REMEDIATION SYSTEM EVALUATION

IDAHO POLE COMPANY SITE
BOZEMAN, GALLATIN COUNTY, MONTANA

Report of the Remediation System Evaluation
Site Visit Conducted at the Idaho Pole Company Site
October 29-30, 2009

Final Report
February 11, 2010

NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) and Tetra Tech for the Montana Department of Environmental Quality (MDEQ) under DEQ Contract No. 407026. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Attachment B - Well Construction Table Prepared by Hydrometrics, Inc.
Attachment C - Comments on Draft RSE Report by Hydrometrics, Inc.

1.0 INTRODUCTION

1.1 PURPOSE

The RSE process involves a team of expert hydrogeologists and engineers that are independent of the site, conducting a third-party evaluation of remedy selection or remedy design. It is a broad evaluation that considers the goals of the remedy, site conceptual model, available site data, performance considerations, protectiveness, cost-effectiveness, and closure strategy. The evaluation includes reviewing site documents, potentially visiting the site, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure

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, and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by site stakeholders.

The RSE at the Idaho Pole Company Site (Idaho Pole) was requested by USEPA Region 8 and MDEQ, and contracted to Tetra Tech by MDEQ. The RSE was led by technical staff from GeoTrans, Inc. (GeoTrans), a wholly-owned subsidiary of Tetra Tech. The site visit for the RSE also provided an opportunity to conduct a site visit and related interviews for the Third Five-Year Review, which will be prepared by Tetra Tech several months after the completion of the RSE.

Idaho Pole is located near the northern limits of Bozeman, Montana. Soil and groundwater contamination resulted from past wood treating operations. The soil remedy is considered complete, and once remaining institutional controls regarding treated soils that were placed back on-site are implemented (expected within the next year), it is anticipated that the entire site will be delisted with respect to soils. Pentachlorophenol (PCP) is the predominant contaminant of concern in groundwater at the site. Groundwater remediation consists of a pump-and-treat (P&T) system plus several additional components (subsurface flushing, in-situ biodegradation, and collection of oil in a trench).

The RSE, which focuses on the groundwater remedy, provides an opportunity for an independent, third-party review of these remediation efforts. This Final RSE Report reflects conditions at the time of the RSE site visit in late October, 2009. Comments from Hydrometrics, Inc. (a contractor at the site) regarding the Draft RSE Report are included in Attachment C. At the instruction of USEPA Region 8 and MDEQ, the Final RSE Report was not modified based on these comments, but the comments are included herein to serve as a basis for subsequent discussion between site stakeholders.

1.2 TEAM COMPOSITION

The RSE team consisted of the following individuals:

Name	Affiliation	Phone	Email
Doug Sutton	GeoTrans, Inc.	732-409-0344	dsutton@geotransinc.com
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Colin McCoy	Tetra Tech	406-442-5588	colin.mccoy@ttemi.com

1.3 DOCUMENTS REVIEWED

The following documents were reviewed. The reader is directed to these documents for additional site information that is not provided in this report.

- Quarterly Progress Reports for 2009 (Hydrometrics, Inc.), various dates for first three quarters of 2009
- September 2009 Residential Well Sampling (Hydrometrics, Inc.), October 2009
- Groundwater Monitoring Network Optimization, Draft Final (GSI Environmental), May 2009
- 2008 Groundwater Assessment Report (Hydrometrics, Inc.), March 2009
- Technical Assistance for Idaho Pole Site (GeoTrans, Inc.), January 2009
- Quarterly Progress Reports for 2008 (Hydrometrics, Inc.), various dates
- Second Five-Year Review Report (USEPA Region 8), September 2005
- Remedial Action Completion Report (RETEC Group, Inc.), December 2002
- Petition for Controlled Groundwater Area to the Department of Groundwater Resources and Conservation, September 2000
- Construction Completion Report (Maul Foster & Alongi, Inc.), November 1999
- Explanation of Significant Differences (USEPA), November 1998
- Construction Completion Report (Geraghty & Miller, Inc.), January 1998
- Operations and Maintenance Manual, Groundwater Remedy (Arcadis Geraghty & Miller, Inc.), January 1998
- Final Design Report, Groundwater Remedy (Geraghty & Miller, Inc.), August 1996

- Explanation of Significant Differences (USEPA), May 1996
- Final Design Report, Soil Remedy (Geraghty & Miller, Inc.), May 1995
- Record of Decision (Montana DEQ and USEPA), September 1992
- Remedial Investigation Report (MSE, Inc.), March 1992

1.4 PERSONS CONTACTED

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

Name	Affiliation	Phone	Email
Lisa DeWitt	MDEQ	406-841-5037	lidewitt@mt.gov
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1.5 BASIC SITE INFORMATION AND SCOPE OF REVIEW

1.5.1 LOCATION

Idaho Pole is located near the northern limits of Bozeman, Montana and occupies approximately 50 acres in the east half of Section 6 and the west half of Section 5, Township 2S, Range 6E of Gallatin County. The site location is illustrated in Figure 1. The Site is bounded to the south by railroad tracks and to the north by Rocky Creek (which appears to represent the downgradient limit of historical groundwater impacts). The site is bisected by Interstate 90 (I-90).

Wood treating infrastructure was historically located south of I-90, though soil and groundwater were impacted both north and south of I-90. All former wood-treating operations were dismantled in 1999. Buildings that currently exist on the former wood treating property include the treatment building associated with the P&T system and an office building owned by Idaho Pole (not currently occupied). Property north of I-90 associated with the Site includes residences, pasture, and a power substation operated by Northwestern Energy that was constructed in the 1970s. As illustrated on Figure 1, some of the property north of I-90 is owned by Idaho Pole including the “Pasture Area” and two previous residences where groundwater wells were historically impacted.

Groundwater that is impacted by previous site operations flows to the northeast towards Rocky Creek. Rocky Creek, which is located north of I-90, also receives water from Mill Creek (which is located south of I-90) through a culvert that runs below I-90 in the eastern portion of the Site. Further downstream (northwest of the Site) Rocky Creek combines with Bozeman Creek (which is located west of the Site) to form the East Gallatin River.

1.5.2 SITE HISTORY, POTENTIAL SOURCES, AND RSE SCOPE

The site is a former wood treating facility. The facility began operation in 1945 using creosote as a preservative. Creosote was replaced with pentachlorophenol (PCP) in carrier oil in 1952. The interstate was constructed between 1967 and 1969, during the period when wood treating operations were occurring. There were ditches present during site operations (illustrated on Figure 2-2 of the RI which is included in Appendix A), such as along L Street, along Cedar Street, and near the substation. These ditches ultimately discharged north of I-90. An oily discharge was noted by MDEQ in ditches near the site and near Rocky Creek in 1978. The facility was closed in 1997. The Record of Decision (ROD) also indicated that surface soil in the Pasture Area north of I-90 was contaminated by shallow ground water transporting wood-treating fluid upward to the ground surface during high water table years. The RI provides extensive discussion of site history and potential sources.

The ROD was signed in 1992, and consisted of remedy components for both soil and groundwater (which were considered one operable unit) as described below:

- Soil components of the remedy selected in the ROD included the following:
    - Excavation and surface land biological treatment of approximately 19,000 cubic yards of contaminated soils from: 1) the pasture area north of I-90; 2) the area between Cedar Street and I-90; and 3) the former roundhouse area (the location of the former roundhouse is illustrated on Figure 2-2 of the RI which is included in Appendix A)
    - Hot water and steam flushing of soils underlying the pole plant facility and I-90 in order to recover hazardous substances
    - Separation and disposal of oily wood treating fluid extracted from soils
    - Closure of onsite treatment units in compliance with RCRA Subtitle C
- Groundwater components of the remedy selected in the ROD included the following:
    - Groundwater cleanup using groundwater extraction wells, biological treatment, and return of treated water to the aquifer to enhance in situ biological degradation and to control potential migration of contaminants
    - Treatment of contaminated residential wells exceeding maximum contaminant levels (MCLs) or risk based concentrations, at the point of distribution, in addition to institutional controls preventing new access to contaminated ground water

- Continued residential and groundwater monitoring

There have been two subsequent Explanation of Significant Differences (ESDs) that amended the remedy described in the ROD:

- An ESD in 1996 included the following elements:
    - Removed the hot water and steam flushing component of the soil remedy
    - Clarified the areas to be excavated
    - Clarified how the land treatment unit (LTU) for soils would be dismantled (eliminating the need for the RCRA cap specified in the ROD)
    - Described how treated soils would be placed on-site (including the isolation of any such soils containing dioxins/furans above ROD cleanup levels from groundwater and from direct contact)
    - Changed the groundwater treatment process from biological treatment to granular activated carbon (GAC)
    - Indicated that a first phase of the groundwater remedy would include the extraction and treatment of ground water on the south side of I-90 in the barkfill and pressure plant areas, plus in-situ treatment of the dissolved plume (i.e., downgradient of these extraction wells) by injection of treated ground water…a second phase would include modifications as necessary to achieve ROD goals, based on results of the first phase
    - Identified that ambient temperature water would be used for flushing the area beneath I-90, rather than hot water or steam
- An ESD in 1998 resulted from the termination of active wood treating operations at the site 1997. This allowed areas that had previously been considered inaccessible for remediation of soils to now be accessed. This ESD specified that all such areas would also be excavated and treated.

Soil was excavated and treated at the LTU which was constructed on-site, and the LTU was dismantled in 2002. Treated soils were placed back on-site (locations illustrated on Figure 9 from the Remedial Action Completion Report by RETEC, included in Appendix A). The treated soil contains dioxin above the soil cleanup standards identified in the ROD. Dioxin compounds adhere tightly to soil particles and do not migrate readily or leach into ground water or surface water. The soil was placed above historic high groundwater levels and was covered with several feet of soil on the surface to prevent direct contact with these soils. The soil remedy is considered complete, and efforts are underway by the Site team to finalize institutional controls for these specific areas containing the treated soils, at which point the entire site is expected to be de-listed with respect to soils.

The groundwater remedy began operation in February 1997. It consists of two lines of extraction wells and two lines of injection wells, all located on the south side (i.e., the upgradient side) of I-90 (see Figure 1 for locations):

- The southernmost line of five extraction wells, referred to as the "pressure plant extraction gallery" (PPEG), was located just downgradient of the pressure plant associated with previous wood treating operations. The "pressure plant injection gallery" (PPIG) is located just south (i.e., upgradient) of the PPEG.
- The northernmost line of five extraction wells, referred to as the "barkfill extraction gallery" (BFEG), was located closer to I-90. The "barkfill injection gallery" (BFIG) is located just south (i.e., downgradient) of the BFEG.

Treated groundwater is reinjected into the aquifer to foster flushing and in-situ bioremediation. In addition, an oil recovery interceptor trench is located on the north side (i.e., the downgradient side) of I-90 to collect oily material not excavated during the soil remedy due to the presence of the interstate. Pentachlorophenol (PCP) is the predominant contaminant of concern in groundwater at the site and has the greatest horizontal and vertical extent at the site. Concentrations of PCP have declined noticeably as a result of remedial actions to date (i.e., the soil remedy and the "first phase" of the groundwater remedy as defined in the 1996 ESD).

A "Controlled Groundwater Area" (CGA) was created in 2001 under State law that includes areas north and south of I-90. The purpose of the CGA designation is to prevent construction of new wells that may extract contaminated groundwater or allow the plume to spread. The extent of the area is illustrated on a figure included in Appendix A.

This RSE includes a holistic third-party review of the overall site remedy. The RSE focuses primarily on the groundwater remedy and the remaining groundwater impacts, since the soils remedy is considered complete. USEPA Region 8 indicated that it would like the RSE and subsequent Five-Year Review to serve as a basis for transitioning to the second phase of the groundwater remedy that is referred to in the 1996 ESD.

1.5.3 HYDROGEOLOGIC SETTING

The subsurface at the site is relatively complex. According to the ROD, there are a few delineated horizons at the Site, including a surficial clay, an intermediate silt at 25 feet below ground surface (bgs), a silty clay at 35 feet bgs, and another silty clay at 50 feet bgs. Intervening aquifers are composed of transmissive sands and gravels. The ROD states that the horizons are of variable thickness and permeability, and are generally continuous (but probably not continuous over the entire Site). A well construction table prepared by Hydrometrics is included in Appendix B. Most of the monitoring locations consist of clustered wells screened at different depth intervals, presumably constructed to address the presence of these different horizons. Most clustered wells are classified as "A" (shallower), "B" (intermediate) or "C" (deeper).

The RI concluded that there was some hydraulic connection between these different horizons based on hydraulic testing results. Groundwater impacts have also been detected in all three horizons, further suggesting that the silty clay layers are not continuous and/or are not sufficiently tight to prevent vertical contaminant migration.

Ground water elevation at the Site is generally within 12 feet of ground surface. During periods with high recharge, water levels reportedly reach ground surface. Potentiometric surface maps in recent reports are developed based on water level measurements at shallow wells, and those maps illustrate that groundwater consistently flows to the northeast throughout the year. The most recent water level map for the site (produced by Hydrometrics, Inc.), for September 2009, is

included in Appendix A. Water levels are typically highest in the spring, but the general groundwater flow pattern is similar throughout the year. The RSE team notes that in the site reports where water levels are reported (e.g., Appendix C of the 2008 Groundwater Assessment Report) water levels do not appear to be measured at all wells, and in particular only appear to be measured at the shallowest well at each well cluster. This does not allow for determination of where groundwater flow is upward versus downward.

Based on the Final Design Report for the Groundwater Remedy by Geraghty & Miller, pump testing conducted at one of the wells in the BFEG indicated a transmissivity of approximately 23,000 gpd/ft (which translates to 3,075 ft^2/d). Assuming sands and gravels comprise an approximate thickness of approximately 20 ft, the associated hydraulic conductivity of the sands and gravels would be approximately 150 ft/d.

The RSE team provides the following calculation of groundwater velocity, using approximate values of 0.011 for hydraulic gradient (based on water level maps) and 0.2 for porosity (estimate for sand):

$$V = ki/n = 150 \text{ ft/d} * 0.011 / 0.2 = 8.25 \text{ ft/d} * 365 \text{ d/yr} = \sim 3000 \text{ ft/yr}$$

This is an extremely fast groundwater velocity. The distance from the source of contaminants to the approximate historical plume extent (i.e., Rocky Creek north of I-90) is less than 2000 ft. Thus, groundwater travel time from the source areas to Rocky Creek is expected to be less than one year (though contaminant transport is expected to be slower due to retardation).

1.5.4 POTENTIAL RECEPTORS

The following issues regarding potential receptors are noted:

- As stated earlier, the treated soil placed back on Site contains dioxin above the soil cleanup standards identified in the ROD. It was stated during the RSE visit that a deed restriction for this part of the Site that was developed after the previous Five-Year Review, to prevent direct contact with these soils, was determined to be not sufficient. Efforts are underway by the Site team to finalize institutional controls for these specific areas, at which point the entire site is expected to be delisted with respect to soils.

- Residences are located in the northern portion of the Site (i.e., north of I-90). To date, impacts from PCP have been detected in two residential wells (RES-8 and RES-10). To prevent use of those water supply wells, the land associated with RES-8 and RES-10 was purchased by Idaho Pole. Groundwater sampling continues at RES-1 to RES-9 (sampling at RES-10 was replaced by sampling at an adjacent monitoring well cluster). The RSE team notes there may be other properties with wells northwest of RES-8 but before Rocky Creek, but those are not detailed in site reports.

- During interviews in November 2009 conducted in support of the upcoming Five-Year Review, an oil sheen was reported at one of the residences (RES-2) in a trough fed by shallow groundwater from which a cow drinks. This may require further evaluation to determine if it is possible that this could be due to local sources at the home rather than due to the historical activities at the Site.

- A CGA was created in 2001, south and north of I-90, to prevent construction of new wells that may pose a threat to human health. The extent of the area is illustrated on a figure included in Appendix A.

- Groundwater impacted with PCP appears to discharge to Rocky Creek. Maps in previous site reports suggest the 1 ug/l contour of PCP in groundwater does not extend to Rocky Creek. However, additional wells (including additional depth intervals at some well clusters) were sampled during September 2009 in advance of the upcoming Five-Year review, and a PCP concentration of 43 ug/l was detected at monitoring well 27-B (located just upgradient of Rocky Creek). This concentration of PCP in groundwater, located near the discharge point to surface water, is slightly above acute and chronic National Recommended Water Quality Criteria (Gold Book) for freshwater, which are ARARs for the site according to the ROD. The Gold Book criteria are pH dependent. With pH 7 (appropriate for groundwater at this site), the acute and chronic freshwater criteria for PCP are 8.7 ug/L and 6.7 ug/L. Although the concentrations in some groundwater discharging to Rocky Creek may exceed these ARARs, it is noted that actual concentrations of PCP that would be measured in surface water flowing in Rocky Creek would be expected to be much lower (or non-detect), and the concentrations of PCP in groundwater that might discharge to Rocky Creek are much lower now than the concentrations prior to the remedy.

- Oil is collected using absorbent pads in an open trench just north of I-90. The area is fenced off, and is surrounded by vegetation. Although oil globules are collected with the absorbent pads, the water quality is not sampled, and it is unclear if this trench is a potential pathway for ecological exposure.

1.5.5 DESCRIPTION OF GROUNDWATER PLUME

Recent plume maps for PCP in groundwater (prepared by Hydrometrics for results from April 2008 and September 2008) are included in Appendix A. Note that these maps provide one composite plume map for the all of the vertical horizons monitored, but results for samples from all horizons sampled are posted.

Based on the PCP plume maps for 2008, concentrations of PCP appear to be below (or close to) the groundwater standard of 1 ug/l prior to reaching Rocky Creek. However, additional wells sampled in September 2009 (for consideration during the Five-Year Review) include some deeper screened wells near the downgradient edge of the plume, and those data indicated somewhat higher PCP concentrations near Rocky Creek (e.g., 43 ug/l at well 27-B and 9.7 ug/l at well 24-B). It also suggests the potential that some PCP contamination may extend beyond RES-8 and GM-8 towards or parallel to Rocky Creek in deeper horizons.

The highest PCP concentrations are found at monitoring well 5-A (located south of I-90, just upgradient of the BFEG) and at monitoring well GM-4 (located just downgradient of I-90). Concentrations of PCP at 5-A are currently on the order of 1,000 ug/l, and concentrations at GM-4 are on the order of 100 to 200 ug/l. Based on the 2008 Groundwater Assessment Report, PAH compounds are generally only detected in groundwater south of I-90.

Figures 5-1 to 5-8 of the 2008 Groundwater Assessment Report (included in Appendix A) present changes in interpreted PCP plume contours from 1998 to 2008. The first four are for spring

conditions, and the second four are for fall conditions. These figures suggest decreasing PCP concentrations over time, presumably due to remedial actions to date (source removal, P&T, and potentially in-situ biodegradation).

2.0 SYSTEM DESCRIPTION

There are multiple components of the groundwater remedy:

- The P&T system located south of I-90
- Flushing of the area beneath I-90 (associated with water treated from the P&T system that is reinjected just south of I-90)
- In-situ biodegradation (potentially augmented with addition of nutrients into the water treated by the P&T system that is reinjected)
- Collection of oil in the ditch just north of I-90

Details regarding these components of the remedy are provided below.

2.1 GROUNDWATER EXTRACTION SYSTEM

The extraction system consists of two separate extraction galleries: the PPEG and the BFEG. Each system consists of five extraction wells. The extraction wells are 6 inches in diameter, and extend to a depth of approximately 40 feet bgs. The pumps are constant speed pumps (Grundfos 4-inch pumps with 0.5 HP Franklin motors) that are controlled by throttling back a valve in the well vault. Each well has a flow totalizer for measuring flow. There is a level sensor in each extraction well that will shut the well off if the sensor dewaters, and turn the well back on when the water level recharges to an appropriate level. The system operators adjust pumping rates via valves so that wells do not cycle in this manner.

The Final Design Report for the Groundwater Remedy indicated anticipated extraction rates of 90 gpm for the PPEG and 50 gpm for the BFEG. It was stated during the RSE site visit that the treatment plant has limited the capacity of the overall P&T remedy. The site team reported that each extraction system could extract approximately 100 gpm, but that in the early stages of remedy operation the treatment plant was only able to achieve 70 gpm. Due to some upgrades, the treatment plant can now handle approximately 100 gpm. Now the informal target for total pumping rate is 100 gpm, but there is no specific target for the extraction rate from either system (it appears the site operator attempts to achieve approximately 50 gpm at each of the two extraction galleries).

2.2 GROUNDWATER TREATMENT AND REINJECTION SYSTEM

The Final Design Report for the Groundwater Remedy indicates that the treatment plant was designed for a maximum capacity of 300 gpm. This 300 gpm was to accommodate 90 gpm from the PPEG, a potential maximum of 90 gpm from the BFEG (though the design only anticipated 50 gpm), additional extraction from a potential second phase of the groundwater remedy, and some contingency. Despite this conservative design capacity, the treatment plant initially only provided 70 gpm of capacity and after some upgrades/modifications can now provide approximately 100 gpm of capacity.

The treatment plant consists of the following components:

- The water enters an influent tank (approximately 7,000 gallon capacity), which operates off of a low level sensor (turns off pump to subsequent treatment process), high level sensor (turns pump on to subsequent treatment process) and a high-high sensor (triggers alarm).

- Water is pumped from the influent tank through two sets of bag filters. There are three pumps (7.5 HP each) but only one is used at a time. The first set of bag filters consists of three pairs of 50-micron filters in parallel. The second set of bag filters consists of three pairs of 10-micron filters in parallel. In the spring both sets of filters are changed approximately daily, with somewhat less frequent changes the rest of the year. Differential pressure can be measured at each bag filter array. The filter bag changeout frequency is one of the capacity limiting processes for the treatment plant.

- Water moves from the bag filters to the GAC units. There are two 20,000 gallon GAC vessels in series. Differential pressure can be measured at each GAC vessel. These units are backwashed approximately once per month (using all three pumps that are available for either effluent or backwash), with backwash water routed to the influent tank. There has only been one GAC change during the lifetime of the remedy, during which the lead GAC vessel was changed and switched to become the lag vessel. At that time the lead vessel had a silty buildup near the top that likely resulted from incomplete filtering (larger bag filters were used at that time) and backwashing at a flow rate that was too low. With the use of the current bag filters, plus the monthly backwash using all three available pumps, no further changes of the GAC have been necessary.

- From the GAC vessels water enters the effluent tank (approximately 7,000 gallon capacity). A nutrient addition of fertilizer material is added to the water in the effluent tank. Idaho Pole indicated that the mixture is 319.31 gallons of 10-34-0 (N-P_2O_5-K_2O) and 254.9 gallons of 32% nitrogen.

- Three pumps (7.5 HP each) are available to discharge water from the effluent tank to the two injection galleries, although only one pump is used at a time for this purpose. However, all three pumps are used during backwashing. The water level can be measured at each of the two injection galleries. The effluent tank has low and high sensors to control pumping and a high-high sensor as a failsafe.

