

REMEDIATION SYSTEM EVALUATION

MACGILLIS & GIBBS SUPERFUND SITE NEW BRIGHTON, MINNESOTA



Report of the Remediation System Evaluation,
Site Visit Conducted at the MacGillis & Gibbs Site
13-14 June, 2000

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NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) and the United States Army Corps of Engineers (USACE) for the U.S. Environmental Protection Agency (U.S. EPA). Work conducted by GeoTrans, including preparation of this report, was performed under Dynamac Contract No. 68-C-99-256, Subcontract No. 91517. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

The site was a wood preserving facility that is no longer active. Key contaminants at the site include pentachlorophenol (PCP), chromium, and to a much lesser extent dioxin, arsenic, and polynuclear aromatic hydrocarbons (PAHs). Both light non-aqueous phase liquids (LNAPL) and dense non-aqueous phase liquids (DNAPL) represent continuing sources of dissolved PCP groundwater contamination. The site is underlain by a sequence of glacial sands and tills. The uppermost unit is the New Brighton Formation, which consists of sand and clayey silt. The remediation system addresses the New Brighton aquifer.

USEPA has divided the site into three Operable Units:

- OU1: Contaminated soil/debris in a former disposal area, plus some soils from OU3 that have been mixed with OU1 soils, plus removal of below-ground tanks, vaults, and pipes from OU3
- OU2: LNAPL in the former PCP process area, plus above-ground process tanks
- OU3: All other contaminated soils and groundwater

This RSE only pertains to the ongoing groundwater remediation of OU2 (a small LNAPL recovery system) and OU3 (a groundwater pump-and-treat system located both on-site and off-site).

The RSE suggests several potential modifications to address effectiveness issues, including:

- development and regular update of a target capture zone for PCP and chromium
- regular evaluation of actual capture with respect to the target capture zone
- formalizing and implementing a long-term monitoring plan for the New Brighton aquifer and the underlying Hillside Aquifer
- improving fencing and/or security and request that Williams Brothers secure a pipeline that runs through the site
- evaluating a proposed new building that will potentially overly LNAPL and/or DNAPL, with respect to potential exposures and/or impacts to the OU2 extraction well

The RSE also suggests several potential modifications to reduce long-term costs, including:

- elimination of the OU2 treatment system by merging it with the OU3 system now that the larger OU3 system is fully operational (potential net savings of approximately \$0.5M over the remaining 4 years of expected operation for the OU2 system, non-discounted)

- elimination the bioreactor from the OU3 treatment system if it is determined (via pilot test) that organo-clay and/or GAC can more cost-effectively treat the water, given that PCP influent concentrations are now significantly lower than original design influent concentrations (potential net savings of more than \$1.5M over 30 years, non-discounted)
- elimination of select discharge monitoring points (potential net savings of nearly \$1M over 30 years, non-discounted)

The RSE also suggests consideration of an alternate strategy where higher discharge limits are potentially negotiated with the POTW, eliminating the need for pretreatment altogether. The RSE also suggests several other potential modifications intended for technical improvement.

Estimated capital and annual costs (and savings) associated with recommendations are summarized in a table at the end of the report.

PREFACE

This report was prepared within the context of a demonstration project conducted by the United States Environmental Protection Agency's (USEPA) Technology Innovation Office (TIO). The objective of the overall project is to demonstrate the application of optimization techniques to Pump-and-Treat (P&T) systems at Superfund sites that are "Fund-lead" (i.e., financed by USEPA). The demonstration project was conducted in USEPA Regions 4 and 5.

The demonstration project has been carried out as a cooperative effort by the following organizations:

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The project team is grateful for the help provided by an EPA Project Liaison in each Region. Kay Wischkaemper in Region 4 and Dion Novak in Region 5 were vital to the successful interaction between the project team and the Regional Project Managers (RPM's) during the course of this project, and both actively participated in one Remediation System Evaluation (RSE) site visit conducted in their Region.

The data collection phase of this project included interviews with many RPM's in EPA Regions 4 and 5. The project could not have been successfully performed without the participation of these individuals.

Finally, for the sites where RSE's were preformed, additional participation and substantial support was provided by the RPM's (Ken Mallary and Ralph Howard in Region 4; Steve Padovani and Darryl Owens in Region 5), and their efforts are very much appreciated, as are the efforts of the State regulators and EPA contractors who also participated in the RSE site visits.

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1.0 INTRODUCTION

1.1 PURPOSE

The US Environmental Protection Agency's (USEPA) Technology Innovation Office (TIO) and the US Army Corps of Engineers (USACE) Hazardous, Toxic, and Radioactive Waste Center of Expertise (HTRW CX) are cooperating in the demonstration of the USACE Remediation System Evaluation process at Superfund sites. The demonstration of the RSE's is part of a larger effort by TIO to provide USEPA Regions with various means for optimization, including screening tools for identifying sites likely to benefit from optimization and computer modeling optimization tools for pump and treat systems, such as the MODMAN code.

The MacGillis & Gibbs site was chosen based on initial screening of pump and treat systems managed by USEPA Region 5 and represented a site with relatively high operation cost and a long projected operating life. One or two sites in Regions 4 and 5 will be evaluated with RSE's in the first phase of this demonstration project. A report on the overall results from these demonstration sites will also be prepared and will identify lessons learned, typical costs savings, and a process for screening sites in the USEPA regions for potential optimization savings.

The RSE process is meant to identify cost savings through changes in operation and technology, to evaluate performance and effectiveness (as required under the NCP, i.e., and "five-year" review), assure clear and realistic remediation goals and exit strategy, and verify adequate maintenance of Government owned equipment. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

1.2 TEAM COMPOSITION

The team conducting the RSE included:

Kathy Yager, HQ EPA TIO
Peter Rich, Engineer, HSI GeoTrans (EPA TIO's contractor)
Rob Greenwald, Hydrogeologist, HSI GeoTrans (EPA TIO's contractor)
Bill Crawford, Chemical Engineer, USACE HTRW CX
Dave Becker, Geologist, USACE HTRW CX

1.3 DOCUMENTS REVIEWED

The following documents were reviewed as part of the RSE evaluation:

