	Date Well Installed: 05 / 18 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 873.39 ft. MSL

C. Land surface elevation 870.89 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 165.35 ft.

F. Fine sand, top ____ ft. MSL or 170.35 ft.

G. Filter pack, top ____ ft. MSL or 172.35 ft.

H. Screen joint, top ____ ft. MSL or 175.35 ft.

I. Well bottom ____ ft. MSL or 180.35 ft.

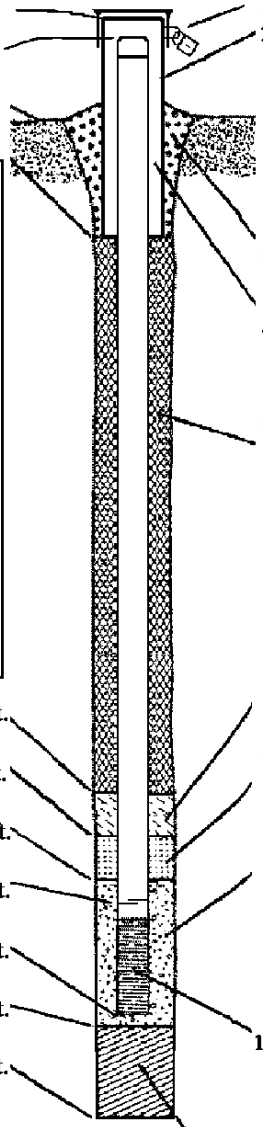
J. Filter pack, bottom ____ ft. MSL or 180.35 ft.

K. Borehole, bottom ____ ft. MSL or 180.35 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 200 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen | Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP - NE Boundary	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: RIN-1006A
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM172 / DNR Well ID No.: 483
Facility ID: 157053930	St. Plane 494635.26 ft. N, 2031718.11 ft. E. (S)C/N	Date Well Installed: 05 / 18 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 873.48 ft. MSL

C. Land surface elevation 870.94 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 75.38 ft.

F. Fine sand, top _____ ft. MSL or 80.38 ft.

G. Filter pack, top _____ ft. MSL or 82.38 ft.

H. Screen joint, top _____ ft. MSL or 85.38 ft.

I. Well bottom _____ ft. MSL or 100.38 ft.

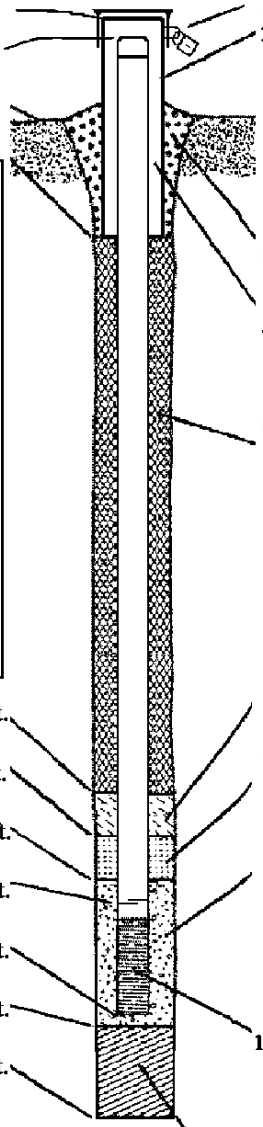
J. Filter pack, bottom _____ ft. MSL or 100.38 ft.

K. Borehole, bottom _____ ft. MSL or 100.38 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ _____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ _____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ _____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐ _____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ _____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ _____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ _____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1005C
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)' ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM181 / DNR Well ID No.: 497
Facility ID: 157053930	St. Plane 489316.84 ft. N, 2045864.92 ft. E. (S)/C/N	Date Well Installed: 05 / 17 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 828.75 ft. MSL

C. Land surface elevation 826.49 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 132 ft.

F. Fine sand, top ____ ft. MSL or 137 ft.

G. Filter pack, top ____ ft. MSL or 139 ft.

H. Screen joint, top ____ ft. MSL or 142 ft.

I. Well bottom ____ ft. MSL or 147 ft.

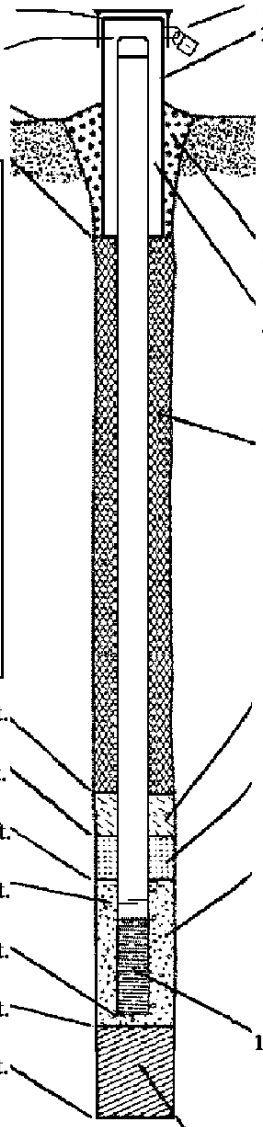
J. Filter pack, bottom ____ ft. MSL or 147 ft.

K. Borehole, bottom ____ ft. MSL or 147 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 6.0 in.
   b. Length: 7.5 ft.
   c. Material: Steel ☑ 04; Other ☐ ____
   d. Additional protection? ☑ Yes ☐ No
   If yes, describe: Steel Bumper Posts
3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____
4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____
5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
   b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
   c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
   d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
   e. 200 gal Ft^3 volume added for any of the above
   f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08
6. Bentonite seal: a. Bentonite granules ☐ 33
   b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
   c. ____ Other ☐ ____
7. Fine sand material: Manufacturer, product name & mesh size
   a. Badger Mining, silica sand, 40-60
   b. Volume added 1 bag ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. Red Flint #40
   b. Volume added 4 bags ft^3
9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____
10. Screen material: same as above
   a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
   b. Manufacturer Campbell Monoflex
   c. Slot size: 0.020 in.
   d. Slotted length: 5 ft.
11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: RIN-1005A
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM180 / DNR Well ID No.: 496
Facility ID: 157053930	St. Plane 489310.71 ft. N, 2045864.38 ft. E. (S)C/N	Date Well Installed: 05 / 17 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 828.61 ft. MSL

C. Land surface elevation 826.74 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 35.5 ft.

F. Fine sand, top _____ ft. MSL or 40.5 ft.

G. Filter pack, top _____ ft. MSL or 42.5 ft.

H. Screen joint, top _____ ft. MSL or 45.5 ft.

I. Well bottom _____ ft. MSL or 60.5 ft.

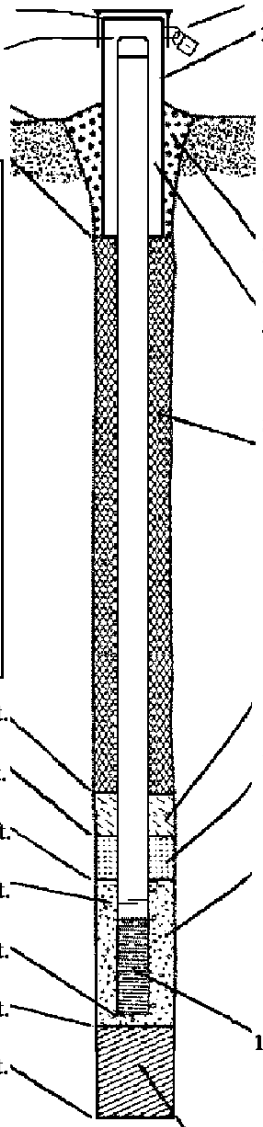
J. Filter pack, bottom _____ ft. MSL or 60.5 ft.

K. Borehole, bottom _____ ft. MSL or 60.5 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 100 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: RIN-1004B
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ___ " Long. ___ ° ___ ' ___ " or	Wis. Unique Well No.: VM182 / DNR Well ID No.: 498
Facility ID: 157053930	St. Plane 486645.01 ft. N, 2044721.14 ft. E. (S)C/N	Date Well Installed: 05 / 13 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ___ 1/4 of ___ 1/4 of Sec. ___, T. ___ N, R. ___ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ___ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ___

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 859.31 ft. MSL

C. Land surface elevation 856.74 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 131.7 ft.

F. Fine sand, top _____ ft. MSL or 136.7 ft.

G. Filter pack, top _____ ft. MSL or 138.7 ft.

H. Screen joint, top _____ ft. MSL or 141.7 ft.

I. Well bottom _____ ft. MSL or 146.7 ft.

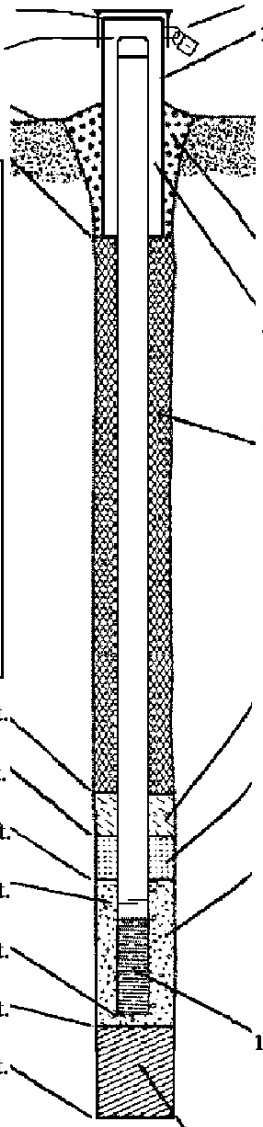
J. Filter pack, bottom _____ ft. MSL or 146.7 ft.

K. Borehole, bottom _____ ft. MSL or 146.7 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ _____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ _____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ _____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 200 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐ _____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ _____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ _____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ _____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1003A
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM179 / DNR Well ID No.: 495
Facility ID: 157053930	St. Plane 489061.45 ft. N, 2044797.07 ft. E. (S)C/N	Date Well Installed: 05 / 05 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 857.10 ft. MSL

C. Land surface elevation 854.66 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 65.5 ft.

F. Fine sand, top _____ ft. MSL or 70.5 ft.

G. Filter pack, top _____ ft. MSL or 72.5 ft.

H. Screen joint, top _____ ft. MSL or 75.5 ft.

I. Well bottom _____ ft. MSL or 90.5 ft.

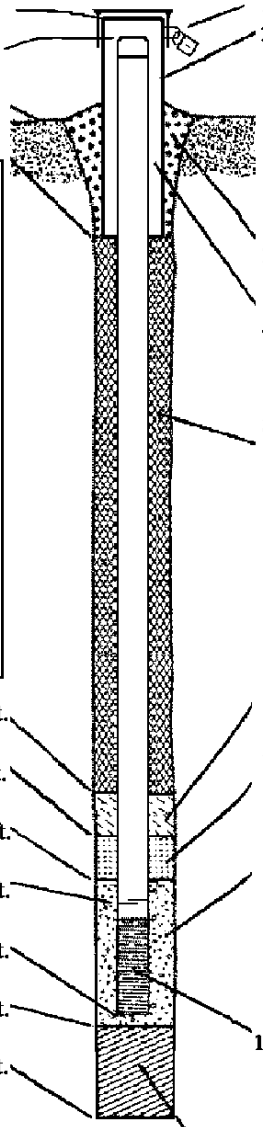
J. Filter pack, bottom _____ ft. MSL or 90.5 ft.

K. Borehole, bottom _____ ft. MSL or 90.5 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 200 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1002C
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM177 / DNR Well ID No.: 493
Facility ID: 157053930	St. Plane 492568.67 ft. N, 2046078.50 ft. E. (S)/C/N	Date Well Installed: 06 / 01 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 862.95 ft. MSL

C. Land surface elevation 860.86 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 164.8 ft.

F. Fine sand, top _____ ft. MSL or 169.8 ft.

G. Filter pack, top _____ ft. MSL or 171.8 ft.

H. Screen joint, top _____ ft. MSL or 174.8 ft.

I. Well bottom _____ ft. MSL or 179.8 ft.

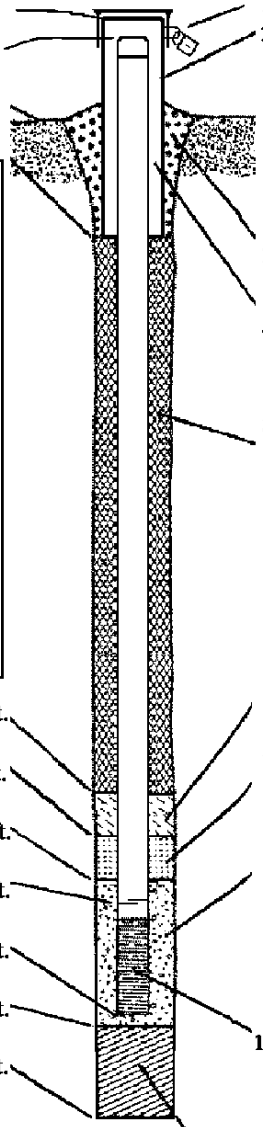
J. Filter pack, bottom _____ ft. MSL or 179.8 ft.