Controls that can trigger an alarm condition via autodialer include the high-high sensors associated with the influent and effluent tanks (mentioned above) plus a level control on the treatment building sump.

Two injection well galleries were constructed, as illustrated on Figure 1:

- The southernmost gallery (PPIG) is located just upgradient of the pressure plant associated with previous wood treating operations, and was intended to provide flushing of that area and promote in-situ biological treatment as a result of the nutrient addition. It includes 15 wells that are two inches in diameter and extend to approximately 26 ft bgs.

- The northernmost gallery (BFIG) is located immediately upgradient of I-90, and was intended to flush contaminants from beneath 1-90 and to promote in-situ biological treatment of groundwater downgradient of I-90 as a result of the nutrient addition. It includes 20 wells that are two inches in diameter and extend to approximately 20 ft bgs.

The wells in both injection galleries were installed in gravel filled trenches that extend to approximately 7 feet bgs to provide hydraulic head equalization between the injection wells and freeze protection for the wellheads.

2.3 OTHER ACTIVE REMEDY COMPONENTS

2.3.1 OIL COLLECTION IN DITCH NORTH OF I-90

A product recovery interceptor trench is located on the north side (i.e., the downgradient side) of I-90. Oily material collects in this trench on a daily to weekly basis, and is removed with absorbent pads that are disposed of in drums. This oily material is likely diesel or a similar oil that was used as a carrier oil during facility operation and likely represents material not excavated during the soil remedy due to the presence of the interstate. It is unclear if this oily material represents a continuing source of dissolved PCP impacts because the water quality of the trench is not sampled. It is possible that the reinjection of treated water upgradient of this trench augments the collection of the oily material within the trench.

2.4 MONITORING PROGRAM

Monitoring at the site includes the following:

- Groundwater samples are collected with a bailer at 24 wells semi-annually (spring and fall) using conventional sampling techniques (i.e., purge a minimum of three well volumes before sampling). PCP analysis is performed for all the wells with Method 8040/8041 (the RSE team refers to "method 8040/8041" here and elsewhere because site reports and chain-of-custody forms refer to "8040" but lab reports indicate "8041", leaving the RSE team somewhat confused). Field parameters (Redox, DO, pH, Temperature, Conductivity) are collected for a subset of the wells, and natural attenuation parameters (ammonia, nitrate, nitrite, total alkalinity, bicarbonate alkalinity, sulfate, sulfite, TOC and orthophosphate) are collected for a different subset of wells. PAHs are collected during one of the two events per year, for another subset of wells, and analyzed with method 8310.

- Groundwater samples are also collected at residential wells (RES-1 to RES-9) north of I-90 with analysis for PCP with Method 8040/8041. This sampling was originally performed on a quarterly basis, but the frequency has been reduced over time based on the consistency of results and is now performed annually (except for RES-8 which is sampled semi-annually). Sampling at well RES-10 was replaced by sampling at adjacent well cluster 26-A/B/C (RSE-10 was last sampled in 1991).

- Process sampling for the P&T system includes the following:

    - Influent samples to the treatment plant are collected monthly from each of the extraction galleries and analyzed for PCP by Method 8040/8041 and for PAHs by Method 8270-SIM. The sample for the PPEG is SP-1 and the sample port for the BFEG is SP-2.

    - Effluent samples from the treatment plant are collected monthly from sample port SP-7 (located after the lag GAC vessel) and analyzed for PCP by method 8270-SIM and for PAHs by Method 8270-SIM. Site reports state that Method 8270-SIM is used for PCP analysis for effluent sampling because it provides a lower detection limit for PCP than

Method 8040/8041. However, the RSE team is somewhat confused by this, since the PCP reporting limit for the samples analyzed with Method 8270-SIM appears to be 0.5 ug/l, whereas the PCP reporting limit for residential sampling using Method 8040/8041 appears to be 0.05 ug/l and the PCP reporting limit for treatment plant influent samples using Method 8040/8041 appears to be 0.25 ug/l. Nevertheless, all of the reporting limits are below the groundwater standard of 1 ug/l for PCP.

- Every two months samples are collected from between the two GAC vessels (sampling port SP-6) and analyzed for PCP using method 8270-SIM and PAHs using method 8270-SIM. Again, the RSE team is not clear on the reason for using 8270-SIM for the PCP analysis given the reporting limits provided in the lab reports.

- In addition, composite samples from each extraction gallery (PPEG and BFEG) are analyzed for field parameters and natural attenuation parameters twice per year.

QA/QC sampling for groundwater monitor well sampling includes a minimum of one field blank and two blind duplicates during each sampling event. Field blanks consist of pouring newly opened deionized water directly into laboratory-supplied sample bottles. Data validation is performed on all groundwater and residential well samples.

With respect to the groundwater monitoring, well 1-A is intended to be sampled as a background well but it is typically dry. Well 19-A is located east of 1-A (also up-gradient of the Site) and is sampled for background water quality when a water sample is not available from 1-A.

The groundwater sampling event conducted in September 2009 included sampling for PCP at 21 additional wells that are not typically sampled. This was done to provide additional PCP concentration data for the forthcoming Five-Year Review in response to suggestions from two previous technical assistance documents provided by independent contractors. One technical assistance report was provided by members of this RSE team and the other technical assistance report other was a monitoring optimization evaluation provided Dr. Mindy Vanderford of GSI Environmental. The sampling data for these additional wells was included in the Third Quarter 2009 Progress Report by Hydrometrics, but detailed interpretation in text or plume map illustrations has not yet been provided in a site report.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The focus of this RSE is on groundwater. Objectives of the overall remedy with respect to groundwater are stated in several places within the ROD, such as the following (note that references to "Table 13" refer to Table 13 in the ROD):

- From the "Cleanup Levels" section of the ROD:

  The purpose of this response action is to control risks posed by direct contact, ingestion and inhalation of soils and ground water and to minimize migration of contaminants to ground and surface water and air…Concentrations of contaminants in sediments, soils and ground water remaining after Site cleanup will correspond to lifetime cancer risks within the acceptable range of 1 x 10[-4] to 1 x 10[-6]. The cleanup levels for compounds having noncarcinogenic effects will result in a collective health hazard index below 1.0. Since no federal or state chemical specific applicable or relevant and appropriate requirements (ARARs) exist for soil or sediments, soil cleanup levels were determined through site specific risk analysis. Ground water cleanup levels were established at the final MCL for pentachlorophenol, benzo(a)pyrene and 2, 3, 7, 8 - TCDD (dioxin) and at proposed MCLs for other carcinogenic PAHs. Ground water will be treated to cleanup levels prior to reinjection into the aquifer or discharge to a publicly owned treatment works. For discharges to a publicly owned treatment works, pretreatment standards may require additional treatment. Treatment will be monitored to ensure that cleanup levels are achieved and maintained. Cleanup which addresses potential cancer risks will also address potential non-cancer health hazards. The cleanup levels for the Site are presented in Table 13.

- From the "Performance Standards" section of the ROD:

  The specific performance standards which will be used to ensure attainment of the remediation goals for ground water are:

  - *Reduction of contaminant levels in ground water within the attainment area to cleanup levels identified in Table 13; the attainment area is the contaminated ground water aquifer bounded by Rocky Creek, Bozeman Creek and I-90;*

  - *Extraction of ground water at the Site with contaminant concentrations exceeding the cleanup levels in Table 13;*

  - *Treatment of extracted ground water to cleanup levels in Table 13;*

- From the “Points of Compliance" section of the ROD:

  For ground water, compliance with remediation levels must be achieved throughout the contaminated ground water plume, located downgradient of I-90, extending to Rocky Creek.

- From the “Institutional Controls" section of the ROD:

  These controls are required to maintain the protectiveness of the remedy. Since cleanup for all media are not likely to be met in less than 10 years, measures must be instituted to ensure that risks do not reach unacceptable levels. Fencing and posting of areas where active remediation is occurring will be required to prevent unauthorized access to contaminated media or to remedial action areas. Institutional controls will include the prevention of domestic or commercial water well drilling in the contaminated ground water plume area to prevent additional receptors of contaminated ground water or an expansion of the plume. Land use and deed restrictions for the closed land treatment units will also be implemented to preserve the integrity of the closed land treatment units.

Table 13 of the ROD provides cleanup levels at the site for soil and groundwater, as follows:

Cleanup Levels from “ROD Table 13”

	Constituent	Cleanup Level	Basis
Soil and Sediments (mg/kg)	PCP	48	Risk
	Total B2 PAHs	15	Risk
	Total D PAHs	145	Hazard quotient
	TCDD TE*	0.001	Risk
Groundwater (ug/l)	PCP	1.0	MCL
	B2 PAHs:		
	Benzo(a)pyrene	0.2	MCL
	Benz(a)anthracene	0.1	MCL
	Benzo(b)fluoranthene	0.2	MCL
	Benzo(k)fluoranthene	0.2	MCL
	Chrysene	0.2	MCL
	Dibenz(a,h)anthracene	0.3	MCL
	Indeno(1,2,3-CD)pyrene	0.4	MCL
	D PAHs	146	Hazard quotient
	2,3,7,8-TCDD (Dioxin)	3.0×10^{-5}	MCL

**refers to sum of toxicity equivalents for individual polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), expressed as concentration of 2,3,7,8-tetrachlorophenol dibenzo-p-dioxin (TCDD)*

In the table above, “B2 PAHs” refer to PAHs that are probable carcinogens, and “D PAHs” refer to PAHs that are not classifiable with respect to cancer impacts.

During the RSE site visit, the RSE team noted that there is some ambiguity regarding the objectives of the groundwater remedy as stated in ROD, specifically with respect to the specific area where groundwater

cleanup levels are to be achieved. In several places the ROD appears to be stating that the objective is to attain cleanup goals in an "attainment area" north of I-90, rather than over the entire Site. Examples of such statements, extracted from the ROD text presented above, include the following:

- "Reduction of contaminant levels in ground water within the attainment area to cleanup levels identified in Table 13; the attainment area is the contaminated ground water aquifer bounded by Rocky Creek, Bozeman Creek and I-90" (from "Performance Standards" section of ROD).

- "For ground water, compliance with remediation levels must be achieved throughout the contaminated ground water plume, located downgradient of I-90, extending to Rocky Creek" (from the "Points of Compliance" section of the ROD).

It is not clear to the RSE team if the ROD wording was an attempt to differentiate cleanup objectives for groundwater north of I-90 versus south of I-90, or if no such differentiation was intended. The two ESDs to date do not provide any further clarification regarding this issue.

3.2 TREATMENT PLANT OPERATION STANDARDS

The "Performance Standards" section of the ROD specifies that extracted groundwater will be treated to cleanup levels stated in Table 13 of the ROD (presented above), which is the same as the cleanup standards for groundwater.

4.0 FINDINGS

4.1 GENERAL 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 site stakeholders. These observations 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 PLUME CAPTURE

During the RSE visit it was noted that no formal capture zone analysis appears to have been performed since operation of the P&T system began. A potential lack of capture at the BFEG is one potential explanation as to why elevated concentrations of PCP continue to be present at GM-4 and other monitoring wells north of I-90. It is noteworthy that well GM-4 is the well located north of I-90 that generally has the highest PCP concentrations, and GM-4 appears to be directly downgradient from the area monitored by well 5-A (which is located south of I-90 and is the most impacted monitoring well at the site).

The RSE team believes it is possible that operation of the P&T system to date has not provided the desired degree of capture at the BFEG, allowing migration of dissolved PCP from the vicinity of monitoring well 5-A towards GM-4 and beyond. The RSE team provides the following observations.

- Potentiometric surface maps generated from recent water level events are not sufficiently detailed to provide a reliable interpretation of the capture zone. This is somewhat typical because water level measurements from many locations, often an impractical number of locations, are needed.

- Interpreting capture using the direction of the hydraulic gradient based on strategically placed well pairs could assist with evaluation of capture if they existed at critical locations between the BFEG extraction wells and the BFIG reinjection wells (to demonstrate flow toward the extraction wells from the downgradient injection wells). These well pairs, however, are not present. Therefore, this potential line of evidence cannot be applied.

- A simplified calculation of extraction rate required to capture a specific plume width is as follows (using consistent units):

  $$Q = k*(b*w) * i * f = T *w * i * f$$

  Where:

  Q = pumping rate

k = hydraulic conductivity
b = aquifer thickness
T = transmissivity
w = plume width requiring capture
i = background hydraulic gradient
f = safety factor (accounts for heterogeneities and/or other sources of water to extraction wells other than from the plume, such as from surface water interaction, "clean" water from horizons above or below, or clean water from outside the horizontal extent targeted for capture…often assigned a value of 1.5 to 2.0 as a "rule of thumb")

Assuming a transmissivity of 3,000 ft^2/d (reported value from pump test at one of the BFEG wells), a hydraulic gradient of 0.011, and plume width of approximately 400 ft (slightly longer than the length of the BFEG gallery), a pumping rate of 68.5 would be required for capture if no safety factor is assumed. The required pumping rate might be closer to 100 gpm if a safety factor of 1.5 is assumed, and closer to 135 gpm if a safety factor of 2.0 is assumed.

The average extraction rate from the BFEG for the least seven quarters has ranged from 39 to 63 gpm (see Section 4.3.1). The RSE team believes the site operators have tried to generally achieve approximately 50 gpm at each of the two extraction galleries. Based on the simple flow rate calculation provided above, the RSE team believes that this may be too little pumping at the BFEG to provide complete capture at the BFEG, whether or not water is reinjected at the BFIG.

- The Final Design Report for the Groundwater Remedy (Geraghty & Miller, August 1996) is somewhat confusing on the issue of the flow rate from the BFEG that would be required for capture. In places the report suggests that a BFEG extraction rate of 90 gpm would be required to achieve appropriate capture. The design document also states that "additional simulations" were performed which indicated that 50 gpm at the BFEG would provide capture consistent with ROD objectives, but none of the figures presented in the design report illustrate the capture extent of the BFEG for a BFEG extraction rate of 50 gpm. The design report indicates that Figure 2-9 pertains to that scenario, but Figure 2-9 of the design report does not illustrate the capture zone of the BFEG; rather, it illustrates the extent of capture for the interceptor trench located north of I-90. The RSE team is not aware of any modeling results presented in the design report that illustrate or substantiate the statements in the design report that 50 gpm at the BFEG would be sufficient.

- More detailed modeling to assess capture has not been performed during operation of the remedy. Although detailed modeling is beyond the scope of the RSE, the RSE team performed some informal MODFLOW/MODPATH simulations as part of the RSE to evaluate these concerns, using a simplified one-layer model with uniform transmissivity (3,000 ft^2/d), uniform hydraulic gradient (0.011) and the coordinates for extraction and injection wells provided on the well logs (which are included in Appendix M of the 1998 Construction Completion Report). The RSE team notes that some of these coordinates are not consistent with other extraction/injection wells or other monitoring wells, but the overall geometry seems reasonably accurate for this simple analysis. Based on these informal simulations, The RSE team notes the following:

    - If both extraction galleries operate at 50 gpm, and both injection galleries operate at 50 gpm, there are simulated gaps in capture between each of the BFEG extraction wells. These extraction and injection rates represent the apparent target for current operations. The widest gap in capture is between the two western-most extraction wells associated with the BFEG (which is near the location where the highest PCP concentrations are observed, near monitoring well 5-A). The larger gap in capture in that area appears to be

due to somewhat larger spacing between the extraction wells, based on the coordinates on the well logs. Particles that escape through this gap travel towards GM-4 according to the simulation.

- The simulation results are quite similar if 50 gpm is extracted from the BFEG and injected at the BFIG (with no extraction or injection at the upgradient pressure plant galleries). This makes sense because the operation of the upgradient galleries creates a recirculation cell between the PPIG and PPEG (with water from the PPIG injection wells recaptured by the PPEG extraction wells, and water from upgradient of the PPIG flowing around the recirculation cell towards the BFEG). In other words, the combination of pumping and injection in the pressure plant area does not significantly alter the hydraulic gradient immediately upgradient of the barkfill area, and therefore does not significantly impact the capture extent at the BFEG.

- If 100 gpm is extracted from the BFEG with no reinjection at the BFIG (with no extraction or injection at the upgradient pressure plant galleries), the simulation indicates minor gaps in capture at the BFEG, particularly on the west side of the BFEG (i.e., in the vicinity of monitoring well 5-A). However, if 100 gpm is also injected at the BFIG, no gaps in capture are simulated.

- If 100 gpm is extracted from the BFEG with no extraction at the PPEG, and reinjection is split evenly between the two injection galleries, the gaps in capture are all eliminated except for one extremely narrow gap in the western portion of the BFEG. Also, water reinjected to the western portion of the upgradient PPIG is captured by the BFEG, and water reinjected to the eastern portion of the upgradient PPIG is not captured by the BFEG.

This simple modeling analysis suggests there is some reason for concern regarding the degree of capture provided by the BFEG under current operations (i.e., apparent target of 50 gpm at each extraction gallery and 50 gpm at each injection gallery). It is plausible that a gap in capture exists in the western portion of the BFEG (in the vicinity of monitoring well 5-A) which allows groundwater impacted by PCP to migrate downgradient towards GM-4 and beyond. Historical extraction rates were even lower than more recent extraction rates, due to treatment plant limitations, suggesting that any gaps in capture that might currently exist may have been larger in the earlier portion of remedy operation.

- PCP concentrations at GM-4 are lower than at 5-A, as indicated by the data presented in the table below (the ratio of PCP concentration at GM-4 versus 5-A is also noted in the table). Just after P&T was initiated, the concentration at GM-4 was more than 50% of the concentration at 5-A. This may be reflective of the degree of attenuation without P&T. During P&T operation, the ratio has stabilized at lower values, typically 10-20%, potentially suggesting that the BFEG captures some but not all of the PCP and the BFIG provides some dilution of the contamination that bypasses the BFEG.

Comparison of PCP at 5-A versus GM-4

Date	PCP at 5-A (ug/l)	PCP at GM-4 (ug/l)	% of PCP at GM-4 versus 5-A
5/90	14,000		
8/90	63,464		
11/90	764		
3/91	11,000		
9/94	12,000		
Source removal plus initiation of P&T			
3/98		4,000	
9/98	3,100	1,800	58%
3/99		820	
9/99	2,500	1,300	52%
3/00		1,300	
9/00	2,300	710	31%
3/01	1,900	1,000	53%
9/01		390	
4/02		450	
4/03	3,900	470	12%
9/03	2,200	350	16%
4/04	2,300	400	17%
9/04	6,900	300	4%
4/05	2,200	460	21%
9/05	1,400	280	20%
4/06	730	330	45%
9/06	1,200	< 0.25	0%
4/07	400	76	19%
9/07	1,000	170	17%
4/08	430	250	58%
9/08	1,200	250	21%
4/09	980	20	2%
9/09	950	93	10%

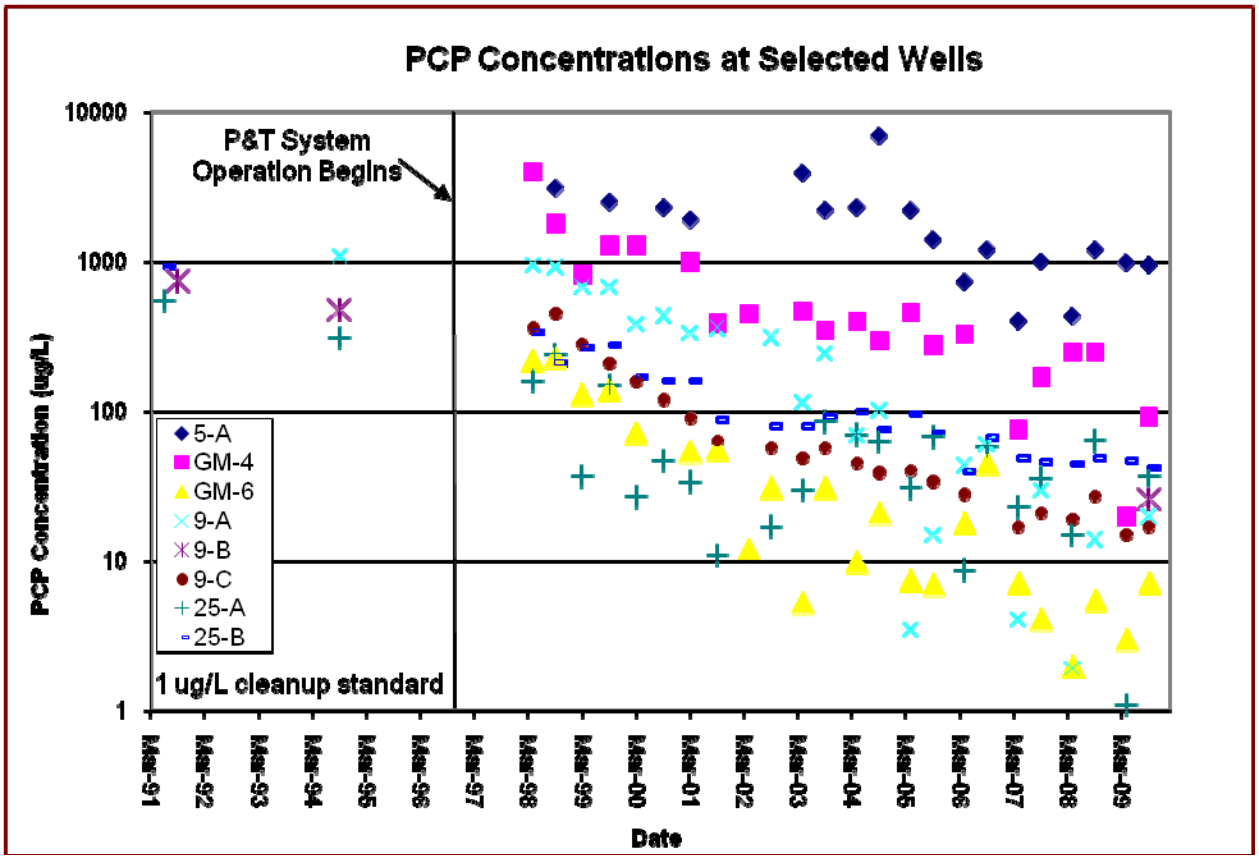
- As discussed in Section 4.3.1, extraction rates at each of the individual extraction wells are not provided in site reports, and the distribution of pumping may play a significant role in any gaps in capture (and would be important input for any future capture zone modeling that might be performed). Heterogeneity may also play a role. The well logs at the five BFEG extraction wells show differences from well to well. Gaps in capture, if they exist, may correlate with localized zones of more transmissive aquifer materials.

The RSE team notes that the potential presence of a continuing source of dissolved PCP beneath I-90 and/or in the pasture north of I-90 complicates the use of concentration trends north of I-90 as evidence regarding capture or lack of capture. A continuing source of dissolved PCP beneath I-90 or north of I-90 could also explain lingering PCP concentrations at GM-4 and beyond. Nevertheless, there are multiple lines of evidence that suggest there may be gaps in capture at the BFEG that allows PCP impacted water to migrate towards GM-4 and beyond. The informal modeling performed by the RSE team also suggests

the gaps in capture, if present, could be reduced or eliminated by focusing future extraction in the BFEG and eliminating extraction at the PPEG, and focusing injection at the BFIG (or perhaps split between the BFIG and PPIG). This approach was suggested by Hydrometrics during the RSE site visit, though the suggestion was made with regard to flushing the area between the two extraction galleries. The RSE team does not believe this modification would cause significant additional flushing between the extraction galleries, but believes the idea has merit because increasing the pumping rate at the BFEG will improve the extent of capture at the BFEG.