Author	Date	Title/Description
EPA	9/30/91	ROD, OU2
Ecology & Environment	7/16/93	Feasibility Study, OU3
Ecology & Environment	2/2/94	Pre-Design Study, OU2
EPA	9/22/94	ROD, OU3
Carbonair	11/10/97	O&M Manual, OU2
BioTrol	11/11/97	O&M Manual, BioTrol Aqueous Treatment System, OU2
Black & Veatch	??	Figures A-1 through A-10 (plume maps based on data from 1995, 1996, and 1997)
Black & Veatch	5/98	OU3 Pre-Remedial Design Groundwater Modeling Report
Black & Veatch	11/98	Figures J, K, and L (draft plume maps based on September 1998 GeoProbe sampling)
Black & Veatch	11/98 and 12/98	Simulated potentiometric surface maps for actual extraction scenarios (i.e., actual locations and design rates)
Black & Veatch	2/99	Subcontract Documents, Volume 1 of 2 (Bidding Documents), OU3
Black & Veatch	Varies, 1999	Subcontract Documents, Volume 1 of 2 (Bidding Documents), OU3
Black & Veatch	Varies, 1999	Subcontract Documents, Volume 2 of 2 (Bidding Documents), OU3
Black & Veatch	Varies, 1999 and 2000	Monthly/Quarterly Status Reports, OU3
Ecology & Environment	Varies, 1999 and 2000	Monthly Technical Status Reports, OU2
EPA	9/30/99	ROD Amendment, OU1 and OU3
Black & Veatch	4/1/00	Figures M, N, and O (Plume maps based on sampling round 1a in February 1999, and sampling round 1B in December 1999)
August Mack	4/26/00	Industrial Waste Discharge Report
Ecology & Environment	5/18/00	Dip Tank 2 Investigation and Product Removal Troubleshooting, OU2
Ecology & Environment	??	Evaluation of EW-1 OU-2
Conestoga Rovers	6/19/00	Quarterly Report, Bell Lumber

1.4 PERSONS CONTACTED

The following individuals were present during the site visit:

Darryl Owens, EPA RPM, Region V
Nile Fellows, Minnesota Pollution Control Agency (MPCA)
Fred Campbell, MPCA
Dan Card, MPCA
Larry Campbell, Project Manager, Black & Veatch, Chicago
Rob Blake, Black & Veatch, Kansas City
Ben Horenziak, P.E., Ecology & Environment
Matt Alleva, Carbonair Environmental Systems

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

This RSE pertains to OU2 and OU3 at MacGillis & Gibbs (“MacGillis”, also referred to as “the site”). MacGillis is listed on the NPL along with Bell Lumber & Pole (Bell), an adjacent property. Bell is being remediated separately by a PRP, while MacGillis is being remediated by USEPA. Only the MacGillis site is addressed in this RSE.

MacGillis was a wood preserving facility that is no longer active. USEPA has divided the site into three Operable Units:

- OU1: Contaminated soil/debris in a former disposal area, plus some soils from OU3 that have been mixed with OU1 soils, plus removal of below-ground tanks, vaults, and pipes from OU3
- OU2: LNAPL in the former PCP process area, plus above-ground process tanks
- OU3: All other contaminated soils and groundwater

Figure 1-1 illustrates the location of OU1 and the recovery well for OU2. The remaining area is OU3. This RSE only pertains to the ongoing groundwater remediation of OU2 (a small LNAPL recovery system) and OU3 (a groundwater pump-and-treat system located both on-site and off-site).

1.5.1 LOCATION

The site is located in a mixed residential and commercial area in New Brighton, Minnesota. The site is located in Ramsey County, and is approximately 30 minutes north of Minneapolis.

The site is generally flat, with scattered debris over much of the site. The site is not fenced, and has open access. All original process buildings and tanks have been removed. There are two separate buildings that house groundwater treatment plants (one for OU2 and one for OU3), located adjacent to each other on the eastern side of the site. There is a pond within the geographic boundary of OU1, on the western side of the site. An exposed Williams Brothers gasoline pipeline was observed running within the pond. A rail yard is located adjacent to the site on the west. The sole extraction well associated with ongoing OU2 activity is located in the northern part of the site, on a large concrete pad. An office building (Donatelle) is located immediately adjacent of the site to the north.

Some extraction wells associated with OU3 remediation are located on-site, and others are located off-site to the east, northeast, and west (see Figure 1-1).

1.5.2 POTENTIAL SOURCES

Materials used for wood preserving included PCP, creosote, and chromated copper arsenate (CCA). An initial environmental investigation occurred in 1979, after a spill of 4000-5000 gallons of CCA. OU1 on the western part of the site was a disposal area for the facility (a topographic depression filled with scrap post and poles, wood chips, solids, spent PCP solutions, etc.). Outside of OU1, there were two significant process areas (see Figure 1-1): 1) the PCP process area; and 2) the chromated copper arsenate (CCA) area. Other areas of the site were used for storage of treated and untreated lumber.

In the 1960's a change was made in PCP processing from a PCP/Proville 4-A mixture to a PCP/P-9 oil mixture. This was significant because the new mixture was less dense than water, whereas the previous mixture was more dense than water. The new mixture required significantly more process wastewater, which was likely disposed of in the pond in OU1. Note that significant LNAPL is still observed on-site in the PCP process area (i.e., EW-8, EW-9, and the OU2 extraction well), and this is likely from the new mixture. The presence of DNAPLs from the old mixture, in the vicinity of the OU1 pond (MW3B, MW8B, MW5B) and far from the OU1 pond (MW19B, WP-5) is also considered likely based on groundwater concentrations in basal wells plus DNAPL observations in borings. Both LNAPL and DNAPL represent continuing sources of dissolved PCP groundwater contamination.

Metal-contaminated soils associated with the CCA process area was remediated in July 1997, primarily through excavation activities.

1.5.3 HYDROGEOLOGIC SETTING

The site is underlain by a sequence of glacial sands and tills. The uppermost unit is the New Brighton Formation, which consists of sand and clayey silt. The New Brighton ranges in thickness from 14 to 71 feet. Depth to water varies from 5 to 20 feet. The New Brighton is underlain by the Twin Cities till, an aquitard that is approximately 25 to 60 feet thick. The underlying aquifer is the Hillside Sand Formation.

The New Brighton receives recharge from precipitation. The New Brighton aquifer is limited in areal extent beyond the site (it extends 0.5 miles west, 0.75 miles east, 2 miles north, and 2 miles south of the site). A series of lakes, streams, and wetlands exist primarily where the aquifer pinches out, and these are interpreted as points of groundwater discharge. Due primarily to these factors, groundwater within the New Brighton flows radially from a potentiometric high located in the vicinity of OU1 pond (see Figure 1-1). Since OU1 was a historical source of groundwater impacts, those impacts are observed in all directions off-site due to the radial flow pattern. With respect to the PCP and CCA process areas, predominant groundwater flow is to the northeast towards Farrel's Lake. The hydraulic conductivity is approximately 10^{-2} to 10^{-3} cm/sec, and groundwater flow velocity is on the order of 0.2 ft/day to 1.0 ft/day (100 to 350 ft/yr).

