REMEDIATION SYSTEM EVALUATION

PENTA WOOD PRODUCTS SITE
DANIELS, WISCONSIN

Report of the Remediation System Evaluation
Site Visit Conducted at the Penta Wood Products Site
October 12, 2005

Final Report
February 14, 2006

NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) for the U.S. Environmental Protection Agency (U.S. E.P.A). Work conducted by GeoTrans, including preparation of this report, was performed under EPA contract 68-C-02-092 to Dynamac Corporation, Ada, Oklahoma. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

A Remediation System Evaluation (RSE) involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all stakeholders.

The Penta Wood Products (PWP) site is a former wood treating facility located on Daniels 70 (former State Route 70) in Burnett County, Wisconsin. The Village of Siren, Wisconsin, is approximately two miles east of the site and there are two residences within 200 feet of the site using private wells. The PWP property currently consists of approximately 82 acres which were actively used for wood treating. The PWP facility operations involved wood treatment from 1953 to 1992 which caused contamination in site soil and ground water. The site was listed on the National Priorities List on June 17, 1996. The 1998 Record of Decision (ROD) for the site specified remedies for both soil and ground water contamination. At the time of the RSE, surface soil contamination had been addressed and subsurface soil contamination, ground water contamination, and LNAPL remained. The primary constituents of concern include pentachlorophenol (PCP), benzene, toluene, ethylbenzene, and xylene (BTEX), naphthalene (from No. 2 fuel oil carrier), arsenic, chromium, and zinc. Metals contamination was primarily present in surface soils, which have already been addressed. The focus of the RSE is on the pump and treat (P&T) and LNAPL recovery system.

In general, the RSE team found a well-operated system. The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators but are offered as constructive suggestions in the best interest of the EPA, the public, and the facility. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations are provided in three of the four categories: effectiveness, cost reduction, and site closeout. The recommendation for improving system effectiveness involves continuing with annual ground water sampling and closely following water quality trends in MW-13 and other wells to evaluate the potential for plume migration.

Recommendations for cost reduction include the following:

- After another year of operation, more accurately forecast materials and disposal costs. Many of the estimates, including those for GAC, LNAPL, and filter cake disposal are overly conservative and result in allocation of additional funding (up to $374,000 extra per year) for the site.

- Consider modifying management of Granular Activated Carbon (GAC) units to reduce costs associated with GAC changeouts and disposal. Various options ranging from improved filtration to the consideration of backwashing are provided. Annual savings from implementing this recommendation might range from $11,000 per year to $30,000 per year depending on the option implemented.

- Modify the monitoring and sampling program to eliminate redundant samples and reduce costs without sacrificing remedy effectiveness. The site team is already moving forward with the elimination of the May sampling event, and the RSE team supports this decision. If consistent with State requirements, the site team should also consider eliminating total metals from the analysis since dissolved metals analysis is conducted and is more representative of potential ground water problems. Costs could be reduced by approximately $3,000 per year without a loss of protectiveness. The site team should also continue to minimize analysis for dioxins in process water sampling given the high cost for the analysis.

- Realize cost savings from the use of the dedicated pumps that have been installed in the monitoring wells. The RSE team estimates that the annual sampling event may be shortened by one or two days, potentially resulting in savings of approximately $4,000 to $8,000 per year from the current annual sampling cost of $29,000. Use of the plant operator during the sampling event could also reduce the time involved and/or the travel of a sampling team member from Milwaukee.

- Investigate the possibility of declassifying waste. The filter cake disposal cost is extremely high. There are examples of similar filter cake being sufficiently stabilized and delisted so that disposal options other than incineration are available. Cost savings of up to $100,000 per year are possible. The RSE team has provided a link to information regarding declassification at another Superfund site.

- Decrease project management/reporting costs as system operation becomes more routine. Project management costs are estimated at about $157,000 per year. These costs are relatively high, partially due to the costs of managing site subcontractors/vendors. The RSE team assumes that PM costs will decrease over time to about $100,000 per year as the system operation becomes more routine.

- Develop tracking of routine and non-routine costs. Routine parts and maintenance and non-routine costs combine for a fairly significant portion of the annual cost. Routine parts and maintenance are expected to be $130,000 and non-routine costs expected to be $53,000. Pump replacements and erosion control are included in these costs but a detailed breakdown was not discussed. Routine and non-routine maintenance should be tracked separately in order to easily see what activities are included in these costs and how they can be reduced.

- Evaluate potential to reduce ground water extraction without substantially affecting LNAPL recovery. If ground water recovery can be decreased by 10% then a savings of approximately $15,000 could be realized in avoided disposal costs and approximately $12,500 might be realized in reduced GAC and chemical usage. Thus, for a 10% reduction in ground water extraction, a savings of approximately $27,500 per year might be realized. The site team should evaluate various pumping schemes to determine if pumping can be reduced without sacrificing the effectiveness of LNAPL recovery or the control of the dissolved contaminant plume. Given that this evaluation consists of decreasing pumping from some wells and tracking LNAPL recovery and concentrations at nearby monitoring wells, this evaluation should be feasible within the existing PM and reporting budget.

The one recommendation with regard to site close out involves the transition from ground water extraction and LNAPL recovery system to the bioventing system and intrinsic remediation. The RSE team agrees that the bioventing system should not be run concurrently with the ground water extraction system given the increased biological activity and the potential for fouling of the recovery wells and treatment system. The site team estimates that the majority of LNAPL will be recovered within 10 years, which means that it is likely that ground water extraction, which is the most costly aspect of this remedy, will not need to occur after the site is transferred to the State. The RSE team supports this overall exit strategy assuming that sufficient data are available at the time of transfer to confirm that the dissolved plume is stable in the absence of pumping.

A table summarizing the recommendations, including estimated costs and/or savings associated with those recommendations, is presented in Section 7.0 of this report.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (U.S. EPA OSRTI) in support of the "Action Plan for Ground Water Remedy Optimization" (OSWER 9283.1-25, August 25, 2004). The objective of this project is to conduct Remediation System Evaluations (RSEs) at selected pump and treat (P&T) systems that are jointly funded by EPA and the associated State agency. The project contacts are as follows:

Organization	Key Contact	Contact Information
U.S. EPA Office of Superfund Remediation and Technology Innovation (OSRTI)	Jennifer Hovis	1235 S. Clark Street, 12th floor Arlington, VA 22202 Mail Code 5201G phone: 703-603-8888 hovis.jennifer@epa.gov
Dynamac Corporation (Contractor to U.S. EPA)	Daniel F. Pope	Dynamac Corporation 3601 Oakridge Boulevard Ada, OK 74820 phone: 580-436-5740 fax: 580-436-6496 dpope@dynamac.com
GeoTrans, Inc. (Contractor to Dynamac)	Doug Sutton	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728 phone: 732-409-0344 fax: 732-409-3020 dsutton@geotransinc.com

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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 Remediation System Evaluations (RSEs) were conducted at 20 Fund-lead pump and treat (P&T) sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, EPA OSRTI has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*. OSRTI has since commissioned RSEs at 10 additional Fund-lead sites with P&T systems. An independent EPA contractor is conducting these RSEs, and representatives from EPA OSRTI are participating as observers.

The Remediation System Evaluation (RSE) process was developed by the US Army Corps of Engineers (USACE) and is documented on the following website:

http://www.environmental.usace.army.mil/library/guide/rsechk/rsechk.html

An RSE involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

The recommendations are intended to help the site team (the responsible party and the regulators) identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all site stakeholders.