4.2.2 GROUNDWATER CONTAMINANT CONCENTRATIONS

A plot of PCP concentration versus time at selected monitoring well, prepared by the RSE team, is presented below.



The RSE team provides the following observations regarding concentration trends:

- The PCP concentration trends at GM-4, 9-A, 9-C, 25-A, 25-B, and some other wells on the north side of I-90 indicate a significant decline around the time of the onset of the monitoring program in 1998. The majority of soil excavation occurred in late 1995, and the P&T system began operation in 1997. It is unclear if the declines are associated with excavation of the source, operation of the P&T system, or a combination of the two.

- Also of note is what appears to be seasonal variation (i.e., spring versus fall) in the PCP concentration trends in 5-A, GM-4, 25A, and 9-A (superimposed on a general downward trend) that is not as apparent in the deeper wells. The variations in 5-A, GM-4, and 9-A are not necessarily in phase (i.e., highs at one well do not necessarily correlate with highs at another well). The difference in phase may be accounted for by travel time between wells. Whereas the variation at 5-A may be caused by recharge or rises in the water table contacting waste within the soil, the variations at GM-4 and 9-A could be caused by this same phenomena but also by changes in the BFEG extraction/injection and associated changes in the degree of capture.

- During the September 2009 sampling event some wells were sampled for the first time in many years to provide additional data for the Five-Year Review. Three of these wells are 16-B, 24-B, and 27-B. The PCP results in September 2009 at these three wells are substantially higher than the concentrations at other adjacent wells in the same cluster. For example, the recent PCP concentrations at 24-A1 have been non-detect but the September 2009 concentration at 24-B was 9.7 ug/L. The recent PCP concentrations at 27-A have been non-detect but the September 2009 concentration at 27-B was 43 ug/L. Well 16-A has not been sampled in recent events, but both 16-A and 16-B were sampled in September 2009, and the PCP concentrations were non-detect at 16-A and 46 ug/L at 16-B. The concentrations of approximately 40 ug/L at 16-B and 27-B help connect the upgradient portion of the plume at 25-A/B to the furthest known downgradient portion of the plume at RES-8. These data more clearly define a pathway for contamination observed at RES-8. The result at 24-B also indicates a potentially broader plume than illustrated in recent reports, and the potential for a portion of the plume to discharge to Rocky Creek further upgradient than previously illustrated. Results at 27-B suggest a potential for groundwater to discharge to Rocky Creek at higher concentrations of PCP than illustrated in recent reports.

- The bioremediation sampling program provides relatively little useful data for evaluating the effect of fertilizer addition and the degree of bioremediation. A few important pieces of information are missing. First, GM-4 is a key well that is contaminated and is located immediately downgradient of the injection system, but this well is not included in the bioremediation monitoring program. Therefore, a comparison of the injected concentrations of nitrogen and other nutrients cannot be compared to observed concentrations at this location. Second, the program does not analyze for some key parameters. Anaerobic degradation of PCP would result in the formation of tetrachlorophenols, trichlorophenols, bi-chlorophenols, and chlorophenol. Samples are not analyzed for these lesser chlorophenols. Third, wells within the same flow path are not included in the bioremediation monitoring program. Contamination likely migrates from GM-4 to the 9-A/B/C cluster, but GM-4 is not included in the program. Contamination from the 9-A/B/C cluster likely migrates to the 25-A/B cluster, but only 9-C is monitored for bioremediation parameters (not 9-A or 9-B). It is unlikely in this part of the plume that groundwater moves vertically upward from 9-C to 25-A or 25-B.

- The recent sampling result for PCP at 27-B (43 ug/L) provides an indication that RES-8 and GM-8 (which may be side-gradient) do not delineate the downgradient extent of the plume and that the plume may extend further than currently depicted on site maps. The plume extent can be generally inferred by the location of Rocky Creek and the likelihood of groundwater to discharge to Rocky Creek, but the reach of the creek where groundwater discharges to surface water is unknown. It appears that groundwater impacted with PCP discharges to Rocky Creek in the general area from 24-A1/A2/B cluster north and west toward the 27-A/B cluster and further west, toward and potentially beyond GM-8. The elevated topography on the far side of Rocky Creek makes it unlikely that the plume migrates any significant distance beyond the creek; however, the plume may follow Rocky Creek for some distance downstream before actually discharging to it.

It is possible that the plume parallels Rocky Creek and may impact groundwater underlying additional properties along Rocky Creek.

- The recent sampling result for PCP at 27-B suggests that PCP is not vertically delineated in that area. Conceptually, it would be expected that vertical gradients would transition to upward near the creek. However, the RSE team notes that at 25-A versus 29-D (upgradient of 27-A/B) there appears to be downward hydraulic gradient. PCP likely migrates upward towards Rocky Creek, but it is not clear where that transition occurs. There appear to be no monitoring points as deep or deeper than 27-B near Rocky Creek to provide vertical delineation (GM-8 is similar depth but may side-gradient).

4.3 COMPONENT PERFORMANCE

4.3.1 GROUNDWATER EXTRACTION AND INJECTION SYSTEM

Flow rates presented in reports for the last two years, by quarter, are as follows for each extraction gallery:

	Extraction		Injection	
Quarter	BFEG (gpm)	PPEG (gpm)	BFIG (gpm)	PPIG (gpm)
2007 – Q1	63	55	???	???
2007 – Q2	52	45	???	???
2007 – Q3	51	44	???	???
2007 – Q4	39	35	???	???
2007 – Q1	45	48	???	???
2007 – Q2	55	40	???	???
2007 – Q3	52	60	???	???

"???" indicates these data are not presented in site reports

The site reports also do not state if the rates presented above are based on totalizing flowmeters on each extraction well (summed together) or if the rates presented above are based on the sensor flowmeter on each extraction line. The RSE team believes results based on the totalizing flowmeter would be more accurate (sensor flowmeters tend to have imperfect calibration). There is a level sensor in each extraction well that shuts the well off if the sensor dewaters, and turns the well back on when the water level recharges to an appropriate level. The system operators throttle the flow to minimize pump cycling.

The RSE team notes that site reports (quarterly and annual) do not provide the flow rates for each injection gallery (as noted in the table presented above). It is not clear to the RSE team if these flow rate data are collected but not reported, or if they are not collected, but these data should be presented in future reports.

The RSE team also notes that site reports do not provide extraction rates for the individual extraction wells. These data are important and should be included in future reports. For instance, the distribution of extraction rates at the five extraction wells in the BFEG may play a significant role in the capture (or potential lack thereof) of the most impacted groundwater near monitoring well 5-A. The Site team stated during the RSE site visit that each extraction well has a totalizing flowmeter, so these data should be available.

The Site team indicated during the RSE site visit that the specific capacity of the pumping wells is not calculated or tracked over time, but water levels can be measured at each extraction well and pumping rates can be monitored at with existing totalizers at each extraction well, so the specific capacity can be calculated in the future. No major issues have been reported with well fouling during the RSE site visit, but the operators did mention that they have instituted a pump cleaning program. A maintenance program has been implemented that includes pulling and cleaning the extraction well pumps once per year, and there are plans to increase this to twice per year. The need for such a pump maintenance program suggests there is potential for well fouling to occur, and a pump cleaning program will not help clean the well screens. Well fouling would be indicated if more drawdown is noted in an extraction well over time, for a similar rate of pumping at the specific extraction well and surrounding extraction wells. By tracking pumping rate versus drawdown in the pumping wells, potential need for well screen maintenance can be indicated before it becomes a critical problem.

It was stated during the RSE visit that there was one acid washing of the influent lines approximately 5 years ago, but such treatments have not been necessary to maintain the target rates that the system has been operating at.

4.3.2 GROUNDWATER TREATMENT SYSTEM

The treatment system is clean and well-maintained. It was stated during the site visit that improvements to the treatment plant have allowed the average flow rate to increase, and the current target rate is approximately 100 gpm. These improvements include backwashing with all three effluent/backwash pumps to improve backwashing effectiveness.

The groundwater treatment system has relatively low influent concentrations, and meeting the effluent standards has not been an issue. Recent influent and effluent concentrations for PCP are indicated below:

Constituent	Month	PPEG Influent Concentration (ug/l)	BFEG Influent Concentration (ug/l)	Mid-Carbon Concentration (ug/l)	Effluent Concentration (ug/l)
PCP	3/4/08	< 0.25	41	< 0.5	< 0.5
	6/2/08	5.5	47	< 0.5	< 0.5
Standard: 1 ug/l	7/26/08	13	54	< 0.5	0.78
	9/24/08	3.9	57	< 0.5	< 0.5
	11/30/08	4.7	28	< 0.5	< 0.5
	1/28/09	1.3	16	< 0.5	< 0.5
	4/8/09	4.6	20	< 0.5	< 0.5
	5/30/09	24	18	< 0.5	< 0.5
	7/31/09	2.6	23	< 0.5	< 0.5
	9/21/09	1.6	16	< 0.5	< 0.5

Influent concentrations of PAHs are quite low, and are treated to non-detect. Carbon has only needed to be changed once, in one vessel, during the course of the remedy.

4.3.3 OIL COLLECTION TRENCH

The oil collection in the trench just north of I-90 has decreased substantially over time, presumably due to flushing of the oil from under I-90 over time. The number of absorbent pads used in recent years is

between 25 to 30 per year, primarily in the second and third quarters. The trench is generally frozen in the first quarter. It is unclear why oil collection decreases in the fourth quarter, but it may be due to a lower water table and/or freezing conditions for the latter part of the quarter.

4.3.4 INSTITUTIONAL CONTROLS

The site team established a CGA to restrict groundwater use within and adjacent to the plume. The CGA process allows for a description of the restrictions, and the restriction provided reads as follows "No new wells within CGA except for remedial action activities. Complete restriction of groundwater use within the area except for remedial activities." The CGA does not distinguish between shallow and deeper groundwater, or groundwater in deeper aquifers.

The area was established by: 1) incorporating all the IPC property to the south of I-90; and 2) establishing a buffer zone around the plume. The buffer zone was determined using model simulations to determine the distance a supply well would need to be from the 1 ug/L contour to avoid capturing or otherwise altering the plume. A number of simulations with varying parameters were run to establish the buffer zone, and the most conservative simulation in the analysis performed (attached to the CGA application) was for a 500 gpm well pumping in a "high permeability" formation. Based on the modeling, supply wells under this pumping scenario would need to be located greater than 320 feet sidegradient of the plume or greater than 170 feet upgradient of the plume. The high permeability formation was defined as 0.13 cm/sec, which is equivalent to a hydraulic conductivity of 370 feet per day. An aquifer thickness of 25 feet and a hydraulic head gradient of 0.011 feet per foot were assumed.

The specified hydraulic conductivity and the aquifer thickness results in a transmissivity of over 9,000 ft^2/day, which is approximately 3 times higher than the values obtained from historic pumping tests and used in the modeling during remedy design. Using the same assumed pumping rate of 500 gpm and a lower transmissivity would either widen the capture zone (and therefore extend the buffer zone) or cause the supply well to run dry. An equally important question, however, is the validity of assuming a 500 gpm supply well when establishing the boundaries of a CGA that completely restricts groundwater use. The current CGA, which was based on pumping rate of 500 gpm (albeit at a higher than appropriate transmissivity), would prohibit use of wells that would have substantially lower extraction rates, including additional or replacement supply wells for some local residences that might have an average extraction rate of under 10 gpm. The restriction may therefore be over-restrictive, especially if it does not allow for replacement of residential supply wells in areas where low extraction rates would not lead to well contamination or plume spreading. The CGA may also be overly restrictive with respect to including all of the IPC property south of I-90. Only a portion of that property is within the calculated buffer zone. On the other hand, the CGA may not fully account for the potential for impacted water to be transported for some distance parallel to Rocky Creek before it discharges.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

This is a private party site, and as such the costs are not a matter of public information. The RSE team estimates the overall system costs on the order of $195,000 per year to operate, and the RSE team estimates the following approximate costs for specific cost items as follows.

Item Description	Approximate* Annual Cost
Routine PM	$ 24,000
O&M Labor	$ 50,000
Electricity	$ 12,000
Supplies, well maintenance subcontractor, and parts	$ 25,000
Groundwater monitoring	$ 9,000
Reporting	$30,000
Analytical costs	$40,000
Waste Disposal	$ 5,000
Total Estimated Annual Cost	**$195,000**

**rough estimates made by RSE team*

4.4.1 UTILITIES

Electricity is used primarily for well pumps, treatment system transfer pumps, and two electric heaters in corners of the treatment building that are utilized from approximately October or November through March or April (assume approximately 6 months per year). Other utilities such as water and phone are very minor relative to the overall costs.

Based on information provided by Idaho Pole, electrical usage is approximately 19,000 kWh/month in winter months (with heating), and approximately 7,500 kWh/month in summer months (without heating). The electrical usage for the summer months is consistent with ten 0.5 HP extraction pumps running continuously and two 7.5 HP transfer pumps (one for influent and one for effluent) operating approximately 33% of the time. This is consistent with expected operation given that the extraction systems provide approximately 100 gpm and the transfer pumps can likely handle between 300 and 400 gpm based on their size. Electricity cost is estimated to be approximately $0.075 per kWh. Thus, electricity cost is estimated to be approximately $1,425 per month for approximately six months with heating, and approximately $550 per month for approximately six months without heating. The annual estimated electricity cost is approximately $12,000 per year. The heating appears to require approximately 11,500 kWh/month (19,000 kWh during winter minus 7,500 kWh during summer), and costs approximately $850/month in the winter.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Materials used at the site include fertilizer for reinjection, bag filters for filtration, GAC for water treatment, absorbent pads for oil collection, and sampling materials (gloves, bailers, etc.). The site team describes that all waste for the site is containerized in approximately 7 drums per year (which seems low given the number of bag filters, but this was the amount of drums indicated during the RSE site visit). The drums are disposed of off-site once per year (incineration). As stated earlier, only 1 carbon vessel has been changed over the course of the remedy.

4.4.3 LABOR

Labor for treatment plant O&M, groundwater sampling and various other on-site duties is provided by an independent contractor to IPC. Treatment plant O&M involves approximately 20 hours per week. Assuming a billing rate of $50 per hour (rough estimate made by RSE team), this translates to approximately $50,000 per year.

Groundwater sampling is conducted twice per year and appears to take approximately three days (perhaps up to 10-hour days), and likely an additional 10 hours of preparation for each event. Water level measurements are collected from 40 wells four times per year, with one person for one day for each event. Groundwater monitoring (water quality and water level measurements) plus perhaps 40 hours for reporting field notes, measured values and other items related to groundwater sampling likely involves approximately 150 hours per year. Using the same assumed labor rate, the field labor cost for groundwater monitoring is approximately $7,500 per year. Miscellaneous equipment or added labor (such as for residential wells) might add an additional $1,500 per year. Thus, a total of $9,000 for sampling is estimated.

Additional labor is involved in general site consulting and report preparation. Preparation of the quarterly reports and the annual report likely costs approximately $20,000 per year. An additional average of $2,000 per month might be set aside for general communication and project management. Additional costs would be associated with meetings and other specific consulting.

A minor amount of subcontractor labor would be associated with the well pump maintenance each year.

4.4.4 CHEMICAL ANALYSIS

For groundwater monitoring, approximate analytical costs are $150 per sample for PAHs by 8310, $200 per sample for PCP by 8041, and $150 per sample for bioremediation parameters. Approximately 30 samples are analyzed for PCP during each semi-annual event (including QA/QC sampling), approximately 20 samples are analyzed each event for bioremediation parameters, and approximately 11 samples are analyzed once per year for PAHs. In sum, this translates to an approximate cost of $20,000 per year for laboratory analysis associated with the groundwater monitoring program.

Process sampling includes three samples six months of the year and four samples for the other six months of the year (sampling between the GAC units is every other month). All samples are analyzed for PAHs by 8270-SIM, PCP using 8041 for the BFEG and PPEG influent streams, and PCP using 8270-SIM for the mid and post carbon samples. Therefore, each year there are 42 PAH analyses, and 42 PCP samples. Assuming $150 for each PAH analysis and $200 for each PCP analysis, this analytical work translates to an approximate annual cost of $15,000.

The residential well sampling includes sampling of eight residential wells for PCP only. This translates to an approximate analytical cost of $1,600 per year.

In sum, the analytical costs for all the sampling is on the order of $40,000 per year.

4.5 RECURRING PROBLEMS OR ISSUES

The site team has worked to increase the actual capacity of the treatment plant from 70 gpm to 100 gpm so that a target rate of 100 gpm can be maintained relatively reliably. No current specific recurring problems or issues were reported by the site team during the site visit or discovered by the RSE team during the review process.

4.6 REGULATORY COMPLIANCE

During the RSE process, the site team did not report any exceedances of discharge standards or other compliance related standards.

4.7 SAFETY RECORD

During the RSE process, the site team did not report any health and safety concerns or incidents related to the remedial activities. However, the site team said there have been some break-ins at the adjacent (empty) office building, and vagrants coming to the door of the treatment plant building while the treatment plant operator is there.

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

5.1 GROUND WATER

The overall remedy has been effective at protecting human health and the environment. Groundwater impacts have declined significantly, and PCP concentrations in groundwater are continuing to decline over time. Idaho Pole purchased two residences where groundwater was impacted, eliminating the risk at those properties, and a groundwater control area effectively prevents use of water from within the controlled area. The RSE team has noted in Section 4.2.2 that there is some possibility that groundwater impacted with PCP above standards may parallel Rocky Creek for some distance beyond 27-B and RES-8, and it is not clear if there are any potential receptors of groundwater in that area (i.e., beyond RES-8). The RSE team also noted in Section 4.2.2 that PCP impacts may not be vertically delineated near 27-B, although it would be expected that hydraulic gradients would transition to upward near Rocky Creek.

Concentrations of PCP well above groundwater cleanup standards remain south of I-90 and north of I-90. Groundwater flows very quickly at the site, such that a particle of groundwater would be expected to travel the full distance of the plume in a year or less. Although a retardation factor would apply to transport of PCP in groundwater, it would be expected (given the fast groundwater velocity) that PCP north of I-90 would clean up relatively rapidly if all continuing sources were removed or successfully contained by the P&T system. The RSE team believes it is likely there is a continuing source of dissolved PCP that is causing the persistence of PCP impacts north of I-90. Possibilities include one or more of the following:

- Potential gaps in capture associated with the BFEG such that groundwater impacts in the barkfill area, such as those observed near monitoring well 5-A, continue to migrate to the north of I-90
- Potential source material located beneath I-90
- Potential source material north of I-90 that may not have been removed during the soil remedy

With existing information it is difficult to determine if all of these potential types of continuing sources for dissolved PCP are present, or if only one continuing source of dissolved PCP is present (or is dominant). As discussed in Section 4.2.1, the RSE team believes there are multiple lines of evidence that suggest there may be gaps in capture at the BFEG that allow PCP impacted water to migrate towards the north. If that is true, it is likely that PCP impacts north of I-90 will persist for many more years unless further action is taken (although the remedy would continue to be protective based on the presence of institutional controls). A gap in capture at the BFEG could likely be mitigated by focusing future extraction in the BFEG and eliminating extraction at the PPEG, and focusing injection at the BFIG (or perhaps split between the BFIG and PPIG). Alternatively, the mass of PCP that might escape through gaps in capture could be mitigated by further investigation and remediation (e.g., excavation) of remaining source material near monitoring well 5-A where highest PCP concentrations are observed, and such activity could ultimately eliminate the need to continue to operate the P&T system. It will be difficult to determine if potential sources of dissolved PCP beneath I-90 or in the Pasture Area north of I-

90 exist, or are significant, until after any PCP impacts emanating from the well 5-A area (if any) are addressed.

5.2 SURFACE WATER

Surface water has not been sampled since the Remedial Investigation, and protectiveness has focused more on potential impacts to nearby residential wells. Groundwater quality samples have not been collected from adjacent to the stream, so it is difficult to determine where impacted groundwater is discharging to surface water and at what concentration. The PCP concentrations detected at 16-B, 27-B, and RES-8 suggest that groundwater impacted by PCP is likely discharging to Rocky Creek above ARARs, but it is unlikely that this results in water quality in Rocky Creek exceeding surface water quality standards (PCP is likely non-detect in surface water). Nevertheless, the potential that groundwater with PCP concentrations of 40 ug/L or higher may be discharging to Rocky Creek merits further attention by the site team.

5.3 AIR

The constituents of concern at this site are not volatile, and impacts to air are not considered to be an issue.

5.4 SOIL

The soil components of the remedy were effective at protecting human health and the environment. Soil was excavated and treated at the LTU which was constructed on-site, and the LTU was dismantled in 2002. Treated soil placed back on-site contains dioxin above the soil cleanup standards that are identified in the ROD. The soil remedy is considered complete, and efforts are underway by the Site team to finalize institutional controls for these specific areas containing the treated soils, at which point the entire site is expected to be delisted with respect to soils.

5.5 WETLANDS AND SEDIMENTS

Based on discussion with MDEQ and USEPA representatives during the RSE site visit, sediments in ditches (south of I-90 and north of I-90) were effectively remediated as part of the soil component of the remedy.

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. The cost impacts of these recommendations are discussed when appropriate.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 MODIFY EXTRACTION/ INJECTION STRATEGY TO IMPROVE CAPTURE NEAR 5-A

The RSE team believes there are multiple lines of evidence that suggest there may be gaps in capture at the BFEG that allow PCP impacted water to migrate towards the north. If that is true, the remedy as currently operated may remain protective due to institutional controls but will not likely achieve cleanup levels of PCP north of I-90 for many more years. Furthermore, it will be difficult to determine if potential sources of dissolved PCP beneath I-90 or in the Pasture Area north of I-90 exist, or are significant, until after PCP impacts potentially emanating from the well 5-A area are addressed.

As discussed in Section 4.2.1, the informal modeling performed by the RSE team as part of this RSE suggests that potential gaps in capture at the BFEG could be reduced or eliminated by focusing future extraction in the BFEG while eliminating extraction at the PPEG, and focusing injection at the BFIG (or perhaps split between the BFIG and PPIG). The RSE team recommends the following approach be implemented as soon as possible (i.e., "Phase 2" of the groundwater remedy):

- Eliminate extraction at the PPEG
- Pump at the BFEG with target rate of 100 gpm or above
- Sample the five BFEG extraction wells for PCP for several months to confirm that the highest PCP concentrations are extracted near well 5-A (i.e., expected to be highest at BE-3, BE-4, or BE-5).
- Track extraction rates at individual BFEG wells monthly, and use valves to pump as much water as possible from the western-most BFEG extraction wells near well 5-A (expected to be extraction wells BE-3 to BE-5, with confirmation provided by the sampling recommended above)
- Inject as much water as feasible at the BFIG, and use valves to focus as much of the injection as possible in the portion downgradient of the well 5-A area (approximately BI-11 to BI-20)
- Treated water that cannot be injected at the BFIG should be injected at the PPIG.
- Monitor PCP concentration at GM-4 quarterly as an indicator.