The Hillside Aquifer is confined, with flow to the north. Hydraulic conductivity is estimated at 10^{-3} cm/sec.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

The remediation system that is the focus of this RSE is limited to the New Brighton aquifer. Contaminants in the New Brighton include PCP, chromium, arsenic, dioxin, and carcinogenic PAH's.

As previously mentioned, DNAPL and LNAPL associated with PCP are found in OU1 as well as specific locations throughout the PCP process area. The operating OU2 system addresses an area of LNAPL located near the northern site boundary. It was essentially an interim system intended to prevent further off-site migration of this LNAPL and associated groundwater contamination. LNAPL thickness of up to 6.5 ft are observed at the extraction well and piezometers located nearby. However, no LNAPL is observed in the two downgradient piezometers (PZ-7 and PZ-8). LNAPL is also observed on-site at EW-8 and in the monitor wells near MW-9.

As discussed above, the past occurrence of a ground water divide under the site and the locations of various processes at this large site has resulted in several dissolved contaminant plumes extending from the site. PCP is most widespread and PCP plumes, defined by a 1 ug/L contour, extend approximately 2000 feet east-northeast and 2100 feet west-northwest of the source areas. A separate Bell PCP plume extends southwest from the Bell property. Another recently discovered PCP plume extends westward from an area between Bell and MacGillis and Gibbs property. Concentrations of PCP exceed 1,000 ug/L in these plumes. The plume extending west-northwest from the MacGillis and Gibbs site has an anomalous hot spot (over 10,000 ug/L) near extraction well EW-13. Concentrations between this hot spot and the MacGillis and Gibbs property are significantly lower. The cause of these high concentrations is not known. A chromium plume extends 1,200 feet east-northeastward from the CCA treatment area and two arsenic plumes extend northward from CCA area and southward from the southern border of the MacGillis and Gibbs property. The southern arsenic plume is not well defined and only based on two sampling points.

PCP strongly sorbs onto soils, and thus migrates very slowly with respect to groundwater velocity. Other PAHs and dioxins are extremely immobile in a dissolved form given their affinity for sorption to soils. The mobility of these contaminants is much higher in the presence of mobile NAPL. The mobility of arsenic and chromium is strongly dependent on the oxidation/reduction conditions in the aquifer and the nature of the contaminant salt. Arsenic is more mobile under reducing conditions and chromium is much less mobile under reducing conditions.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The remediation system consists of two operating systems:

OU2 - 1 extraction well on-site in an area with LNAPL, expected to operate for 4 more years

OU3 - 13 extraction wells (12 active) in areas of dissolved contamination located both on-site and off-site

The treatment system for each operable unit is very similar, and consists of an oil/water separator, a bioreactor, a filter system, and GAC. The OU2 system was an interim system, and the full-scale system (OU3) required a new treatment plant with significantly larger capacity.

The purpose of the bioreactor is primarily to reduce concentrations of PCP. Water is discharged from the treatment plant to the sanitary sewer. For OU3, some of the off-site wells discharge directly to the sanitary sewer without treatment. Furthermore, water from several additional OU3 wells is diverted directly to the treatment plant effluent holding tank for discharge to the sewer, without treatment. Water from one additional OU3 well is only treated with GAC (no biotreatment). Details of the extraction and treatment systems are provided below.

2.2 EXTRACTION SYSTEM

The OU2 extraction well ("OU2 EW-1") has a Clean Environment pneumatic total fluids submersible pump that maintains a drawdown at the pump level. The well is operated with a four foot drawdown, which is interpreted to provide a capture zone that prevents product migration offsite to the northeast. There is a bladder pump intended for automated collection of LNAPL, but the automation has never worked well and instead LNAPL is manually collected from the extraction well and nearby piezometers. This well went on-line in December 1997, with full operation in March 1998. To date, approximately 134 gallons of LNAPL have been removed, and it is estimated that 128 of the 134 gallons have been removed via hand-bailing (ROD originally estimated oil removal of 10 gal/day, but that has not occurred). The treatment plant for OU2 was designed for 10 gpm, and originally 4 gpm was achieved. After the OU3 system was installed, however, production dropped at the OU2 well to approximately 1 gpm.

OU3 has 13 existing wells (12 active), plus 1 planned well, as follows:

OU3 Well	Status	Destination of Water	Design Rate(gpm)	Avg. 1999(gpm)	Avg 2000(gpm)
EW-1*	Active	To plant effluent tank, direct discharge to sewer	7.0	2.2	4.0
EW-3	Planned	Will go to sewer once access for well is gained	35.0	-	-
EW-4	Active	Direct discharge to sewer	10.0	6.4	5.0
EW-5	Active	To plant, treatment with GAC only	7.0	4.7	6.0
EW-7	Active	To plant effluent tank, direct discharge to sewer	6.0	2.0	3.4
EW-8	Not Active	LNAPL periodically removed (peristaltic pump)	10.0	-	-
EW-9	Active	Treatment in plant	5.0	7.5	5.5
EW-10	Active	Treatment in plant	15.0	15.2	20.6
EW-11	Active	Treatment in plant	10.0	6.6	14.8
EW-12	Active	Direct discharge to sewer	7.0	8.1	5.4
EW-13	Active	Treatment in plant	12.0	9.5	12.7
EW-14	Active	Direct discharge to sewer	5.0	0.5	0.1
EW-15	Active	Direct discharge to sewer	10.0	1.7	0.9
EW-16	Active	Direct discharge to sewer	5.0	5.6	2.9

* EW-1 in OU3 is not the same well as "OU2 EW-1"
EW-2 and EW-6, located east/northeast of the site, were not installed (MNA planned in that area)

The OU3 system went online in March 1999. EW-3, located northeast of the site, has not yet been completed due to access restrictions. EW-8, located on-site in the PCP process area, has significant LNAPL (up to 20-25 ft has been observed), and this well is not actively treated to avoid harm to the biomass in the bioreactor. Extraction wells EW3 and EW15 are configured to pump either to the water treatment plant or to the sewer, based on contaminant concentrations.

The OU3 wells are typically 8-inch diameter stainless steel (SS) wells with three 2-inch diameter SS rehab wells located five feet from the extraction well to treat fouling. The extraction wells are all screened in the surficial New Brighton aquifer. The OU3 extraction wells have electric submersible pumps with high and low level controls. The onsite wells are operated to dewater the pond induced groundwater mound area and prevent further impacted groundwater migration offsite. The offsite wells are operated to provide a capture zone for groundwater with PCP over 50 to 100 µg/L and chromium over the MCL of 100 µg/L. The wells are completed below grade with a pitless adaptor and a flow control valve nearby. The well discharge lines are led back to the treatment system individually with flow meters prior to the system influent tank. Power for the offsite wells is taken

via metered lines from nearby utility poles and the well pumps are controlled by radio from the treatment plant.