K. Borehole, bottom _____ ft. MSL or 179.8 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 200 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP - NE Boundary	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1002A
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM176 / DNR Well ID No.: 492
Facility ID: 157053930	St. Plane 492556.37 ft. N, 2046081.69 ft. E. (S)/C/N	Date Well Installed: 05 / 04 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 862.81 ft. MSL

C. Land surface elevation 860.46 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 67.2 ft.

F. Fine sand, top _____ ft. MSL or 72.2 ft.

G. Filter pack, top _____ ft. MSL or 74.2 ft.

H. Screen joint, top _____ ft. MSL or 77.2 ft.

I. Well bottom _____ ft. MSL or 92.2 ft.

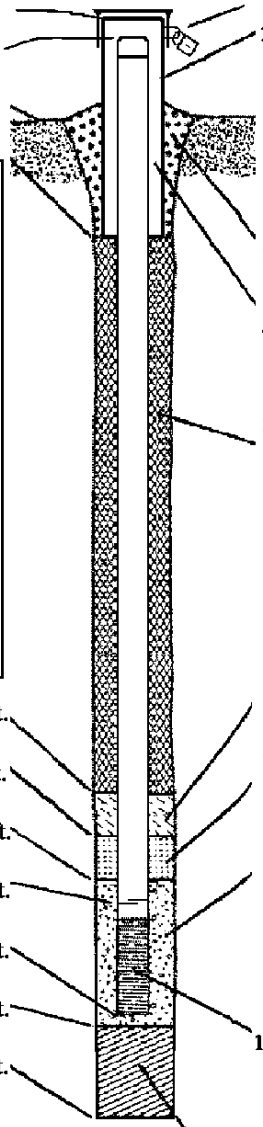
J. Filter pack, bottom _____ ft. MSL or 92.2 ft.

K. Borehole, bottom _____ ft. MSL or 92.2 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIN-1001C
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM170 / DNR Well ID No.: 481
Facility ID: 157053930	St. Plane 497096.68 ft. N, 2035224.60 ft. E. (S)/C/N	Date Well Installed: 05 / 24 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 884.02 ft. MSL

C. Land surface elevation 882.01 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 166.41 ft.

F. Fine sand, top ____ ft. MSL or 171.41 ft.

G. Filter pack, top ____ ft. MSL or 173.41 ft.

H. Screen joint, top ____ ft. MSL or 176.41 ft.

I. Well bottom ____ ft. MSL or 181.41 ft.

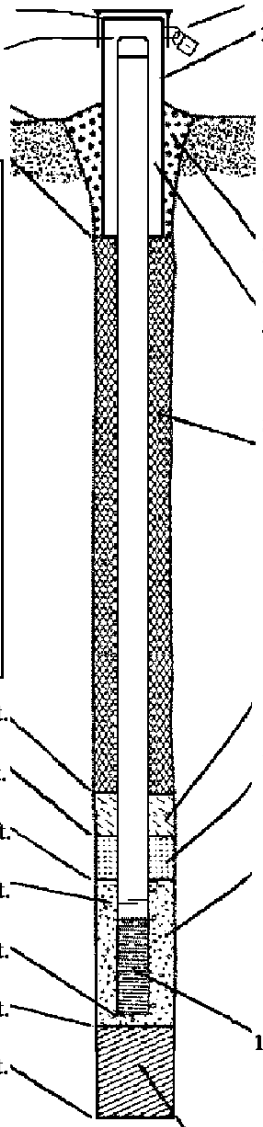
J. Filter pack, bottom ____ ft. MSL or 181.41 ft.

K. Borehole, bottom ____ ft. MSL or 181.41 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 225 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

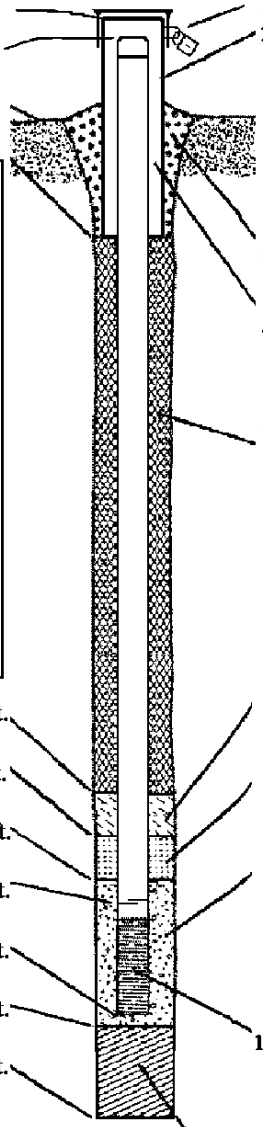
Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: RIN-1001A
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM169 / DNR Well ID No.: 480
Facility ID: 157053930	St. Plane 497066.20 ft. N, 2035220.81 ft. E. (S)/C/N	Date Well Installed: 04 / 28 / 2010 (m m / d d / y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	



A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 884.38 ft. MSL

C. Land surface elevation 882.05 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 81.8 ft.

F. Fine sand, top _____ ft. MSL or 86.8 ft.

G. Filter pack, top _____ ft. MSL or 88.8 ft.

H. Screen joint, top _____ ft. MSL or 91.8 ft.

I. Well bottom _____ ft. MSL or 106.8 ft.

J. Filter pack, bottom _____ ft. MSL or 106.8 ft.

K. Borehole, bottom _____ ft. MSL or 106.8 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.

1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIM-1005
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM174 / DNR Well ID No.: 490
Facility ID: 157053930	St. Plane 497534.67 ft. N, 2041193.13 ft. E. (S)/C/N	Date Well Installed: 05 / 06 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 882.69 ft. MSL

C. Land surface elevation 880.06 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 85.24 ft.

F. Fine sand, top _____ ft. MSL or 90.24 ft.

G. Filter pack, top _____ ft. MSL or 92.24 ft.

H. Screen joint, top _____ ft. MSL or 95.24 ft.

I. Well bottom _____ ft. MSL or 110.24 ft.

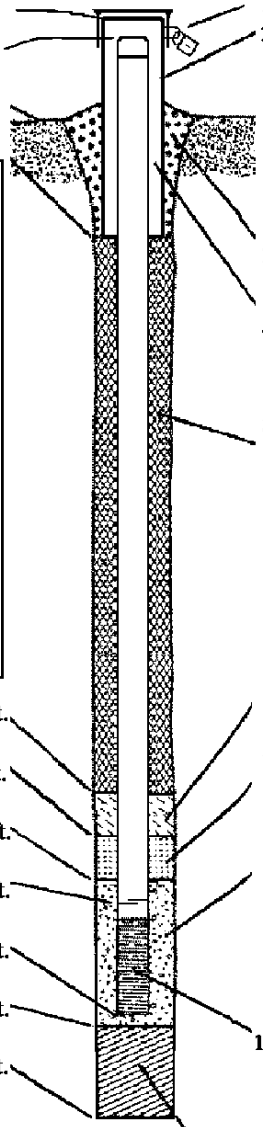
J. Filter pack, bottom _____ ft. MSL or 110.24 ft.

K. Borehole, bottom _____ ft. MSL or 110.24 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIM-1004
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM178 / DNR Well ID No.: 494
Facility ID: 157053930	St. Plane 489552.08 ft. N, 2044244.43 ft. E. (S)C/N	Date Well Installed: 05 / 05 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 836.40 ft. MSL

C. Land surface elevation 833.60 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 45.52 ft.

F. Fine sand, top ____ ft. MSL or 50.52 ft.

G. Filter pack, top ____ ft. MSL or 52.52 ft.

H. Screen joint, top ____ ft. MSL or 55.52 ft.

I. Well bottom ____ ft. MSL or 70.52 ft.

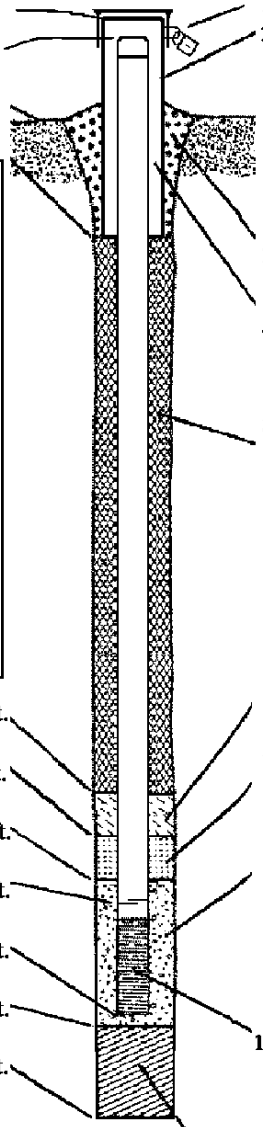
J. Filter pack, bottom ____ ft. MSL or 70.52 ft.

K. Borehole, bottom ____ ft. MSL or 70.52 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 200 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIM-1003
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM175 / DNR Well ID No.: 491
Facility ID: 157053930	St. Plane 492554.74 ft. N, 2043660.80 ft. E. (S)/C/N	Date Well Installed: 05 / 03 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 885.06 ft. MSL

C. Land surface elevation 882.78 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 89.3 ft.

F. Fine sand, top ____ ft. MSL or 94.3 ft.

G. Filter pack, top ____ ft. MSL or 96.3 ft.

H. Screen joint, top ____ ft. MSL or 99.3 ft.

I. Well bottom ____ ft. MSL or 114.3 ft.

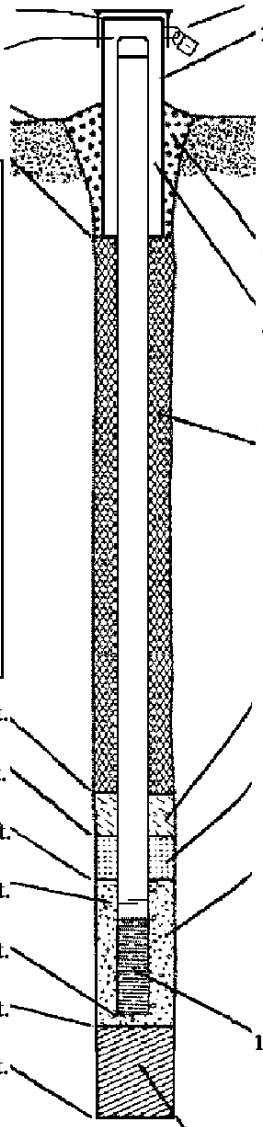
J. Filter pack, bottom ____ ft. MSL or 114.3 ft.

K. Borehole, bottom ____ ft. MSL or 114.3 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen | Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIM-1002
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM167 / DNR Well ID No.: 478
Facility ID: 157053930	St. Plane 499282.00 ft. N, 2034868.80 ft. E. (S)/C/N	Date Well Installed: 04 / 29 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known	Gov. Lot Number: ____

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 891.01 ft. MSL

C. Land surface elevation 888.51 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 85.2 ft.

F. Fine sand, top ____ ft. MSL or 90.2 ft.

G. Filter pack, top ____ ft. MSL or 92.2 ft.

H. Screen joint, top ____ ft. MSL or 95.2 ft.

I. Well bottom ____ ft. MSL or 110.2 ft.

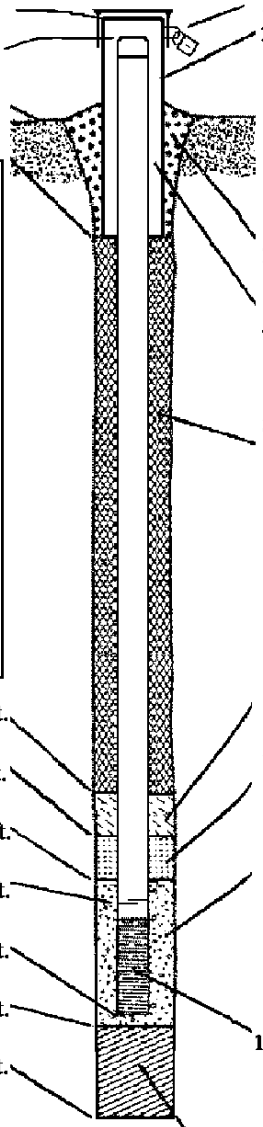
J. Filter pack, bottom ____ ft. MSL or 110.2 ft.

