UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 7
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

DEC 23 2008

MEMORANDUM

SUBJECT: Proposed Plan for Operable Unit 4
Riverfront Superfund Site, New Haven, Missouri

FROM: Jeffrey L. Field, Remedial Project Manager
Missouri/Kansas Remedial Branch

THRU: For Diane Easley, Chief
Missouri/Kansas Remedial Branch

TO: Cecilia Tapia, Director
Superfund Division

Attached for your concurrence is the Proposed Plan for Operable Unit 4 (OU4), Riverfront Superfund site, located in New Haven, Missouri. The Proposed Plan identifies the Preferred Alternative for addressing the contaminated soils and groundwater at OU4 and provides the rationale for this preference.

The Preferred Alternative for addressing OU4 includes injection of a chemical oxidant to address soil contamination and the imposition of institutional controls. Because this alternative does not actively restore the groundwater, it does not comply with all applicable or relevant and appropriate requirements (ARARs). Therefore, a technical impracticability waiver for chemical-specific ARARs would be issued. Institutional controls would involve strict well construction requirements under the Special Area 3 designation, public education, and may include environmental covenants. The groundwater monitoring will confirm the efficacy of the chemical oxidation treatments and track plume migration.

The public comment period will begin December 31, 2008, and run through January 29, 2009. The public meeting will be held in New Haven on January 6, 2009.

If you have any questions, please call me at extension 7548.

Attachment

cc: Evan Kifer, Missouri Department of Natural Resources

Approve: ____________ Date: 12/23/08

Disapprove: ____________ Date: ____________

U.S. ENVIRONMENTAL PROTECTION AGENCY
SUPERFUND PROGRAM
PROPOSED PLAN
RIVERFRONT SUPERFUND SITE
OPERABLE UNIT 4
NEW HAVEN, MISSOURI **December 2008**

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan (Plan) identifies the Preferred Alternative for addressing the contaminated soil and groundwater at the Riverfront Superfund Site (Site), Operable Unit 4 (OU4), and provides the rationale for this preference. In addition, this Plan includes summaries of other alternatives evaluated for use at OU4. This Plan is issued by the U.S. Environmental Protection Agency (EPA), the lead agency for the Site, and the Missouri Department of Natural Resources (MDNR), the support agency. EPA, in consultation with MDNR, will select a final remedy for OU4 after reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with MDNR, may modify the Preferred Alternative or select another response action presented in this Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Plan.

Dates to remember:
MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD:

EPA will accept written comments on this Plan during the public comment period of December 31, 2008, through January 29, 2009.

PUBLIC MEETING:

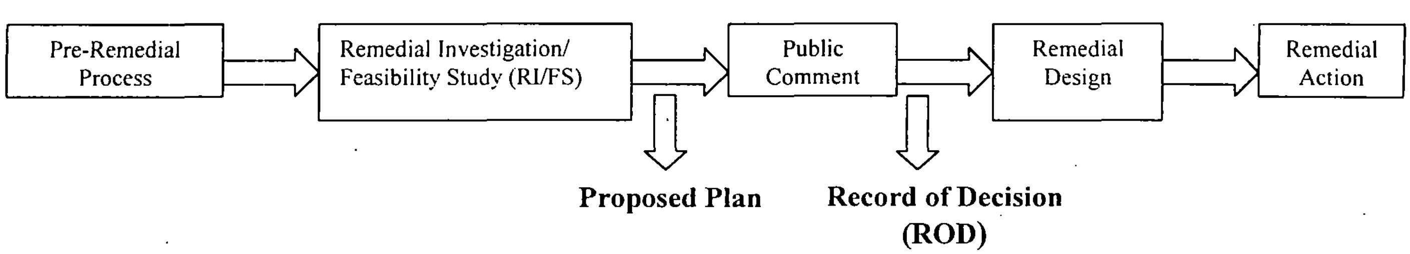
EPA will hold a public meeting to explain this Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held on January 6, 2009, at the Trinity Lutheran Church from 7:00 to 9:00 p.m.