2.3 TREATMENT SYSTEM

The OU2 and OU3 treatment systems are quite similar. The OU2 system was an interim system, and the full-scale system (OU3) required a new treatment plant with significantly larger capacity. Details of each system are highlighted below, followed by a listing of significant differences between the OU2 and OU3 treatment systems.

The OU2 treatment system, designed for 10 gpm, consists of the following:

- HDPE (contained in PVC) transfer pipe from the lone extraction well;
- A 50 gpm oil/water separator (Carbonair COW50);
- A bioreactor system (approximately 7500 gallon capacity Biotrol 4K3) with appurtenant preheater and nutrient and caustic addition;
- A settling tank;
- Four bag filters (FSI);
- Two 1500-pound liquid phase granular activated carbon (GAC) units (Carbonair PC13-100 gpm capacity); and
- One 2000-pound vapor phase GAC unit (Carbonair GPC-20).

The OU2 system was designed for a flow rate of 10 gpm at PCP levels up to 100 mg/L when operation was initiated. The actual flow rate is currently approximately 1 gpm, with influent PCP level of 10 to 25 mg/L. The flow rate has decreased from a reported volume of 4 gpm since the OU3 system was started in March 1999. Chromium in the 100 mg/l range can poison the microbes in the bioreactor, but current chromium concentrations in the OU2 extraction well (approximately 50 ug/l) are not negatively impacting the bioreactor.

The OU3 treatment system, designed for 50 gpm, consists of the following:

- Radio controlled electric submersible pumps;
- HDPE piping to the treatment system;
- A 3300 gallon influent holding tank;
- A 50 gpm oil/water separator (Carbonair COW50);
- A bioreactor system (approximately 14,000 gallon capacity Biotrol 12K4) with appurtenant boiler and nutrient addition;
- A flash floc and clarifier system ((Model IPC Great Lakes Environmental);
- A 2500 gallon filter feed tank;

- Ten 5-micron bag filters (Krystil Klear);
- Two 5000-pound liquid phase GAC units (Carbonair PC28-200 gpm capacity);
- A 3300 gallon effluent holding tank;
- A 10-65 cubic foot Model 50 Waterlink - Lanco filter press; and
- One 2000-pound vapor phase GAC units (Carbonair GPC-20R).

The OU3 system was designed for a flow rate of 50 gpm and an influent PCP concentration of 10 mg/L. The system operates near its design flow rate and slightly below its design influent concentration.

Extraction wells are routed to the OU3 treatment system based on PCP concentration. Offsite wells with levels less than 3 mg/L are discharged directly to the sewer at nearby manholes. In addition to PCP levels, onsite wells have the potential for dioxin levels which require GAC treatment (although onsite well EW-11 had been discharged directly to the sewer prior to January 5, 2000).

In each system, the phase separator is designed to remove a portion of the suspended solids and the light and dense non-aqueous phase liquids from the influent groundwater stream. The free product phase (LNAPL) is collected in a 55 gal drum which is disposed of off-site at a RCRA permitted facility. The suspended solids and DNAPL phase (if any) are removed together and disposed of off site at a RCRA approved facility. The operator has the option of sending sludge (if not contaminated with DNAPL) from the phase separator to the sludge tank. The water phase is pumped through a heat exchanger where the temperature is raised to 70°F prior to entering the fixed film Bioreactor (note that the heat exchanger for OU2 is not operated because it has been empirically determined to not be necessary). A natural gas fired boiler installed outside the building supplies the hot water to preheat the water fed to the bioreactor.

The bioreactor in each system is designed to remove dissolved phase organic compounds, in this case mainly PCP, by microbial action. Nutrients and air are added in both systems, and the pH is controlled (in OU2 only, via chemical addition) to promote the growth of these microorganisms. The water flows through the bioreactor and collects in the discharge chamber. A blower collects vapors from the influent tank, phase separator, bioreactor, and sludge tank for treatment in a vapor phase activated carbon vessel prior to discharge to the atmosphere.

For OU3, water is pumped from the bioreactor discharge chamber to the flash/floc tank and clarifier system to remove biological and suspended solids. Polymer is added to the flash/floc tank to promote coagulation of these particles. For OU2, water goes directly to the clarifier (sodium hydroxide is added to increase pH). In the OU3 system, the sludge collects in the bottom of the clarifier and is pumped to the sludge tank. Sludge is then pumped to the plate and frame filter press. Water from the filter press is recycled to the water treatment plant influent tank. The sludge, which is collected in 55 gal drums, is classified as F032 waste and is shipped off-site to RCRA treatment, storage and disposal facilities. For the OU2 system, the sludge is accumulated in the bottom of the clarifier. For each system, loading on floc tanks/clarifiers is very low, and thus very hard to run. Therefore, very little sludge is generated. The OU3 filter press has only been used once in a year of operation and the OU2 clarifier has not required sludge removal in two years of operation.

In each system, water is pumped through the bag filters and granular activated carbon vessels to the effluent holding tank. The bag filters operate in parallel and remove residual biological sediment

carried over from the clarifier system. The bag filters require frequent changing (as much as 1-2 times per day in OU3, which adds up to 200 or more filter bags per month) because the clarifier does not effectively removed sloughed biomass from the bioreactor.

The two liquid phase carbon units are operated in series and adsorb dioxins and other residual dissolved organics prior to discharge to the effluent holding tank. The effluent tank water provides flow and process control and blends extracted water from other wells as needed. The effluent water is sampled, flow and pH are monitored and displayed prior to final discharge to the POTW sanitary sewer system lift station.

Carbon usage in each system is extremely minimal, and has never been changed out in either system (liquid or vapor phase). However, the lead liquid-phase carbon vessel in OU3 is being backwashed twice a week to prevent pressure drop due to biofouling.

Plant air is supplied by an air compressor located in the building. The compressor is used to supply air to the filter press and sludge pumps.

The building also contains a sump to collect clean up water and for spill control. There are two sump pumps which can either discharge to the influent tank for recycle through the treatment plant or discharge directly to the sewer.