This approach should maximize capture of the most impacted area of groundwater (near well 5-A) until that area is actively addressed (see section 6.4.1) or until the area near well 5-A remediates naturally

(which may take many years). PCP concentration trends at GM-4 will provide valuable information over a period of approximately 2 to 5 years:

- If PCP concentrations decline rapidly at GM-4 after this change is implemented and approach cleanup goals at GM-4 (and points further downgradient), it will suggest that gaps in capture at the BFEG have been mitigated and also suggest that continuing sources of PCP impacts beneath I-90 and/or north of I-90 are not very significant.

- If PCP concentrations decline rapidly at GM-4 after this change is implemented but then stabilize well above cleanup goals at GM-4 (and points further downgradient), it will suggest that gaps in capture at the BFEG have been mitigated but that other continuing sources of PCP impacts beneath I-90 and/or north of I-90 are likely significant.

- If PCP concentrations at GM-4 (and points further downgradient) are not noticeably reduced, it will suggest that the impacts at GM-4 and beyond are more likely due to continuing sources of PCP impacts beneath I-90 and/or north of I-90.

Realistic time estimates to achieve cleanup goals north of I-90 cannot be estimated in a meaningful way until these results are obtained.

The RSE team believes this approach can be successfully implemented without further modeling. Furthermore, this option should be relatively cost-neutral relative to the current operation. There would be some additional cost for sampling water quality at individual BFEG extraction wells for several events, and some additional sampling events for PCP at GM-4. Also, if one or more of the BFEG wells does prove to have much higher concentrations than the others, that extraction well might be monitored periodically. However, those costs should be offset by not having to analyze monthly samples for the PPEG (since no pumping would occur from the PPEG).

6.1.2 MODIFY GROUNDWATER SAMPLING LOCATIONS FOR PCP AND PAHS

Recommendations regarding locations for sampling and analysis of PCP and PAHs are provided in this section. Recommendations regarding the bioremediation sampling and analysis are provided in Section 6.2.1.

With respect to the PAH sampling and analysis, the historic data indicate that the PAH plume is substantially smaller in extent than the PCP plume. The historic data set indicates that PAH concentrations have routinely met standards at 9-A since 1994 (prior to the onset of soil or groundwater remediation) and have been non-detect at wells downgradient of 9-A. The only detected PAH compound in 9-A has been fluorene, which has had a concentration of approximately 1 ug/L in the past several monitoring events. The applicable standard for fluorene is the total DPAH standard of 146 ug/L. Given that fluorene is the only detected PAH at 9-A, the total DPAH concentration at 9-A is less than standards. In wells that are routinely analyzed for PAHs, contamination above standards has been limited to 5-A, 15-A, and 22 (all north of I-90). However, the two wells that are immediately downgradient of these wells (i.e., GM-4, GM-5, GM-6, 23-A, and 23-B) are not analyzed for PAHs. It seems reasonable to discontinue PAH analysis at 9-A, 19-A, 25-A, 25-B, and 26-C. However, it seems reasonable to continue PAH analysis at 5-A, 15-A, and 22 on an annual basis, and to add PAH analysis on an annual basis to GM-4, GM-6, 23-A, and 23-B. The RSE team recognizes that 19-A is a background well and that the team may want to continue monitoring this well for PAHs to document the quality of water flowing onto the site from upgradient, but it might be reasonable to limit sampling of the background well to every five

years, with contingent sampling at the upgradient well if unexpected increases in concentrations are observed in other on-site wells.

With respect to PCP sampling and analysis, recent data at 16-B and 27-B (46 ug/L and 43 ug/L, respectively) indicate that the preferential pathway for contaminant transport in the downgradient portion of the plume is more significant in the B horizon (or possibly deeper) rather than the A horizon. Recent data at other B horizon wells have also indicated higher concentrations than in the A wells. To better characterize the core of the plume, the following wells should be added to the monitoring program and analyzed for PCP:

- 9-B
- 24-B
- 16-B
- 26-B
- 26-C
- 27-B

Many of these locations are consistent with the findings of Dr. Vanderford's MAROS evaluation. In addition to including these wells in the sampling program, it is reasonable to sample GM-5, 14-A (if it still exists), or the interceptor trench for PCP and PAHs. Well 14-A was historically sampled and had a PCP concentration of over 200 ug/L, but sampling in this area was later discontinued despite these elevated concentrations and despite the open (but fenced in) trench that wildlife might access.

The following wells that are currently sampled and analyzed for PCP appear to provide redundant information and can likely be removed from the monitoring program:

- 10-A
- 12-A
- 13-A

In addition, it seems reasonable to discontinue sampling of the following wells for the reasons stated below:

- 4-A
- 7-A
- 27-A
- GM-7

PCP concentrations at 4-A and 7- wells have been non-detect since remediation began and were below the standard of 1 ug/L in1994 prior to the onset of remediation. PCP concentrations at GM-7 have been non-detect since sampling began in 1998, indicating that the plume does not extend as far as GM-7.

In sum, the above changes reflect no significant net change in the number of monitoring locations. For wells where sampling is recommended to be eliminated, the RSE team suggests the wells be maintained so they can be periodically sampled (such as prior to a Five-Year Review).

The RSE team also believes that groundwater sampling should continue on a semi-annual basis given the speed with which groundwater flows, apparent seasonal fluctuations, and the changes that are being suggested with respect to modifying the groundwater extraction/injection strategy.

6.1.3 ADDRESS POTENTIAL DISCHARGE OF IMPACTED GROUNDWATER TO SURFACE WATER

The recent sampling result at 27-B (43 ug/L) provides an indication of the PCP concentrations that might discharge to Rocky Creek. As indicated in Section 5.2, this exceeds an existing ARAR specified in the ROD. The ARAR, as written in the ROD, discusses the concentrations that are permitted to discharge from groundwater to surface water, but the Gold Book standards that are used apply to the actual quality of the surface water. Whereas the PCP concentration in groundwater discharging to Rocky Creek might exceed the ARARs as currently defined, the water quality of Rocky Creek likely continues to meet the Gold Book standard due to dilution.

The site team should revisit the ARARs, State regulations, and the administrative record to determine if the ARARs still apply, and should work to reconcile any difference between existing groundwater quality and the ARARs if an issue is found to exist. No cost is estimated for this recommendation.

6.1.4 EXTRAPOLATE PLUME EXTENT AND ADDITIONAL POTENTIAL RECEPTORS

As discussed in Section 4.2.2 and Section 5.1, it is possible that the plume parallels Rocky Creek and may impact groundwater underlying additional wells beyond RES-8 (if any) along Rocky Creek. The RSE team suggests that the site team identify if any wells (supply or otherwise) are located in this area, determine their uses, determine their construction, and sample them for PCP. The results from this effort may help delineate the plume and/or may identify additional receptors. These findings may suggest the need for further characterization and potentially extending the CGA.

6.1.5 COMPLETE ICS FOR AREAS WHERE TREATED SOILS WERE PLACED

As discussed earlier, the treated soils placed back on the site contained dioxin above the soil cleanup standards identified in the ROD. The soil was placed above historic high groundwater levels and was covered with several feet of soil on the surface to prevent direct contact with these soils. The soil remedy is considered complete, and efforts are underway by the Site team to finalize institutional controls for these specific areas containing the treated soils, at which point the entire site is expected to be de-listed with respect to soils. The RSE team recognizes that efforts are underway to finalize these institutional controls, and includes this recommendation for completeness of the report. No cost is estimated for this effort since it is already largely completed.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 ELIMINATE BIOREMEDIATION SAMPLING

The bioremediation monitoring program has been ineffective in quantifying the extent of bioremediation at the site for the reasons discussed in Section 4.2.2. Continued sampling for bioremediation parameters such as alkalinity, nitrate, and phosphorus may help establish that conditions are appropriate for bioremediation to occur, but continued sampling of these parameters will not help determine the role that bioremediation is playing in addressing site contamination. The PCP data, however, provide useful

information regarding bioremediation. It is clear from the PCP data that bioremediation does not sufficiently address the contamination that is currently migrating downgradient through a potential gap in a capture at the BFEG and/or from other potential continuing sources (under or north of I-90). As such, the remedy will likely need to focus on source control or source remediation to allow the area downgradient of I-90 to achieve standards. Monitoring of PCP concentrations will provide adequate information to evaluate remedy performance. The lack of data on bioremediation parameters and the associated lack of information regarding bioremediation effectiveness are somewhat inconsequential.

The extent to which fertilizer addition augments bioremediation is not clear, but the cost of attempting to evaluate its contribution through a modified bioremediation monitoring program is not merited given the relatively low cost of continuing to add fertilizer.

The RSE team suggests discontinuing the bioremediation monitoring program, and to use the PCP data from the monitoring program suggested in Section 6.1.2 to evaluate the groundwater remedy as a whole. The bioremediation monitoring program currently involves sampling 18 wells plus a field blank twice per year for alkalinity, carbonate, bicarbonate, ammonia, nitrate, nitrite, nitrate+nitrite, orthophosphorous, sulfate, sulfite, and total organic carbon. The RSE team estimates that the laboratory cost for analyzing these parameters is approximately $150 per sample. With a total of 38 samples (18 wells and a field blank two times per year), the total savings in laboratory costs would be approximately $5,700 per year. It is not clear that field parameters such as DO and ORP are providing useful information, but since they are so inexpensive to collect the RSE team suggests they continue to be collected. As discussed during the RSE site visit, DO measured with Hach kits is likely much more accurate than measurements made with field meters.

6.2.2 CONSIDER MODIFYING TREATMENT PLANT PUMPING

The treatment plant was designed with a hydraulic capacity of 300 gpm. The extraction systems provides relatively consistent flow of approximately 100 gpm, but the actual batch flow rate through the treatment plant is likely 300 gpm based on the design capacity and the size of the operating transfer pumps. There are two primary alternatives to the current pumping scheme that could be implemented to reduce electrical usage.

One option is to install variable frequency drives on one of the influent transfer pumps and on one of the effluent transfer pumps, and primarily use those pumps. Less electricity would be used if a consistent lower flow rate is maintained through the treatment plant instead of higher flow rates on a batch basis. The RSE team estimates that on average approximately three times more electricity is used to run the pumps in batch mode at 300 gpm than on a relatively consistent basis at 100 gpm. This is because the required power for the transfer pumps is likely nine times higher for operating at 300 gpm vs. 100 gpm (because the higher flow rate increases the pressure drop through the piping, filters, and GAC units) but only operates one-third as often as a pump operating continuously at 100 gpm. Based on these numbers, this modification would reduce electrical usage by approximately 29,000 kWh per year and electrical cost by approximately $2,200 per year. Purchasing and installing two variable frequency drives (one for one influent pump and one for one effluent pump) would likely cost approximately $4,000, resulting in a payback period of approximately two years.

The second option is to install a new process line to give the option of bypassing the influent and effluent tanks. As is currently operated, the flow from the extraction wells is throttled such that energy from these pumps is wasted. With the bypass line, the water from the extraction wells would flow directly through the bag filters and GAC units, through the static mixer for the fertilizer addition, and into the reinjection

galleries. The extraction pumps have more than enough power to accomplish this. During backwashing, the extraction pumps would be shut down, and the backwashed water would be discharged to the influent tank and then fed through the bag filters (to remove the sediment) and the rest of the system (including the effluent tank) as is currently the process. With this modification, the power for operating the extraction system would remain the same, but the power for operating the two transfer pumps would be eliminated (except for backwashing). This modification would reduce the electrical usage by approximately 43,000 kWh or approximately $3,200 per year. The plumbing modifications could likely be made for $5,000 to $7,500, resulting in a payback period of approximately two to three years.

With either modification, the backwashing frequency might need to remain the same, which means that a lower pressure differential across the GAC units would be used to signal the appropriate time for backwashing. With the lower consistent flow rate through the system and lower pressure differentials across the GAC units, the site team could experiment with longer intervals between backwashing events, but this could have an adverse affect of allowing irreversible fouling, which might require a premature GAC replacement.

The decision to implement this recommendation is contingent on forecasted system operation. If source area remediation is conducted and P&T system operation may be discontinued in the near term (see Section 6.4.1), then it may not be worth investing the capital associated with these modifications. Furthermore, the estimated savings is somewhat based on flow rate. If the overall system flow rate increases, then the projected savings from implementing one of these alternatives would likely decrease.

6.2.3 USE OF WATER SOURCE HEAT PUMP FOR BUILDING HEAT

Approximately six months per year of heating the building, with inefficient electrical heat, costs approximately $5,000 per year and uses approximately 69,000 kWh of electricity per year. More efficient building heat could be provided with a water source heat pump tied to the system effluent. This is the same technology as ground source or geothermal heat pumps except that heat would be transferred to and from the system effluent rather than to the subsurface. Water source heat pumps operating with an influent concentration of approximately 45 degrees F would be approximately four times more efficient than heating with electrical resistive heating. The water source heat pump should reduce electrical usage by approximately 75% yielding savings of approximately $3,800 per year. Capital improvements would require a water source heat pump capable of providing approximately 120,000 btus per hour of heat, a heat exchanger to allow heat transfer with the effluent without sending the effluent directly through the heat pump, piping, feed pump, and a heat distribution system. The evaluation and sizing of the system is fairly straightforward, and the option would only make sense if the water for the geothermal system is the water that is already extracted and treated (precluding the need to design and install closed loops or standing column wells). The capital costs (approximately $15,000) for this system would likely be paid back with savings in approximately four years. This option only makes sense if P&T is expected to continue for years to come.

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

6.3.1 MEASURE AND TRACK SPECIFIC CAPACITY OF WELLS

During the RSE site visit it was stated that the specific capacity of the extraction wells is not measured or tracked. The specific capacity of each extraction wells is calculated as the pumping rate divided by the drawdown at that extraction well (i.e., gpm per ft of drawdown). The value of tracking this parameter is

that a decline in specific capacity indicates well fouling and can serve as an indicator for performing well rehabilitation. The measurement of drawdown (i.e., versus a non-pumping condition) at an individual well can be complicated by several factors, such as regional water level changes and interference from the other extraction wells. However, corrections can be made for background water levels based on changes in water level far away from the extraction wells, and the interference between wells is a relatively minor impact especially if extraction rates remain relatively consistent over time. Therefore, adding this to the routine monitoring at the site will only involve measuring depth to water at each extraction well when other site water levels are measured, and then performing a few simple calculations. This is not expected to have any impact on annual costs.

6.3.2 OTHER RECOMMENDATIONS FOR SITE DATA COLLECTION AND REPORTING

The RSE team has the following additional recommendations for technical improvement:

- A number of analytical methods are used at the site to analyze the same parameters. For example, site reports indicate that PAHs are analyzed with method 8270-SIM for process water sampling and method 8310 for groundwater. The reporting limits are the same for both methods, and it is unclear why two different methods are used. For PCP, influent process samples are analyzed with method 8040/8041, while mid-carbon and post-carbon process samples are analyzed with method 8270-SIM (reporting limit of 0.50 ug/L). Groundwater samples are analyzed with method 8040/8041 (reporting limit 0.25 ug/L) for PCP, and residential samples are analyzed with method 8040/8041 (reporting limit 0.05 ug/L). The RSE team refers to "method 8040/8041" here and elsewhere because site reports and chain-of-custody forms refer to "8040" but lab reports indicate "8041". It is unclear why different methods are used for the same parameters and why in some cases the reporting limits are different for the same method. It is recommended that the site team explain more clearly why there is a need to use different methods, and if there is no need, it is recommended that the methods be standardized to one method for PCP and one method for PAHs.

- For plume maps, the RSE team agrees with plotting all of the analytical results on the same contour map as is currently done; however, the RSE team suggests that the highest value at a particular well cluster be used for contouring purposes, which does not appear to always be the case on maps in previous reports. A note can be added to each map to indicate this is the procedure being utilized. The RSE team believes this is preferable to constructing plume maps for each horizon.

- There is a general lack of understanding and/or documentation regarding vertical hydraulic gradients at the site, and the site conceptual model would be improved if water levels from all intervals were measured at each existing well cluster. The RSE team suggests collecting water level measurements at all site wells, preparing a potentiometric surface map based on the shallow wells, but then using the water level measurements from the deeper wells (presented in tables in site reports) to help interpret the direction of vertical flow. In addition to plotting the potentiometric surface map for the shallow zone, the site reports might also include a second map that illustrates where flow is interpreted to be upward and where flow is interpreted to be downward. The RSE team also believes that sufficient information regarding water levels would be provided by semi-annual water level events and therefore suggests that the frequency for water level events be decreased from quarterly to semi-annual (to coincide with water quality sampling events).

- The site reports should provide the average injection rates at the two injection galleries over the course of a reporting period (or perhaps monthly), so there is a better understanding of the distribution of water reinjection and its potential implications for source control.

- The site team should provide the monthly extraction rates at each of the extraction wells in site reports, based on the existing flow totalizers on each well. This will help with the interpretation of plume capture. In addition, the flow rates for extraction wells reported in the quarterly and annual reports should be those based on measurements from the flow totalizers rather than the influent flow sensors. If reported flow rates have been based on the flow sensors, the site team should consider comparing the influent flow rates based on the totalizers with those measured by the flow sensors to determine how accurate previous flow sensor measurements may have been.

- It was mentioned during the site visit that site data should be added to the database maintained by the Groundwater Information Center (GWIC) at the Montana Bureau of Mines and Geology, Montana Tech of The University of Montana. The site team might also consider managing water level and water quality data electronically in a database or spreadsheet that easily allows concentration trends to be developed. For instance, water quality data are currently stored in individual spreadsheets for each event, which does not allow data to be queried for a specific well over time.

The cost implications for these recommendations are relatively minor and are not quantified. The suggested decrease in the water level measurement frequency will offset the increased level of effort associated some of these other recommendations.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

6.4.1 CLARIFY "ATTAINMENT AREA" FOR GROUNDWATER CLEANUP

As discussed in Section 3.1, there appears to be some ambiguity regarding the objectives of the groundwater remedy as stated in ROD, specifically with respect to the specific area where groundwater standards are to be achieved. In several places the ROD appears to be stating that the objective is to attain cleanup goals in an "attainment area" north of I-90, rather than over the entire Site. It is not clear to the RSE team if the ROD wording was an attempt to differentiate cleanup objectives for groundwater north of I-90 versus south of I-90, or if no such differentiation was intended. The two ESDs to date do not provide any further clarification regarding this issue. It is recommended that this issue be discussed among site stakeholders and clarified in future site documents. No cost is estimated for this recommendation.

6.4.2 CONSIDERATIONS FOR POTENTIALLY TERMINATING THE P&T SYSTEM

There are likely two scenarios where termination of the P&T system might be merited:

- If remaining impacts near 5-A are actively addressed such that remaining levels of PCP south of I-90 would not cause groundwater standards north of I-90 to be exceeded in the absence of P&T; and/or

- If it can be demonstrated any continuing transport of PCP from the area south of I-90 would cause PCP concentrations north of I-90 that are lower than those caused by continuing source of PCP impacts beneath I-90 that cannot be feasibly addressed.

The recommendation to modify the extraction/injection strategy (provided in Section 6.1.1), which could be considered "Phase 2" of the groundwater remedy, should help to clarify if there is a significant continuing source of PCP impacts beneath I-90. Ideally, improving the capture provided by the BFEG will cause PCP concentrations to decline north of I-90, and if PCP concentrations north of I-90 approach cleanup standards as a result of that change it will suggest that there is not a significant source of PCP beneath I-90. If that turns out to be true, it will suggest that eliminating the P&T operation would only be reasonable if the remaining sources of PCP impacts south of I-90 (i.e., near 5-A) are addressed. However, if "Phase 2" results in stable concentrations north of I-90 that are well above cleanup standards, it will suggest that there is a significant source of PCP impacts beneath I-90 and a different rationale regarding termination of P&T may apply. Some considerations are discussed below.

Addressing Continuing Source of Impacts Near 5-A

This option may have significant merit if the changed pumping strategy recommended in Section 6.1.1 suggests there is not a significant continuing source beneath I-90 (based on several years of monitoring after the change is implemented), because addressing the impacts near 5-A could then allow P&T to be discontinued. There would be a tradeoff between the up-front cost of investigation and remediation of the area near 5-A, compared to potential savings that might result from not operating the P&T system (which might save on the order of $125,000 per year).

If this option is pursued, the first step would likely include a direct push investigation with sampling for PCP and PAHs. The goal would be to delineate the volume of the subsurface that would require remediation, so costs of possible remedy alternatives can be accurately estimated. The RSE team believes the volume of this remaining source is likely quite small, based on the relatively low concentrations of PCP measured at the composite BFEG influent and the fact the impacts are much greater in shallow groundwater (5-A) relative to deeper horizons (5-B and 5-C).

We assume the direct push investigation would include a brief work plan, two or three days of direct push to collect samples, and a brief report (possibly integrated into another site report). Direct push would likely start in a direction moving from well 5-A towards Cedar Street. Once the upgradient boundary of the source area is delineated, several transverse lines of direct push points could be selected. Based on the fact that PCP concentrations in groundwater are much higher at 5-A compared to 5-B and 5-C, focusing on shallow direct push points is likely appropriate. Assuming 10 points per day (one sampling interval per point corresponding to the "A" zone), the upgradient delineation might take one day, and the transverse delineation might take one or two days. These could be performed in separate mobilizations, to avoid extra charges from the lab for fast turnaround. Interpretation would be based on visual observations, odor, and comparison of water quality results between locations (i.e., the definition of the "target area" for remediation would likely best be made using a qualitative review of all of these types of results, rather than a specific numerical value for any specific constituent).

Cost for a brief work plan, up to three days of direct push, and analysis of up to 30 samples for PCP and PAHs might be approximately $40,000. Choosing to analyze for PCP only (i.e., no analysis for PAHs) would save approximately $5,000 but would result in reduced data quality for the delineation.