The Penta Wood Products site was selected by EPA OSRTI based on a recommendation from the associated EPA Region, the effectiveness of the remedy to protect human health and the environment, and the annual costs of operating the remedy. This report provides a brief background on the site and current operations, a summary of observations made during a site visit, and recommendations regarding the remedial approach. The cost impacts of the recommendations are also discussed.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Jessica Leerkes, Civil and Environmental Engineer, GeoTrans, Inc.
Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

The RSE team was also accompanied by the following observer:
Charles Sands from EPA OSRTI

1.3 DOCUMENTS REVIEWED

Author	Date	Title
US EPA	9/29/1998	Record of Decision, Penta Wood Products, Daniels, WI 09/29/1998
CH2M Hill	3/26/2003	Bioventing/Ground water Treatment Facility Modifications – Process and Instrumentation Diagram
Wisconsin Dept. of Natural Resources	3/2005	5 Year Review
CH2M Hill	8/2005	Monthly Technical Status Report
CH2M Hill	9/2005	2004 Annual Report
CH2M Hill	9/2005	Waste Handling Plan
CH2M Hill	10/2005	Penta Wood Products, Operations and Maintenance Manual
Wisconsin Dept. of Natural Resources		Substantive Requirements of A WPDES Permit WPDES Permit No. WI-0061531-01-0

1.4 PERSONS CONTACTED

The following individuals associated with the site were present for the visit:

Chuck Sands, RSE Project Liaison, EPA Region V
Tom Williams, Remedial Project Manager, EPA Region V
Bill Shultz, State Regulator, Wisconsin Department of Natural Resources
Bill Andrae, Site Manager, CH2M Hill
Mary Wicklund, Lead Plant Operator, OMI

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The Penta Wood Products (PWP) site is a former wood treating facility located on Daniels 70 (former State Route 70) in Burnett County, Wisconsin. The Village of Siren, Wisconsin, is approximately two miles east of the site and there are two residences within 200 feet of the site using private wells. The PWP property originally consisted of approximately 120 acres. Approximately 40 undeveloped acres consisting of forest were sold after the facility closed, and the site currently consists of approximately 82 acres that were actively used. The property is located in a rural agricultural and residential setting and is bordered to the east, west, and north by forested areas; some of these areas are classified by the State of Wisconsin as wetlands. With the exception of an eight acre parcel, Daniels 70 forms the southern property boundary. The Amsterdam Slough Public Hunting area covers 7,233 acres and is located one mile north of the site. The site layout is shown on Figure 1-1. Onsite soils and ground water were contaminated with pentachlorophenol (PCP), arsenic, copper, and zinc from the wood treating activities which occurred on the site.

The wood-treating facility operated from 1953 to 1992, when the plant shut down. In 1988, the on-site production well was closed for potable use when it was found to contain 2,700 parts per billion (ppb) of PCP. The State of Wisconsin Department of Justice filed a preliminary injunction against Penta Wood Products in 1991, citing WPDES violations and violations of other State statutes regarding storage of raw materials, and waste handling practices. The facility voluntarily closed in May 1992 with the promulgation of the Resource Conservation and Recovery Act (RCRA) drip track regulations. The site was listed on the National Priorities List on June 17, 1996.

In September 1998, the Record of Decision (ROD) for the site was finalized specifying remedies for both soil and ground water contamination. The selected remedy included soil and sediment consolidation, bioventing, collection and disposal of light non-aqueous phase liquid (LNAPL), ground water collection and treatment, and monitored natural attenuation. Remedial construction activities in support of the RA began in 1999 and continued through September 2000. These activities included the demolition and off-site disposal of buildings and foundations, addressing the soil contamination, and constructing P&T system for ground water extraction and LNAPL recovery. Contaminated soils were excavated and consolidated into a 7-acre Corrective Action Management Unit (CAMU). PCP-contaminated soils were deposited on the CAMU's southern portion and arsenic-contaminated soils were placed on the northern portion. A wall of concrete rubble and stabilized arsenic-contaminated soil divides the two portions. A soil cover was placed over the CAMU consisting of 6 inches of sand followed by 6 inches of topsoil and was then seeded and mulched. This soil cap allows percolation of rain water and introduction of moisture that is necessary for biological activity. Erosion control structures including gabion basket downchutes, velocity control check dams and rip-rapped drainage ditches were constructed to protect the integrity of the CAMU. A gated 6-foot high fence was installed encircling the perimeter of the CAMU to restrict access. The primary ongoing effort associated with the CAMU portion of the remedy is to control soil erosion. The P&T and LNAPL recovery system began operation in 2000, underwent modifications, and resumed operation in 2004. This RSE focuses on the modified P&T and LNAPL collection system that has been in operation since March 2004.

1.5.2 POTENTIAL SOURCES

The PWP facility operated from 1953 to 1992. Raw timber was cut into posts and telephone poles and treated with either a 5 to 7 percent PCP solution in a No. 2 fuel oil carrier, or with a water borne salt treatment called Chemonite consisting of ammonia, copper II oxide, zinc and arsenate (ACZA). PWP also conducted toll blending of pentachlorophenol and fuel oil on a contract basis for other industrial users just prior to closing in 1992. During its 39 years of operation, PWP discharged wastewater from an oil/water separator down a gully into a lagoon on the northeast corner of the property. Process wastes were also discharged onto a wood chip pile in the northwestern portion of the property. Ash from a boiler was used to berm a cooling pond. Beginning in the 1970s, WDNR investigators noted several large spills, stained soils, fires and poor operating practices.

The site was put into the Superfund Accelerated Cleanup Model (SACM) pilot program in 1993. The site was listed on the National Priorities List on June 17, 1996. A removal action was conducted from 1994 to 1996. The ACZA treatment building and half of the oil/water separator building were demolished and remaining chemicals and sludges were disposed off-site. Grossly PCP-and metals-contaminated soils were excavated and disposed off-site, and metals-contaminated soils were excavated and mixed with cement on-site to form a 3-acre concrete biopad.

The PCP/oil mixture, which has traveled to the ground water and spread horizontally as a light non-aqueous phase liquid (LNAPL) layer extends over an estimated four acre area. The LNAPL exists both as a free phase and as a residual phase. A dissolved phase PCP plume exists in the ground water. Ground water contamination appears to be stable, and there is no evidence of contaminated ground water discharging to the wetland or migrating below the wetland to surface water bodies. The contaminants of concern at the PWP site include PCP, benzene, toluene, ethylbenzene, and xylene (BTEX), naphthalene (from the No. 2 fuel oil carrier), arsenic, chromium, and zinc. Metals contamination at the site was primarily present in soils, which have been addressed as part of the OU1 activities. Metals concentrations in ground water are below standards. BTEX and naphthalene are also generally below relevant standards. The primary contaminant of concern is PCP, which is present in the vadose zone soils, LNAPL, and ground water. All known surface sources of contamination have been eliminated, but the LNAPL and subsurface soil contamination provides an ongoing source of ground water contamination.

1.5.3 HYDROGEOLOGIC SETTING

Most of the site is located on a plateau. On the north portion of the site there is a steep drop so that there is a 110-foot drop in elevation from the southern boundary to the northern boundary. The site geology consists of three stratigraphic layers: an upper sand, a glacial till that is not continuous throughout the site, and a lower sand. The upper sand is fairly continuous across the site extending from the natural surface to depths of 90 to 120 feet below ground surface (bgs). Below the upper sand unit is the glacial till. The glacial till has a variable lithology and consists mainly of silts and silty sands to sandy silts with gravel. This unit is present beneath most of the site and ranges from 3 to 45 feet in thickness. The till is underlain by a layer of sand and gravel which is similar to the upper sand unit. The top of this lower sand unit was found at depths ranging from 102.5 feet bgs to 215 feet bgs and it extends to at least 300 feet bgs. The lower sand may be interbedded with glacial till layers at depths between 120 and 180 feet bgs. The depth to ground water is approximately 100 feet on the plateau. Groundwater occurs both in a thin unconfined aquifer and within a multi-layered semiconfined aquifer system. The regional ground water flow direction is to the north. Onsite, the ground water flow has been radial, with a strong downward vertical gradient, since the closure of the production well. The site is situated in a ground water recharge zone, and because of the high permeability of the surficial soils, precipitation rapidly infiltrates the soil.

The unconfined aquifer consists of a thin zone of ground water, within the upper sand unit, perched upon the less permeable till. The observed saturated thickness ranges from less than 5 feet to greater than 25 feet. The ROD indicates that given an average hydraulic conductivity of 21 feet per day and an effective porosity of 0.30, the average horizontal ground water velocity is estimated at approximately 25 feet per year. This estimate is comparable to a previous estimate of ground water velocity based on distribution of chloride.