Significant differences between the OU2 and OU3 treatment systems are as follows:

- The OU2 system was designed for 10 gpm (actually treating 1 gpm), the OU3 system was designed for 50 gpm (actually treating close to 50 gpm)
- The feed water to the bioreactor in the OU2 system is not heated, while the water in the OU3 system is heated
- The OU2 system influent is a slurry of LNAPL and water, while the OU3 system influent does not generally handle any LNAPL
- The OU2 requires caustic addition to adjust the pH, while the OU3 system operates in the 6.8-7.6 pH range without adjustment
- The OU3 system has a sludge-handling dewatering system, while in the OU2 system sludge is accumulated for eventual removal/disposal.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The OU2 ROD indicates that the goal of the OU2 system is to lower the aquifer in the vicinity of the extraction well, to draw LNAPL towards the extraction well. Therefore, the goal of the OU2 system is to contain LNAPL movement as well as to remove LNAPL. There is no stated closure criteria for the OU2 system.

The OU3 ROD indicates the goal is to remediate groundwater to the following concentrations:

PCP:	1 ug/l
chromium:	100 ug/l
carcinogenic PAH's:	0.2 ug/l
arsenic:	5 ug/l
dioxin:	12 picograms/liter

In practice, the OU3 system is being managed to contain the 50 to 100 ug/l PCP plume, and/or the 100 ug/l chromium plume.

The ROD also states that groundwater contamination may be persistent, and that contingency measures and objectives may have to be implemented. The contingency measures might include:

- groundwater containment (gradient control)
- waiving chemical-specific ARARs based on technical impracticability or inability to achieve further contaminant reduction
- institutional controls to restrict aquifer access

The ROD states that performance will be monitored, and that modifications may include any or all of the following:

- discontinued pumping at individual wells where cleanup goals have been attained
- alternating pumping wells to eliminate stagnation points
- pulse pumping to allow adsorbed contaminants to dissolve
- install additional wells
- remedial technologies to enhance removal of DNAPL

However, a formal groundwater monitoring plan has yet to be implemented.

3.2 TREATMENT PLANT OPERATION GOALS

This is a continuously operating system. It is manned periodically during the week (less than 15 hrs/wk for OU2 and approximately 30 hrs/wk for OU3). The plant operates automatically over the weekend. Groundwater is extracted from wells for treatment and/or direct discharge to the POTW sanitary sewer system. Effluent water discharged to this sewer must meet Metropolitan Council Environmental Services (MCES) discharge requirements included in the MCES Permit. These limits include the following:

any individual organic:	3,000 ug/l
total organics:	10,000 ug/l
dioxin:	< 0.002 ug/l
chromium:	8,000 ug/l
copper:	6,000 ug/l
arsenic:	4,000 ug/l
pH:	5 to 11
COD:	500 mg/l
TSS:	250 mg/l
CN	4000 ug/l
Pb	1000 ug/l
Hg	100 ug/l
Ni	6000 ug/l
Zn	8000 ug/l

PCP (an individual organic) is the only compound that commonly exceeds these standards in several wells. Additionally, dioxin at levels exceeding the standard has occasionally been found at on-site wells.

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

In general, the RSE team found the system to be well operated and maintained. The observations and recommendations given below are not intended to imply a deficiency in the work of either the designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations obviously have the benefit of the operational data unavailable to the original designers.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Although water levels are routinely monitored (at least monthly), detailed water level maps have not been produced under pumping conditions (except in informal and/or draft format). It should be noted that the design of this system is well suited for detailed water level analysis, because pumping wells generally have adjacent piezometers and rehab wells for water level measurements.

4.2.2 CAPTURE ZONES

In addition to the fact that water level maps have not been produced, there has been no real attempt made to date to formally compare observed capture zones (based on equipotentials) with a target containment zone. No superposition of water levels with a target containment zone was reported. It should be noted, however, that this is a relatively recent system (OU3 has operated only about a year), and most effort to date has focused on getting the system operational.

4.2.3 CONTAMINANT LEVELS

A clear summary was not presented detailing whether or not contaminant concentrations have increased or declined in the aquifer. It should be noted, however, that this is a relatively recent system (OU3 has operated only about a year).

4.3 TREATMENT SYSTEM DOWN-TIME

There have not been significant problems with system down-time, although individual wells are sometimes down for various reasons.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF COSTS

A cost breakdown was provided for the first 11 months of OU3 system operation. This totaled about \$300,000 after subtracting one time plan preparation fees; however, general consulting fees

(reportedly over \$150,000) were not included in this total. Expected future O&M costs are about \$395,000 per year, if consulting/reporting fees can be held to \$90,000 per year.

A rough estimate of annual costs of \$140,000 per year, including consulting fees, was provided for OU2. A breakdown of approximately \$70,000 for the system operation and \$70,000 for consulting/reporting was reported.

	Estimated Annual Consulting	Estimated Annual O&M	Total Estimated Annual Cost
OU2	\$70K/yr	\$70K/yr	\$140K/yr
OU3	\$90K/yr	\$305K/yr	\$395K/yr

4.4.1 UTILITIES (OU3 ONLY, DETAIL FOR OU2 NOT PROVIDED)

Based on the first 11 months of operation, annual electric costs are expected to be \$18,000. Electricity powers the well pumps, transfer pumps, mixers, compressor, blowers, and building heat. Annual natural gas costs are expected to be about \$21,000. A natural gas boiler is used for the heat exchanger to preheat groundwater prior to the bioreactor.

POTW discharge fees are expected to be about \$73,000 per year based chiefly on volume rates. Telephone charges are expected to be about \$3,000 per year. Total utility cost are estimated at \$115,000 per year.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL (OU3)

The following items and approximate expected annual cost are included in this category:

Replace Liquid Phase GAC	\$16,000	
Replace Vapor Phase GAC	\$ 5,500	
Bag Filters	\$14,400	(200 filt/mo x \$6/filt x 12 mo = \$14,400)
Sludge Disposal	\$10,000	
Product Disposal	\$ 1,500	
Sodium Hydroxide	\$ 2,000	
Nutrients	\$ 9,000	
Polymer	<u>\$ 500</u>	
TOTAL	\$58,900	

4.4.3 LABOR (OU3)

Two Carbonair technicians working a combined total of 30 hours per week are responsible for treatment system operation and periodic water level measurement. This function costs about \$42,000 per year. Additional labor required for sampling and analysis and maintenance is discussed below.

Consulting costs during the first year of operation were reportedly over \$150,000 due in part to start-up issues. These costs are expected to be reduced to about \$90,000 beginning with the second year of operation.

Total labor costs will be about \$130,000 per year.

4.4.4 SAMPLING AND ANALYSIS (OU3)

For OU3, monthly effluent sampling is conducted for PAHs, phenols, dioxin, arsenic, chromium, copper, COD and TSS at six discharge locations at a cost of about \$60,000 per year. Select performance samples are taken and analyzed at points in the treatment plant process at an additional cost of about \$20,000 per year. Total sampling and analysis costs are therefore \$80,000 per year.