For more information, see the Administrative Record at the following locations:

New Haven Scenic Regional Library 109 Maupin New Haven, MO 63068	U.S. EPA Records Center Region 7 901 N. 5th Street Kansas City, KS 66101

EPA is issuing this Plan as part of its public participation responsibilities under Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Plan summarizes information that can be found in greater detail in the Remedial Investigation/ Feasibility Study (RI/FS) report and other documents contained in the Administrative Record file for this Site. EPA and MDNR encourage the public to review these documents to gain a more comprehensive understanding of OU4 and Superfund activities that have been conducted at OU4.

The Superfund Remedial Process



SITE HISTORY

The Site is located in Franklin County, Missouri, in the town of New Haven. During routine public supply well testing in 1986, MDNR detected the volatile organic compound (VOC), tetrachloroethene (PCE), in two public supply wells in the northern part of New Haven. Several environmental investigations were conducted over the next 13 years to find the contaminant source areas and the extent of contamination. Following the completion of an Expanded Site Inspection (ESI)/RI, the PCE-contaminated areas in New Haven were proposed to be included on the National Priorities List[1], and the contaminated areas became known as the Site.

For ease of administration, EPA divided the Site into six OUs: (1) OU1 involves the soil and groundwater contamination within a two-acre area known as the Front Street site; (2) OUs 2 and 6 involve groundwater and soil contamination on approximately 20 acres known as the Kellwood site; (3) OU3 involves contaminated groundwater and soils on approximately three acres known as the Old City Dump; (4) OU4 involves soil, groundwater, and surface water contamination in an area know as the Maiden Lane site; and (5) OU5 involves groundwater contamination in an area known as the Old Hat Factory. All six OUs are shown in Figure 1.

OU4 was designated in 2000 after PCE was detected in a bedrock monitoring well (BW-02) located upgradient (south) of the closed city well W2. There were no known industrial activities or suspected PCE disposal areas in the Maiden Lane area or within the entire OU4 area, and the detection of PCE in well BW-02 was not expected. Based on groundwater flow information established in the ESI/RI, it was suspected that the source of the PCE contamination that caused the closure of city well W2 was located upgradient (south) of city well W2 and monitoring well BW-02 but probably north of the shallow groundwater divide that is in the vicinity of State Highway 100. After being designated an OU in 2000, investigation of OU4 has included reconnaissance sampling of sanitary sewers, streams, and trees followed by the installation of monitoring wells and finally soil borings. With no known or suspected source area within OU4, the overall investigation can best be described as a methodical *walk* upgradient from known deep (200 to 400 feet) groundwater contamination at city well W2 and monitoring well BW-02 to progressively shallower groundwater and higher levels of contamination to the south. Installation of monitoring wells was made difficult by the steep topography and closely spaced residences which greatly restricted well drilling activities. At this point, a reasonably small (about 20 acres) potential source area was defined based primarily on tree-core sampling data, groundwater levels, and PCE distributions in monitoring wells; soil investigations began

Through a deliberative progression of monitoring well installation and vertical sampling, a plume of PCE contamination—referred to as the north plume—in the bedrock was identified which extends southward from city well W2. While the width and the depth of the plume decreases southward, PCE concentrations increase from about 5 to 40 micrograms per liter (µg/L) at 200 to 400 feet deep near the Missouri River to more than 2,000 µg/L in a shallow (135 feet deep) sandstone bed referred to as the *upper sandstone bed* at monitoring well BW-10 (3,300 feet south of the river). Well BW-10 is located at the top of the topographic divide about 2,000 feet south of city well W2. By 2003, the data indicated that while the source of the plume was not known, the presence of a shallow groundwater divide in the vicinity of State Highway 100 and increasing PCE concentrations to the south at shallower depths and smaller widths of contamination to the south led to the logical conclusion that the source of the PCE that impacted city well W2 was located somewhere in what is referred to as the Maiden Lane area of OU4 (Figure 2).

During the initial sampling of the Maiden Lane area, significant levels of PCE were detected in several trees located along a shallow drainage area south of Maiden Lane with lower levels of PCE detected in several trees along a fence line southeast of an old green garage. The results of the 2003 tree-core sampling indicated that there was a cluster of

[1] The National Priorities List is EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long–term remedial action under Superfund.

trees containing PCE in a 0.2-acre area about 200 feet south of Maiden Lane. The presence of PCE in the trees suggested a relatively shallow source of PCE within the residential area.