K. Borehole, bottom ____ ft. MSL or 110.2 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: RIM-1001
Facility License, Permit or Monitoring No.: 3487	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM171 / DNR Well ID No.: 482
Facility ID: 157053930	St. Plane 495730.04 ft. N, 2034806.71 ft. E. (S)/C/N	Date Well Installed: 04 / 27 / 2010 (m m d d y y y y)
Type of Well: Well Code 11 / MW	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 874.90 ft. MSL

C. Land surface elevation 872.51 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe ____

17. Source of water (attach analysis, if required): ____

E. Bentonite seal, top ____ ft. MSL or 73.75 ft.

F. Fine sand, top ____ ft. MSL or 78.75 ft.

G. Filter pack, top ____ ft. MSL or 80.75 ft.

H. Screen joint, top ____ ft. MSL or 83.75 ft.

I. Well bottom ____ ft. MSL or 98.75 ft.

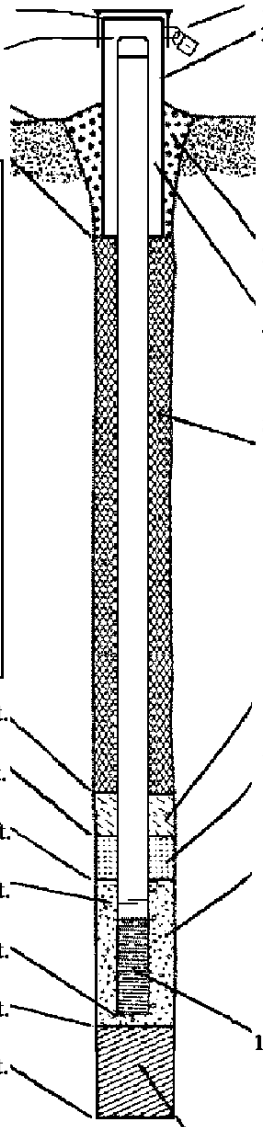
J. Filter pack, bottom ____ ft. MSL or 98.75 ft.

K. Borehole, bottom ____ ft. MSL or 98.75 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 150 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 15.0 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Joel Janssen	Firm: SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: PBN-1003C
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM185 / DNR Well ID No.: 592
Facility ID: 157053930	St. Plane 487681.33 ft. N, 2034447.60 ft. E. (S)/C/N	Date Well Installed: 06 / 03 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 848.21 ft. MSL

C. Land surface elevation 846.51 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 174.6 ft.

F. Fine sand, top ____ ft. MSL or 179.6 ft.

G. Filter pack, top ____ ft. MSL or 181.6 ft.

H. Screen joint, top ____ ft. MSL or 184.6 ft.

I. Well bottom ____ ft. MSL or 189.6 ft.

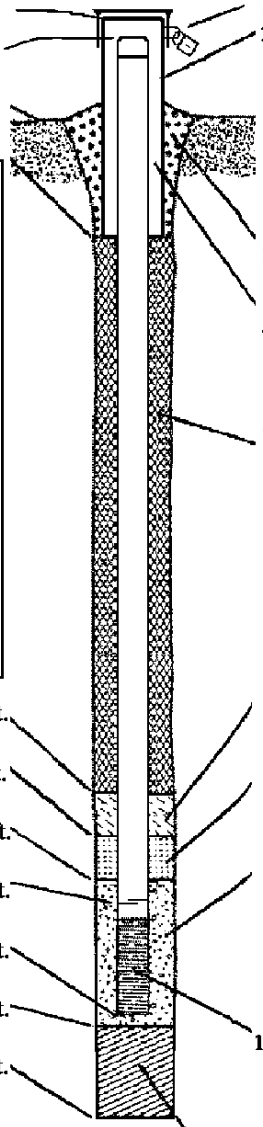
J. Filter pack, bottom ____ ft. MSL or 189.6 ft.

K. Borehole, bottom ____ ft. MSL or 189.6 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 250 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

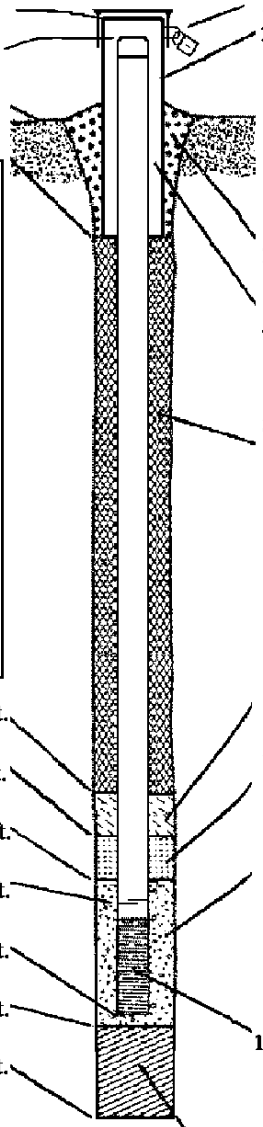
Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ☐ N. ☐ S. _____ ft. ☐ E. ☐ W. _____ ft.	Well Name: PBN-1002C
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83) ' " Long. ° ' " or	Wis. Unique Well No.: VM184 / DNR Well ID No.: 591
Facility ID: 157053930	St. Plane 488449.71 ft. N, 2035908.47 ft. E. (S)C/N	Date Well Installed: 06 / 09 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number:	



A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation 893.48 ft. MSL

C. Land surface elevation 891.48 ft. MSL

D. Surface seal, bottom _____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top _____ ft. MSL or 201.8 ft.

F. Fine sand, top _____ ft. MSL or 206.8 ft.

G. Filter pack, top _____ ft. MSL or 208.8 ft.

H. Screen joint, top _____ ft. MSL or 211.8 ft.

I. Well bottom _____ ft. MSL or 216.8 ft.

J. Filter pack, bottom _____ ft. MSL or 216.8 ft.

K. Borehole, bottom _____ ft. MSL or 216.8 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.

1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 300 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. _____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☑ Other ☐ _____

MONITORING WELL CONSTRUCTION
Form 4400-113A Rev. 7-98

Facility/Project Name: Badger AAP	Local Grid Location of Well: ____ ft. ☐ N. ☐ S. ____ ft. ☐ E. ☐ W.	Well Name: PBN-1002B
Facility License, Permit or Monitoring No.: 2814	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. (NAD 83)° ____ " Long. ____ ° ____ ' ____ " or	Wis. Unique Well No.: VM183 / DNR Well ID No.: 590
Facility ID: 157053930	St. Plane 488447.03 ft. N, 2035926.71 ft. E. (S)/C/N	Date Well Installed: 05 / 19 / 2010 (m m d d y y y y)
Type of Well: Well Code 12 / PZ	Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E. ☐ W.	Well Installed By: Name (first, last) and Firm: Roy Buckenberger; Layne Christensen Company
Distance from Waste/Source ____ ft. / Enf. Stds. Apply ☑	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☑ Downgradient n ☐ Not Known; Gov. Lot Number ____	

A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 894.27 ft. MSL

C. Land surface elevation 892.27 ft. MSL

D. Surface seal, bottom ____ ft. MSL or 4 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☑
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☑ No

14. Drilling method used: Rotary ☐ 50; Hollow Stem Auger ☐ 41; Other ☑ Rotosonic

15. Drilling fluid used: Water ☑ 02; Air ☐ 01; Drilling Mud ☐ 03; None ☐ 99

16. Drilling additives used? ☐ Yes ☑ No

Describe _____

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ____ ft. MSL or 161.5 ft.

F. Fine sand, top ____ ft. MSL or 166.5 ft.

G. Filter pack, top ____ ft. MSL or 168.5 ft.

H. Screen joint, top ____ ft. MSL or 171.5 ft.

I. Well bottom ____ ft. MSL or 176.5 ft.

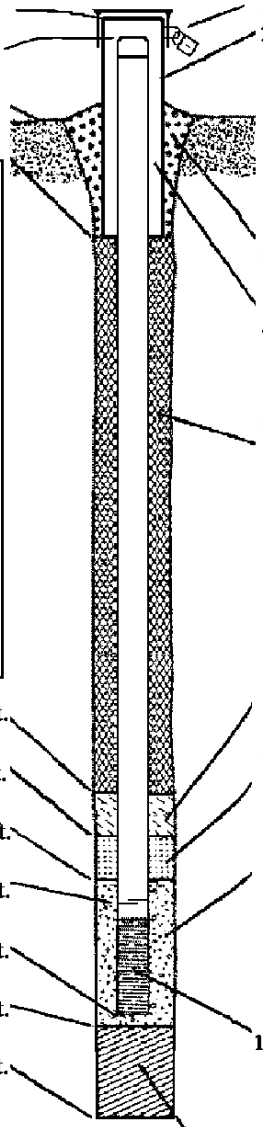
J. Filter pack, bottom ____ ft. MSL or 176.5 ft.

K. Borehole, bottom ____ ft. MSL or 176.5 ft.

L. Borehole, diameter 7.0 in.

M. O.D. well casing 2.9 in.

N. I.D. well casing 2.3 in.



1. Cap and lock? ☑ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 6.0 in.
b. Length: 7.5 ft.
c. Material: Steel ☑ 04; Other ☐ ____
d. Additional protection? ☑ Yes ☐ No
If yes, describe: Steel Bumper Posts

3. Surface seal: Bentonite ☑ 30; Concrete ☐ 01; Other ☐ ____

4. Material between well casing and protective pipe: Bentonite ☑ 30; Other ☐ ____

5. Annular space seal: a. Granular/Chipped Bentonite ☐ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. 3.5 Lbs/gal mud weight . . . . . Bentonite slurry ☑ 31
d. ____ % Bentonite . . . . . Bentonite-cement grout ☐ 50
e. 225 gal Ft^3 volume added for any of the above
f. How installed: Tremie ☑ 01; Tremie pumped ☐ 02; Gravity ☐ 08

6. Bentonite seal: a. Bentonite granules ☐ 33
b. ☐ 1/4 in. ☑ 3/8 in. ☐ 1/2 in. Bentonite chips ☑ 32
c. ____ Other ☐ ____

7. Fine sand material: Manufacturer, product name & mesh size
a. Badger Mining, silica sand, 40-60
b. Volume added 1 bag ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. Red Flint #40
b. Volume added 4 bags ft^3

9. Well casing: Flush threaded PVC schedule 40 ☐ 23; Flush threaded PVC schedule 80 ☑ 24; Other ☐ ____

10. Screen material: same as above
a. Screen type: Factory cut ☑ 11; Continuous slot ☐ 01; Other ☐ ____
b. Manufacturer Campbell Monoflex
c. Slot size: 0.020 in.
d. Slotted length: 5 ft.

11. Backfill material (below filter pack): None ☑ 14; Other ☐ ____

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Joel Janssen | Firm SpecPro, Inc.

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 292, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be sent.

WDNR Well Development Forms

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	DBM-1001

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3037	57	VM161	471

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 127.6 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 20.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 122.6 ft.	122.6 ft.
Date	b. 05/11/2010 (m m / d d / y y y y)	05/11/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe) light brown	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	DBN-1001B

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3037	57	VM162	472

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 161.8 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 127.27 ft.	127.27 ft.
Date	b. 05 / 26 / 2010 (m m d d y y y y)	05 / 26 / 2010 (m m d d y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	. inches	. inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	. mg/l	. mg/l
15. COD	. mg/l	. mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	DBN-1001C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3037	57	VM163	473

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 199.0 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 129.90 ft.	129.90 ft.
Date	b. 06/01/2010 (m m / d d / y y y y)	06/01/2010 (m m / d d / y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	DBN-1001E

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3037	57	VM164	474

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 282.3 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 130.10 ft.	130.10 ft.
Date	b. 07/01/2010 (mm/dd/yyyy)	07/01/2010 (mm/dd/yyyy)
Time	c. ☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Vince Last Name: Meindel
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	DBN-1002C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3037	57	VM165	476

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 212.5 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 134.74 ft.	134.74 ft.
Date	b. 06/21/2010 (m m / d d / y y y y)	06/21/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	DBN-1002E

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3037	57	VM166	477

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 282.95 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 135.12 ft.	135.12 ft.
Date	b. 07/13/2010 (mm/dd/yyyy)	07/13/2010 (mm/dd/yyyy)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	. inches	. inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
Fill in if drilling fluids were used and well is at solid waste facility:		
14. Total suspended solids	. mg/l	. mg/l
15. COD	. mg/l	. mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Vince Last Name: Meindel
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1001A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM186	593

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 815 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 74.35 ft.	74.35 ft.
Date	b. 05/04/2010 (m m d d y y y y)	05/04/2010 (m m d d y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
Fill in if drilling fluids were used and well is at solid waste facility:		
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1001B

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM187	594

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 141.6 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 74.20 ft.	74.20 ft.
Date	b. 06/03/2010 (m m / d d / y y y y)	06/03/2010 (m m / d d / y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1001C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM188	595

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 202.0 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 74.60 ft.	74.60 ft.
Date	b. 06/09/2010 (m m / d d / y y y y)	06/09/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1002A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM189	589

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 1330 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 124.32 ft.	124.32 ft.
Date	b. 05/24/2010 (m m d d y y y y)	05/24/2010 (m m d d y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1002B