4.4.5 OTHER COSTS (OU3)

Undefined maintenance issues are indicated to require an additional \$30,000 per year.

4.4.6 SUMMARY OF TOTAL COSTS

An estimate of total costs for the OU2 and OU3 systems is as follows (these are approximations based on somewhat limited data, and do not include system wide aquifer monitoring):

Item	Estimated Annual Cost
Consulting OU2	\$70K/yr
Consulting OU3	\$90K/yr
Labor (O&M, Combined OU2 and OU3)	\$40K/yr
Utilities OU3	\$115 K/yr
Consumables OU3	\$60K/yr
Process/Discharge Sampling OU3	\$80K/yr
Other OU2	\$50K/yr
Other OU3	\$30K/yr
Total (w/out aquifer monitoring)	\$535K/yr

4.5 RECURRING PROBLEMS OR ISSUES

4.5.1 BAG FILTERS

The original system design for OU3 included four bag filters; 10 are online currently. The five micron bags in use must be changed out on a daily basis (sometimes twice daily) to maintain flow through the treatment system. Filter usage is approximately 200 filters/month at a cost of \$6.00 per bag. The fouling of the bags is mainly due to sloughed biological growth from the fixed film

bioreactor which is not captured in the clarifier. The clarifier has been largely ineffective in removing this material.

4.5.2 PRODUCT RECOVERY, OU2

The automated product recovery pump for OU2 has never worked properly, and product is therefore removed with hand-bailing.

4.5.3 PIPING CLOGGING

There have been problems with pipe clogging in the OU3 plant, and there was a change from small pipe to 3" pipe to reduce clogging. Also, the procedure of sending filtrate to the influent tank was stopped to hopefully reduce piping fouling.

4.5.4 RADIO CONTROLLERS AND WELL CYCLING

There have been some problems with the reliability of the radio controlled pumps and the cycling of wells. EW-15 is low producer, for instance, and this may be due to a communication problem with EW-15. Wells are currently cycled on and off based on a single level. The situation might be improved if a high and low fluid level was used.

4.5.5 BIOFOULING AT WELLS

There has been biofouling problems with some wells. Monitoring specific capacity of the extraction wells is performed, and when a decrease is noted, rehab is performed using NuWell from Johnson Screen. There has also been biofouling problems with OU2 pump.

4.5.6 HEAT EXCHANGER

Heat exchanger cleanings (OU3) have required more operation and maintenance time than expected. Scale and biological fouling in the heat exchanger has required cleaning at least twice monthly to maintain flow to the bioreactor. Note the heat exchanger is not used for OU2.

4.5.7 TREATMENT SYSTEM FLOW RATE

Pumping of extraction wells appears to be limited by the treatment system design/operating limit of 50 gpm. Greater capacity within the treatment system would allow more flexibility in extraction well pumping rates and drawdowns. Greater capacity in the treatment system may be possible if the heat exchanger and bag filter issues are resolved. However, as the oil water separator and bioreactor are both rated for 50 gpm, the potential increase is minor based on current system configuration. If in the future the rate limit of the O/W separator is a limiting factor (i.e., if the bioreactor is removed from the treatment process), it may be possible to modify piping so fewer wells feed into the O/W separator.

4.5.8 EW8

Initial pumping of EW8 indicated considerable free product (LNAPL and possibly DNAPL). Pumping from the well was terminated immediately when this was discovered (to avoid damaging the OU3 biomass) and this well is still inactive. The well could be pumped, possibly with a pneumatic pump for several days, with product recovered and water treated (possibly in the OU2 system which has excess capacity) until it can be returned to the OU3 system.

4.6 REGULATORY COMPLIANCE

No regulatory compliance problems were noted.

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

The heat exchanger and/or discharge pump has leaked historically in the OU2 plant. There appears to be minor problems with leakage in the OU3 influent tank.

4.8 SAFETY RECORD

The plant appears to have had an excellent safety record.

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

5.1 GROUND WATER

It is not clear whether or not the off-site plume is being effectively captured by the current extraction system. Although the aquifer cleanup goal for PCP is 1 ug/l, the current target currently used for containment is 50 to 100 ug/l. The protectiveness afforded by the 50 to 100 ug/l target has not been formally assessed.

5.2 SURFACE WATER

If the off-site plume is not being effectively captured, then there is a potential threat to streams, wetlands, and lakes. For instance, the OU3 ROD indicated that PCP was detected in surface water and sediments of Farrel's Lake (northeast of the site), although it is not clear whether or not the MacGillis site is the cause.

5.3 AIR

A blower transports vapors from the water treatment vessels to a vapor phase carbon unit prior to discharge to the atmosphere. A standard operating procedure should be developed to sample the discharge of the vapor phase carbon unit to confirm protectiveness.

5.4 SOILS

Not a focus of this RSE.

5.5 OTHER

The site is currently not fenced. There is debris on the site, plus an open (potentially contaminated) pond and an exposed gasoline pipeline.

It was discussed during the site visit that there is a plan for Donatelle (office building immediately north of the site) to expand, with another office building to be constructed on the site. This may lead to an office building built directly over free product. It is not clear that this has been evaluated in detail with respect to construction workers and building occupants. It is also not clear if this will impact the OU2 extraction well, and therefore potentially compromise LNAPL containment at the northeast site boundary.

6.0 RECOMMENDATIONS

6.1 RECOMMENDED STUDIES TO IMPROVE EFFECTIVENESS

6.1.1 DEVELOP/UPDATE TARGET CONTAINMENT ZONE

Although the aquifer cleanup goal for PCP is 1 ug/l, the current target currently used for containment is 50 to 100 ug/l. The protectiveness afforded by the 50 to 100 ug/l target has not been formally assessed. Now that the system is fully operational, it is an appropriate time to perform these analyses. It is recommended that a target containment zone for key constituents (PCP, chromium) be developed and updated annually (based on long-term monitoring data from aquifer monitor wells). Without this step, the adequacy of the capture zone provided by the extraction system cannot be assessed. If the target containment zone for PCP is to be substantially higher than the ROD cleanup level of 1 ug/l, this should be justified based on technical/risk arguments, and then formalized in a ROD amendment. The target containment zone should take into account potential DNAPL near EW-13 (dissolved hot-spot) and consider the adequacy of plume characterization near the outer extent of the target containment zone. Estimated cost is \$30K capital (year 1), \$5K/yr annual.

6.1.2 CAPTURE ZONE ANALYSIS

At least quarterly, a formalized capture zone analysis should be performed by superposing on one map the measured equipotentials (with interpreted capture zones) and the target capture zone. A procedure for review of the results should be established, so that potentially inadequate capture can be addressed in a timely manner. Estimated cost is \$10K/yr.