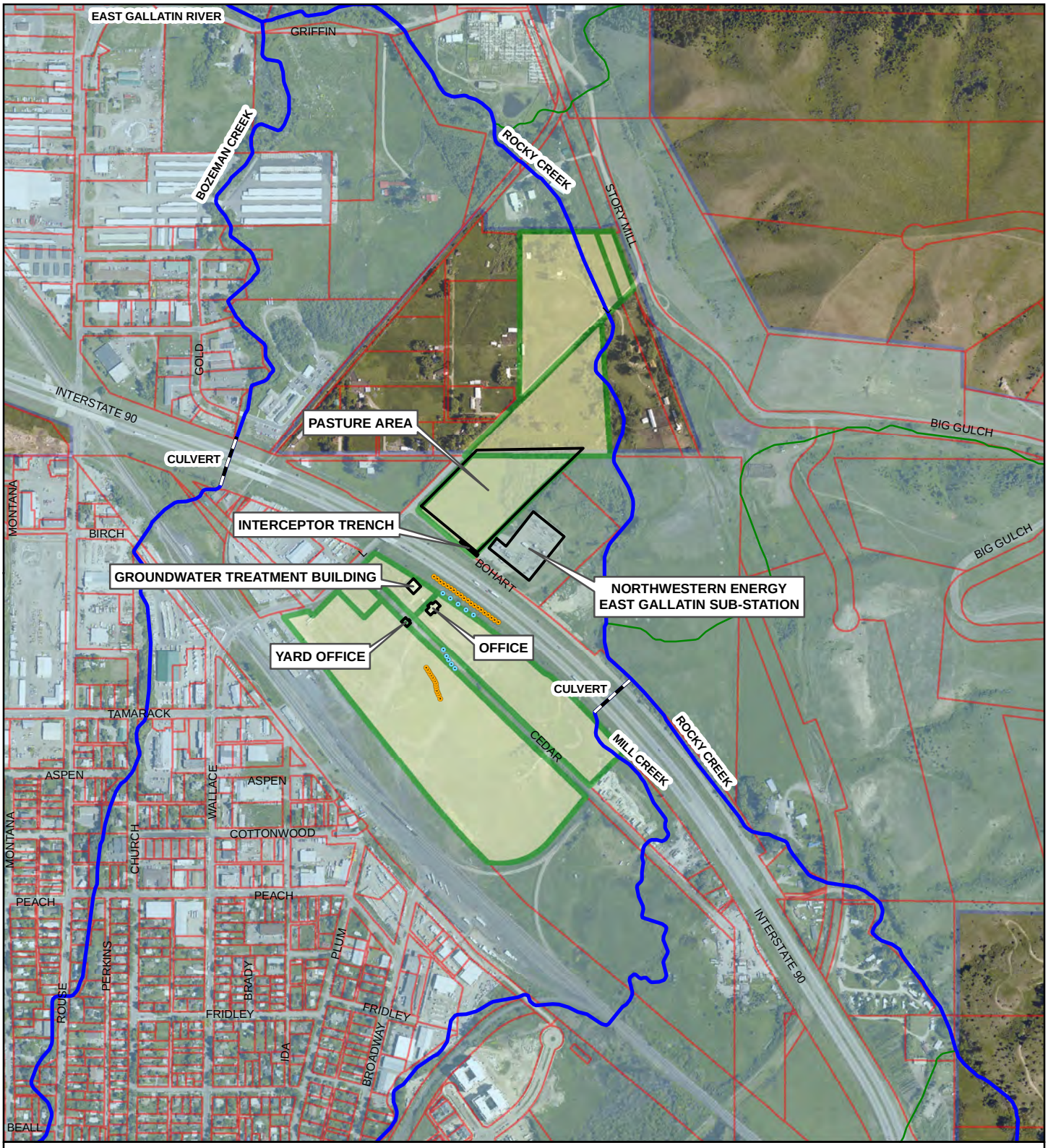
Once the size of the impacted area is determined, detailed costing of remedy alternatives could be conducted. The evaluation of alternatives would likely cost approximately $15,000. Likely potential options would include:

- Excavation and disposal
- Thermal treatment
- In-Situ chemical oxidation

It is premature to discuss the likely costs of such options until the remaining source area is better delineated. However, if it is assumed that the characterization and alternatives analysis described above can be completed for approximately $55,000, and if it assumed that approximately $125,000 per year could be saved by terminating P&T, the approximate payback periods can be estimated. For instance, if a remedial option is estimated to cost $200,000, the payback period (including the cost of the investigation and alternatives analysis) would be close to 2 years. If a remedial option is estimated to cost $500,000, the payback period (including the cost of the investigation and alternatives analysis) would be less than 5 years.

<u>If Significant Continuing Sources of PCP impacts Beneath I-90 are Indicated</u>

If "Phase 2" suggests there is a significant continuing source beneath I-90, and there is no feasible option for addressing those impacts, it might be reasonable to terminate P&T if it can be demonstrated that the P&T does not cause any reduction in groundwater quality north of I-90 above and beyond any degradation caused by source material beneath I-90. For instance, if all concentrations observed south of I-90 (at monitoring and individual BFEG extraction wells) are observed to be lower than wells just north of I-90 (such as GM-4) for several consecutive events, it could indicate that the P&T is providing little net benefit. Again, this would only be the case if years of monitoring after capture of the BFEG is improved suggest that there is in fact a significant continuing source of PCP impacts beneath I-90 that cannot be feasibly addressed.



LEGEND

- PARCEL - IDAHO POLE COMPANY (Source: NRIS-Gallatin County Cadastral, July 2009)
- PARCEL - EXISTING (Source: NRIS-Gallatin County Cadastral, July 2009)
- BOZEMAN CITY LIMITS (Source: City of Bozeman GIS Department, 2004)
- EXTRACTION WELL (Source: Figure 1 from 5-Year Review, 2005)
- INJECTION WELL (Source: Figure 1 from 5-Year Review, 2005)

N

350 0 350 700

Feet

TETRA TECH EM, INC.

Idaho Pole

Bozeman, Montana

FIGURE 1

SITE MAP - EXISTING PARCELS

Figure-1_Site_Map_Existing-Parcels_120709.mxd - DWH - TtEMI

ATTACHMENT A:

Selected Figures from Previous Site Reports

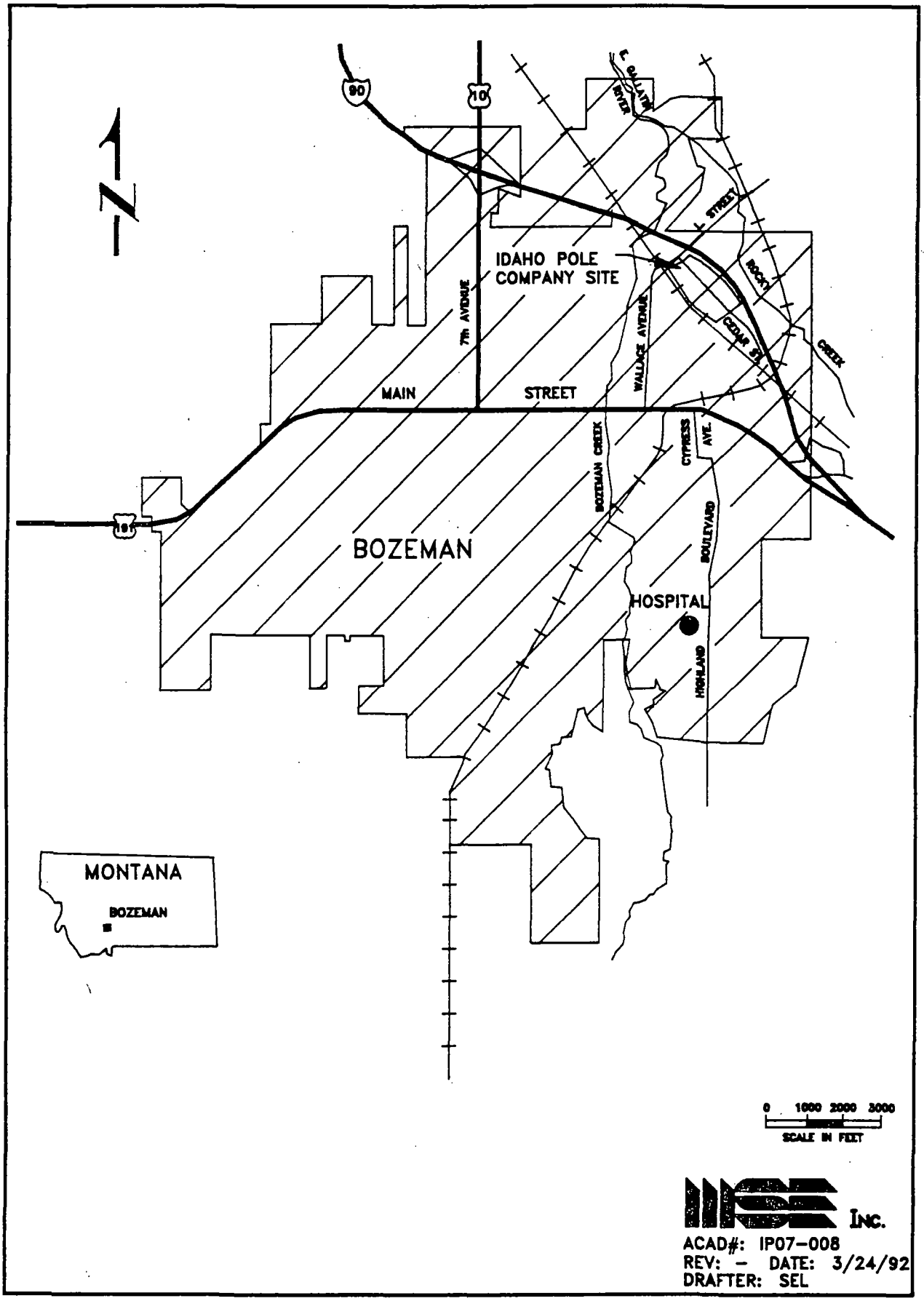


FIGURE 2-1 -- VICINITY MAP OF IDAHO POLE COMPANY NPL SITE BOZEMAN,MONTANA

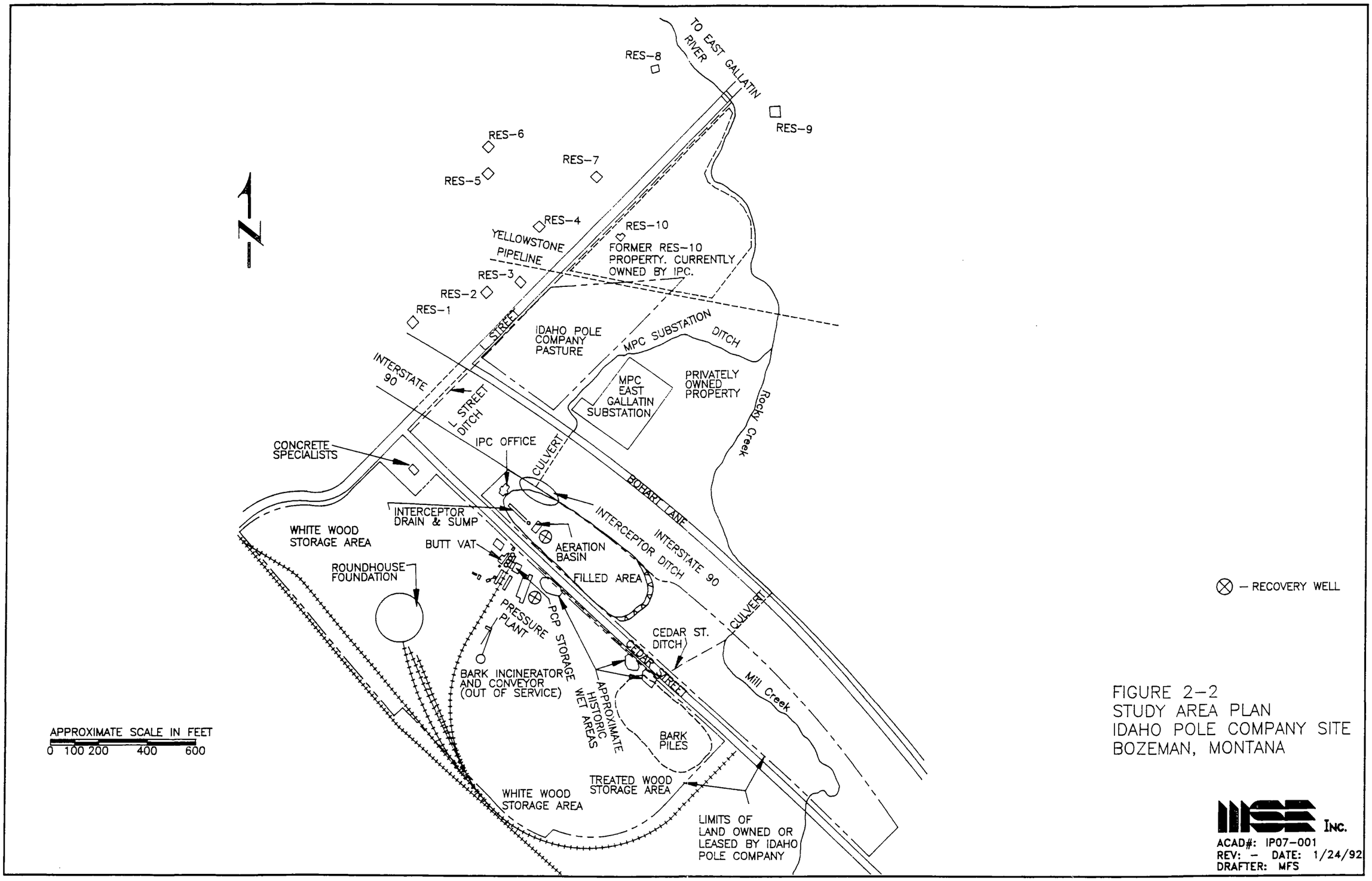
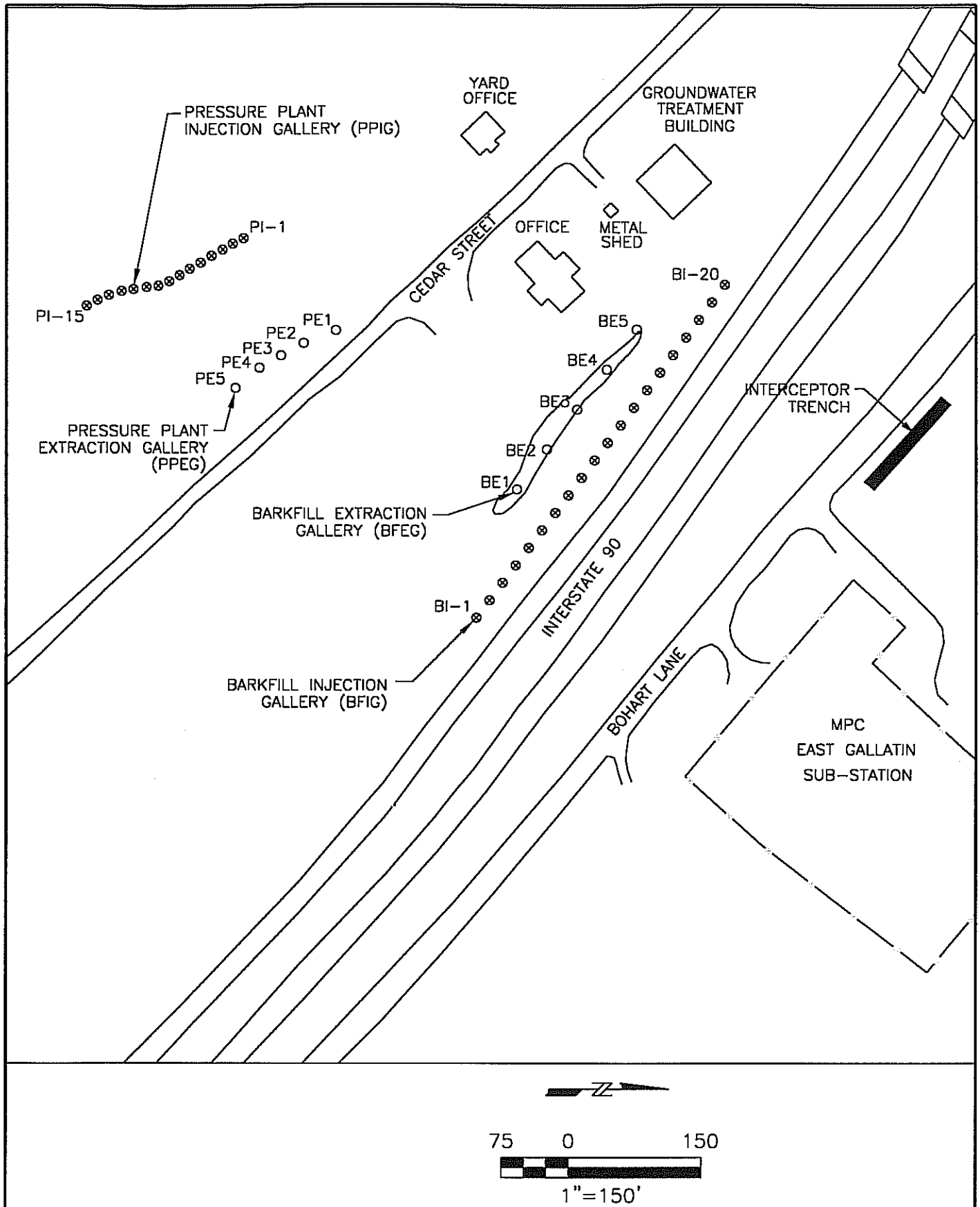


FIGURE 2-2
STUDY AREA PLAN
IDAHO POLE COMPANY SITE
BOZEMAN, MONTANA



IDAHO POLE COMPANY Bozeman, Montana 5029-300	GROUNDWATER REMEDY SYSTEM COMPONENTS IPC - BOZEMAN, MT	FIGURE 4-1

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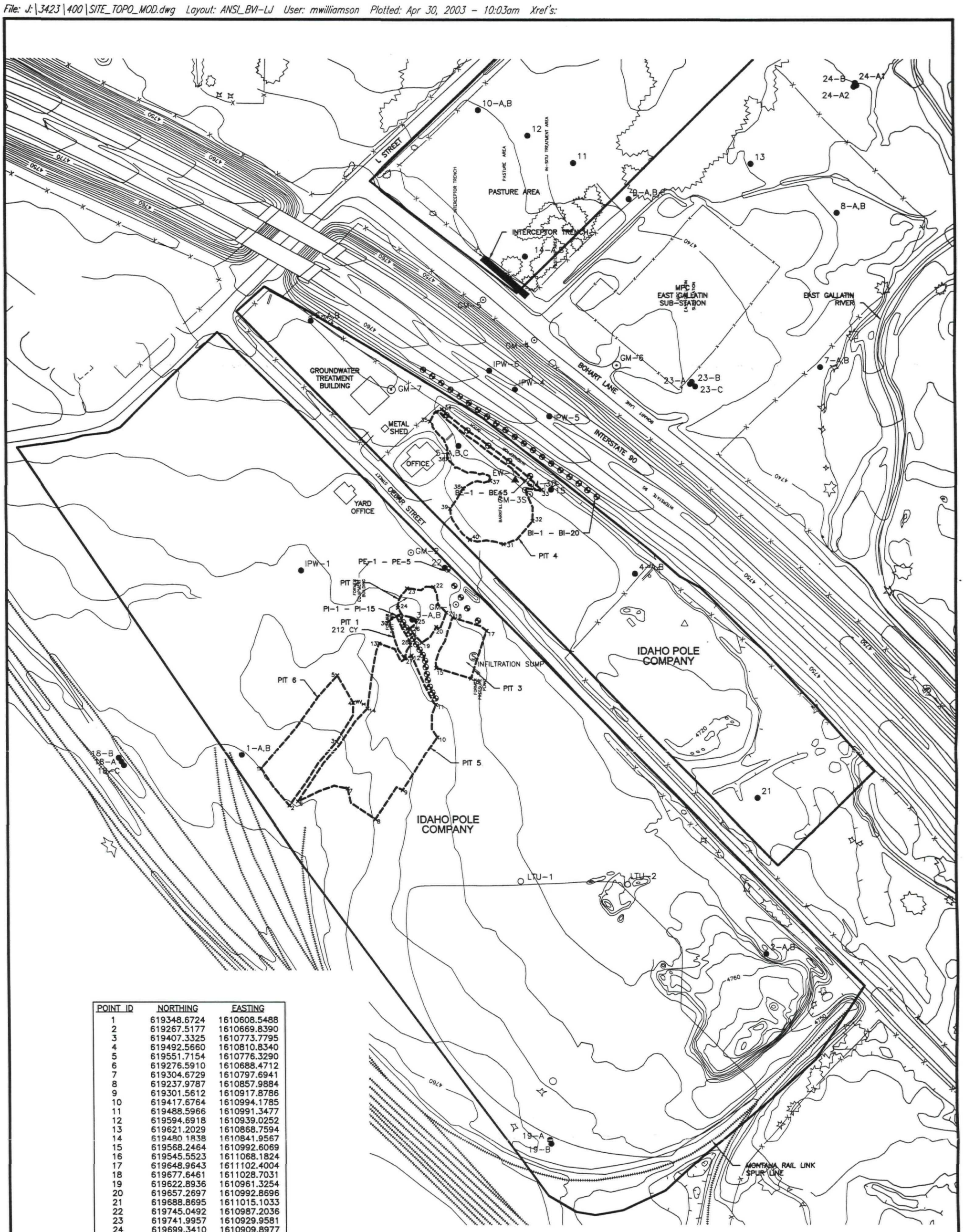
Hydrometrics, Inc.
Consulting Scientists and Engineers



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2	619267.5177	1610669.8390
3	619407.3325	1610773.7795
4	619492.5660	1610810.8340
5	619551.7154	1610776.3290
6	619276.5910	1610688.4712
7	619304.6729	1610797.6941
8	619237.9787	1610857.9884
9	619301.5612	1610917.8786
10	619417.6764	1610994.1785
11	619488.5966	1610991.3477
12	619594.6918	1610939.0252
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15	619568.2464	1610992.6069
16	619545.5523	1611068.1824
17	619648.9643	1611102.4004
18	619677.6461	1611028.7031
19	619622.8936	1610961.3254
20	619657.2697	1610992.8696
21	619688.8695	1611015.1033
22	619745.0492	1610987.2036
23	619741.9957	1610929.9581
24	619699.3410	1610909.8977
25	619671.6836	1610948.6988
26	619654.3461	1610936.1248
27	619589.3355	1610923.7723
28	619617.6786	1610936.2733
29	619680.9034	1610906.0073
30	619669.5978	1610890.8295
31	619837.9805	1611140.6035
32	619888.8314	1611203.7767
33	619957.4897	1611224.1318
34	620134.2030	1611007.1577
35	620107.2854	1610981.2063
36	620024.6120	1611019.1541
37	619977.2467	1611111.6911
38	619960.6002	1611052.9842
39	619916.1782	1611024.9397
40	619847.4836	1611067.3356

LEGEND

- EXTRACTION/INJECTION WELLS
- LTU-1 PROPOSED LTU WELL ABANDONMENT
- WV CITY WATER SUPPLY VALVE
- BOUNDARY OF TREATED LTU SOIL CONTAINED PAH, PCP AND DIOXINS
- IPC PROPERTY BOUNDARY

N

100 0 200

1"=200'