Ground water within the lower sand unit makes up the semiconfined aquifer system. Given an average hydraulic conductivity of 7.6 feet per day and an effective porosity of 0.30, the average horizontal ground water velocity is estimated at approximately 19 feet per year.

The water levels in the unconfined aquifer are generally a foot higher than those measured in the semiconfined aquifer. The data suggests that the till, where present, acts as a confining layer. Data indicate that strong downward vertical gradients, 0.008 to 0.045 feet per foot, exist between the shallow unconfined aquifer and semiconfined systems.

1.5.4 POTENTIAL RECEPTORS

There are four houses within 1,000 feet of the site, all of which have potable wells. Monitoring of residential wells has demonstrated that the plume has been contained on site. Annual sampling events monitor the residential wells. There was one sampling event where a low level of PCP below the MCL was found in one of the residential wells, but no PCP was found during subsequent sampling events. A number of surface water bodies are present north and east of the site. Doctor Lake and an unnamed lake are located 2,000 feet east and northeast of the site, respectively. A wetland is located within 130 feet of the northern property boundary. The Amsterdam Slough Public Hunting area covers 7,233 acres and is located 1 mile north of the site.

1.5.5 DESCRIPTION OF GROUND WATER PLUME

The contaminants of concern at the PWP site include PCP, BTEX and naphthalene (from No. 2 fuel oil carrier), arsenic, chromium, and zinc. The extent of dissolved ground water contamination as determined by the annual sampling event in September 2004 is illustrated in Figure 1-2. The PCP/oil mixture, which is present in ground water and spread horizontally as a light non-aqueous phase liquid (LNAPL) layer is floating on the water table over an estimated 4-acre area within the 1,000 ug/L contour indicated on Figure 1-2. The LNAPL exists both as a free phase and as a residual phase. A dissolved phase PCP plume exists in both the unconfined and semi-confined units. The contours on Figure 1-2 represent the plumes in both of these units together. Ground water contamination appears to be stable, and there is no evidence of contaminated ground water discharging to the wetland or migrating below the wetland to surface water bodies.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

A P&T system was constructed and began operation at the site in 2000. The system extracted ground water with the purpose of creating a cone of depression to funnel LNAPL towards the recovery wells where it could be extracted for offsite disposal. The wells were constructed to extract water from 20 feet below the water table to minimize the extraction of emulsified product; however, this approach was not effective. The ground water extraction included emulsified product, and the treatment system, which consisted of an oil-water separator, bag filters, organoclay, and GAC, was not capable of meeting discharge standards. Because ground water extraction needed to continue for an effective remedy, the site team designed and constructed a pretreatment plant to remove the emulsified product. Construction of the pretreatment system was completed in February 2004.

2.2 EXTRACTION SYSTEM

A total of ten borings have been installed for remediation at the site. Eight of these borings have both bioventing and ground water recovery wells in a single borehole. Two have bioventing wells only. The bioventing wells have screened intervals that extend from 40 feet above the water table to 10 feet below the water table. The ground water recovery wells have 20-foot screen intervals that begin at 20 feet below the water table. The bioventing aspect of the remedy will begin when the LNAPL recovery effort ends. Therefore, for the combined bioventing/water extraction locations, the bioventing wells are used for LNAPL recovery. Ground water is extracted from each of the eight water extraction wells at approximately 10 to 12 gpm with 2 horsepower centrifugal pumps. LNAPL is extracted with pneumatic pumps from the co-located bioventing. The 2004 Annual Report showed an estimated PCP mass removal from the aqueous phase of 2,100 pounds from February through December 2004, and a total removal since September 2000 of approximately 4,600 pounds. As of the time of the RSE site visit, the site team reported an average flow rate of 90 gpm and an average influent concentration of 12,600 ug/L. Given this influent concentration and an average influent flow rate of 90 gpm, mass removal via ground water extraction and treatment is approximately 13.6 lbs per day (or 4,500 pounds per year assuming the system operates 90% of the time.

$$\frac{90\text{ gal}}{\text{min}} \times \frac{3.785\text{ L}}{\text{gal}} \times \frac{12{,}600\text{ ug}}{\text{L}} \times \frac{1\text{ kg}}{10^9\text{ ug}} \times \frac{2.2\text{ lbs}}{\text{kg}} \times \frac{1440\text{ min}}{\text{day}} = \frac{13.6\text{ lbs}}{\text{day}}$$

2.3 TREATMENT SYSTEM

The pretreatment plant includes an oil-water separator, chemical addition for coagulation and flocculation, dissolved air flotation, dewatering with a rotary drum vacuum filter, and associated tanks for storage. The current treatment system (which includes the pretreatment system and components of the original treatment system) has the following primary components:

- Oil-water separator
- Chemical conditioning with ferric sulfate and polymer addition
- Dissolved air flotation (DAF)

- Rotary drum vacuum filter (RDVF)
- Bag filters
- 2,500-pound granular activated carbon (GAC) unit (which replaces the original organo-clay unit)
- Two 10,000-pound GAC units arranged in series
- Sodium hydroxide addition for pH adjustment
- Discharge to an on-site infiltration gallery

The system is designed for a capacity of 120 gpm. The current extraction rate is 90 gpm. The system is contained in two joined metal frame buildings. The components from the original system are contained in a 30-foot by 42-foot building, and the components for the pretreatment system are contained in a 52-foot by 67-foot building, which includes office space and a separate room for the RDVF.

Bioventing will be used as a follow-up to the LNAPL recovery effort, and the system includes a 75 horsepower centrifugal blower to inject air into the aquifer. This aspect of the remedy will begin operating when operation of the LNAPL recovery system is discontinued.

2.4 MONITORING PROGRAM

The monitoring program consists of both ground water monitoring and process monitoring for the P&T system.

The ground water monitoring program consists of an annual sampling event in September of each year and another smaller event in May of each year. The September event consists of sampling 20 monitoring wells, five residential wells, and one potable well. The May event consists of sampling five monitoring wells and four residential wells. Samples are analyzed for PCP, naphthalene, BTEX, and total and dissolved copper, arsenic, zinc, and manganese. Ground water samples are not analyzed for dioxin. Static water level measurements are also collected during each sampling event to assess ground water flow direction. The site team is considering eliminating the May event.

PCP data are presented on concentration contour site maps for each sampling event and potentiometric surface maps are prepared for each round of water level measurements that includes data from monitoring wells.

Process monitoring includes monthly sampling of the influent (after the DAF) and effluent analyzed for PCP. The effluent is also analyzed for naphthalene, BTEX, phenol, dioxin/furans, Copper (Cu), Zinc (Zn), Arsenic (As), and Manganese (Mn). The process water between the two GAC units is sampled and analyzed for PCP as needed. Usually this occurs right before change out, which is approximately every 2.5 months.

There are two sets of reports generated: monthly technical status / O&M reports and annual reports. The detailed tech status reports include process sampling results as well as other operational information. The annual report summarizes the progress onsite, hazardous waste generation and disposal, site inspection and maintenance activities and includes interpretation of data associated with the ground water sampling and analysis.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The remedial action objectives are specified in the September 1998 ROD as follows:

- Reduce the PCP content in soils and ground water to achieve compliance with ch. NR 720, Wisconsin Administrative Code, and in ground water to achieve compliance with preventative action limits (PALs), as established in ch. NR 140, Wisconsin Administrative Code, by removing the free phase LNAPL, and associated highly contaminated ground water, remediating the PCP in the soils, and monitoring the intrinsic remediation of PCP in the ground water.

- Highly contaminated arsenic soils will be immobilized and consolidated with other arsenic contaminated soils, and secured, in order to achieve compliance. Soil contaminated with arsenic and other metals will be managed to essentially eliminate the direct contact exposure route and to protect ground water

- An erosion control plan will be implemented and maintained to prevent physical transport of contamination off-site and to protect the cap and consolidated areas from damage.