6.1.3 LONG-TERM MONITORING

Because the system is relatively recent, a long-term monitoring schedule is not yet in place for the New Brighton aquifer, or for the underlying Hillside aquifer. A long-term monitoring plan should be developed that indicates which well should be sampled, at what frequency, and for what parameters. Sampling should be probably occur annually. This monitoring plan should include sampling of select aquifer monitor wells and individual extraction wells. Extraction flow rates should also be regularly monitored and reported as part of the long-term monitoring plan. Estimated cost is \$40K capital to develop the plan, and \$100K/yr annual to implement the plan.

6.1.4 FENCING/SECURITY AND EXPOSED PIPELINE

There is debris on the site, plus an open (potentially contaminated) pond and an exposed gasoline pipeline. Access to this site should be restricted until such time as the debris is completely removed, the pond is filled, and the pipeline is no longer exposed. The pipeline is not currently marked with appropriate warnings, and this at a minimum should be immediately corrected. Estimated capital cost \$25,000, estimated annual cost of \$3K/yr.

6.1.5 DONATELLE EXPANSION

It was discussed during the site visit that there is a plan for Donatelle (office building immediately north of the site) to expand, with another office building to be constructed on the site. This may lead to an office building built directly over free product, and the risk to construction workers and building occupants should be specifically evaluated. An evaluation should also be performed regarding potential impacts if the OU2 extraction well is destroyed. Estimated capital cost is \$20K.

6.1.6 ATMOSPHERIC DISCHARGE FROM THE WATER TREATMENT PLANT

The atmospheric discharge from the water treatment plant consists of a collection of vapors from the water treatment vessels and treatment in a vapor phase carbon unit. A standard operating procedure should be developed for sampling the discharge of the vapor phase carbon unit (perhaps quarterly or semi-annually) to confirm protectiveness.

6.2 RECOMMENDED CHANGES TO REDUCE COSTS

6.2.1 SHUTDOWN OU2 SYSTEM

The OU 2 system was an interim system designed to capture LNAPL and the full scale system (OU 3) required a new treatment plant with significantly larger capacity to treat the entire contaminant plume. With the successful operation of the OU 3 system now demonstrated, the opportunity now exists to discontinue operation of the OU 2 treatment plant and treat the OU 2 flow at the OU 3 facility much more cost effectively. The influent from EW-1 (OU2) could be directed to the influent tank of the OU3 system. OU2 system components could be used or kept for future use in the OU3 system or salvaged. Estimated capital cost of \$50K, estimated annual savings of \$140K/yr (note the OU2 system is only expected to operate an additional 4 years based on the ROD).

6.2.2 CONSIDER MODIFYING OU3 TREATMENT (ELIMINATE BIOREACTOR)

The bioreactor component of the OU3 treatment system has been very effective to date. This system yields sufficient removal of PCP (about 10 mg/L at 50 gpm = 6 lb/day) and carcinogenic PAHs (less than 0.5 mg/L at 50 gpm = 0.3 lbs/day). However, this removal occurs at a high price including the following:

· Cost of nutrients, NaOH, polymer to run the bioreactor and the clarifier	\$11,500
· Cost of fuel to run the heat exchanger	\$21,000
· Cost to dispose of sludge and run the sludge tank and filter press (90% of sludge disposal)	\$ 9,000
· Excess cost to replace and dispose bag filters (50% of filters) due to sloughing from bioreactor	\$ 7,200
· Power for above (50% of electric)	\$ 9,000
· Maintenance for above (50% of maintenance)	\$21,000
· Labor for above (50% of operator time)	<u>\$21,000</u>
	TOTAL: <u>\$99,700</u>

(***Does not include consulting cost and vapor phase GAC cost)

Based on current influent concentrations for PCP (which are lower than original design values), an opportunity may now exist to eliminate the bioreactor and expand the role of GAC (to be the main treatment component). Currently the GAC is a polishing step for any potential dioxin and a backup for bioreactor upset. In the revised system, the treatment train would consist of the oil/water separator, bag filter and liquid GAC only, prior to discharge (organo-clay could potentially be added prior to GAC if the oil/water separator was not completely effective for product removal). In addition to being a much simpler system from the operation standpoint, greater flexibility to increase the system flow rate would be possible as the existing liquid phase GAC units have a 200 gpm capacity. The only cost that would increase with the elimination of the bioreactor would be the replacement of GAC due to greater PCP loading. Using 100 mg PCP per lb. GAC (Nyer, Groundwater Treatment Technology, 1992), about 22,000 lbs of GAC would be required per year, yielding a potential \$55,500 savings (Bioreactor costs: \$99,700 + Current Liquid Phase GAC Costs: \$16,000 - Projected GAC Costs: \$60,200) based on GAC replacement/regeneration cost of \$2.75 per pound.

This savings would increase over time as influent concentrations decrease and offsite wells EW5 and EW13 could be routed directly to the POTW. The GAC usage rate should be evaluated with a bench or pilot scale test to confirm that these cost savings are likely. Estimated capital cost is \$25K, estimated potential savings is \$55.5K/yr.

Another alternate strategy to consider (again possible due to current influent concentrations that are lower than original design values) is to approach the POTW regarding the potential for them to accept somewhat higher concentrations than currently, and avoid treatment altogether (including the GAC). This would require sampling for dioxin at specific locations to confirm they are NDs.

6.2.3 REDUCE SAMPLED DISCHARGE POINTS

For the first quarter of 2000, six discharges were sampled monthly with analysis for PAHs, phenols, dioxin, arsenic, chromium, copper, COD and TSS. Samples from EW14 and EW16 are collected and analyzed separately for all these parameters on a monthly basis even though the discharge from both wells is to the same manhole.

The discharges could be retrofitted so that EW14, EW12, EW15, and EW16 are combined. For the cost of installing about 500 feet of piping, three separately sampled discharges would be eliminated and \$30,000 per year saved. Select parameters (PCP) could be analyzed at each well on a less frequent basis for performance monitoring needs. Estimated capital cost of \$30K, estimated savings of \$30K/yr. Potentially, all extraction wells could be routed to the OU3 building for one common discharge point, with even greater savings.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

Additional recommendations intended for technical improvement include:

- Replace the pH sensor on the OU3 bioreactor to avoid requirement for operator to climb ladder.
- Revising the well rehabilitation program to consider specific treatments to fight biological growth. Current treatment approach may not adequately address the biological issues. Suggest the operator diagnosis the fouling problem using BART tests and select the rehabilitation technique that is appropriate to the type of bacteria.