RETEC

IDAHO POLE COMPANY

MCFR2-03423-400

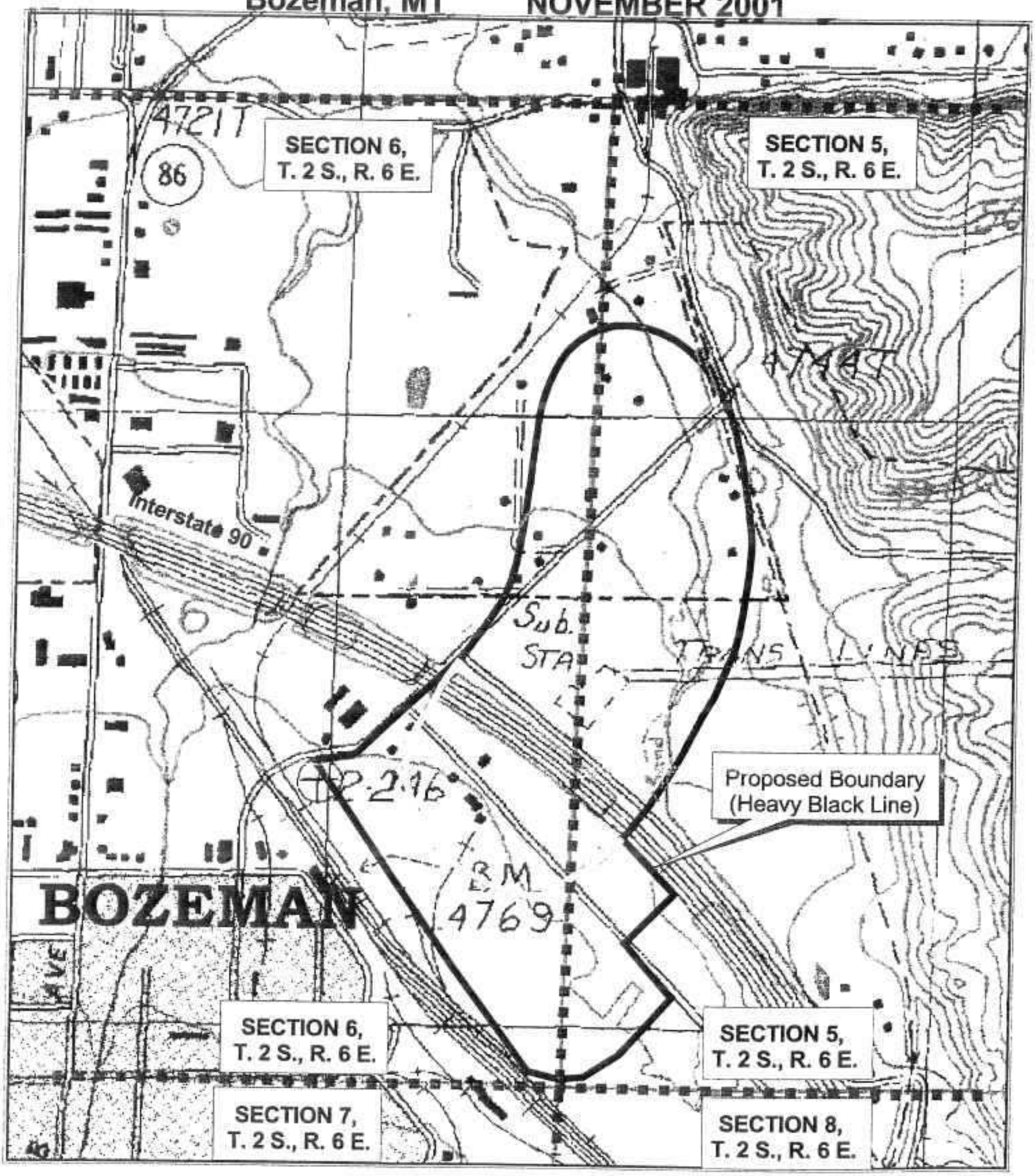
DATE: 4/30/03 DRWN: MAW/BIL

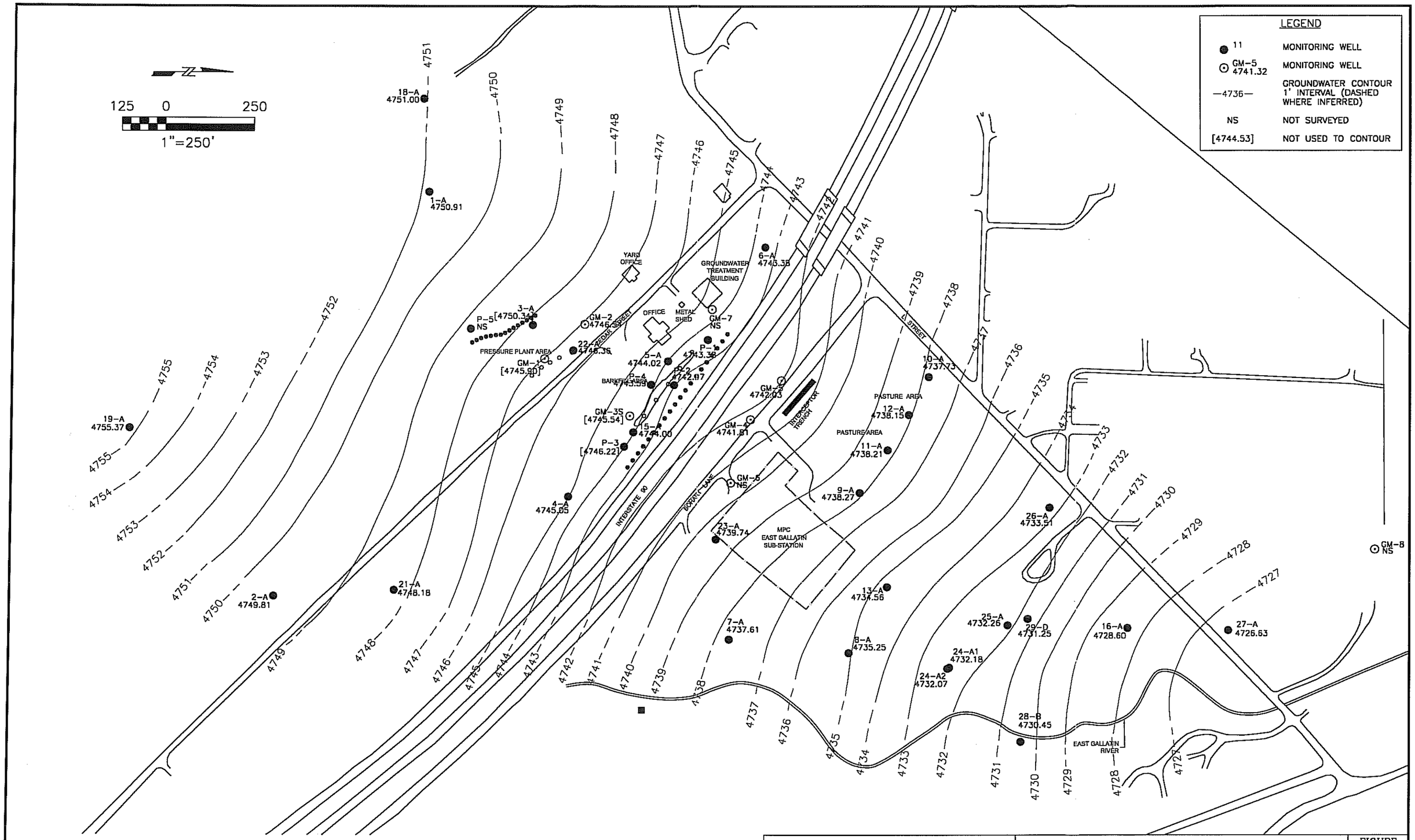
IPC PROPERTY BOUNDARIES AND FINAL LOCATION OF TREATED LTU SOILS
IPC - BOZEMAN, MT

FIGURE 9

ATTACHMENT TO FINAL ORDER FOR 41H-114172

Montana Department of Natural Resources and Conservation
Proposed Idaho Pole Company Controlled Groundwater Area,
Bozeman, MT NOVEMBER 2001





IDAHO POLE COMPANY Bozeman, Montana 5029-300	POTENTIOMETRIC SURFACE MAP APRIL 2008 IPC - BOZEMAN, MT	FIGURE 2-2

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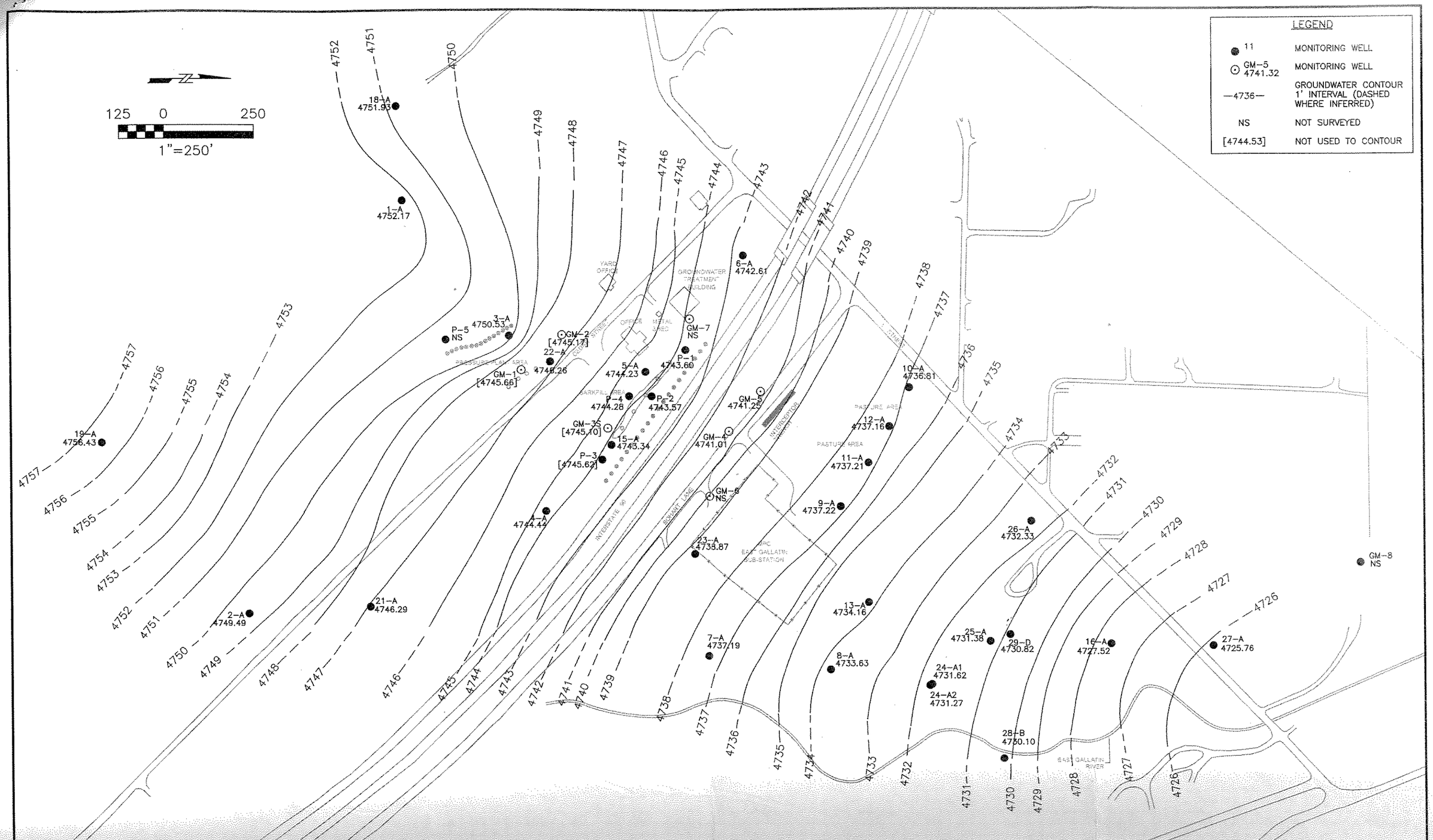
Consulting Scientists and Engineers



IDAHO POLE COMPANY Bozeman, Montana 5029-300	POTENTIOMETRIC SURFACE MAP SEPTEMBER 2009 IPC - BOZEMAN, MT	FIGURE 1

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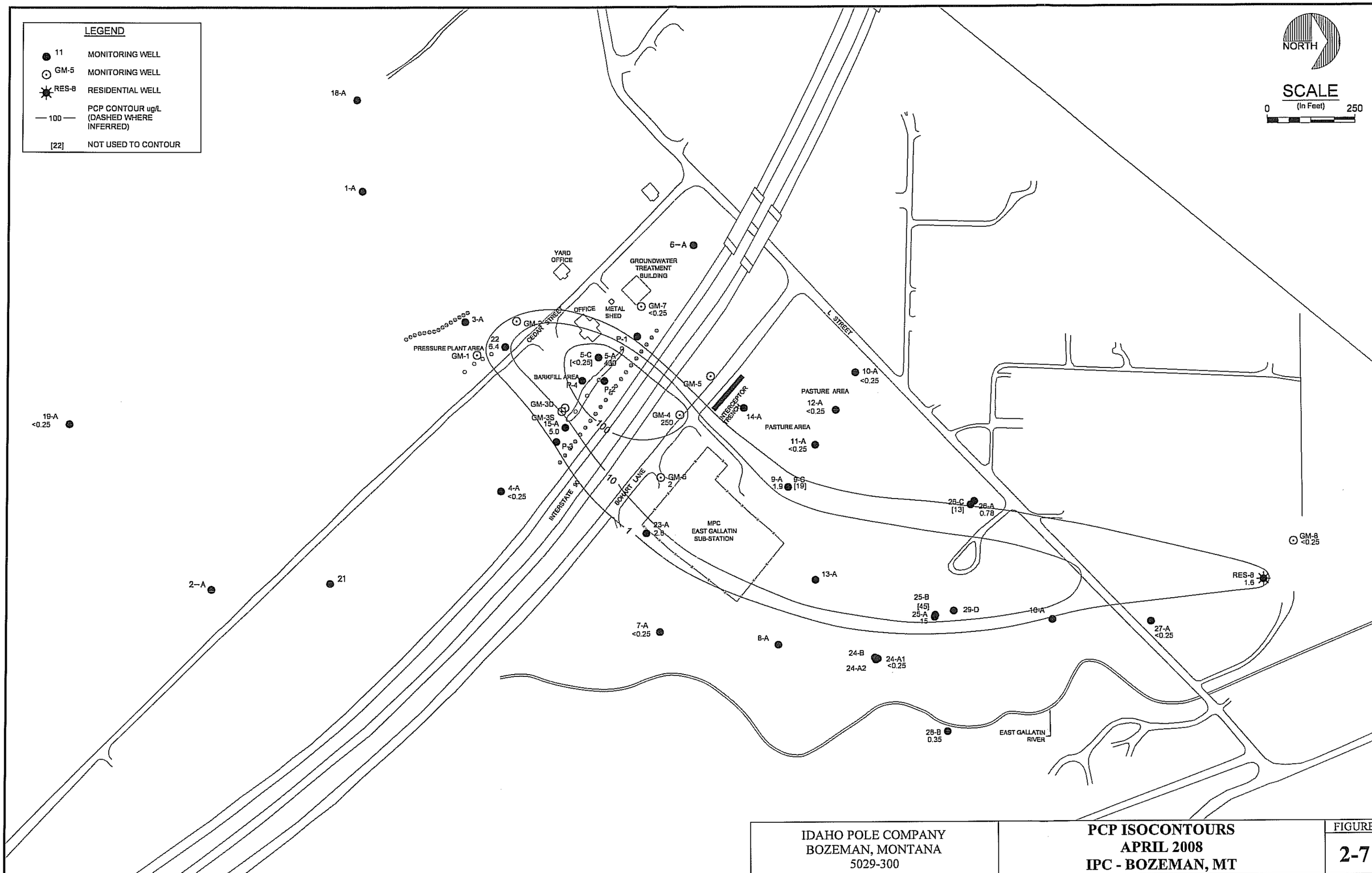
Hydrometrics, Inc.
Consulting Scientists and Engineers



IDAHO POLE COMPANY BOZEMAN, MONTANA 5029-300	**PCP ISOCONTOURS APRIL 2008 IPC - BOZEMAN, MT**	FIGURE **2-7**

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KHOFERER\BIL\20090116\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 2-7.DWG

Hydrometrics, Inc.
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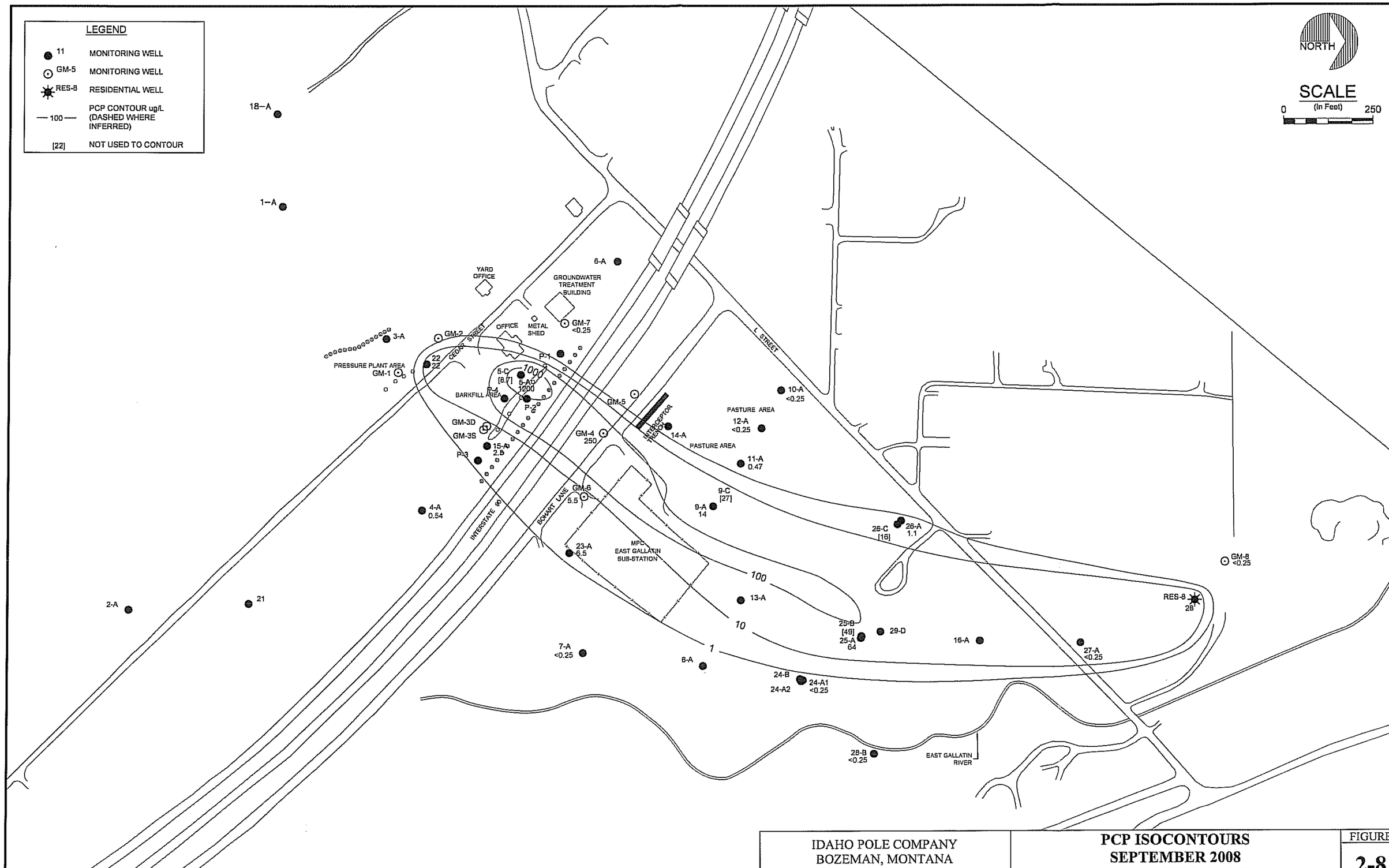

IDAHO POLE COMPANY BOZEMAN, MONTANA 5029-300	**PCP ISOCONTOURS SEPTEMBER 2008 IPC - BOZEMAN, MT**	FIGURE **2-8**

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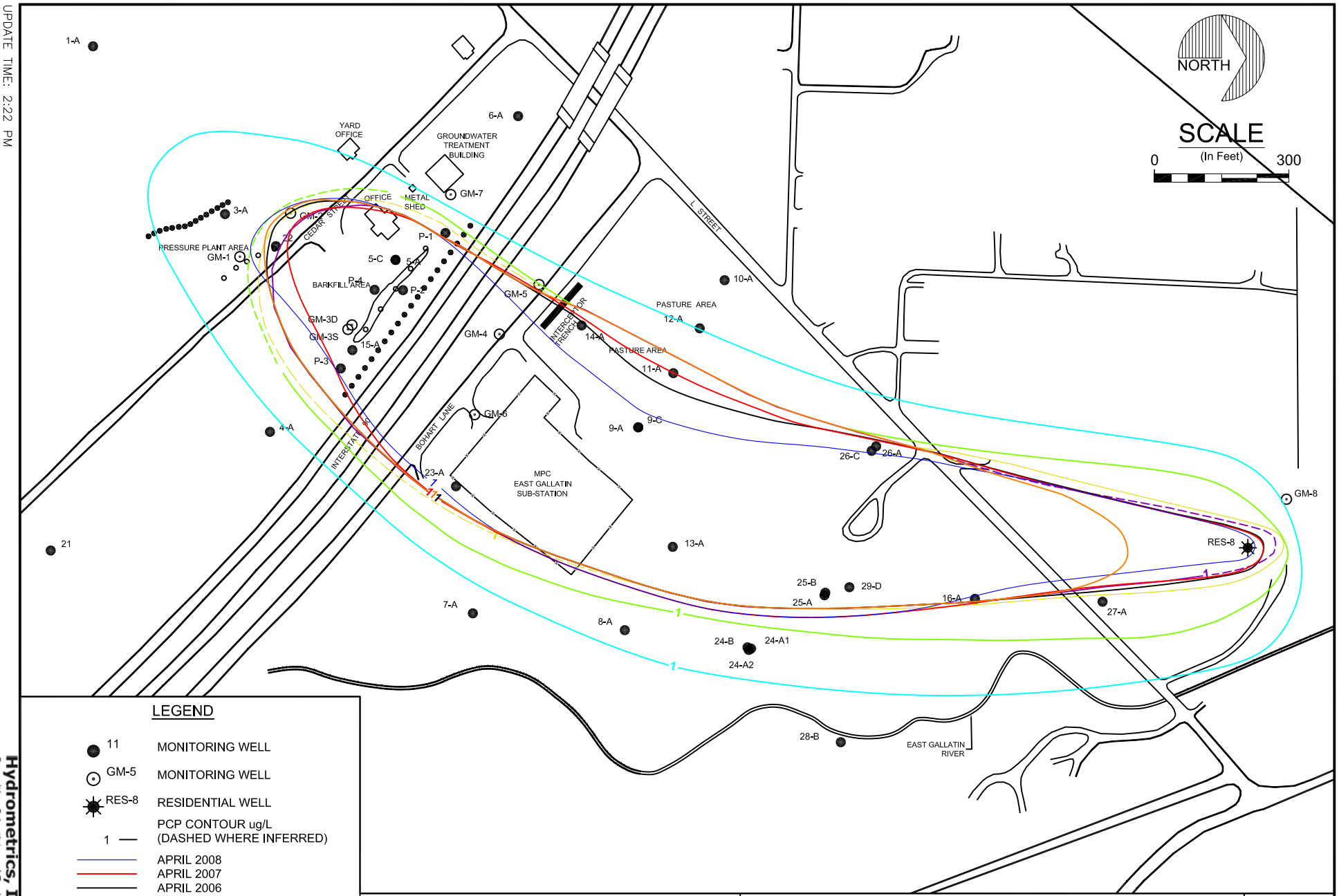
KHOFERER\BIL\20090116\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 2-8.DWG