Data collected during the deliberative process of installing monitoring wells progressively upgradient from city well W2 combined with the data from tree-core sampling, surface water and spring sampling, along with soil borings, were eventually used to identify a small area (less than 0.2 acre) of PCE-contaminated soils.

The origin of the PCE in the Maiden Lane source area was the apparent use of waste PCE to clean grease traps and floor drains in a nearby residence.

Because of the close proximity of the source area soils to occupied homes, three rounds of indoor air sampling were conducted by EPA and the U.S. Geological Survey. Approximately 25 samples were collected for analysis.

OU4 CHARACTERISTICS

• The upper-most bedrock unit beneath the Maiden Lane area is the Cotter Dolomite (Figure 3). The thickness of the Cotter Dolomite is variable because of erosion and ranges from about 85 feet thick beneath the Missouri River alluvium to about 295 feet thick at monitoring well BW-07, just southeast of the Maiden Lane area. The Cotter Dolomite also contains scattered, fine-grained, well-cemented sandstone beds that usually are less than two feet thick. Two thicker sandstone beds in the Cotter Dolomite—the *upper sandstone* and the Swan Creek sandstone—are used as marker beds in the subsurface and at surface exposures. The upper sandstone was encountered at about 110 feet below ground surface (bgs) in well BW-07 and was the target unit for monitoring wells in the Maiden Lane area (BW-10, BW-11, BW-13, and BW-14) where it was encountered between 80 feet bgs (well BW-14) and 136 feet bgs (well BW-10).

• Beneath the Cotter Dolomite is the Jefferson City Dolomite which is generally undifferentiated from the overlying Cotter Dolomite. The Jefferson City Dolomite beneath the Maiden Lane area is about 160 feet thick.

• The Roubidoux Formation underlies the Jefferson City Dolomite and is the first unit encountered in the New Haven area that yields reliable quantities of water. The lithology of the Roubidoux Formation is highly variable and includes sandstone, sandy dolomite, dolostone, mudstone, chert, and cherty dolostone. The most distinctive feature of the Roubidoux Formation in the New Haven area is the presence of a 20- to 30-foot thick, fined-grained, poorly cemented, well-sorted quartzose sandstone (white sand) beneath the top of the unit. The white sand zone of the Roubidoux was the target zone for most of the bedrock monitoring wells in the New Haven area such as BW-07.

• The shallow bedrock at the Maiden Lane area is part of a local flow system controlled by local topography that is superimposed on the regional groundwater flow system. The shallow flow system in the New Haven area exists primarily within the Cotter-Jefferson City Dolomites.

• A shallow groundwater divide is located south of the Maiden Lane area in the vicinity of State Highway 100. South of State Highway 100, shallow groundwater flows south, opposite the regional groundwater flow direction. North of State Highway 100, shallow groundwater flows north/northeast beneath the Maiden Lane area and the topographic divide toward the Missouri River (Figure 4).

• The primary contaminants of concern (COCs) for all investigations at the Site are VOCs—specifically PCE and its daughter products trichloroethene (TCE), cis-dichloroethene (cis-DCE), and vinyl chloride (VC).

• A total of nine monitoring wells have been installed in the shallow (less than 170 feet bgs) bedrock and overburden in the Maiden Lane area.

• PCE concentrations as high as 9,100 µg/L have been detected in bedrock monitoring wells at the Maiden Lane area. This contamination is within or immediately beneath the upper sandstone bed and about 130 to 160 feet bgs in the immediate vicinity. While the upper sandstone bed appears to convey PCE to the 210 tributary surface seep and Bates Spring, monitoring well data indicate that PCE has migrated beneath this unit. Ultimately, it is believed that the Maiden Lane area is the source of a PCE plume in the bedrock extending about 0.75 of a mile north to the Missouri River and contributed to the contamination which resulted in the closure of city wells W1 and W2.