7.0 SUMMARY

In general, the RSE team found the system to be well operated and maintained. There are several protectiveness issues that should be addressed, most notably establishing a target containment zone and regularly evaluating the actual capture zone with respect to the target. The anticipated costs of implementing these and other recommendations related to protectiveness are summarized on the following “Cost Summary Table” (Table 7-1).

Several recommendations are also made to potentially reduce future operations and maintenance costs. These opportunities to reduce cost arise from the fact that the OU3 system is now fully operational, and influent concentrations are lower than originally designed for. The recommendations include eliminating the OU2 treatment system (potential net savings of approximately \$0.5M over the remaining 4 years of expected operation for the OU2 system, non-discounted), and potentially eliminating the bioreactor from the OU3 treatment system, subject to a pilot-test and a cost/benefit analysis (potential net savings of more than \$1.5M over 30 years). The anticipated costs and potential savings of implementing these and other recommendations to reduce costs are also summarized on the “Cost Summary Table” (Table 7-1).

Table 7-1. Cost Summary Table

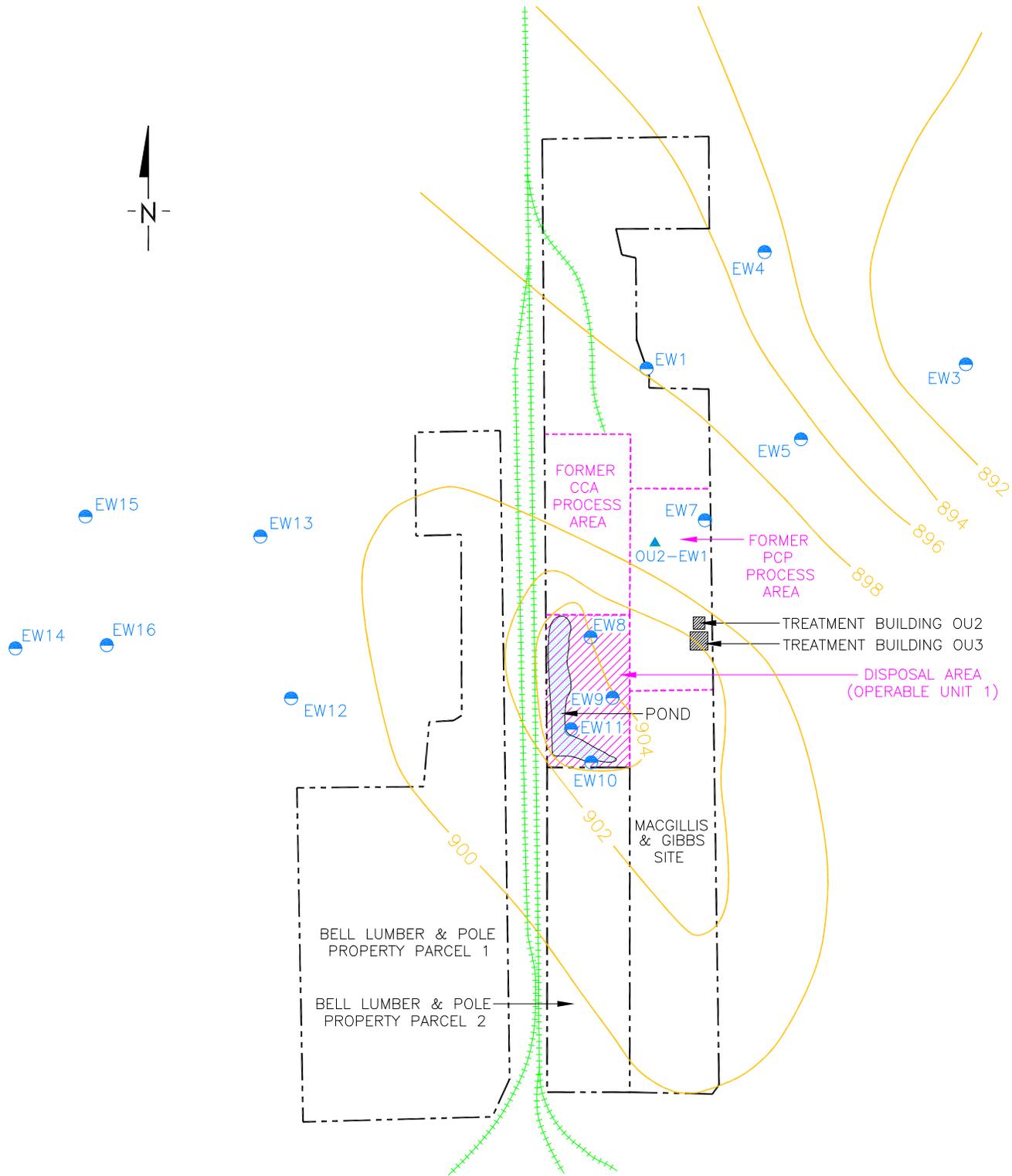
Recommendation	Reason	Additional Capital Costs (\$)	Estimated Change in Annual Costs (\$/yr)	Estimated Change In Lifecycle Costs (\$) *
Develop/update target capture zone	Effectiveness	\$30,000	\$5,000	\$180,000
Capture zone analysis	Effectiveness	\$0	\$10,000	\$300,000
Long-term monitoring	Effectiveness	\$40,000	-	***
Fencing/security & exposed pipeline	Effectiveness	\$25,000	\$3,000	\$115,000
Donatelle expansion	Effectiveness	\$20,000	\$0	\$20,000
Vapor Monitoring	Effectiveness	\$2,000	\$2,000	\$62,000
Shut down OU2 system	Cost reduction	\$50,000	(\$140,000)**	(\$510,000)**
Eliminate bioreactor, OU3	Cost reduction	\$25,000	(\$55,500)	(\$1,640,000)
Reduce sampled discharge points	Cost reduction	\$30,000	(\$30,000)	(\$870,000)
Replace pH sensor, OU3	Tech. improvement	\$500	\$0	\$500
Revise well rehab program	Tech. improvement	\$10,000	\$3,000	\$100,000

* Estimated change in life-cycle costs assumes 30 years, no discount rate, except where noted.

** Assumes 4 years additional operation for OU2 system, based on ROD.

** There is no “cost increase” for the long-term monitoring, since monitoring is anticipated, just not yet implemented. Annual costs are estimated to be \$100,000 for a life-cycle cost of \$3,040,000.

(1) Costs in parentheses imply a cost reduction.



NOTES:

1. PREPARED FOR RSE BASED ON SITE MAPS.
2. ALL LOCATIONS ARE APPROXIMATE
3. WATER LEVELS FROM DECEMBER 20, 1992.

Figure 1.1 Site Location and Groundwater High Near the Pond, MacGillis & Gibbs, New Brighton, Minnesota.



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