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM183	590

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 178.5 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 124.48 ft.	124.48 ft.
Date	b. 05/20/2010 (m m / d d / y y y y)	05/20/2010 (m m / d d / y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1002C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM184	591

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 218.8 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 124.64 ft.	124.64 ft.
Date	b. 06/10/2010 (m m / d d / y y y y)	06/10/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	PBN-1003C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
2814	57	VM185	592

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 191.3 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 79.15 ft.	79.15 ft.
Date	b. 06/07/2010 (m m / d d / y y y y)	06/07/2010 (m m / d d / y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIM-1001

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM171	482

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 101.15 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 92.09 ft.	92.09 ft.
Date	b. 04/28/2010 (mm/dd/yyyy)	04/28/2010 (mm/dd/yyyy)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIM-1002

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM167	478

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 112.4 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 104.38 ft.	104.38 ft.
Date	b. 05/03/2010 (mm/dd/yyyy)	05/03/2010 (mm/dd/yyyy)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIM-1003

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM175	491

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 116.3 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 108.18 ft.	108.18 ft.
Date	b. 05/04/2010 (m m / d d / y y y y)	05/04/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIM-1004

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM178	494

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 73.12 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 62.45 ft.	62.45 ft.
Date	b. 05/06/2010 (m m / d d / y y y y)	05/06/2010 (m m / d d / y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIM-1005

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM174	490

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 112.64 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 101.67 ft.	101.67 ft.
Date	b. 05/10/2010 (mm/dd/yyyy)	05/10/2010 (mm/dd/yyyy)
Time	c. ☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1001A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM169	480

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 108.80 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 100.04 ft.	100.04 ft.
Date	b. 04/29/2010 (m m d d y y y y)	04/29/2010 (m m d d y y y y)
Time	c. ☐ a.m. ☐ p.m.	☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1001C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM170	481

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 183.40 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 99.68 ft.	99.68 ft.
Date	b. 05/25/2010 (mm dd yyyy)	05/25/2010 (mm dd yyyy)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1002A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM176	492

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 941 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 86.70 ft.	86.70 ft.
Date	b. 05/05/2010 (m m d d y y y y)	05/05/2010 (m m d d y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1002C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM177	493

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 181.5 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 86.88 ft.	86.88 ft.
Date	b. 06/02/2010 (m m / d d / y y y y)	06/02/2010 (m m / d d / y y y y)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact /Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1003A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM179	495

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 92.8 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 83.76 ft.	83.76 ft.
Date	b. 05/06/2010 (m m / d d / y y y y)	05/06/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1004B

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM182	498

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 149.0 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 89.10 ft.	89.10 ft.
Date	b. 05/17/2010 (mm/dd/yyyy)	05/17/2010 (mm/dd/yyyy)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1005A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM180	496

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 628 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 55.34 ft.	55.34 ft.
Date	b. 05/18/2010 (m m d d y y y y)	05/18/2010 (m m d d y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1005C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM181	497

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 149.0 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 54.90 ft.	54.90 ft.
Date	b. 05/18/2010 (mm/dd/yyyy)	05/18/2010 (mm/dd/yyyy)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1006A

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM172	483

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 102.68 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 88.94 ft.	88.94 ft.
Date	b. 05/19/2010 (mm dd yyyy)	05/19/2010 (mm dd yyyy)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1006C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM173	484

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 182.85 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 89.28 ft.	89.28 ft.
Date	b. 05/19/2010 (mm dd yyyy)	05/19/2010 (mm dd yyyy)
Time	c. ___:___ ☐ a.m. ☐ p.m.	___:___ ☐ a.m. ☐ p.m.
12. Sediment in well bottom	___.___ inches	___.___ inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)
14. Total suspended solids	____.___ mg/l	____.___ mg/l
15. COD	____.___ mg/l	____.___ mg/l

Fill in if drilling fluids were used and well is at solid waste facility:

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

State of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 7-98

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☑ Other ☐ _____

Facility/Project Name	County Name	Well Name
Badger AAP	Sauk	RIN-1007C

Facility License, Permit or Monitoring Number	County Code	Wis. Unique Well Number	DNR Well ID Number
3487	57	VM168	479

1. Can this well be purged dry? ☐ Yes ☑ No

2. Well development method
   - surged with bailer and bailed ☐ 41
   - surged with bailer and pumped ☑ 61
   - surged with block and bailed ☐ 42
   - surged with block and pumped ☐ 62
   - surged with block, bailed and pumped ☐ 70
   - compressed air ☐ 20
   - bailed only ☐ 10
   - pumped only ☐ 51
   - pumped slowly ☐ 50
   - Other _____ ☐

3. Time spent developing well 60 min.

4. Depth of well (from top of well casisng) 177.70 ft.

5. Inside diameter of well 2.30 in.

6. Volume of water in filter pack and well casing 200.0 gal.

7. Volume of water removed from well 150.0 gal.

8. Volume of water added (if any) 0.0 gal.

9. Source of water added None

10. Analysis performed on water added? ☐ Yes ☑ No
(If yes, attach results)

	Before Development	After Development
11. Depth to Water (from top of well casing)	a. 98.83 ft.	98.83 ft.
Date	b. 06/16/2010 (m m / d d / y y y y)	06/16/2010 (m m / d d / y y y y)
Time	c. : ☐ a.m. ☐ p.m.	: ☐ a.m. ☐ p.m.
12. Sediment in well bottom	inches	inches
13. Water clarity	Clear ☐ 10 Turbid ☑ 15 (Describe)	Clear ☑ 20 Turbid ☐ 25 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	mg/l	mg/l
15. COD	mg/l	mg/l

16. Well developed by: Name (first, last) and Firm
First Name: Roy Last Name: Buckenberger
Firm: Layne Christensen Company

17. Additional comments on development:

Name and Address of Facility Contact/Owner/Responsible Party
First Name: Joan Last Name: Kenney
Facility/Firm: Department of the Army
Street: 2 Badger Road
City/State/Zip: Baraboo, Wisconsin 53913-5000

I hereby certify that the above information is true and correct to the best of my knowledge.
Signature: Joel Janssen
Print Name: Joel Janssen
Firm: SpecPro, Inc.

NOTE: See instructions for more information including a list of county codes and well type codes.

Soil Boring Logs

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3037	DBM-1001

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/10/10	5/10/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM161	471	DBM-1001	789.64 Feet MSL	909.21 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 501035.03 N 2042233.38 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 125.3 feet No soil samples were collected Set well screen from 110.3–125.3 feet End of boring at 125.3 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

This form is authorized by Chapters 281, 283, 289, 291, 292, 293, 295, and 299, Wis. Stats. Completion of this form is mandatory. Failure to file this form may result in forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be used for any other purpose. NOTE: See instructions for more information, including where the completed form should be sent.

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3037	DBN-1001B

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/25/10	5/25/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM162	472	DBN-1001B	785.79 Feet MSL	909.77 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 501062.19 N 2043112.65 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 159.5 feet No soil samples were collected Set well screen from 154.5–159.5 feet End of boring at 159.5 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3037	DBN-1001C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/26/10	5/27/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM163	473	DBN-1001C	783.66 Feet MSL	909.78 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 501062.97 N 2043094.50 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 197 feet No soil samples were collected See DBN-1001E soil boring log for soil descriptions Set well screen from 192 –197 feet End of boring at 197 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3037	DBN-1001E

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Vince Last Name: Meindel Firm: Layne Christensen Company	6/21/10	6/30/10	DWRC

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM164	474	DBN-1001E	784.21 Feet MSL	909.95 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 501064.75 N 2043076.32 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 60 feet										
			60-85	Sand, fine-medium, trace gravel	SW									
			85-135	Sand, fine-medium-coarse, some gravel	SW									
			135-140	Sand, fine	SP									
			140-160	Clay, brown, high plasticity	CH									
			160-170	Gravel, medium-coarse sand	GW									
			170-180	Sand, fine-medium, some gravel	SW									
			180-240	Sand, fine-medium, trace gravel	SP									
			240-258	Sand, medium-coarse	SW									
			258-279.9	Shale, gray, 1-2 inch sandstone stringers	Bed-rock									
				Set well screen from 274.9 –279.9 feet End of boring at 279.9 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3037	DBN-1002C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/16/10	6/17/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM165	476	DBN-1002C	782.84 Feet MSL	913.72 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 500487.21 N 2044487.97 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 210.1 feet No soil samples were collected See DBN-1002E soil boring log for soil descriptions Set well screen from 205.1–210.1 feet End of boring at 210.1 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3037	DBN-1002E

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Vince Last Name: Meindel Firm: Layne Christensen Company	7/01/10	7/12/10	DWRC

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM166	477	DBN-1002E	782.53 Feet MSL	913.84 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 500510.82 N 2044484.94 E ¼ of ¼ of Section T R	N E _____ Feet S _____ Feet W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 60 feet										
			60-105	Sand, fine-medium, trace gravel/cobbles	SW									
			105-115	Sand, fine-medium-coarse, trace cobbles, granite boulder at 111 feet	SW									
			115-145	Gravel, some sand	GW									
			145-150	Sand, fine-medium-coarse, trace gravel	SW									
			150-160	Gravel, medium-coarse sand	GW									
			160-235	Sand, fine-medium, trace gravel	SP									
			235-260	Sand, fine-medium-coarse, trace gravel	SW									
			260-265	Sand, silty, fine-medium	SM									
			265-280.55	Sandstone and siltstone, gray, interbedded	Bed-rock									
				Set well screen from 280.55 –280.55 feet End of boring at 280.55 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	2814	PBN-1001A

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/03/10	5/03/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM186	593	PBN-1001A	766.38 Feet MSL	838.17 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 485983.78 N 2035769.90 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 79.3 feet No soil samples were collected Set well screen from 64.3-79.3 feet End of boring at 79.3 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	2814	PBN-1001B

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/02/10	6/02/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM187	594	PBN-1001B	766.52 Feet MSL	838.23 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 485975.99 N 2035767.53 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 139.9 feet No soil samples were collected Set well screen from 134.9-139.9 feet End of boring at 139.9 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	2814	PBN-1001C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/07/10	6/08/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM188	595	PBN-1001C	766.36 Feet MSL	837.71 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 485968.12 N 2035767.23 E ¼ of ¼ of Section T R	N E _____ Feet S _____ Feet W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 199.7 feet No soil samples were collected Set well screen from 194.7-199.7 feet End of boring at 199.7 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name: Badger Army Ammunition Plant	License/Permit/Monitoring Number: 2814	Boring Number: PBN-1002A
Boring Drilled by: Name of crew chief (first, last) and Firm First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	Date Drilling Started: 5/20/10 Date Drilling Completed: 5/20/10	Drilling Method: Rotosonic
WI Unique Well No: VM189 DNR Well ID No.: 589 Well Name: PBN-1002A	Final Static Water: 770.55 Feet MSL Surface Elevation: 891.70 Feet MSL	Borehole Diameter: 7.0 inches
Local Grid Origin (estimated:) or Boring Location State Plane 488450.52 N 2035896.71 E ¼ of ¼ of Section T R	Local Grid Location _____ Feet N S _____ Feet E W	
Facility ID: 157053930	County: Sauk County Code: 57	Civil Town/City/ or Village: Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 130.8 feet No soil samples were collected Set well screen from 115.8-130.8 feet End of boring at 130.8 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	2814	PBN-1002B

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/19/10	5/19/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM183	590	PBN-1002B	770.58 Feet MSL	892.27 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 488447.03 N 2035926.71 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 176.5 feet No soil samples were collected Set well screen from 171.5-176.5 feet End of boring at 176.5 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	2814	PBN-1002C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/08/10	6/09/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM184	591	PBN-1002C	770.55 Feet MSL	891.48 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 488449.71 N 2035908.47 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 216.8 feet No soil samples were collected Set well screen from 211.8-216.8 feet End of boring at 216.8 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	2814	PBN-1003C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/03/10	6/03/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM185	592	PBN-1003C	773.74 Feet MSL	846.51 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 487681.33 N 2034447.60 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 189.6 feet No soil samples were collected Set well screen from 184.6-189.6 feet End of boring at 189.6 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIM-1001

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	4/27/10	4/27/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM171	482	RIM-1001	784.41 Feet MSL	872.51 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 495730.04 N 2034806.71 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 98.75 feet No soil samples were collected Set well screen from 83.75-98.75 feet End of boring at 98.75 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIM-1002

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	4/29/10	4/29/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM167	478	RIM-1002	787.72 Feet MSL	888.51 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 499282.00 N 2034868.80 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 110.2 feet No soil samples were collected Set well screen from 95.2-110.2 feet End of boring at 110.2 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIM-1003

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/03/10	5/03/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM175	491	RIM-1003	777.77 Feet MSL	882.78 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 492554.74 N 2043660.80 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 114.3 feet No soil samples were collected Set well screen from 99.3-114.3 feet End of boring at 114.3 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIM-1004