- There is a substantial increase in PCE concentrations from north to south down the groundwater flow path. Average concentrations increase from approximately 2.0 µg/L in well BW-14 to 36 µg/L in well BW-11; to 8,600 µg/L in well BW-13; then decrease to 3,370 µg/L in well BW-10.

- Groundwater at OU4 flows essentially from south to north from well BW-14 through wells BW-11, BW-13, and finally BW-10. The data indicate that there is minimal PCE contamination to the south with large amounts of PCE entering the groundwater between wells BW-11 and BW-13. The distribution of PCE in groundwater is consistent with a Maiden Lane area PCE source area.

- Groundwater in the Maiden Lane area is not currently used as a source of drinking water. The state of Missouri has designated OU4 as part of Special Area 3 under the Missouri Well Drillers' Act. This designation places strict requirements on drinking water well installation within the area.

The contaminated soils in the OU4 source area are considered to be "principal threat wastes" because the COCs are considered a mobile source material. The subsurface soils contain high concentrations of COCs that can migrate through the soils to impact groundwater. Although the groundwater also poses a risk, it is not considered to be a "principal threat" for the Site as defined below.

WHAT IS A "PRINCIPAL THREAT"?

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable [Section 300.430(a)(1)(iii)(A)]. The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that acts as a reservoir for migration of contamination to groundwater, surface water, or air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material; however, nonaqueous phase liquids in groundwater may be viewed as source material.

SCOPE AND ROLE OF THE ACTION

A time-critical-removal action was conducted by EPA in 2007 at OU4 to mitigate the high levels of PCE detected in soils near the old garage south of Maiden Lane. The removal action consisted of the injection of sodium permanganate directly into the contaminated soil and perched groundwater to destroy the PCE and other VOCs by chemical oxidation. The permanganate injections were done in two phases—the first was done in May 2007 in an area primarily southwest and adjacent of the old garage, and the second phase was done in October 2007. Approximately 4,200 gallons of sodium permanganate were injected into 120 injection points within the targeted depth.

This is the final of three fund-lead OUs (OU1, OU4, and OU5) to address contamination at the Site. OUs 2, 3, and 6 are being addressed by the responsible parties. The scope of activities for OU4 is to use in situ chemical oxidation to lower PCE concentrations to levels that will prevent continued migration to groundwater and to utilize long-term groundwater monitoring to track plume movement and to assess the impact of treating the source area soils.

SUMMARY OF SITE RISKS

Superfund is required to seek permanent solutions to protect human health and the environment from hazardous substances. These solutions provide for removal, treatment, or containment of hazardous substances, pollutants, and contaminants so that any remaining contamination does not pose an unacceptable health risk to anyone that might come in contact with them.

As part of the RI/FS, a baseline risk assessment was conducted to determine the current and future effects of OU4 contaminants on human health and the environment.

The following two subsections—Human Health Risks and Ecological Risks—summarize the results of the baseline risk assessment process.

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund human health risk assessment estimates the "baseline risk." This is an estimate of the likelihood of health problems occurring if no cleanup action were taken at a site. To estimate the risk, the process undertakes four steps:

Step 1: Analyze Contamination
Step 2: Estimate Exposure
Step 3: Assess Potential Health Dangers
Step 4: Characterize Site Risks

In Step 1, comparisons are made between site-specific concentrations and health-based standards to determine which contaminants are most likely to pose the greatest threat to human health.

In Step 2, different ways people might be exposed to contaminants are identified. Concentrations, frequency, and duration of exposure are used to calculate the "reasonable maximum exposure" which portrays the highest level of exposure that could reasonably be expected to occur.

In Step 3, information from Step 2 is combined with toxicity information for each chemical to assess potential health risks. EPA considers two types of risk: cancer and noncancer. The likelihood of any kind of cancer resulting from a site is generally expressed as an upper bound probability; for example, a "1 in 10,000 chance." In other words, for every 10,000 people exposed, one extra cancer may occur as a result. For noncancer effects, a "hazard index" is calculated. The key concept here is that a hazard index less than one predicts no noncancer effects.

In Step 4, the results of the three previous steps are combined, evaluated, and summarized into a total site risk. EPA then determines if the site risks require action to prevent exposures to the contaminants.