The ROD provided an initial estimate of 10 years for active LNAPL and ground water recovery.

The cleanup standards for the site contaminants are provided in the following table.

Contaminant of Concern	Cleanup Criteria (μg/L)
Arsenic	5
Benzene	0.5
Chloride	125,000
Copper	130
Ethylbenzene	140
Iron	150
Manganese	25
Naphthalene	8
Pentachlorophenol	0.1
Toluene	68.6
Xylene, mixture	124
Zinc	2,500

3.2 TREATMENT PLANT OPERATION STANDARDS

Treated ground water is discharged to the onsite infiltration gallery. Discharge is governed by a WPDES Permit Equivalent. The criteria specified in the permit equivalent are listed in the following table.

Parameter	**Discharge Limits (μg/L)**
Dioxin (2,3,7,8 TCDD)	0.000003
Pentachlorophenol	0.1
Naphthalene	8.0
Benzene	0.5
Arsenic, Total Recoverable	5.0

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of the EPA and the public. These observations obviously have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, it is likely that site conditions and general knowledge of ground water remediation have changed over time.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Water level data from the site are recorded semi-annually, in the spring and in the fall. These data are used to generate potentiometric surface maps for each sampling event, and the potentiometric surface maps for both events are included in the annual report. The background hydraulic gradient on site is reportedly relatively flat with radial flow. Potentiometric surface maps do not show a consistent pattern as a result of pumping, other than that there appears to be a ground water divide that runs north-south through the site to the west of the extraction system. This may be due to a relative lack of piezometers in some areas of the site. For example, there are no piezometers to the east to show if there is a divide in that direction. Data from only two rounds of monitoring were available since the treatment system was restarted in 2004: one in May 2004 and one in September 2004. Further monitoring events will provide additional data that can be used to determine flow patterns and trends.

4.2.2 CAPTURE ZONES

The ground water remedy system at the PWP site is not specifically designed to provide capture. Rather, the site team was looking to establish a cone of depression that encompassed the LNAPL plume so that the LNAPL plume could be funneled toward the LNAPL recovery wells. There is likely an unstated goal that the contamination should not expand to affect residential wells or begin to migrate uncontrollably. Monitoring of the concentration trends and potentiometric surfaces over time will help determine if the contamination is adequately contained by a combination of ground water extraction and intrinsic remediation.

4.2.3 CONTAMINANT LEVELS

The site team reports state that the plume is shrinking, but this appears to be due to interpolation only, and not due to substantial reductions at outer monitoring wells. Since there are only two rounds of well sampling that have occurred since the pretreatment system began operation, it is difficult to accurately predict contaminant concentration trends. Given the presence of LNAPL, substantial decreases of PCP concentrations in ground water are not expected.

Concentration trends in the outer monitoring wells are important in determining whether or not plume migration is being controlled. Concentrations of PCP in these wells have generally remained stable at or below 1 ug/L. However, there are a few exceptions. Most notable is the detection of PCP at 2.9 ug/L and 4.67 ug/L in MW-13 in 2003 and 2004, respectively. This increase, if statistically significant and not the result of cross contamination from other samples, could indicate that the plume is migrating to the northeast.

4.2.4 LNAPL RECOVERY

LNAPL recovery on site is on the order of 700 gallons per month. Over 12,000 gallons of LNAPL have been recovered since March 2004. There is no accurate measure of which wells produce the most LNAPL. The site team suggests that the greatest recovery is likely from EW-10.

4.3 COMPONENT PERFORMANCE

4.3.1 EXTRACTION SYSTEM WELLS, PUMPS, AND HEADER

The extraction system is operating at approximately 90 gpm rather than the design rate of 120 gpm. The site team however, believes that the 90 gpm is reasonable for the site based on operational data. The ground water extraction wells have 2-hp electric submersible pumps that were oversized for the yields. The site team has installed variable frequency drives (VFDs) for each of these pumps to use the pumps more efficiently. Pumping appears to be based on maximum well yields. It is unclear if less ground water pumping could accomplish the LNAPL collection goals.

4.3.2 OIL/WATER SEPARATOR & EQUALIZATION TANK

The coalescing oil/water separator (COW) was designed to remove free phase product from the liquid stream sent to it from the free product pumps. It is not designed to remove emulsified oils that are present in the liquid stream. The COW receives flow from the free product pumps located in the biovent/LNAPL recovery wells. The oil/water separator requires some routine maintenance including: cleaning the site glass, inspection and adjustment of skimmer, cleaning the water pump, and lubricating the electric motor.

The equalization system was designed to balance the flow into the treatment system. Ground water is pumped directly into the equalization tank from the well heads and the COW effluent water is also pumped to the equalization tank. The equalization tank is a continuously mixed tank, sized to provide equalization of approximately 1 day of COW effluent. Both the COW and equalization tank function as designed.

4.3.3 CHEMICAL CONDITIONING

Chemical conditioning, which consists of the addition of ferric sulfate and flocculent polymer, is used to enhance the removal of TSS and free and emulsified oil and grease in the Dissolved Air Flotation (DAF) unit. Chemical conditioning and the DAF were added to the treatment system after initial operation revealed large quantities of emulsified oil present in the ground water that resulted in repeated fouling of the granular activated carbon (GAC). The coagulant (ferric sulfate) is fed on a pH control basis in order to maintain pH at approximately 5.5 to 5.9 as determined by pilot testing. Flocculent polymer is added in very small amounts (approximately 6 gallons over several months) based on operational experience during 2004. Process water flows by gravity from the COW through the coagulation and flocculation tanks and through the DAF. All pumps, piping, probes, and other system components are inspected weekly.

4.3.4 DISSOLVED AIR FLOTATION

The DAF system is designed to significantly improve the performance of the GAC system. The DAF system is intended to provide removal of total suspended solids (TSS) and free and emulsified oil and grease from the combined ground water and COW effluent water stream. The system is operated in a continuous mode with a float handling system to remove the floated solids. DAF effluent flows over a weir and into the DAF pump tank to be pumped through bag filters and the GAC. Float from the DAF unit is pumped to the float storage tank, which holds up to 3 days of DAF float volume so that the RDVF does not need to operate on weekends. According to the site team, the DAF is functioning well and up to expectations with respect to removal of solids and emulsified oil and grease. The DAF is cleaned each week day using a garden hose to clear sludge buildup from paddles and rails. The operation of the skimmer, sludge pump, recirculation pumps, and probes is periodically checked throughout each week day. The DAF is drained completely and pressure washed on a bi-monthly basis.

4.3.5 ROTARY DRUM VACUUM FILTER DEWATERING SYSTEM

The RDVF is used to dewater float from the DAF system. The RDVF dewaters float on a diatomaceous earth precoat built up at the beginning of each batch run. Under vacuum, the float adheres to the surface of the precoat, and water is pulled through the float to the interior of the drum and exits as filtrate. Solids remaining on the precoat material are scraped off by a blade and fall into a collection dumpster where it is stored until transported offsite for disposal. The filtrate from the RDVF is collected in a filtrate collection tank equipped with a filtrate transfer pump included in the RDVF system. The filtrate is pumped to the filtrate storage tank and then into the DAF system influent. The operator runs the RDVF once every one to two weeks. Each run takes approximately 4 to 6 hours and produces 4 cubic yards of filter cake. Approximately 150 to 175 pounds of diatomaceous earth are used per run.

4.3.6 BAG FILTERS

Bag filters (25 microns) are used inline prior to the GAC pre-filter unit and the GAC vessels to collect particulate matter. The bag filters are considered spent and require replacement when there are elevated pressure readings, indicating a reduction of flow (approximately once or twice per week). The spent bag filters are considered to be a listed hazardous waste because they have been in contact with the constituents in the ground water.