Hydrometrics, Inc.
Consulting Scientists and Engineers



LEGEND

11	MONITORING WELL
GM-5	MONITORING WELL
RES-8	RESIDENTIAL WELL
1	PCP CONTOUR ug/L (DASHED WHERE INFERRED)
	APRIL 2008
	APRIL 2007
	APRIL 2006
	APRIL 2005
	APRIL 2004
	APRIL 2002
	MARCH 2000
	APRIL 1998

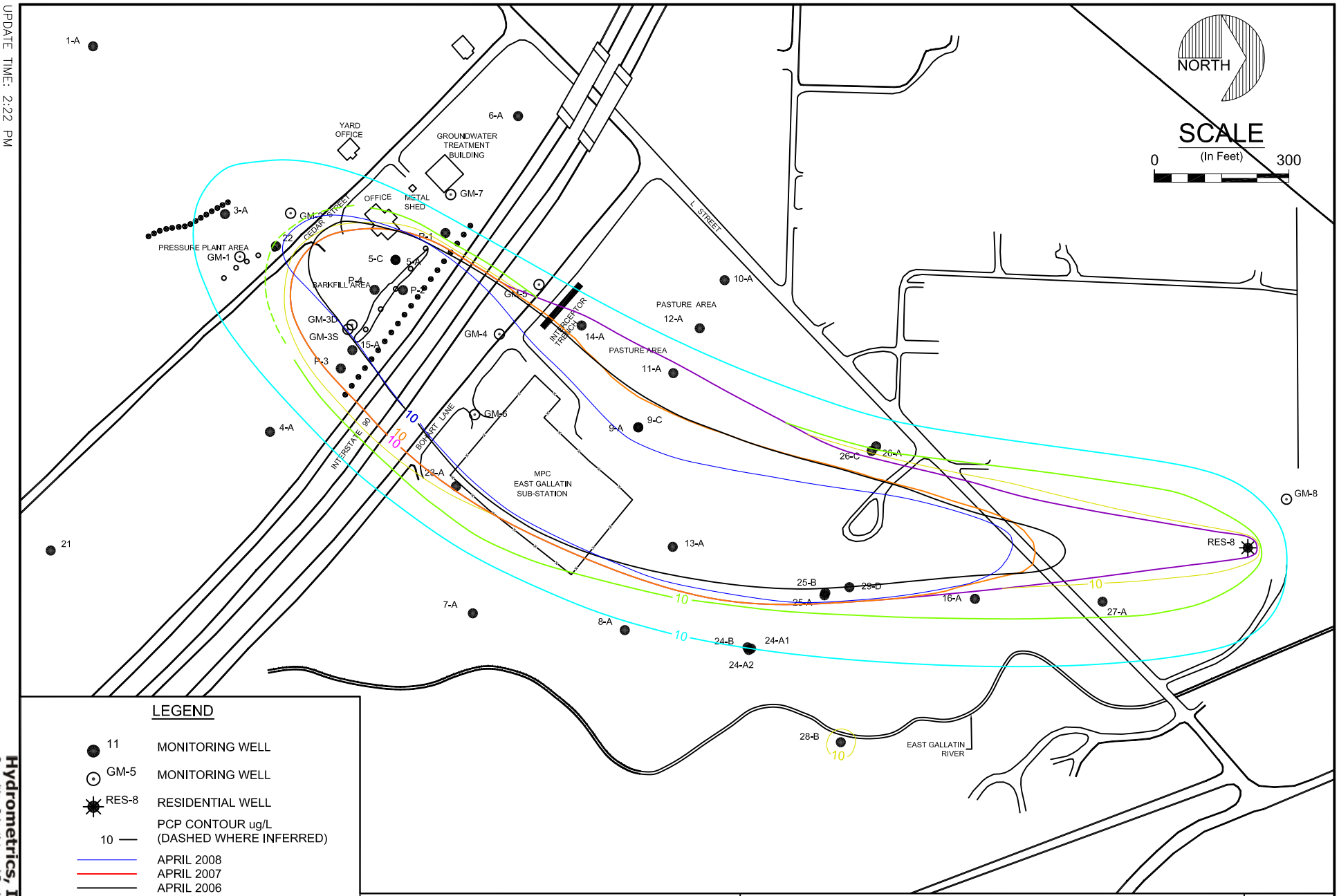
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 1 UG/L
SPRING SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-1

Hydrometrics, Inc.
Consulting Scientists and Engineers

UPDATE TIME: 2:22 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5-1.DWG



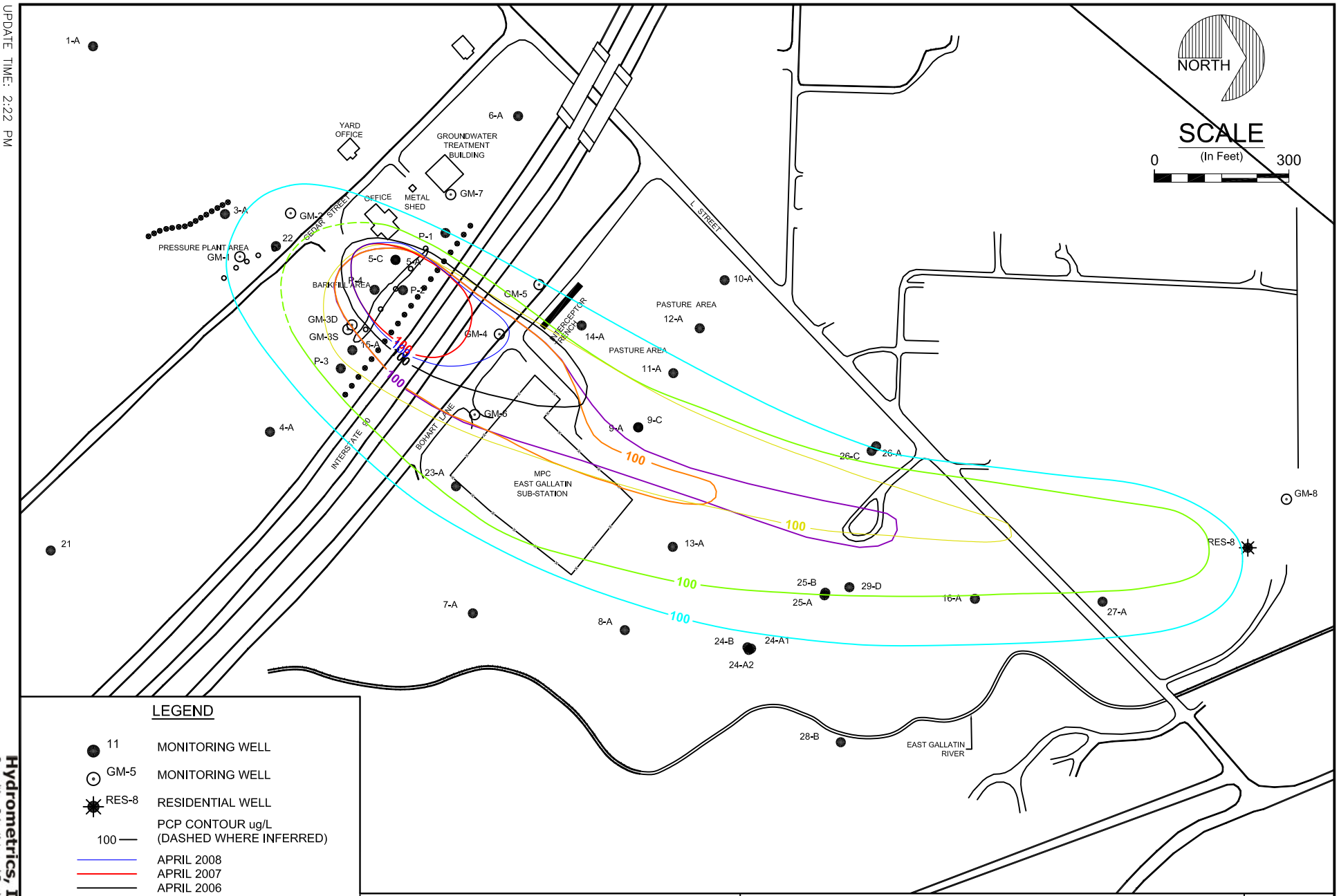
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 10 UG/L
SPRING SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-2

Hydrometrics, Inc.
Consulting Scientists and Engineers

UPDATE TIME: 2:22 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5-1.DWG



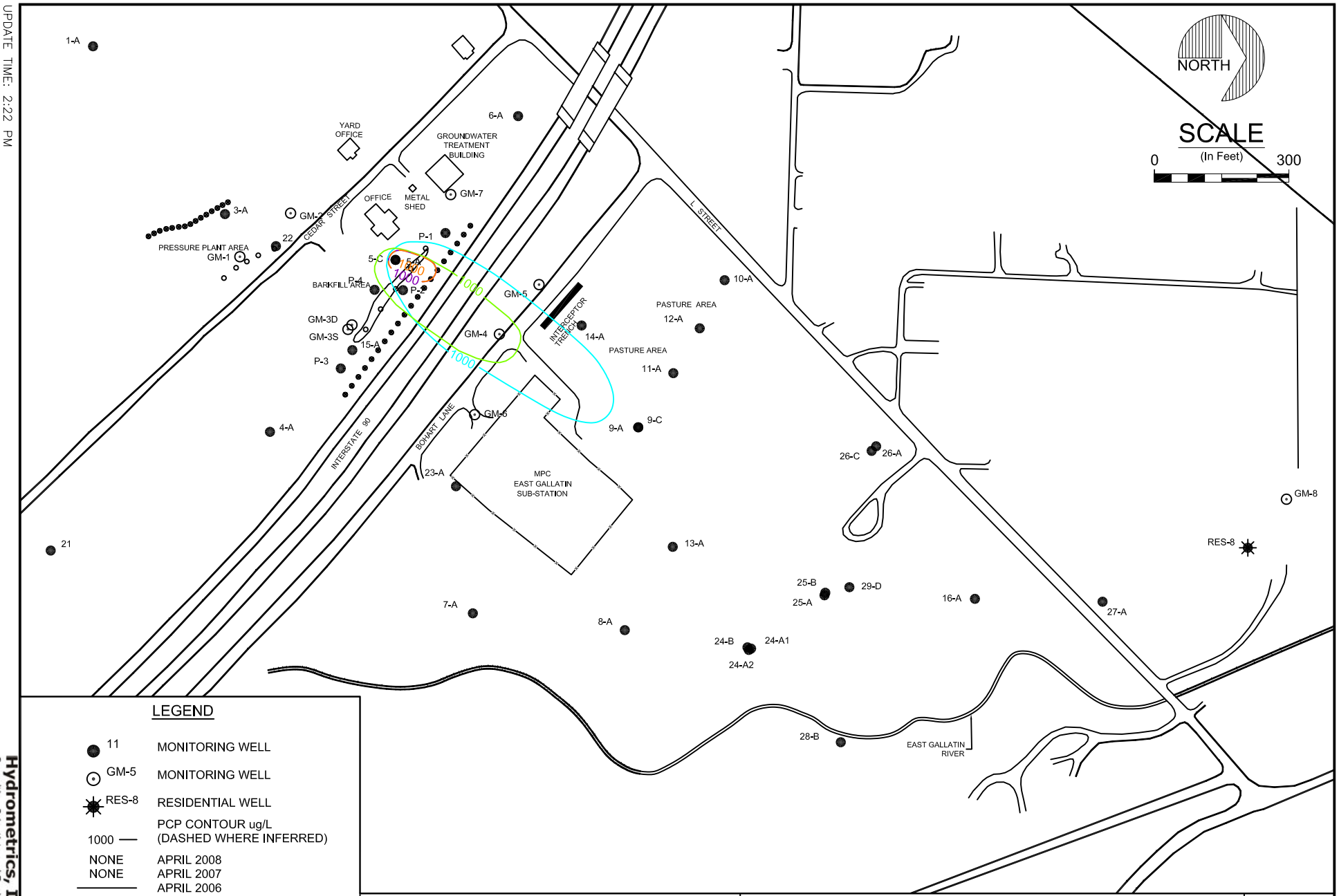
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 100 UG/L
SPRING SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-3

Hydrometrics, Inc.
Consulting Scientists and Engineers

UPDATE TIME: 2:22 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5-1.DWG



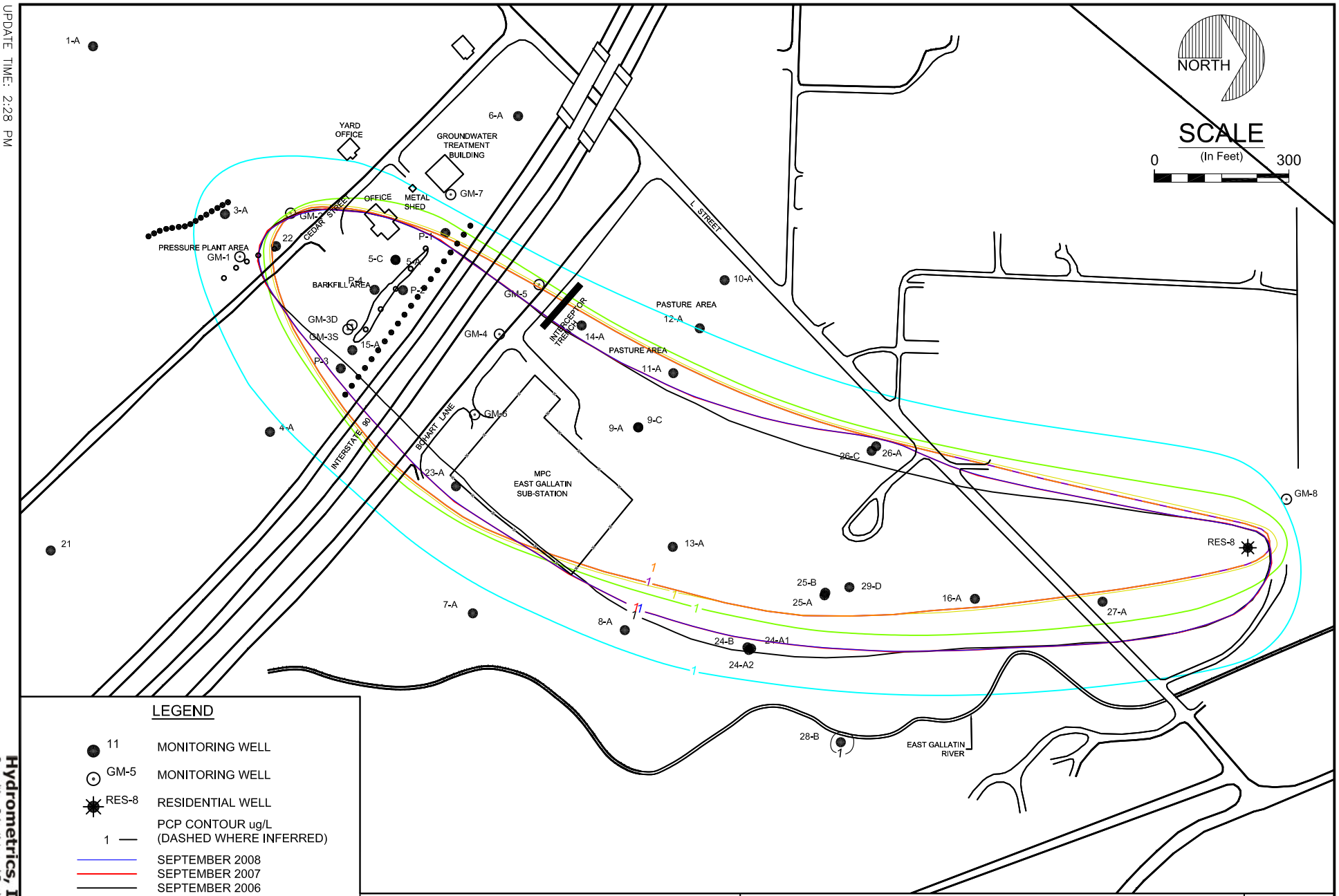
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 1000 UG/L
SPRING SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-4

Hydrometrics, Inc.
Consulting Scientists and Engineers

UPDATE TIME: 2:22 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5-1.DWG



LEGEND

11	MONITORING WELL
GM-5	MONITORING WELL
RES-8	RESIDENTIAL WELL
1	PCP CONTOUR ug/L (DASHED WHERE INFERRED)
	SEPTEMBER 2008
	SEPTEMBER 2007
	SEPTEMBER 2006
	SEPTEMBER 2005
	SEPTEMBER 2004
	SEPTEMBER 2002
	SEPTEMBER 2000
	SEPTEMBER 1998

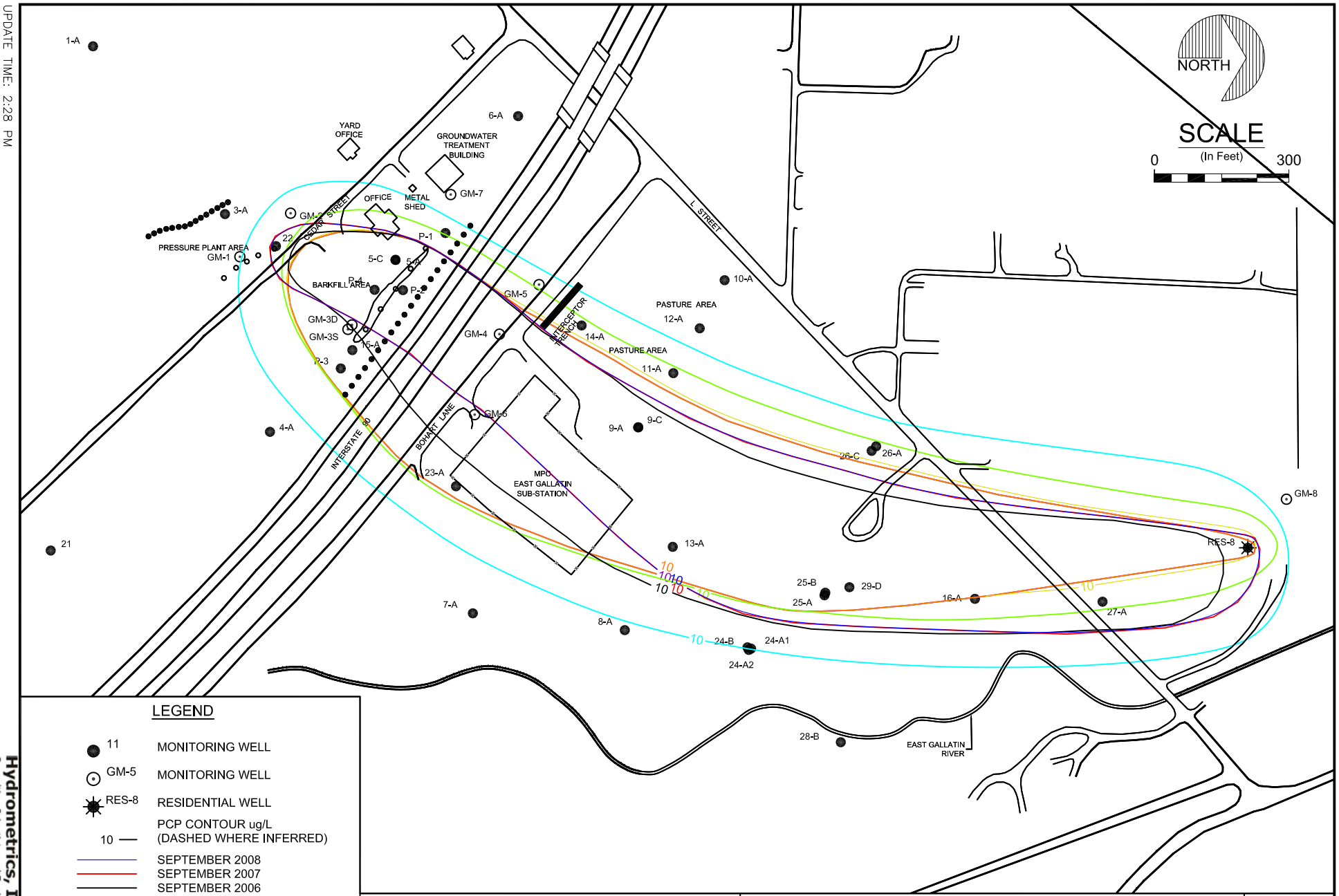
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 1 UG/L
FALL SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-5

Hydrometrics, Inc.
Consulting Scientists and Engineers

UPDATE TIME: 2:28 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5--5T05-8.DWG