Human Health Risks

Step 1: Contaminants of Concern

The media of concern are the contaminated soils directly south of Maiden Lane and the contaminated groundwater plume that extends from the contaminated soils to the Missouri River.

The COCs have been categorized into two groups, soil COCs and groundwater COCs. The primary soil COCs are PCE, TCE, and VC. The primary groundwater COCs are PCE, TCE, cis-DCE, and trans-DCE. VC is not a COC for groundwater. The indicator contaminant for both soil and groundwater is PCE.

Step 2: Estimate Exposure

The exposure assessment uses the site description and constituent characterization to identify potentially exposed human receptor populations, identify potential exposure pathways, and calculate estimated daily intakes of the chemicals of potential concern.

STEP 1: CONTAMINANTS OF CONCERN

PCE: The Safe Drinking Water Act standard or "Maximum Contaminant Level" (see definition below) for PCE is 5 ug/L. Long-term exposure to this compound has been associated with health effects to the liver and an increased risk of developing cancer.

TCE: The MCL for TCE is 5 ug/L. Long-term exposure to this compound has been associated with health effects to the liver and may have an increased risk of developing cancer.

Cis-DCE: The MCL for cis-DCE is 70 ug/L. Long-term exposure to this compound above the MCL has been associated with health effects to the liver, circulatory, and central nervous system.

Trans-DCE: The MCL for trans-DCE is 100 ug/L. Long-term exposure to this compound above the MCL has been associated with health effects to the liver, circulatory, and central nervous system.

Vinyl chloride: The MCL for vinyl chloride is 2 ug/L. Long-term exposure to this compound above the MCL may cause damage to the liver and central nervous system.

Behavioral and physiological factors influencing exposure frequency and levels are presented in a series of exposure scenarios as a basis for quantifying constituent intake levels by receptor populations for each identified exposure pathway.

Site-specific information such as climate, geology, soils, groundwater, surface water, population demographics, land use, water use, agricultural practices, etc., will be incorporated to predict the constituent levels to which receptors would be exposed. Once these exposure levels are determined, they will be compared with the appropriate health effects criteria to characterize human health risks.

Steps 3 and 4: Assess and Characterize Risk

Risk characterization integrates the results of the exposure and toxicity assessments to derive quantitative and qualitative estimates of the potential cancer risk and noncancer hazards that may occur due to exposure to site-related contaminants. The following is a brief discussion of the potential cancer risk and noncancer hazards associated with each affected media at OU4.

- There are no hazardous substances present in surface soils (0 to 2 feet in depth) at OU4 that present an unacceptable cancer risk or noncancer hazard to human health. For subsurface soils (below 2 feet in depth), PCE is present at levels that present an unacceptable cancer risk and noncancer hazard to future residents at OU4. PCE is also present in OU4 subsurface soils at levels that present a cancer risk to current/future industrial workers at OU4.

• There are no COCs present in surface water that present an unacceptable cancer risk to human receptors. In addition, there are no COCs in surface water that present a noncancer hazard to human receptors at OU4.

• There are no COCs present in sediments that present an unacceptable cancer risk to human receptors. In addition, there are no COCs present in sediments that present a noncancer hazard to human receptors at OU4.

• PCE and TCE are present in groundwater at levels that pose an unacceptable cancer risk to future residents. In addition, cis-1,2-DCE; PCE; and TCE are present at levels in groundwater that pose a noncancer hazard to future residents.

• There are no hazardous substances present in indoor air that present an unacceptable cancer risk to human receptors. In addition, there are no hazardous substances present in indoor air that present a noncancer hazard to human receptors at OU4.

• There are no OU4 COCs present in sewer water that present an unacceptable cancer risk to human receptors. In addition, there are no hazardous substances present in sewer water that present a noncancer hazard to human receptors at OU4.

Ecological Risks

An ecological risk assessment (ERA) was conducted in 2002 for all OUs of the Site using water, stream bed sediment, and flood plain soil samples from the Missouri River and several streams in the New Haven area. None of the samples collected for the ERA contained PCE or other chlorinated ethenes above screening levels. The overall conclusion of the ERA was that ecological risks from any of the OUs of the Site are minimal. In May 2008, a review of current analytical results reaffirmed the initial conclusion of *minimal* risk.