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/05/10	5/05/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM178	494	RIM-1004	774.55 Feet MSL	833.60 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 489552.08 N 2044244.43 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 70.52 feet No soil samples were collected Set well screen from 55.52-70.52 feet End of boring at 70.52 feet										

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SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIM-1005

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/06/10	5/06/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM174	490	RIM-1005	782.58 Feet MSL	880.06 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 497534.67 N 2041193.13 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 110.24 feet No soil samples were collected Set well screen from 95.24-110.24 feet End of boring at 110.24 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1001A

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	4/28/10	4/28/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM169	480	RIN-1001A	785.27 Feet MSL	882.05 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 497066.20 N 2035220.81 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 106.8 feet No soil samples were collected Set well screen from 91.8-106.8 feet End of boring at 106.8 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1001C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/24/10	5/24/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM170	481	RIN-1001C	785.30 Feet MSL	882.01 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 497096.68 N 2035224.60 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 181.41 feet No soil samples were collected Set well screen from 176.41-181.41 feet End of boring at 181.41 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1002A

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/4/10	5/4/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM176	492	RIN-1002A	776.92 Feet MSL	860.46 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 492556.37 N 2046081.69 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 92.2 feet No soil samples were collected Set well screen from 77.2- 92.2 feet End of boring at 92.2 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1002C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/1/10	6/1/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM177	493	RIN-1002C	776.84 Feet MSL	860.86 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 492568.67 N 2046078.50 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 179.8 feet No soil samples were collected Set well screen from 174.8- 179.8 feet End of boring at 179.8 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1003A

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/5/10	5/5/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM179	495	RIN-1003A	773.87 Feet MSL	854.66 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 489061.45 N 2044797.07 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 90.5 feet No soil samples were collected Set well screen from 75.5- 90.5 feet End of boring at 90.5 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1004B

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/13/10	5/13/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM182	498	RIN-1004B	770.55 Feet MSL	856.74 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 486645.01 N 2044721.14 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 146.7 feet No soil samples were collected Set well screen from 141.7-146.7 feet End of boring at 146.7 feet										

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1005A

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/17/10	5/17/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM180	496	RIN-1005A	775.27 Feet MSL	826.74 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 489310.71 N 2045864.38 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 60.5 feet No soil samples were collected Set well screen from 45.5- 60.5 feet End of boring at 60.5 feet										

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Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name: Badger Army Ammunition Plant	License/Permit/Monitoring Number: 3487	Boring Number: RIN-1005C
Boring Drilled by: Name of crew chief (first, last) and Firm First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	Date Drilling Started: 5/17/10 Date Drilling Completed: 5/17/10	Drilling Method: Rotosonic
WI Unique Well No: VM181 DNR Well ID No.: 497 Well Name: RIN-1005C	Final Static Water: 774.33 Feet MSL Surface Elevation: 826.49 Feet MSL	Borehole Diameter: 7.0 inches
Local Grid Origin (estimated:) or Boring Location State Plane 489316.84 N 2045864.92 E ¼ of ¼ of Section T R	Local Grid Location _____ Feet N S _____ Feet E W	
Facility ID: 157053930 County: Sauk	County Code: 57 Civil Town/City/ or Village: Town of Merrimac	

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 147 feet No soil samples were collected Set well screen from 142-147 feet End of boring at 147 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1006A

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/18/10	5/18/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM172	483	RIN-1006A	785.99 Feet MSL	870.94 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 494635.26 N 2031718.11 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 100.38 feet No soil samples were collected Set well screen from 85.38-100.38 feet End of boring at 100.38 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1006C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	5/18/10	5/18/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM173	484	RIN-1006C	785.45 Feet MSL	870.89 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 494632.57 N 2031731.00 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 180.35 feet No soil samples were collected Set well screen from 175.35-180.35 feet End of boring at 180.35 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: *Joel Janssen* Firm: SpecPro, Inc.

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION
Form 4400-122

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☒ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Badger Army Ammunition Plant	3487	RIN-1007C

Boring Drilled by: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Roy Last Name: Buckenberger Firm: Layne Christensen Company	6/14/10	6/15/10	Rotosonic

WI Unique Well No	DNR Well ID No.	Well Name	Final Static Water	Surface Elevation	Borehole Diameter
VM168	479	RIN-1007C	786.18 Feet MSL	881.41 Feet MSL	7.0 inches

Local Grid Origin (estimated:) or Boring Location	Local Grid Location
State Plane 497857.57 N 2035155.19 E ¼ of ¼ of Section T R	_____ Feet N S _____ Feet E W

Facility ID	County	County Code	Civil Town/City/ or Village
157053930	Sauk	57	Town of Merrimac

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	SOIL ROCK DESCRIPTION	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/Comments
				Blind drilled to 175.3 feet No soil samples were collected Set well screen from 170.3-175.3 feet End of boring at 175.3 feet										

I hereby certify that the information on this form is true and correct to the best of my knowledge.

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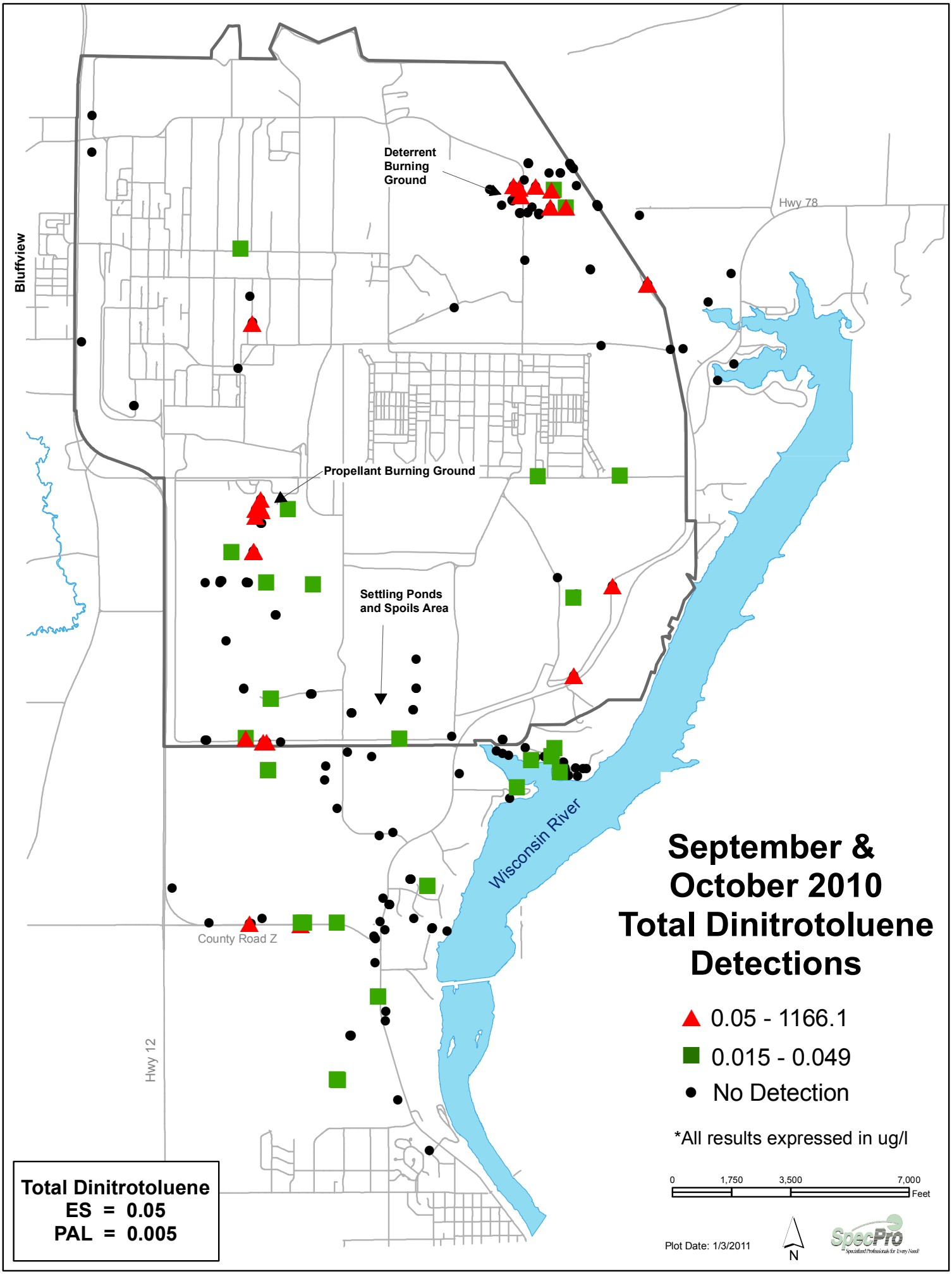
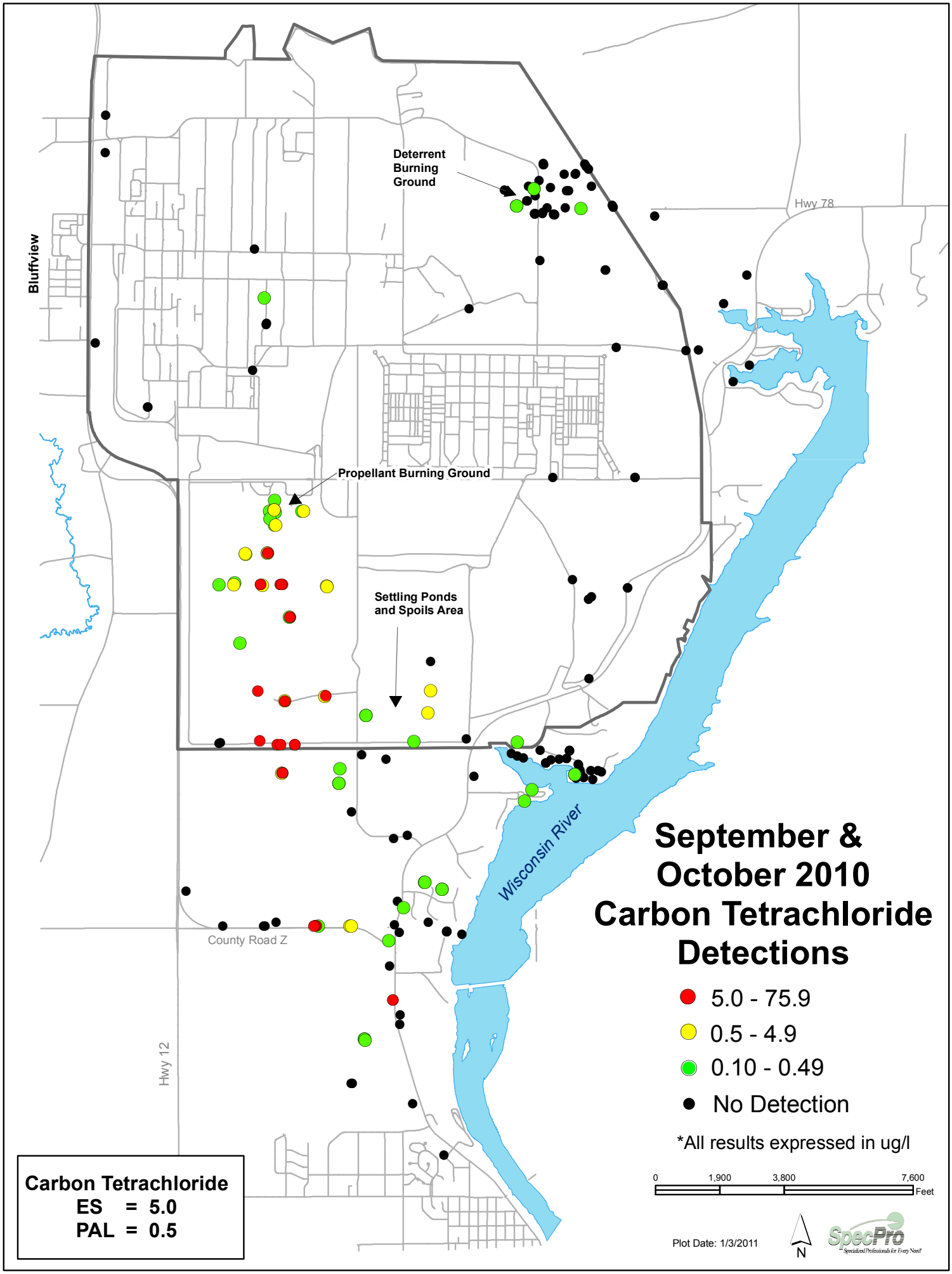
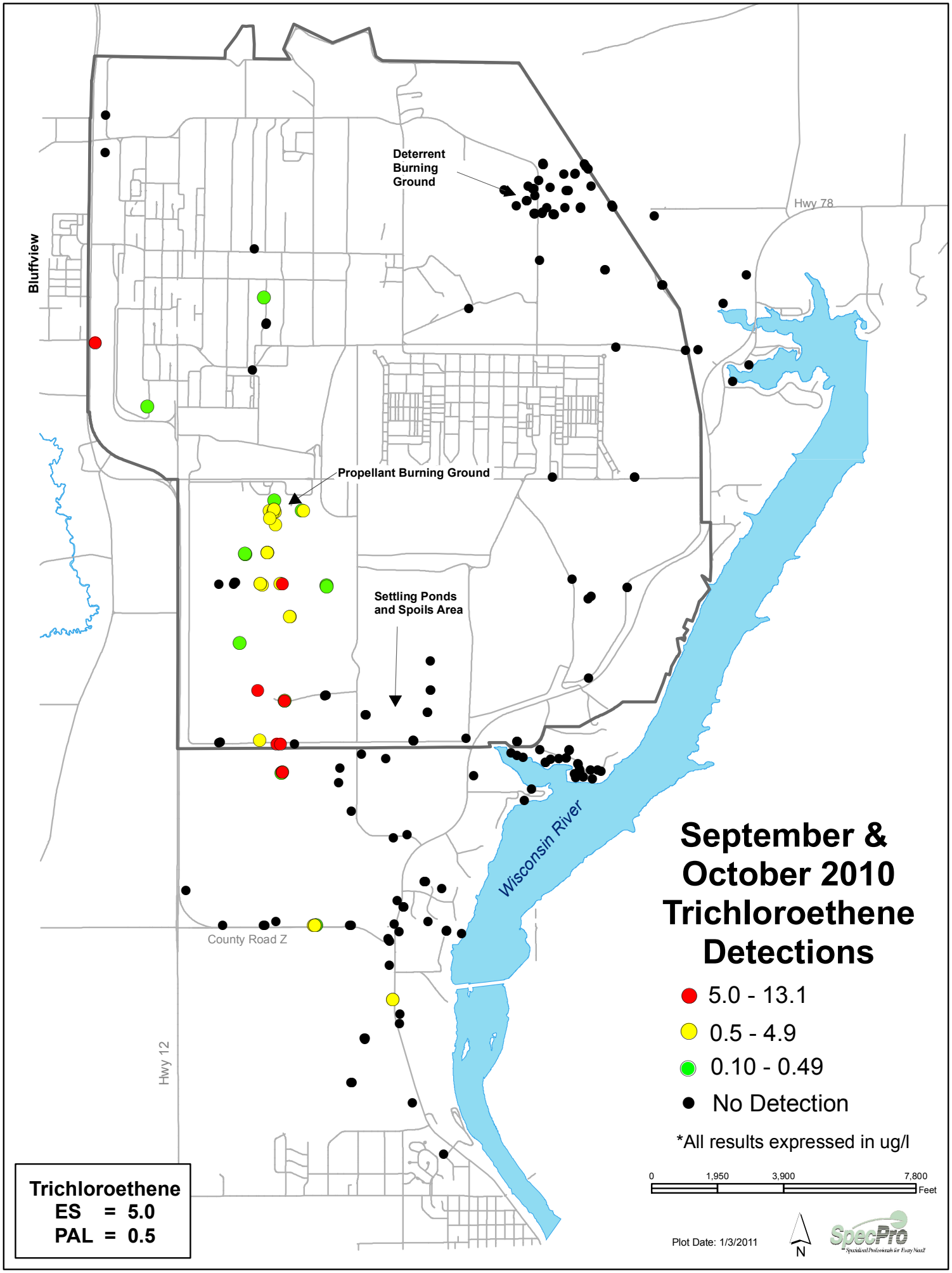
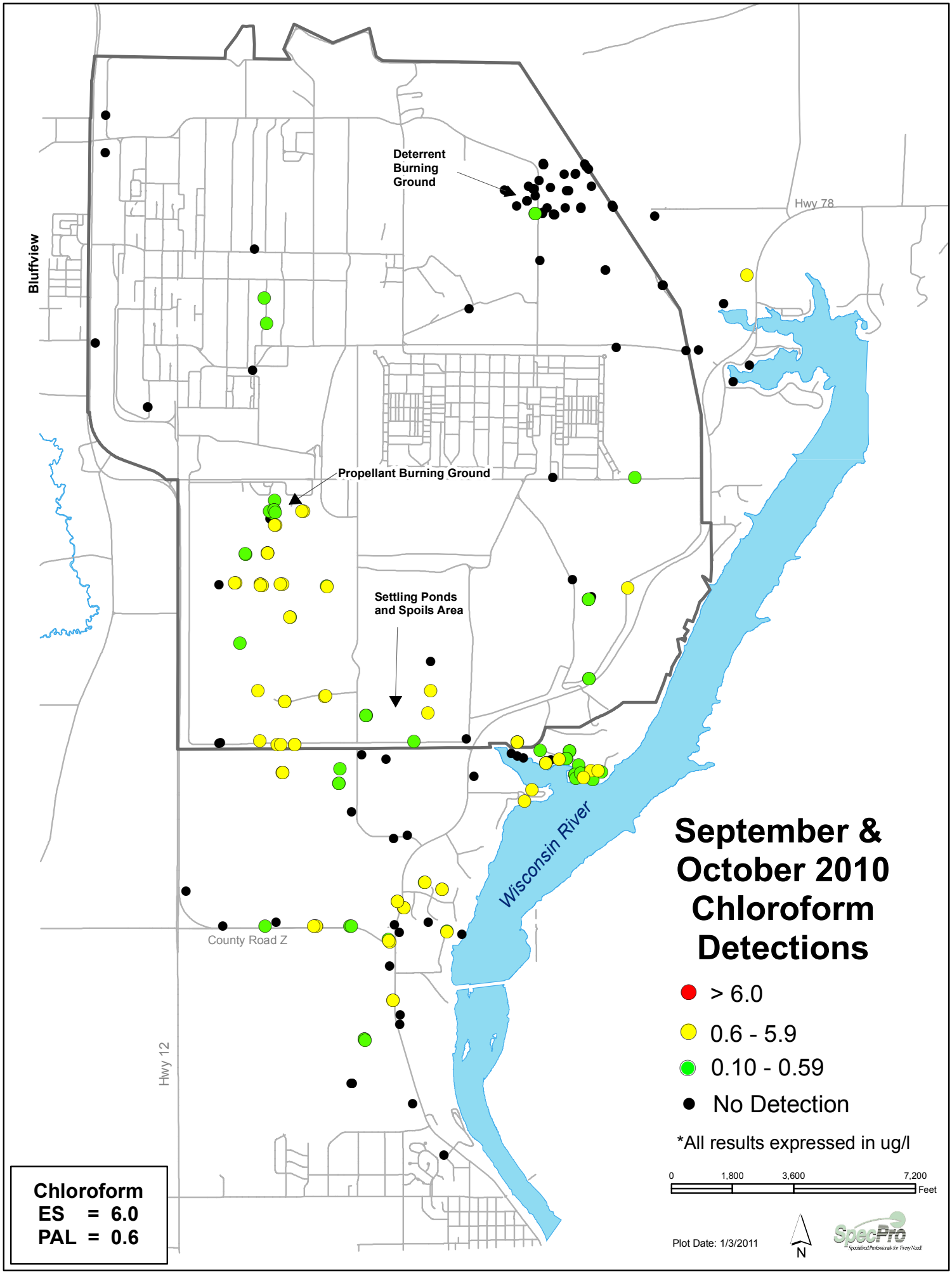
Appendix D