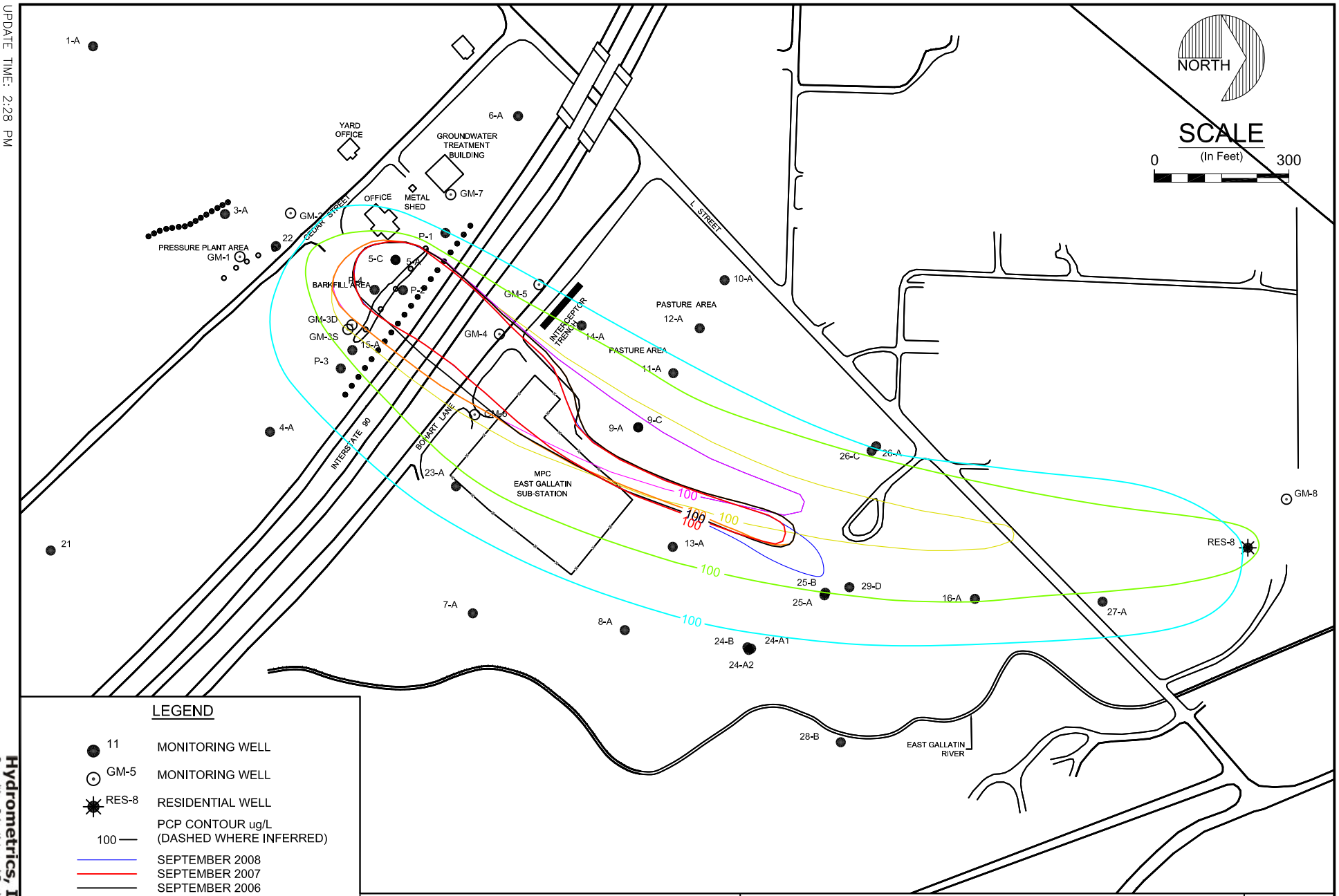
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 10 UG/L
FALL SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-6

Hydrometrics, Inc.
Consulting Scientists and Engineers

UPDATE TIME: 2:28 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5--5T05-8.DWG



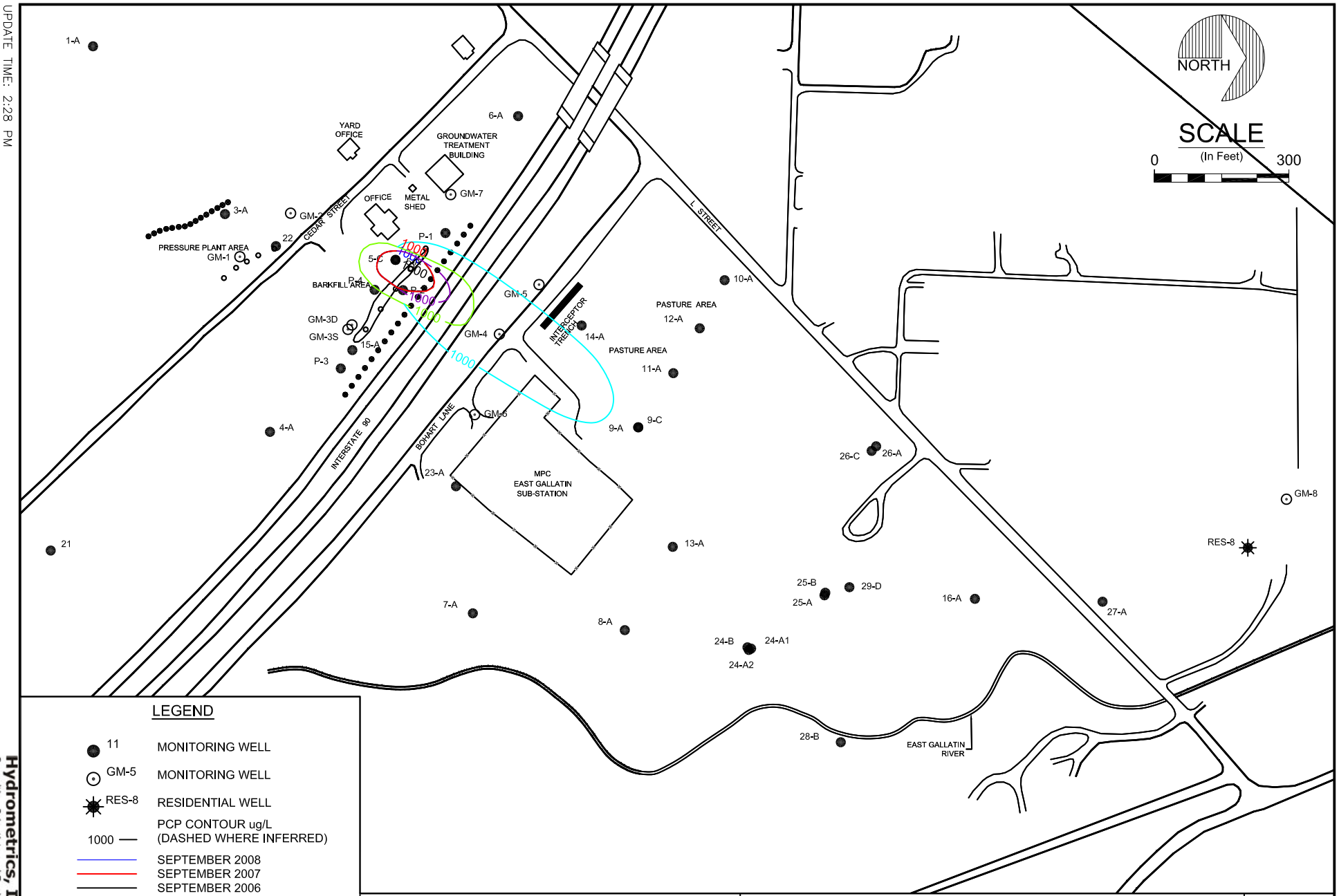
IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 100 UG/L
FALL SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-7

UPDATE TIME: 2:28 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5--5T05-8.DWG

Hydrometrics, Inc.
Consulting Scientists and Engineers



IDAHO POLE COMPANY
BOZEMAN, MONTANA
5029-300

PCP ISOCONTOURS 1000 UG/L
FALL SAMPLING EVENT
IPC - BOZEMAN, MT

FIGURE
5-8

UPDATE TIME: 2:28 PM
DSTREMCHA\BIL\20090306\I:\DRAFTING\MCFARLAND CASCADE\2008\2008 ANNUAL REPORT\FIG 5--5T05-8.DWG

Hydrometrics, Inc.
Consulting Scientists and Engineers

ATTACHMENT B:

Well Construction Table Prepared by Hydrometrics

Well Construction Data for Potentiometric Monitoring
Idaho Pole Company, Bozeman, Montana

Well ID	Northing	Easting	Screened Interval	TOC (FT MSL)	Total Depth (FT)
1-A	619378.81	1610566.24	9-14	4764.39	14
1-B	619378.81	1610566.24	17-22	4763.31	22
2-A	618945.26	1611709.21	5-12	4752.17	12
2-B	618945.26	1611709.21	24-29	4756.47	29
3-A	619673.30	1610940.88	5-10	4758.77	10
3-B	619673.30	1610940.88	21-24	4758.85	24
4-A	619773.72	1611427.15	4-14	4750.83	14
4-B	619773.72	1611427.15	25-29	4749.72	29
5-A	620053.96	1611043.18	4-14	4751.92	14
5-B	620053.96	1611043.18	19-21	4751.72	21
5-C	620053.96	1611043.18	28-30	4751.99	30
6-A	620327.59	1610722.13	5-10	4751.45	10
6-B	620327.59	1610722.13	25-30	4751.79	30
7-A	620226.53	1611832.24	5-12	4743.53	12
7-B	620226.53	1611832.24	25-30	4743.18	30
8-A	620565.63	1611869.87	2-12	4739.41	12
8-B	620565.63	1611869.87	16-21	4739.36	21
9-A	620595.73	1611416.97	4-12	4741.81	12
9-B	620595.73	1611416.97	26-28	4741.89	28
9-C	620595.73	1611416.97	47-50	4741.85	50
10-A	620788.48	1611088.45	9-14	4741.5	14
10-B	620788.48	1611088.45	25-29	4741.21	29
11-A	620674.04	1611296.03	8-13	4742.2	13
12-A	620732.97	1611195.95	8-13	4741.97	13
13-A	620672.72	1611683.87	4.5-9.5	4737.68	9.5
14-A	620469.34	1611189.64	4-9	4741.11	9
14-B	620469.34	1611189.64	15-20	4742.04	20
15-A	619957.60	1611244.51	10-15	4750.83	15
16-A	621347.21	1611799.97	3.5-8	4733.96	8
16-B	621347.21	1611799.97	10.5-11.5	4733.14	11.5
18-A	619363.69	1610304.2	6-16	4766.32	16
18-B	619371.82	1610298.32	21-32	4767.04	32
18-C	619355.56	1610309.55	37-42	4766.48	42
19-A	618536.95	1611234.12	7-16.5	4761.39	16.5
19-B	618528.36	1611236.92	30-35	4761.72	35
21	619284.33	1611692.09	4-14	4749.23	14
22	619787.06	1611012.43	21-26	4756.36	26
23-A	620188.91	1611548.66	4-14	4745.96	14
23-B	620193.38	1611552.52	31-36	4746.1	36
23-C	620183.63	1611559.83	41-46	4746.14	46
24-A1	620847.58	1611911.08	3-13	4738.48	13
24-A2	620842.47	1611914.09	12-22	4738.56	22
24-B	620839.52	1611908.27	25-30	4738.39	30
25-A	621011.36	1611792.02	2-12	4737.68	12
25-B	621013.20	1611786.27	27-32	4737.55	32
26-A	621126.71	1611459.37	2-12	4737.31	12
26-B	621121.90	1611463.97	28-33	4738.12	33
26-C	621116.58	1611469.55	38-43	4738.23	43
27-A	621631.95	1611806.35	3.5-13.5	4733.19	13.5
27-B	621636.85	1611803.2	27-32	4733.05	32
28-B	621047.79	1612120.14	22-27	4736.11	27
29-D	621066.99	1611773.98	53-58.5	4735.45	58.5
GM-1	619706.57	1611036.09	4-14	4756.75	14
GM-2	619819.82	1610938.96	5-15	4758.68	15
GM-3S	619956.69	1611188.33	2.5-7.5	4753.41	7.5
GM-3D	619947.71	1611198.28	10-15	4753.23	15
GM-4	620285.84	1611208.99	6-11	4742.66	11
GM-5	620374.27	1611098.33	5.5-10.5	4742.86	10.5
GM-6	TBD	TBD	5-15	TBD	
GM-7	TBD	TBD	5-15	TBD	
GM-8	TBD	TBD	5-15	TBD	
IPW-4	620177.19	1611166.34	7-22	4757.97	22
IPW-5	620188.74	1611241.13	7-22	4756.83	22
IPW-6	620218.63	1611110.76	8.5-23.5	4758.48	23.5
P-1	620165.40	1610983.20	5-15	4752.7	15
P-2	620070.60	1611110.70	5-15	4748.6	15
P-3	620177.20	1610897.30	5-15	4752.8	15
P-4	620007.30	1611109.90	5-15	4749.6	15
P-5	TBD	TBD	5-15	TBD	15

ATTACHMENT C:

Comments on Draft RSE Report by Hydrometrics , Inc.

Hydrometrics, Inc.
consulting scientists and engineers

M E M O R A N D U M

DATE: January 11, 2010

TO: Les Lonning, McFarland Cascade

FROM: Daniel Stremcha, Hydrometrics
Ashley Thorson, Hydrometrics

SUBJECT: Comments on the *Remediaiton System Evaluation, Idaho Pole Company Site, Bozeman, Gallatin County, Montana*

Les,

Hydrometrics performed a review of the draft *Remediation System Evaluation, Idaho Pole Company Site, Bozeman, Gallatin County, Montana* report (RSE) prepared by GeoTrans, Inc. and Tetra Tech for the Montana Department of Environmental Quality (MDEQ). In general, Hydrometrics agrees with the recommendations outlined in the RSE. A detailed discussion of select items within the body of the report and each of the RSE recommendations is given below.

<u>Items of Note:</u>

- Under the Potential Receptors section of the RSE, it is noted that although oil globules are collected with absorbent pads, the water quality is not sampled, and it is unclear if this trench is a potential pathway for ecological exposure. Hydrometrics recommends the site team evaluates this comment to determine if any necessary actions need to be undertaken.
- The RSE team is unclear what method is used to analyze PCP in the groundwater at the site. The chain of custody records and site reports refer to Method 8040 while the laboratory reports site Method 8041. However, these are essentially the same method. Method 8041 is an update to Method 8040 with very little changes. In order

to prevent any confusion in the future, Hydrometrics agrees that the chain of custodies and reports should cite Method 8041 in the future.

- The RSE team is unclear why Method 8270-SIM is used to measure PCP concentrations in the treatment system effluent when Method 8041 is used for the groundwater and treatment system influent. Site reports state that Method 8270-SIM is used because it provides a lower detection limit. However, review of site data indicates that Method 8041 actually has a lower detection limit. Method 8270-SIM is used on the effluent to measure polycyclic aromatic hydrocarbons (PAHs) at levels low enough to determine if treatment goals are being met. This method is also capable of measuring PCP at levels below the cleanup goal. Therefore, Method 8270-SIM is used to measure PCP in order to prevent the cost of having to run a second analysis (Method 8041). Method 8270-SIM was not historically used on the treatment system influent because there were historically high concentrations of PAHs were high enough that they would saturate the detectors and exceed the calibration range of the equipment. Therefore Method 8270 (with higher detection limits) was used. The problem was that PCP could not be measured at a low enough detection with Method 8270, so Method 8041 was used. The groundwater PCP analysis is independent of the PAH analysis since different sub-sets of wells may be analyzed for each constituent. Therefore, it did not make sense to use the method that combines PAH and PCP analysis. For future monitoring, Hydrometrics recommends using Method 8270-SIM to analyze all treatment system samples (influent and effluent) and all groundwater samples that are analyzing for both PCP and PAHs.

RSE Recommendations

Modify Extraction/Injection strategy to Improve Capture Near 5-A:

The RSE team believes there is evidence that suggests there may be gaps in capture at the BFEG that allow PCP impacted water to migrate towards the north. They recommend the following:

- Eliminate extraction at the PPEG,
- pump at the BFEG with a target rate of 100 gpm or above,

- sample the five BFEG extraction wells for PCP for several months to confirm that the highest PCP concentrations are extracted near well 5-A,
- track extraction rates at individual BFEG wells monthly and use valves to pump as much water as possible from the western-most BFEG extraction wells near well 5-A,
- inject as much water as feasible at the BFIG and use valves to focus as much of the injection as possible in the portion down gradient of well 5-A,
- treated water that cannot be injected at the BFIG should be injected at the PPIG, and
- monitor PCP in GM-4 quarterly as an indicator.

Hydrometrics mostly agrees with these recommendations with the following exceptions:

- with the current design of the injection system, injected water cannot be focused into a specific area and hydrometrics does not feel it is necessary at this time to undertake injection redesign and
- GM-4 only needs to be monitored semi-annually on the regular monitoring schedule for PCP.
- Monitoring of the BFEG wells may be a good idea, but we can do it semiannually.

Currently, the PPEG has already been monitored and shut off.

Modify Groundwater Sampling Locations for PCP and PAHs

The RSE recommends discontinuing analyses of PAHs in the following wells:

- 9-A
- 19-A,
- 25-A,
- 25-B, and
- 26-C

The recommendation to remove PAH analysis from these wells stems from historic data that is consistently below cleanup goals. Hydrometrics agrees with this recommendation.

The RSE recommends adding PAH analysis on an annual basis to the following:

- GM-4,
- GM-5

- GM-6,
- 14-A,
- 23-A, and
- 23-B

The reasoning is that these wells are either directly down gradient of the wells that are consistently above cleanup goals (5-A, 15-A, and 22) or they are in the vicinity of the interceptor trench. Hydrometrics agrees with this recommendation with the exception of well 14-A. This well appears to have been abandoned.

With respect to PCP sampling, the RSE team believes that recent data at B horizon wells indicate higher concentrations of PCP then A wells. To better characterize the core of the plume in this horizon, the RSE recommends adding PCP monitoring to some of the B horizon wells. The RSE also recommends adding two wells to the monitoring programs around the interceptor trench. The list of wells to be added is as follows:

- GM-5,
- 9-B,
- 14-A,
- 24-B,
- 16-B,
- 26-B,
- 26-C, and
- 27-B.

Hydrometrics does not believe it is necessary to sample the B horizon wells. The September 2009 sampling event indicated that the concentrations in this horizon are decreasing. There is no exposure pathway to this water. Therefore, hydrometrics recommends only sampling these wells every five years.

The RSE recommends discontinuing PCP analysis of the following wells due to redundancy and/or lack of previous detection:

- 10-A,

- 12-A,
- 13-A,
- 4-A,
- 7-A,
- 27-A,
- GM-7, and
- GM-8.

Hydrometrics agrees with this recommendation.

Address Potential Discharge of Impacted Groundwater to Surface Water

The RSE team believes contaminated groundwater is migrating into Rocky Creek. This is based on an extremely fast calculated groundwater velocity and the PCP concentration that was measured in Well 27-B during the September 2009 monitoring event. The concentration in Well 27-B exceeds the ARAR specified in the ROD. The RSE recommends revisiting the ARARs, state regulations, and the administrative record to determine if the ARARs still apply, and recommend reconciling any differences between existing groundwater quality and the ARARs.

Hydrometrics does not believe there is any evidence to suggest surface water bodies in the area are being impacted. PCP monitoring has been conducted in monitoring wells that are screened along a similar plane as Rocky Creek for several years. Wells 7-A, 8-A, 16-A, 24-A1, and 27-A were all below 1ug/L during the September 2009 sampling event. The PCP concentration measured in well 27-B during the September 2009 sampling indicates the remnants of contaminated groundwater at a much deeper interval that is not impacting the creek. Since this concentration has greatly decreased since the last time it was measured in June 1991 (647 ug/L to 43 ug/L), it is Hydrometrics' belief that the remaining contamination at this level is biological degrading and requires no further action. This scenario is the same for wells 7-B, 8-B, 16-B, 24-A2 and 24-B.

Extrapolate Plume Extent and Additional Potential Receptors

The RSE suggests the possibility that the plume parallels Rocky Creek and may impact groundwater underlying additional wells beyond RES-8. The RSE team suggests identifying if any wells are located in this area, determine their uses, determine their construction, and sample them for PCP. These finding may suggest the need for further characterization and potentially extending the CGA.

Hydrometrics believes any properties beyond RES-8 lie outside of the plume area and do not require sampling. If necessary, a GWIC search for additional wells within a small buffer zone could be performed and a one time sampling event for PCP could be conducted to eliminate any wells on these properties as potential exposure pathways.

Complete ICs for Areas Where Treated Soils Were Placed

The RSE team recognizes that efforts are underway to finalize institutional controls for the treated soil that was placed back on the site containing dioxin above the soil cleanup standards identified in the ROD. They only included a recommendation that these efforts continue for completeness of the report. Hydrometrics agrees with this recommendation.

Eliminate Bioremediation Sampling

The current bioremediation monitoring program is ineffective in quantifying the extent of bioremediation at the site. The parameters that are monitored only demonstrate whether the conditions are right for bioremediation to take place. Therefore, the RSE team suggests discontinuing the bioremediation monitoring program and instead use PCP data to evaluate remedy performance. Hydrometrics agrees with this recommendation.

However, Hydrometrics does not agree that it is clear from the PCP data that bioremediation does not sufficiently address the contamination that is currently migrating down gradient from potential sources. Contaminant concentrations are decreasing throughout the site. While the pump and treat system is operating, it is impossible to determine how much it is contributing to the decreasing concentrations and how much bioremediation is contributing to the decrease.

Consider Modifying Treatment Plant Plumbing and Use of Water Source Heat Pump for Building Heat

The RSE recommends modifying the treatment plant plumbing in order to operate continuously rather than in batch cycles. It also recommends removing the current electric building heaters and installing a water source heat pump tied to the system effluent. Both of these recommendations are to save money on electrical expenses. Hydrometrics agrees that with time these recommendations may pay for themselves and eventually save money. However, with the uncertainty of when the system will be shut-down, we do not recommend making these changes at this time.

Measure and Track Specific Capacity of Wells

The RSE recommends tracking the specific capacity (pumping rate divided by the drawdown) of each extraction well to monitor for well fouling. Hydrometrics does not believe this tracking is necessary. There has not been an issue with wells fouling in the past and, as the RSE points out, the measurement of drawdown in an individual well can be complicated by several factors such as regional water level changes and interference from other extraction wells. The extraction rates of the individual extraction wells is already monitored. Hydrometrics recommends reviewing the possibility of well fouling only when well extraction rates unexpectedly decline.

Other Recommendations for Site Data Collection and Reporting

The RSE team has the following additional recommendations:

- Standardize the analytical methods so there is one method for PCP and one method for PAHs. Hydrometrics response to this is detailed above.
- The RSE team suggest that the highest value at a particular well cluster be used for contouring purposes. Hydrometrics does not agree with this recommendation. The wells within each cluster are screened at different aquifer depths. Only wells located within the same hydrostratigraphic interval can be contoured together.
- The RSE recommends including map in the site reports that illustrates where flow is interpreted to be upward and where flow is interpreted to be downward.

Hydrometrics recommends that the site team evaluates this suggestion at a later time to determine if there is any benefit.

- The RSE team believes that sufficient information regarding water levels would be provided by semi-annual water level events and therefore suggests that the frequency for water level events be decreased from quarterly to semi-annually. Hydrometrics agrees with this recommendation.
- The site reports should provide the average injection rates at the two injection galleries over the course of a reporting period so there is a better understanding of the distribution of water reinjection and its potential implications for source control. Hydrometrics does not believe this is possible with the current system. The quantity of water sent to each injection gallery can be measured, but there is no way of measuring the distribution to specific areas of the individual injection galleries based on the current system design.
- The site team should report the extraction rates at each of the extraction wells based on the existing flow totalizers on each well on a monthly basis. This is currently being done and totaled for the quarterly reports. If it is determined that reporting individual flow rates would be beneficial, this can be done.
- The site team might consider managing water level and water quality data electronically in a database. Hydrometrics does not feel a site analytical database is necessary at this time. Populating over ten years of analytical data into a database would be time consuming and costly and not sure what the benefit would be. If EPA and MDEQ determine that future management decisions for the site will be made using software such as Monitoring and Remediation Optimization System (MAROS), IPC would like to evaluate the benefit of a database at that time.

Clarify "Attainment Area" for Groundwater Cleanup

There is some ambiguity regarding the area in which the groundwater standards are the be achieved. Hydrometrics believes this area is the attainment area defined in the ROD as the area north of I-90.