Based upon the results of the baseline risk assessment, it is EPA's current judgment that the Preferred Alternative identified in this Plan or one of the other measures considered is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

Section 121(b) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, informally referred to as the Superfund law) requires the selection of remedial actions that attains a degree of cleanup that ensures protection of human health and the environment, is cost effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. To satisfy CERCLA requirements, the following remedial action objectives (RAOs) were developed for soils at OU4:

(1) For protection of human health – prevent exposure to soils with contaminant concentrations which result in an excess cancer risk greater than 1×10^{-6} or a Hazard Quotient greater than 1.0, whichever is less.

(2) For protection of the environment – reduce the soil contaminant levels to prevent continued migration of PCE from soils to groundwater.

The following RAOs were developed for groundwater at OU4:

(1) For protection of human health – prevent exposure to groundwater with contaminant levels greater than the maximum contaminant levels (MCLs)[2]. For those contaminants without established MCLs, prevent exposure to groundwater with contaminant concentrations which result in an excess cancer risk of greater than 1×10^{-6} or a Hazard Quotient greater than 1.0, whichever is less.

[2] MCLs are the maximum permissible levels of contaminants in water which are delivered to a user of a public water system. MCLs are promulgated by EPA pursuant to the Safe Drinking Water Act.

(2) For protection of the environment – minimize further degradation of the local groundwater by the contaminant plume.

Target cleanup levels for OU4, as developed in the FS Report, were chosen to be equivalent to MCLs (for COCs which have established MCLs) because they are legally enforceable standards for drinking water. For COCs without MCLs, the nonzero maximum contaminant level goal (MCLG) was chosen.

However, a Technical Impracticability (TI) waiver is being sought as it has been determined that it is technically impracticable from an engineering perspective to remediate the fractured bedrock groundwater.

SUMMARY OF REMEDIAL ALTERNATIVES

The RI delineated areas and volumes of contaminated soils and groundwater at OU4 for developing remedial alternatives.

Area and Volume of Contaminated Soil

For the purpose of containment or in situ treatment, the surface area is estimated to be approximately 600 square yards (yd^2) and the volume of contaminated soils was estimated to be approximately 3,700 cubic yards (yd^3). For any above ground treatment or excavation alternatives, the volume of soil that must be removed is larger because the excavation's slopes must be cut back to reach the deeper (10 to 15 feet bgs) contaminated soils. The RI estimated this volume to be approximately 6,200 yd^3.

Volume of Contaminated Groundwater

The RI estimated that the area of the contaminated plume with detectable PCE levels was approximately 164 acres (7.1 million square feet) (Figure 5), and the area of the plume above the MCL for PCE was approximately 82 acres (3.6 million square feet). The RI calculated the volume of contaminated groundwater at approximately 120 million gallons (16,000,000 cubic feet). This volume of contaminated groundwater is contained within approximately 160 million cubic feet of fractured bedrock (Figure 6). Most of the contamination is traveling within higher permeability zones such as the sandstone layers, chert beds, or along bedding planes and fractures.

In order to address the soil and groundwater contamination, the FS developed and evaluated three alternatives. The remedial alternatives that received a detailed evaluation in the FS are identified below.

The Preferred Alternative (Alternative 3) will require a TI waiver for chemical-specific applicable or relevant and appropriate requirements (ARARs) since it is technically impracticable from an engineering perspective to remediate the fractured bedrock groundwater.

Remedial alternatives for OU4 are presented below:

REMEDIAL ALTERNATIVES

Alternative 1 – No Action
*This alternative would not involve any remedial actions. With the exception of monitoring well closures, the Site would remain in its present condition.
*This alternative is required by NCP and CERCLA and is a baseline alternative against which effectiveness of the other alternatives can be compared.

Alternative 2 – Hydraulic Containment and Above Ground Treatment/Capping, Sheet Piling, and Rock Grouting
*This alternative would use hydraulic containment, above ground treatment, groundwater monitoring, and ICs to address the potential health risks associated with the contaminated groundwater.
*This alternative would contain the contaminant plume and minimize the contaminant migration from the source area soils and the shallow bedrock.