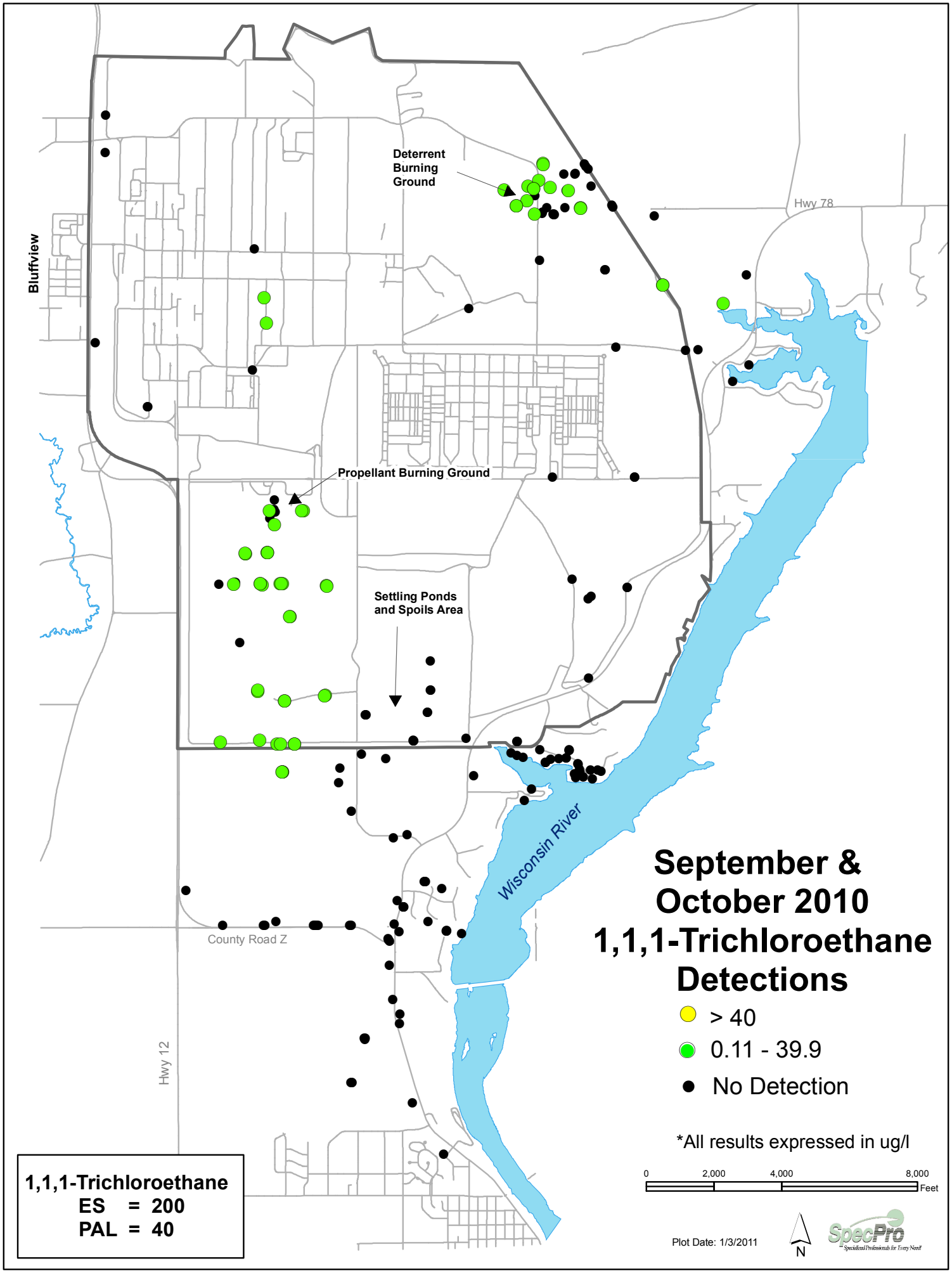
September and October 2010 Contaminant Concentration Maps