4.3.7 GRANULAR ACTIVATED CARBON UNITS

The treatment system has three GAC vessels operated in series, a 2,500-pound pre-filter vessel and two 10,000-pound GAC vessels. The 2,500-pound GAC pre-filter vessel (which was previously an organoclay unit) removes the remaining particulate from the water so that the two 10,000-pound vessels can function more efficiently. The two 10,000-pound vessels are operated in a lead-lag scenario such that the bulk of the contaminant adsorption occurs in the first (lead) vessel and the second (lag) vessel further polishes the water. The vessels were originally sized to reduce the PCP concentration in the ground water from approximately 15 milligram per liter (mg/L) to less than 0.1 microgram per liter (ug/L). Initially, the lead vessel effluent was supposed to be routinely monitored for PCP breakthrough to determine when the GAC requires replacement, but the site team reports that GAC changeout is normally based on pressure buildup and occurs every two months. Typically 12,500 pounds of GAC are changed out each time because the 2,500-pound and one 10,000-pound unit are changed out together. During a GAC changeout, the carbon in the lead vessel is replaced, and the flow path will be reversed so that the former lead vessel becomes the lag vessel and the former lag vessel is now the lead vessel.

4.3.8 NEUTRALIZATION TANK

Prior to discharge to the on-site infiltration basin, GAC effluent pH is adjusted from approximately 5.7 to a pH of 7 with 20% sodium hydroxide (caustic soda).

4.3.9 BIOVENTING WELLS, PIPING AND BLOWER SYSTEM

Once LNAPL is no longer consistently removed, the bioventing subsystem will commence operation. The bioventing wells have screened intervals that extend from 40 feet above the water table to 10 feet below the water table to achieve air distribution over the full target depth. There are ten bioventing wells, eight of which are co-located with ground water extraction wells. The airflow rate to each biovent well will be manually adjusted based on oxygen levels within the target depth area and soil gas pressure readings will be collected at various monitoring points. Based on the results of the bioventing treatability test, the design airflow rate for six of the biovent well nests was 500 standard cubic feet per minute (scfm) and 200 scfm for two shallow biovent well nests, at a pressure of approximately 50 inches water to the subsurface target area. Most of the biovent wells are constructed with Schedule 80, 4-inch-inner diameter (ID) polyvinyl chloride (PVC) pipe.

The blower is a 75 horsepower (hp) centrifugal blower capable of providing up to a total of 5,000 scfm at 55 inches water in order to provide the required airflow rate to each biovent well. The piping system consists of a 12-inch high-density polyethylene (HDPE) intake pipe attached to an intake filter/silencer, a 16-inch HDPE manifold that feeds 8-inch or 6-inch headers. Each pipe is equipped with a flow meter, flow control valve, and a pressure indicator and excess air is vented to the outside of the building via a vent pipe. At the well vault, the 8-inch or 6-inch HDPE pipe is reduced to a 4-inch flexible pipe connected to the biovent well. Airflow to the biovent well can be further controlled using the additional flow control valve located in the well vault. Maintenance on the biovent system would typically consist of inspecting and replacing air intake filters and greasing the bearing on the electric motor.

4.3.10 SYSTEM CONTROLS

The controls from the original treatment system remain in place in the old building and monitor that same equipment, except for the COW that was moved to the new building. An additional system was installed in the control room of the new building that monitors all new equipment, the COW, and information from the old PLC system, which is linked to the new PLC. This allows all operating systems to be monitored from one PLC. The system utilizes several level controllers, flow meters, and pH controllers. Level controllers are on the COW, equalization tank, DAF pump tank, float storage tank, filtrate storage tank, and neutralization tank. The coagulant tank and the neutralization tanks are equipped with pH meters.

4.3.11 DISCHARGE

Treated ground water is discharged to a combination infiltration basin/gallery located northwest of the former biopad site. It is located to minimize the potential for treated water to discharge over the target ground water collection area and induce gradients away from the ground water collection system. The infiltration basin/gallery is designed to infiltrate the pumping capacity of the ground water wells (120 to 160 gpm).

During freezing temperatures, treated water is discharged through the infiltration gallery (i.e., underground leach field) to avoid complications due to freezing. During above-freezing conditions, water is discharged above ground through a more conventional infiltration basin. Discharge to the gallery or basin can be easily controlled with manual values. In addition, there is a manhole inlet that connects the basin and the gallery, so if either clogs, the treated water flows to the other structure.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

The construction of the pretreatment system was completed in March 2004, and the full system resumed operation in March 2004. The following table provides the budgeted annual O&M costs for calendar year 2005, which are similar to the projections for calendar year 2006.

Item Description	Estimated Cost*
Labor: Project management, reporting, etc.	$156,736
Labor: System operation	$120,120
Labor: Ground water sampling	$37,800
Utilities: Electricity	$37,931
Utilities: Other	$41,037
Non-utility Consumables (GAC, chemicals, etc.)	$156,301
Discharge or disposal costs	$538,400
Analytical costs	$34,700
Other (parts, routine maintenance, etc.)	$83,975
Total Estimated Cost	**$1,207,000**

** Projected for calendar year 2005*

4.4.1 UTILITIES

The primary utility expenditure is for the propane used for building heat, approximately $40,000 per year. Electrical costs for the plant tend to average approximately $3,000 per month due to the large number of motors associated with the system.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Non-utility consumables include GAC, bag filters, and chemical addition. The GAC is the primary cost in this category. There are approximately six replacements of 12,500 lbs of GAC each year. At an estimated unit cost of $0.76 per pound (provided by the site team), the cost for this is estimated to be $57,000. Approximately $71,000 is budgeted for the ferric sulfate, sodium hydroxide, bag filters, and polymer. Therefore, the actual costs are approximately $128,000 ($28,000 less than the budgeted costs).

The largest portion of the budgeted site costs are for disposal at about $538,400 for 2005 with the following breakdown: LNAPL (25%), GAC (12.5%), filter cake (60%), and debris disposal (2.5%). Based on information provided by the site team during the RSE site visit, the actual costs are closer to $200,000 per year as follows:

Disposal Item	Units per Year	Unit Cost	Total Cost per Year
LNAPL	8,400 gallons	$6 per gallon	$50,400
GAC	75,000 pounds	$0.25 per pound	$18,750
Debris (bag filters, etc.)	3,200 pounds	$1.50 per pound	$4,800
Filter cake	155,960 pounds	$0.79 per pound	$123,200
		Total	**$197,150**

The site team conservatively estimates usage so that the site has enough funding to keep operating. At this rate, however, the conservative estimates result in approximately $346,000 in extra funding for the site.

4.4.3 LABOR

There are three principal labor cost categories: project management, operator labor, and ground water sampling. Project management (PM) and reporting is approximately $156,000 per year. This cost is mainly time for the project manager but also includes general PM, budget tracking, preparation of annual reports, preparation of monthly tech status reports, management of subcontractors, and data evaluation. Operator labor is approximately $125,000 and involves one full-time local operator plus time for someone to help with two-person tasks, a total of 1.25 full time equivalents (FTEs) with travel costs from Milwaukee for the second person. The labor for the ground water sampling was approximately $38,000 for 2005, but is estimated to drop to approximately $29,000 due to the elimination of the May sampling event. Two two-person teams can complete the September event in 5 days, including travel from Milwaukee. This cost is relatively high for sampling 20 monitoring wells and 9 residential well samples, but the relatively high costs are in part due to travel time from Milwaukee and the depth of wells.

4.4.4 CHEMICAL ANALYSIS

The annual analytical costs for 2005 were approximately $34,700, but the estimated costs for 2006 are approximately $26,800 due to the elimination of the May sampling event. Monitoring wells are sampled annually for PCP; benzene, toluene, ethylene, and xylene (BTEX); naphthalene; Target Analyte List (TAL) metals; and natural attenuation indicator parameters. The ground water treatment system influent is sampled for PCP on a monthly basis. The table below illustrates the monitoring requirements for the system effluent to the infiltration basin.