Alternative 3 – In Situ Chemical Oxidation/Long-term Monitoring
* This alternative would use in situ chemical oxidation and possibly ICs to address the potential health risks associated with the contaminated soils.
* Long-term monitoring and ICs would address the potential health risks associated with the contaminated groundwater.

Common Elements

Many of these alternatives include common components. Except for the "no action" alternative, all alternatives require the use of institutional controls (ICs)[3] to reduce exposure to contaminated soils and/or groundwater. As referenced above, OU4 is within a Special Area designation made by MDNR pursuant to the Missouri Well Drillers' Act. The Special Area designation results in the imposition of enforceable, stringent well construction standards throughout OU4. This provides a reliable and durable IC on the groundwater exposure pathway. Recently completed soil sampling in the source area soils indicates that the two previous injections of sodium permanganate have resulted in a decrease in contaminant levels in the soils. The residual contamination will be addressed in the chemical oxidation treatment described in Alternative 3. Accordingly, ICs affecting the soil may not be required. In the event that soil ICs are required, it is expected that they can readily be implemented through informational or educational devices (i.e., notices to area residents) through the imposition of activity and use limitations through environmental covenants or other appropriate mechanisms.

For all alternatives, CERCLA requires that EPA review the remedy every five years to assure that the remedy continues to be protective of human health and the environment. This five-year review would be a site-wide review with OU4 being one of the six OUs reviewed. The intent of the review is to evaluate the remedial action to assure that human health and the environment are being protected by the remedial action being implemented. Depending on the results of the evaluation, additional remedial actions could be required.

For cost-estimating purposes, each alternative was standardized to a 30-year time period.

ALTERNATIVE 1: NO ACTION

Estimated Capital Cost: $ 93,000
Present Worth O&M Cost: $ 28,100
Total Present Worth Cost: $121,100
Estimated Time to Achieve RAOs: Not Achievable

Alternative 1 would not involve any remedial actions and the subsite would remain in its present condition. This alternative, required by the NCP and CERCLA, is a baseline alternative against which the effectiveness of the other alternatives can be compared. Under the "no action" alternative, the subsite is left "as is" and no funds would be expended for monitoring, control, or cleanup of the remaining contaminated soils. However, a five-year review of the subsite would be required under CERCLA so funds would have to be expended to conduct the review.

ALTERNATIVE 2: HYDRAULIC CONTAINMENT and ABOVE GROUND TREATMENT/CAPPING, SHEET PILING, AND ROCK GROUTING

Estimated Capital Costs: $ 825,000
Present Worth O&M Costs: $1,738,000
Total Present Worth Cost $2,563,000
Estimated Time to Achieve RAOs: Greater than 30 years

Alternative 2 includes the containment of the contaminated source area soils and shallow bedrock by capping over, sheet piling around, and rock grouting below the contaminated soil/shallow bedrock and extraction of groundwater at a rate to contain the head of the groundwater contaminant plume. It is estimated that ten extraction wells, pumping at a total rate of approximately 10 gallons per minute, would be necessary to contain the plume and remove perched water from the soil. Extracted groundwater would be treated by granulated activated carbon. The treated groundwater would then be discharged to a local tributary or storm drain and ultimately to the Missouri River.

This alternative also includes groundwater monitoring to determine the effectiveness of the plume containment and ICs including existing requirements for new well certification and public education.

ALTERNATIVE 3: IN SITU CHEMICAL OXIDATION TREATMENT/LONG-TERM MONITORING

Estimated Capital Cost: $ 223,000
Present Worth O&M Cost: $1,178,000
Total Present Worth Cost: $1,401,000
Estimated Time to Achieve RAOs: Less than 10 years for soils and greater than 30 years for groundwater.

Alternative 3 includes in situ chemical oxidation of the contaminated soil. The treatment would be similar to the two in situ chemical oxidation efforts conducted during the removal action in 2007. The

[3] ICs are nonengineered controls, such as administrative and/or legal controls, that are intended to help to minimize the potential for human exposure to contamination.