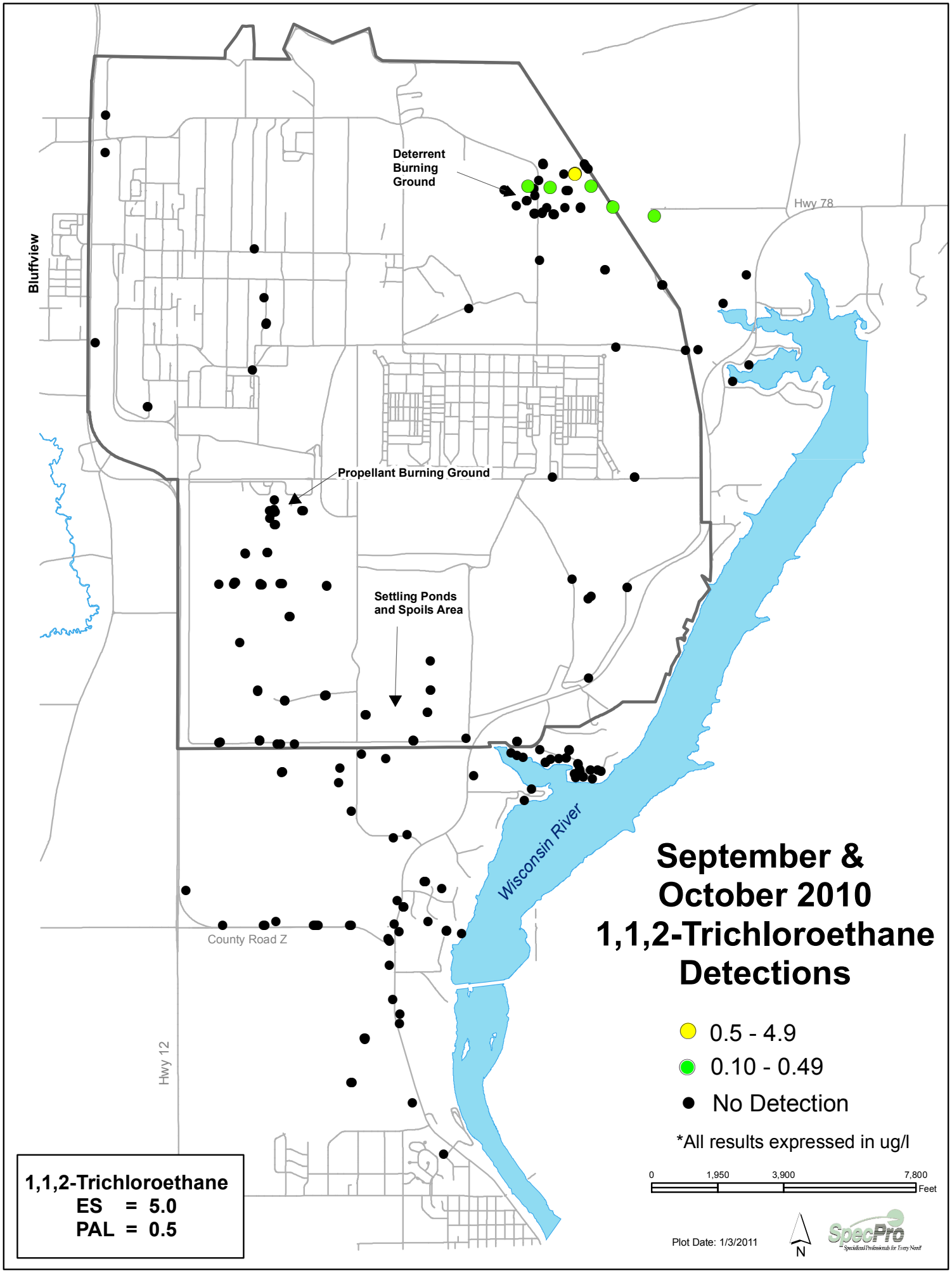

Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Hwy 12
County Road Z
Wisconsin River
September & October 2010 Total Dinitrotoluene Detections
0.05 - 1166.1
0.015 - 0.049
No Detection
*All results expressed in ug/l
0
1,750
3,500
7,000
Feet
Plot Date: 1/3/2011
N
SpecPro
Specialized Professionals for Every Need!
Total Dinitrotoluene
ES = 0.05
PAL = 0.005

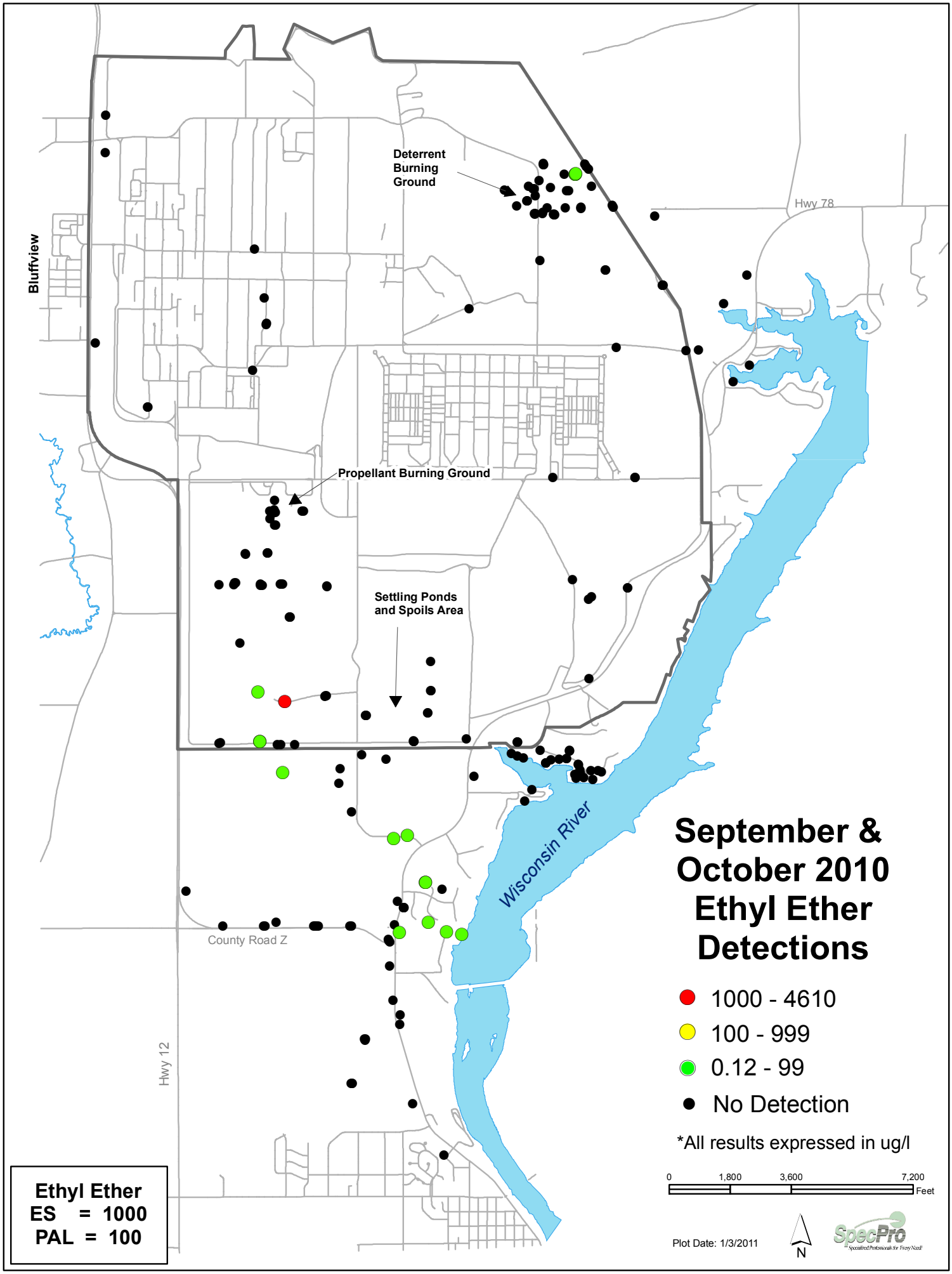

Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Hwy 12
County Road Z
Wisconsin River
September & October 2010 Carbon Tetrachloride Detections
5.0 - 75.9
0.5 - 4.9
0.10 - 0.49
No Detection
*All results expressed in ug/l
0
1,900
3,800
7,600
Feet
Plot Date: 1/3/2011
N
SpecPro
Specialized Professionals for Every Need!
Carbon Tetrachloride
ES = 5.0
PAL = 0.5

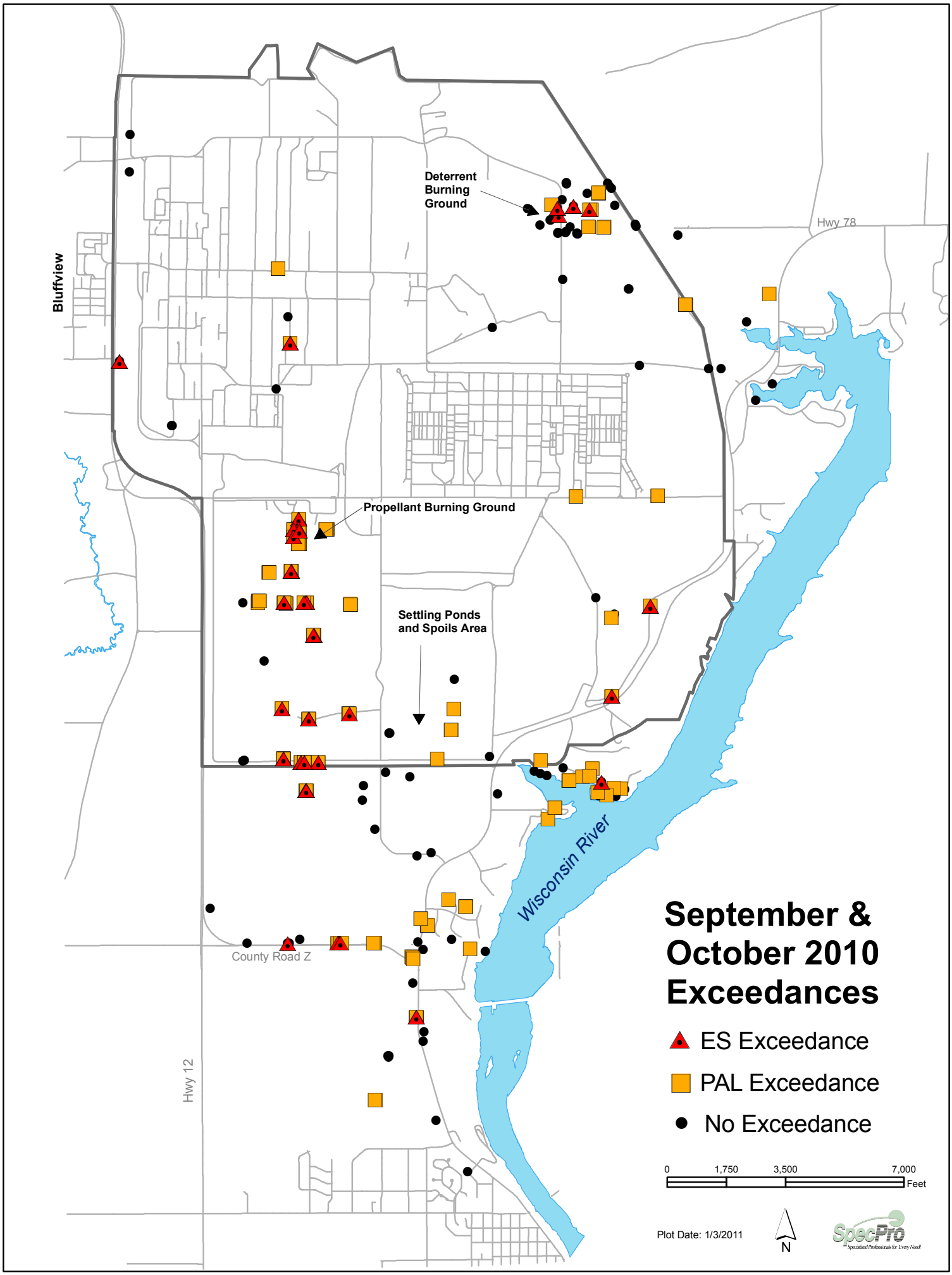

Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Hwy 12
County Road Z
Wisconsin River
September & October 2010 Trichloroethene Detections
5.0 - 13.1
0.5 - 4.9
0.10 - 0.49
No Detection
*All results expressed in ug/l
0
1,950
3,900
7,800
Feet
Trichloroethene
ES = 5.0
PAL = 0.5
Plot Date: 1/3/2011
N
SpecPro


Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Hwy 12
County Road Z
Wisconsin River
September & October 2010 Chloroform Detections
> 6.0
0.6 - 5.9
0.10 - 0.59
No Detection
*All results expressed in ug/l
0
1,800
3,600
7,200
Feet
Plot Date: 1/3/2011
N
SpecPro
Chloroform
ES = 6.0
PAL = 0.6


Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Hwy 12
County Road Z
Wisconsin River
September & October 2010 1,1,1-Trichloroethane Detections
> 40
0.11 - 39.9
No Detection
*All results expressed in ug/l
0
2,000
4,000
8,000
Feet
Plot Date: 1/3/2011
N
SpecPro
Specialized Professionals for Every Need!
1,1,1-Trichloroethane
ES = 200
PAL = 40


Deterrent Burning Ground
Hwy 78
Bluffview
Propellant Burning Ground
Settling Ponds and Spoils Area
Wisconsin River
County Road Z
Hwy 12
September & October 2010 1,1,2-Trichloroethane Detections
0.5 - 4.9
0.10 - 0.49
No Detection
*All results expressed in ug/l
0
1,950
3,900
7,800
Feet
Plot Date: 1/3/2011
N
SpecPro
1,1,2-Trichloroethane
ES = 5.0
PAL = 0.5


Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Wisconsin River
County Road Z
Hwy 12
September & October 2010 Ethyl Ether Detections
1000 - 4610
100 - 999
0.12 - 99
No Detection
*All results expressed in ug/l
0
1,800
3,600
7,200
Feet
Plot Date: 1/3/2011
N
SpecPro
Specialized Professionals for Every Need!
Ethyl Ether
ES = 1000
PAL = 100


Deterrent Burning Ground
Propellant Burning Ground
Settling Ponds and Spoils Area
Bluffview
Hwy 78
Hwy 12
County Road Z
Wisconsin River
September & October 2010 Exceedances
ES Exceedance
PAL Exceedance
No Exceedance
0
1,750
3,500
7,000
Feet
Plot Date: 1/3/2011
N
SpecPro

Badger Army Ammunition Plant

September 2010 Sampled Wells

Sampled Well

N
W E
S

Map Scale 1:10,000

0 850 1,700 3,400 5,100 6,800 Feet

SpecPro
Specialized Professionals for Every Need!