Parameter	Sample Frequency
pH field	Quarterly
Total Suspended Solids (TSS)	Quarterly
Chloride	Quarterly
Diesel Range Organics (DRO)	Monthly
Total Organic Carbon (TOC)	Monthly
1,3,5-Trimethylbenzene	Quarterly
1,2,4-Trimethylbenzene	Quarterly
Total Trimethylbenzene	Quarterly
Dioxin (2,3,7,8 TCDD)	Quarterly
Pentachlorophenol	Weekly
Phenol	Monthly
Naphthalene	Monthly
Benzene	Quarterly
Ethylbenzene	Quarterly
Toluene	Quarterly
Xylene	Quarterly
Arsenic, Total Recoverable	Quarterly
Copper, Total Recoverable	Quarterly
Zinc, Total Recoverable	Quarterly
Iron, Total Recoverable	Quarterly
Manganese, Total Recoverable	Quarterly
Acid Extractable	Annual
Dioxins & Furans (all congeners)	Annual

4.5 RECURRING PROBLEMS OR ISSUES

The previous problem of not meeting discharge standards has been addressed through the construction and operation of the pretreatment unit. Upon completion of the pretreatment system, there were concerns about indoor air quality in treatment plant; however, this concern was addressed by improving tank lids and increasing the air exchange rate in the building. Other issues, beyond the control of the site team, include a severe tornado in 2004, which came close to the site, and frequent lightning strikes in the area.

4.6 REGULATORY COMPLIANCE

Since operation of the pretreatment system, discharge standards are routinely met and no issues regarding compliance were reported by the site team.

4.7 TREATMENT PROCESS EXCURSIONS AND UPSETS, ACCIDENTAL CONTAMINANT/REAGENT RELEASES

The site team reports that there have not been any uncontrolled releases of contaminants or reagents.

4.8 SAFETY RECORD

The site team reports no health and safety incidents.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The 2003 and 2004 increases in PCP concentrations for MW-13 suggest that the PCP plume might be expanding toward the northeast. Additional years of monitoring data will help confirm if the plume is expanding. The current system is not designed to provide hydraulic containment, so it is possible for the system to operate as intended and for the plume to potentially expand. The migration toward MW-13 is away from residences with potable wells but is toward wetlands and lakes to the northeast of the property. The remedy currently appears to be protective of human health and the environment but future monitoring will need to be evaluated to determine if the remedy will be protective over the long-term.

5.2 SURFACE WATER

The potential migration toward MW-13 is in the direction of Doctor Lake and an unnamed lake. Therefore, if migration is occurring and continues to occur in this direction, it could eventually present a threat to surface water. However, the lakes are 2,000 feet from the site, and contaminant migration would likely need to be much more substantial than currently observed to eventually impact the lakes.

5.3 AIR

Air is not expected to be impacted by the current ground water remedy. The primary contaminant of concern is PCP which will not affect air quality. The water table at the site is approximately 100 feet deep. Although LNAPL is present, concentrations of BTEX compounds and naphthalene are relatively low. The maximum concentrations found during the September 2004 sampling event were as follows: benzene non-detect (ND) at 5 μg/L and naphthalene at 282 μg/L). These results are well below any air quality limits and would not pose a risk to human health.

5.4 SOIL

Surface soils at the site have been addressed by consolidating and stabilizing soil in the on-site CAMU. The RSE team did not review this aspect of the remedy. Subsurface soils impacted with fuel oil and PCP will be addressed by bioventing after LNAPL collection is completed.

5.5 WETLANDS AND SEDIMENTS

A wetland located along the northern property boundary and the Amsterdam Slough Public Hunting area north of the site are the closest natural receptors for the contaminants of concern. Continued sampling to the northeast will help determine if contamination is migrating toward wetlands.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30%/+50%), and these cost estimates have been prepared in a manner consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July, 2000.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 FOLLOW WATER QUALITY TRENDS IN MONITORING WELLS TO DETERMINE IF THE PLUME IS MIGRATING

The potential migration evidenced by increased PCP concentrations in MW-13 suggests the need to continue to closely evaluate the concentration trends in this well to determine if plume migration is occurring. It is recommended that the site team continue to closely follow the sampling data from this and other monitoring wells to evaluate the potential for plume migration. These monitoring wells represent the only source of information that will provide evidence of migration before residential wells or ecological receptors are impacted. If continued increases are observed in MW-13, the site team may want to consider installing a monitoring well approximately 300 feet east of MW-13 (if access is available) to monitor potential migration in this direction. If data suggests that migration is occurring in the direction of the residences, a more thorough capture zone analysis is likely merited to determine if pumping needs to increase to prevent migration and protect these wells.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 PROVIDE MORE ACCURATE PREDICTION OF CONSUMABLES AND DISPOSAL COSTS

After another year of operation, the site team should more accurately predict materials and disposal costs and budget site costs accordingly. Many of the estimates provided to the RSE team, including those for GAC, LNAPL, and filter cake disposal are too conservative and over estimate the expenditures for the site. The RSE team found that the estimates for utilities, lab analysis, and labor are reasonable and there are no significant savings likely. Based on the actual and budgeted costs discussed in Section 4.4 of this report, the site team budgets approximately $374,000 per year in extra funding for consumables and disposal costs. Another year of operation will provide the site team with more data to provide better estimates for funding in future years. The site team should strive to estimate/budget costs accurately so that unnecessary funding is not allocated to this site instead of other sites where it might be more appropriate. If the budget does include this extra $374,000, then the annual costs are closer to $833,000 per year.

6.2.2 CONSIDER MODIFYING MANAGEMENT OF GAC UNITS

Assuming an influent PCP concentration on the order of 10,000 μg/L, GAC isotherms suggest a GAC usage of approximately 1 pound of GAC per 1 pound of PCP. With this influent concentration and a flow rate of 90 gpm, the mass of PCP exiting the DAF is approximately 4,000 pounds per year. Based on chemical loading, this should translate to a GAC usage of approximately 4,000 pounds per year. However, the site team reports changing out 12,500 pounds approximately 6 times per year for a total of 75,000 pounds per year. Thus, it seems that the GAC may be replaced, in large part, due to pressure build up or solids loading. The site team should evaluate the following three options and move forward with the most appropriate one:

Option 1

> Consider replacing the 2,500-pound GAC unit (which is currently used more for its filtering capacity than for its chemical adsorption ability) with a sand filter, multimedia filter, or additional bag filters for improved filtering. This option might decrease the amount of solids loading to the downstream 10,000-pound GAC units thus extending the life of the GAC in those bigger units. In addition, because the 2,500-pound unit would no longer require GAC replacement, it might reduce GAC usage for the site by approximately 15,000 pounds per year (2,500 pounds per changeout times six changeouts per year). At a cost of approximately $0.76 for GAC and GAC disposal, this translates to a savings of approximately $11,000 per year in savings associated with GAC.

Option 2

> Consider using GAC in the 2,500-pound unit but do not change it out as frequently. It would no longer provide adsorptive capacity, but it would continue to serve as a filter. This might reduce GAC usage by approximately 10,000 pounds per year (an estimated reduction of four replacements per year), but would not involve the capital costs of replacing the 2,500 pound unit with a new filter. This would be feasible because backwashing capability is available for this smaller GAC unit.

Option 3

> Evaluate the cost-effectiveness of adding backwashing capability to the lead 10,000-pound GAC unit. This would require more substantial capital cost and would be more of an engineering challenge due to the space requirements for the larger tank. However, if the GAC usage can be reduced by half (e.g., by approximately 37,500 pounds per year), the savings might be on the order of $30,000 per year.

6.2.3 ELIMINATE REDUNDANT OR UNNECESSARY LABORATORY ANALYSIS

The monitoring and sampling program can be modified to eliminate redundant samples and reduce costs without sacrificing remedy effectiveness. There is a significant amount of total and dissolved metals data from ground water sampling that exists and it is not being used for additional decisions. At a minimum, if consistent with State requirements, the site team should consider eliminating total metals since dissolved analysis occurs and is more representative of potential ground water problems. Costs could be reduced by approximately $3,000 per year without a loss of protectiveness. The site team should also seek to minimize analysis for dioxins in process water sampling given the high cost for the analysis. Where possible, other contaminants (e.g., PCP) should be used as indicators for contaminant presence. The RSE team acknowledges that the site team is already pursuing reducing the number of samples that are analyzed for dioxins. The RSE team agrees with the site contractor’s recommendation to eliminate the spring sampling event.

6.2.4 SAVINGS FROM THE USE OF DEDICATED PUMPS IN MONITORING WELLS

The installation of dedicated pumps in monitoring wells, which was accomplished during 2005, should reduce the time associated with purging the wells and decontaminating equipment. Therefore, the time associated with sampling should be reduced. The RSE team estimates that the annual sampling event may be shortened by one or two days, potentially resulting in savings of approximately $4,000 to $8,000 per year from the current annual sampling cost of $29,000. This estimate assumes that the semi-annual event has already been eliminated. The RSE team agrees with the site contractor's recommendation to eliminate the spring sampling event. The site team should also evaluate the potential for the plant operator to assist with the ground water sampling effort since the operator is already paid to be at the site and also does not incur travel costs from Milwaukee.

6.2.5 INVESTIGATE POSSIBILITY OF DECLASSIFYING WASTE

The filter cake disposal cost is extremely high. There are examples of similar filter cake being sufficiently stabilized and delisted so that disposal options other than incineration are available. Since the disposal costs are so high, the site team is encouraged to consider these other disposal options. Cost savings of up to $100,000 per year are possible. As an example, the link below discusses the delisting of filter cake at the GROWS landfill.

http://www.epa.gov/fedrgstr/EPA-WASTE/2001/July/Day-26/f18533.htm

6.2.6 DECREASE PROJECT MANAGEMENT/ REPORTING COSTS

The project management costs are estimated at about $157,000 per year, having decreased and stabilized since the design efforts in FY03. The cost is primarily time for the site contractor's project manager as well as contracting and technical support. These costs are high in comparison with similar sites. The RSE team would assume that PM costs will decrease over time to about $100,000 per year as the system operation becomes more routine.

6.2.7 DEVELOP TRACKING OF ROUTINE & NON-ROUTINE COSTS

Routine parts and maintenance and non-routine costs combine for a fairly significant portion of the annual cost. Routine parts and maintenance are expected to be $130,000 and non-routine costs expected to be $53,000. Pump replacements and erosion control are included in these costs but a detailed breakdown was not discussed. These costs seem relatively high, but likely result from the sampling pump installations and significant erosion control measures. A detailed tracking of routine and non-routine maintenance should be developed in order to easily see what activities are included in these costs and how they can be reduced.

6.2.8 EVALUATE POTENTIAL TO REDUCE GROUND WATER EXTRACTION WITHOUT SUBSTANTIALLY AFFECTING LNAPL RECOVERY

Disposal costs represent the single largest cost category for the site, even when considering the actual disposal values rather than the conservative estimates provided by the site team. Moreover, the majority of the disposal costs are associated with the disposal of the filter cake. For example, if ground water recovery can be decreased by 10% then a savings of approximately $15,000 could be realized in avoided disposal costs (approximately $12,500 for avoided filter cake disposal and approximately $2,500 for avoided GAC disposal). In addition, approximately $12,500 might be realized in reduced GAC and chemical usage. Thus, for a 10% reduction in ground water extraction, a savings of approximately

$27,500 per year might be realized. The site team should evaluate various pumping schemes to determine if pumping can be reduced without sacrificing the effectiveness of LNAPL recovery or the control of the dissolved contaminant plume. Given that this evaluation consists of decreasing pumping from some wells and tracking LNAPL recovery and concentrations at nearby monitoring wells, this evaluation should be feasible within the existing PM and reporting budget.

6.2.9 ADJUST pH TO 6.5 INSTEAD OF 7.0

Prior to discharge of treated water, the site team currently adjusts pH from approximately 5.7 to 7.0. Alternatively, the site team could adjust pH to 6.5. A pH of 6.5 is still within discharge criteria of 6 and 9 and is likely closer to the natural pH of the ground water. Adjusting to a pH of 6.5 would decrease the use of sodium hydroxide and the associated costs without sacrificing remedy effectiveness. Implementing this recommendation may result in savings of approximately $10,000 per year.

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

No recommendations are provided in this category.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

6.4.1 TRANSITION FROM GROUND WATER EXTRACTION & LNAPL RECOVERY SYSTEM TO BIOVENTING SYSTEM & INTRINSIC REMEDIATION

The site team estimates that the majority of LNAPL will be recovered within 10 years and that ground water extraction and LNAPL recovery system can be discontinued in favor of the bioventing system and intrinsic remediation. The RSE team agrees that the bioventing system should not be run concurrently with the ground water extraction system given the increased biological activity and the potential for fouling of the recovery wells and treatment system. This means that it is likely that ground water extraction, which is the most costly aspect of this remedy, will not need to occur after the site is transferred to the State. The RSE team supports this overall exit strategy assuming that sufficient data are available at the time of transfer to confirm that the dissolved plume is stable in the absence of pumping. If it is not stable, then the potential exists for PCP to migrate to residential wells and nearby wetlands and the RSE team would suggest that ground water extraction may need to continue.

7.0 SUMMARY

The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations are provided in three of the four categories: effectiveness, cost reduction, and site closeout. The recommendation for effectiveness focuses on plume delineation and migration. Recommendations for cost reduction include more accurate materials and disposal cost projections, considering modifications to the management of GAC units, eliminating redundant/unnecessary lab analysis, the use of dedicated pumps in monitoring wells, investigating declassifying waste, reduction in project management/reporting costs, tracking routine and non-routine costs, evaluating the potential to reduce ground water extraction without significantly affecting LNAPL recovery, and decreasing the pH adjustment from 7.0 to 6.5. The section on site closeout agrees in concept with the site team's exit strategy but emphasizes that the site team should document plume stability in the absence of pumping before discontinuing operation of the P&T system.

Table 7-1 summarizes the costs and cost savings associated with each recommendation in Sections 6.1 through 6.4. Both capital and annual costs are presented. Also presented is the expected change in life-cycle costs over a 10-year period for each recommendation both with discounting (i.e., net present value) and without it.