Plot Date: 12/7/10

Wisconsin River

BGM-9101
Orbitec
BGM-9102
BGM-9103
ELN-8204A
ELN-8204B
ELN-8204C
ELN-8904A
ELN-8904B
ELM-9110
S1134R
ELM-8909
DBM-8202
ELN-8203A
ELN-8203B
ELN-8203C
ELM-8901
ELM-8903
DBN-8201B
DBN-8201C
DBM-8201
ELN-9402AR
ELN-8902B
S1122
DBM-8905
DBM-8903
ELM-8907
ELN-9107A
ELN-9107B
ELM-8908
DBN-9502A
DBN-9502B
DBN-9502C
DBN-8902A
DBN-8902B
DBN-9501A
DBN-9501B
DBN-9501C
DBN-9501E
Spear
DBM-9501
ELN-0802A
ELN-0802C
ELM-9501
ELN-0801B
ELN-0801C
ELN-0801E
Purcell-G
Purcell-Dan
NLM-0302R
S1121
Groth
Curto
Nowotarski
PBM-9801
PBM-0005
PBM-0001
PBM-0002
PBN-8202C
PBM-0008
LON-8903A
LON-8903B
PBN-8910A
PBN-8910C
PBN-8203A
PBN-8203C
PBN-8205A
PBN-8205B
PBN-8205C
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PBN-8901C
PBN-8901D
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PBN-8902C
PBN-9301B
PBN-9301C
USDA 6
SPN-0401A
PBN-9112C
PBN-9112D
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PBN-9303C
PBN-9303D
SPN-0402A
SPN-0402C
PBN-9402B
PBN-9402C
PBN-9402D
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SPN-0403C
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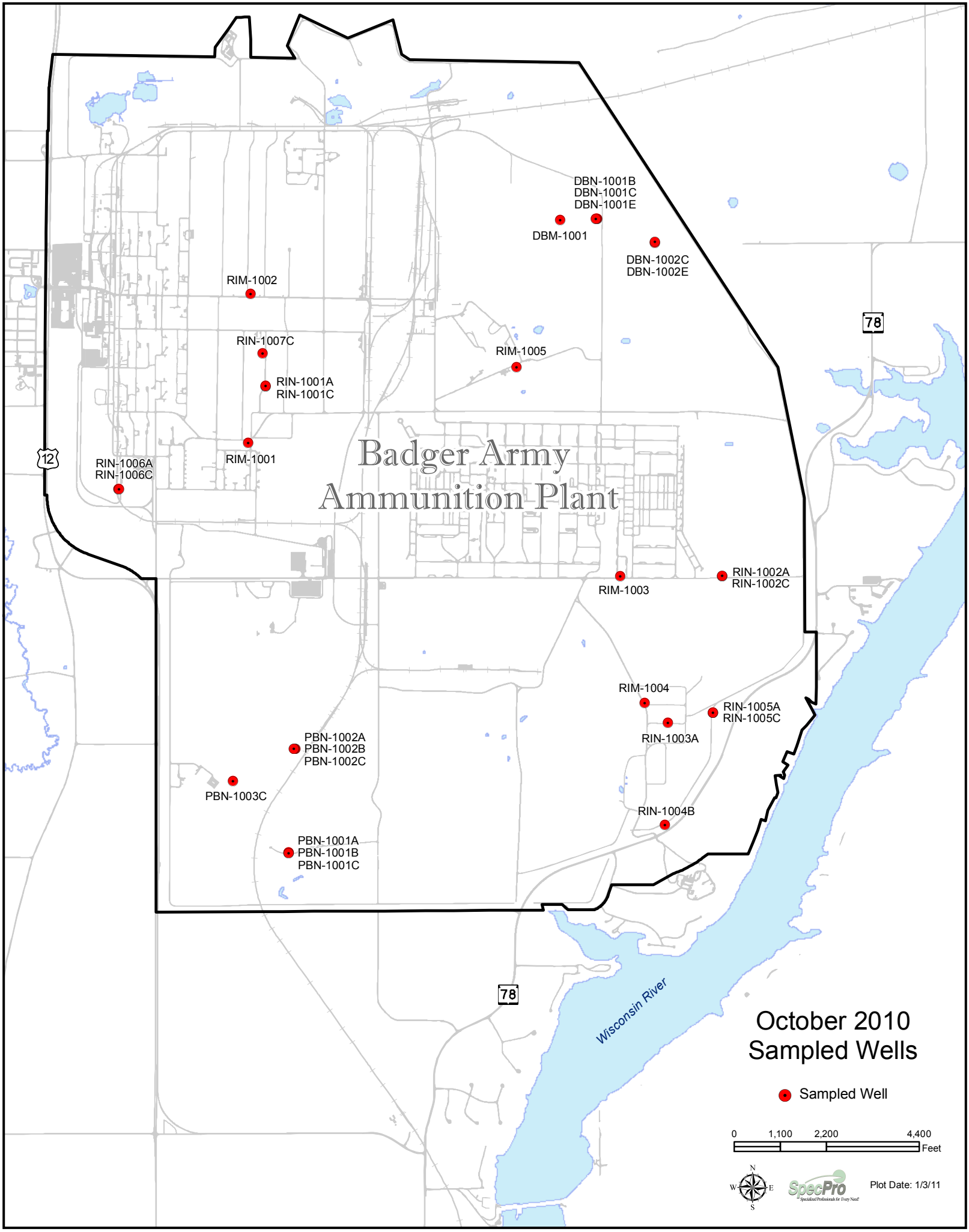
PBN-9902B
PBN-9902C
PBN-9902D
S1104
S1105
S1106
SPN-0404D
SPN-8902B
SPN-8902C
S1103
SPN-8904B
SPN-8904C
SPN-0406A
SPN-0406B
SPN-0406C
SEN-0503A
SEN-0503B
SEN-0503D
WE-RM383
WE-SQ001
SEN-0502B
Goelz
Chamberlain
Brabender
WE-UK125
SEN-0502A
SEN-0502D
WE-QR441
WE-SQ017
WE-TM599
SEN-0501A
SEN-0501B
SEN-0501D
WE-TF023
WE-RR542
WE-RR598
WE-UK124
WE-SQ002
WE-RD430
WE-QN039
Priebe
Crow
Mittenzwei
Delaney
PBN-9903A
PBN-9903B
PBN-9903C
PBN-9903D
Nimmow
Krumenauer
Weum
Ramaker-J
Zander
Hanson
SWN-0501B
SWN-0501C
SWN-0501D
SWN-0501E
Schlender
Kindschi-V
Judd
SWN-0502B
SWN-0502C
SWN-0502D
SWN-0502E
SWN-9103B
SWN-9103C
SWN-9103D
SWN-9103E
SWN-9104C
SWN-9104D
Urban
Lins-K
Lins-R
Hankins
SWN-9102C
SWN-9102D
Roth-G
Ellingson
SWN-9105B
SWN-9105C
SWN-9105D
SWN-0503B
SWN-0503C
SWN-0503D
SWN-0503E
Gruber-North
PBM-9001D
Mueller-J
Kirner
PBN-9102B
PBN-9102C
PBM-9002D
PBN-9103B
PBN-9103C
PBM-9003D
Cramer
PDS-3


Badger Army
Ammunition Plant
DBN-1001B
DBN-1001C
DBN-1001E
DBM-1001
DBN-1002C
DBN-1002E
RIM-1002
RIN-1007C
RIM-1005
RIN-1001A
RIN-1001C
RIM-1001
RIN-1006A
RIN-1006C
RIM-1003
RIN-1002A
RIN-1002C
RIM-1004
RIN-1005A
RIN-1005C
RIN-1003A
PBN-1002A
PBN-1002B
PBN-1002C
PBN-1003C
RIN-1004B
PBN-1001A
PBN-1001B
PBN-1001C
12
78
78
Wisconsin River
October 2010
Sampled Wells
Sampled Well
0
1,100
2,200
4,400
Feet
N
W
E
S
SpecPro
Plot Date: 1/3/11

Appendix E

Remedial Alternative Cost Summary

Alternative 1 Cost Summary
Groundwater Alternative Feasibility Study
Badger Army Ammunition Plant

Alternative	Item Description	Comments		Sub Totals	Total Costs
IRM/MIRM Treatment and MNA	**Engineering Design**	No design cost to implement alternative			$0
	Capital Cost	No capital cost to implement alternative			$0
	Annual O&M	- IRM/MIRM Operation	19 years of operation	$ 29,581,000	$76,911,000
		- Groundwater Monitoring	24 years of quarterly sampling; 455 tests from monitoring wells per year; 214 tests from private wells per year	$ 47,330,000	
	Monitoring and Closeout Plan/Report	Prepare final report that requests closure			$55,000
					$76,966,000

Notes:
Costs are based on current monitoring plans and engineering estimates.
IRM/MIRM - Interim Remedial Measures/Modified Interim Remedial Measures
O&M - Operations and Maintenance
MNA - Monitored Natural Attenuation

Alternative 2 Cost Summary
Groundwater Alternative Feasibility Study
Badger Army Ammunition Plant

Alternative	Item Description	Comments		Sub Totals	Total Costs
In-Situ Biochemical Treatment and MNA	**Engineering Design**	Perform field pilot study and design treatment plan			$45,000
	Capital Cost	- Install and Abandon Temporary Wells	1,950 temporary wells installed to appropriate depth and horizontal spacing to treat contaminated groundwater	$ 27,100,000	$41,200,000
		- Inject CL-Out® Mixture	Mix CL-Out® with water and pump mixture into each well to force it into the groundwater aquifer	$ 14,100,000	
	Post-Treatment Monitoring	- IRM/MIRM Operation	5 years of operation to enhance treatment process	$ 6,000,000	$20,047,000
		- Groundwater Monitoring	20 years of sampling to evaluate treatment results and monitor contaminant reduction or stabilization; first 10 years of quarterly sampling: 455 tests from monitoring wells per year and 214 tests from private wells per year; the last 10 years of semiannual sampling: 130 tests from monitoring wells per year and 105 tests from private wells	$ 14,047,000	
	Monitoring and Closeout Plan/Report	Prepare final report that requests closure			$55,000
					$61,347,000

Notes:
Costs are based on current monitoring plans and engineering estimates
IRM/MIRM - Interim Remedial Measures/Modified Interim Remedial Measures
MNA - Monitored Natural Attenuation

Alternative 3 Cost Summary
Groundwater Alternative Feasibility Study
Badger Army Ammunition Plant

Alternative	Item Description	Comments		Sub Totals	Total Costs
Public Water System and MNA	**Engineering Design**	Prepare plans that can be used to construct the water system and oversee the installation of the wells, well houses, reservoir, and underground distribution piping			$2,900,000
	Capital Cost	- Distribution Piping	Install water mains, hydrants, and water laterals to homes, and abandon existing private wells in the proposed remedy area	$ 18,087,000	$24,746,000
		- Well Installation	Install and test 2 high capacity drinking water wells into the sandstone	$ 472,000	
		- Building Construction	Construct 2 well houses and a treatment/administration building	$ 5,446,000	
		- Reservoir	Construct an elevated water reservoir with a capacity of 75,000 gallons	$ 655,000	
		- Equipment	Provide equipment to operate and maintain the water system	$ 86,000	
	Annual O&M	- Water System Operation	5 years of operation	$ 445,000	$12,347,400
		- IRM/MIRM Operation	4 years of operation	$ 4,800,000	
		- Groundwater Monitoring	20 years of sampling to monitor contaminant reduction or stabilization; first 4 years of quarterly sampling: 455 tests from monitoring wells per year and 214 tests from private wells per year; the next 5 years of semiannual sampling: 240 tests from monitoring wells per year and no testing of private wells per year; the last 10 years of semiannual sampling: 110 tests from monitoring wells per year and no testing of private wells per year	$ 7,102,400	
	Monitoring and Closeout Plan/Report	Prepare final report that requests closure			$55,000
					$40,048,400

Notes:
Costs are based on current monitoring plans and engineering estimates.
IRM/MIRM - Interim Remedial Measures/Modified Interim Remedial Measures
O&M - Operations and Maintenance
MNA - Monitored Natural Attenuation