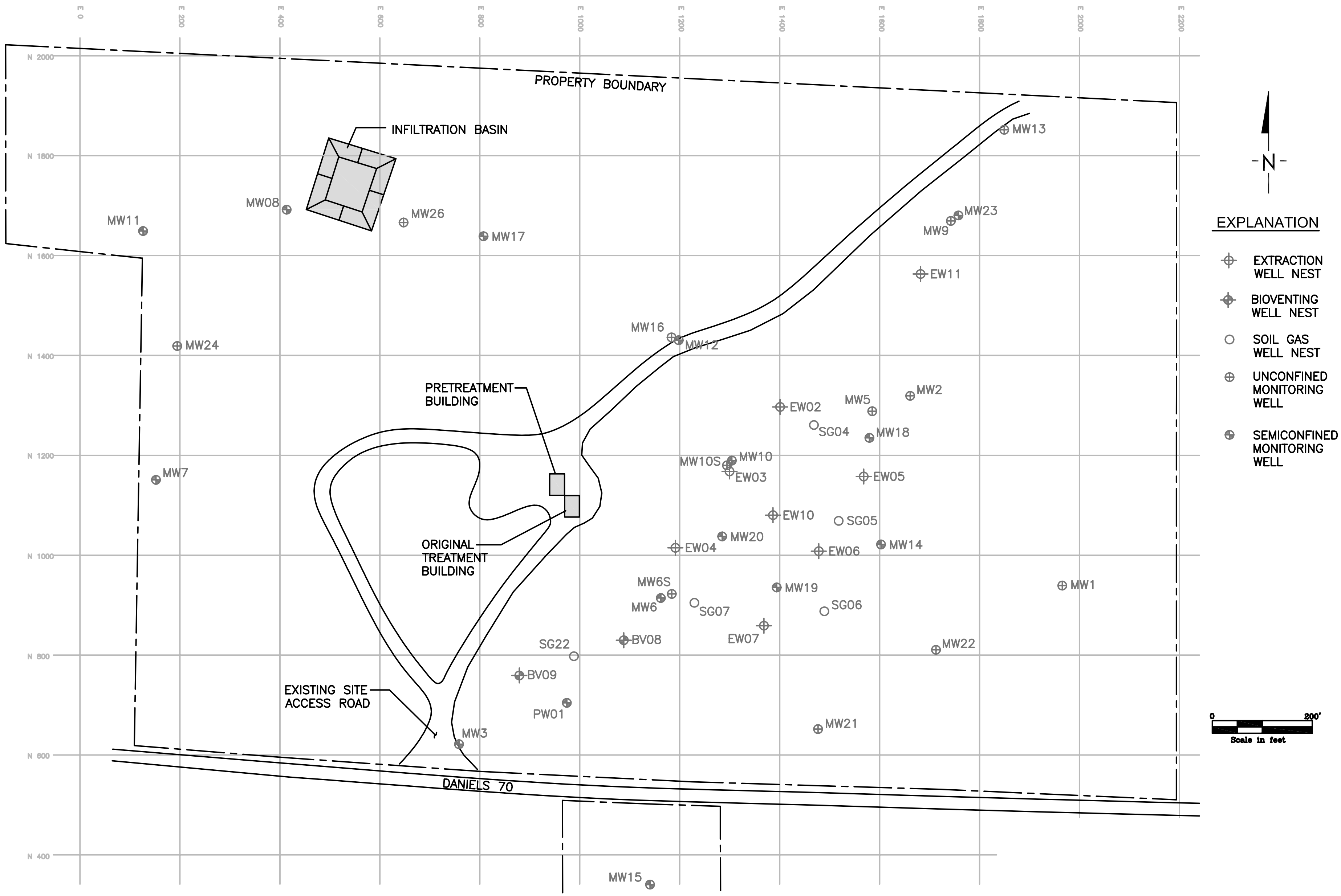
Table 7-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-cycle Costs ($)*	Estimated Change in Life-cycle Costs ($)**
6.1.1 Follow trends in monitoring wells to determine if plume is migrating	Effectiveness	$0	$0	$0	$0
6.2.1 Provide more accurate prediction of consumables and disposal costs	Cost Reduction	$0	($374,00)	($3,740,000)	($3,029,000)
6.2.2 Consider modifying management of GAC units	Cost Reduction	Not quantified	($10,000) to ($30,000)	($100,000) to ($300,000)	($81,000) to ($243,000)
6.2.3 Eliminate redundant or unnecessary lab analysis	Cost Reduction	Negligible	($3,000)	($30,000)	($24,000)
6.2.4 Use of dedicated pumps installed in monitoring wells	Cost Reduction	Negligible	($8,000)***	($80,000)***	($65,000)***
6.2.5 Investigate possibility for declassifying waste	Cost Reduction	Negligible	($100,000)	($1,000,000)	($811,000)
6.2.6 Decrease project management/reporting costs	Cost Reduction	Negligible	($57,000)	($570,000)	($462,000)
6.2.7 Develop tracking of routine & non-routing costs	Cost Reduction	$0	Not Quantified	Not Quantified	Not Quantified
6.2.8 Evaluate potential to reduce ground water extraction without significantly affecting LNAPL recovery	Cost Reduction	Negligible	($27,500)	($275,000)	($222,000)
6.2.9 Adjust pH to 6.5 instead of 7.0	Cost Reduction	Negligible	($10,000)	($100,000)	($81,000)
6.4.1 Transition from ground water extraction & LNAPL recovery system to bioventing system & intrinsic remediation	Site Closeout	Not quantified	Not quantified	Not quantified	Not quantified

Costs in parentheses imply cost reductions
* assumes 10 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 10 years of operation with a discount rate of 5% and no discounting in the first year
*** indicates savings that should be realized from actions that the site team took prior to the RSE

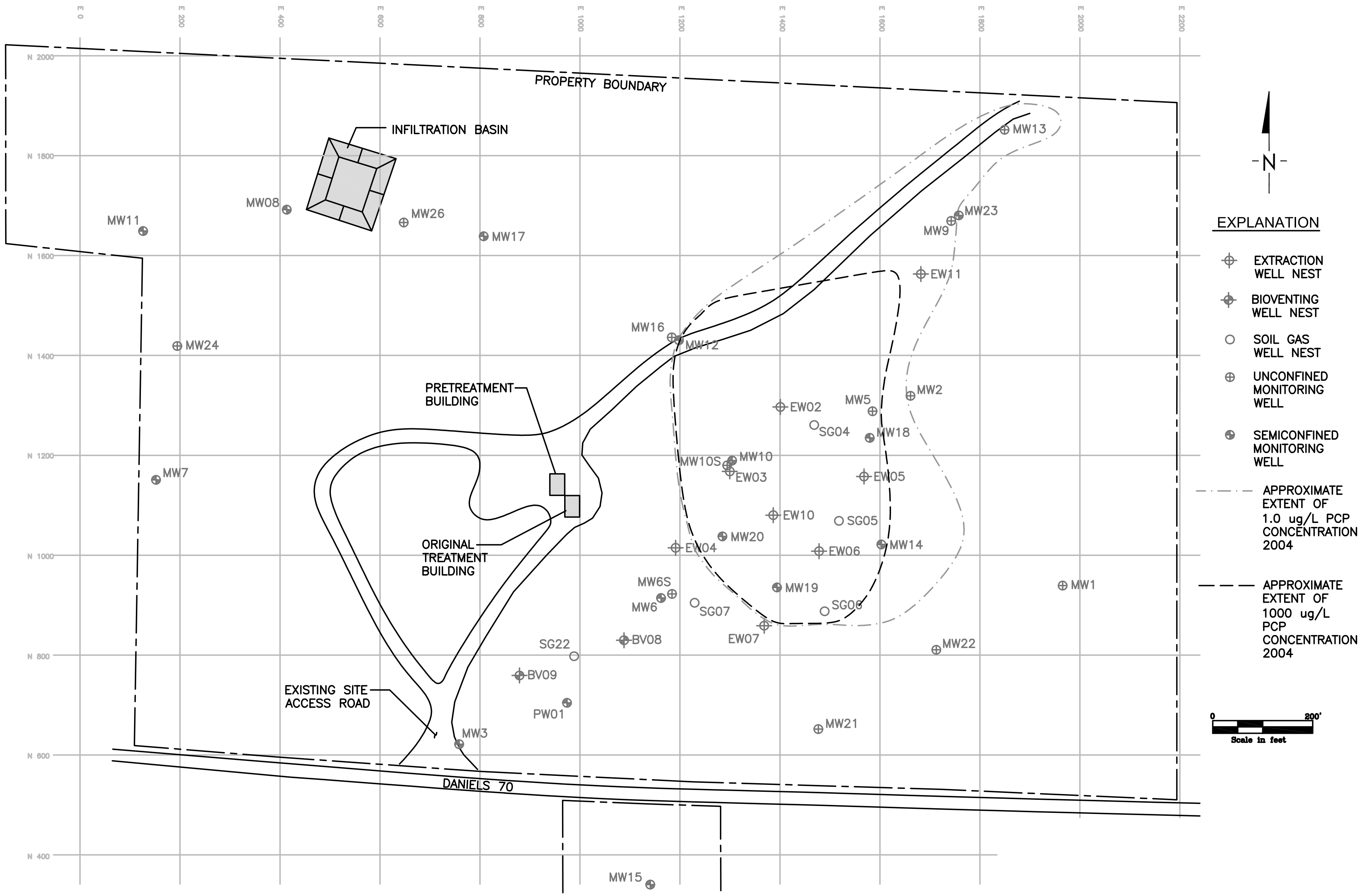
FIGURES

Figure 1-1 SITE MAP



(Note: Figure generated based on 2004 Annual Report, CH2M Hill, 2005)

Figure 1-2 EXTENT OF PCP GROUNDWATER CONTAMINATION 2004



(Note: Figure generated based on independent plume maps for the 1,000 ug/L and 1.0 ug/L plumes as depicted in the 2004 Annual Report, CH2M Hill, 2005. The 1,000 ug/L plume has been modified slightly to ensure it fits completely within the 1.0 ug/L plume)