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall Protection of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to human health and the environment through ICs, engineering controls, or treatment.
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the Site, or whether a waiver of such requirement is justified.
Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of contaminants, their ability to move in the environment, and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of needed services and materials.
Cost includes estimated capital and annual operations and maintenance costs as well as present net worth cost. Present net worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State/Support Agency Acceptance considers whether the state agrees with EPA's analyses and recommendations as described in the RI/FS and Proposed Plan.
Community Acceptance considers whether the local community agrees with EPA's analyses and Preferred Alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

injection activities would be conducted during the lowest perched water table levels (late summer or early fall).

ICs for the soils would consist of public education/information. ICs would only be necessary until the soil treatment had been completed and sampling had confirmed that no soil contamination levels were below the soil-to-groundwater migration levels.

Alternative 3 would also include monitoring of the groundwater contaminant plume to ensure that any migration of the contaminated groundwater toward sensitive receptors would be detected.

EVALUATION OF ALTERNATIVES

In this section, the remedial alternatives are evaluated in detail to provide enough relevant information about each alternative so that an appropriate remediation measure can be selected. Under CERCLA and the NCP, nine criteria (as shown in the table above) are used to evaluate remedial alternatives. The first two criteria—the threshold criteria—are requirements that an alternative must meet to be selected as the Preferred Alternative. The next five criteria— balancing criteria—are used to weigh major trade-offs among the alternatives. The last two criteria— modifying criteria—will be fully evaluated only after public comment is received on this Plan

Overall Protection of Human Health and the Environment

Alternative 1 – Because no remedial action or monitoring would be conducted as part of this alternative, human health and the environment would not be adequately protected.

Alternative 2 – Would protect the public and the environment from the risks posed by the groundwater contamination by preventing the migration of the heavily contaminated portion of the plume. The cap/sheet piling/rock grouting enclosure would eliminate direct contact with the contaminated soil and minimize migration of the contaminants into the groundwater. This is a containment alternative so some risk would remain because the bulk of the contaminants would not be actively remediated.

No long-term risk would be associated with the groundwater that is extracted and treated. Granular activated carbon adsorption is proven to be effective for the removal of organics from contaminated groundwater. Groundwater monitoring would be implemented to monitor how effectively the groundwater contaminant plume is contained. Discharge of the treated effluent to the Missouri River should not pose a significant risk because contaminant concentrations in the effluent would be regulated by the National Pollution Discharge Elimination System program.

Alternative 3 – Human health would be adequately protected from by this alternative. The long-term risk from the soil that is treated in situ would be substantially less than the current risk. In situ chemical oxidation is effective for removing the VOCs present in the soils at OU4. Because all treatment would be in situ, no short-term or cross-media risk should occur.

Currently, two subsite-specific factors protect human health from the contaminated groundwater at OU4. The city of New Haven provides potable water to the residents in OU4 and the surrounding area so no one is currently exposed to the contaminated groundwater. In addition, all of OU4 is within Special Area 3. If any new wells are installed in OU4, they must comply with the well construction requirements listed in the Special Area 3 regulations. These existing factors, combined with the monitoring of the contaminant plume and the public education/information on the dangers of using contaminated groundwater, should prevent current and future human health exposure to the contaminated groundwater.

Compliance with Applicable or Relevant & Appropriate Requirements[4]

Section 121(d) of CERCLA requires that remedial actions comply with ARARs. ARARs include the requirements of federal environmental laws and promulgated state environmental laws that are more stringent than the equivalent federal law.

Applicable requirements include federal or state cleanup standards, standards of control, and other substantive requirements, criteria, or limitations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at OU4.

Relevant and appropriate requirements include federal and state cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations that, while not applicable, address problems or situations sufficiently similar to those at OU4.

Alternative 1 – The chemical-specific ARARs specific to the present quality of the groundwater include the National Primary Drinking Water Standards. The concentrations of PCE, TCE, cis-DCE, and trans-DCE in the groundwater currently exceed the MCLs and the MCLGs. Thus, the present quality of the groundwater does not meet these standards so this alternative would not comply with the chemical-specific ARARs. No chemical-specific ARARs were identified for the soils at OU4.

The only action under this alternative that would be affected by action-specific ARARs would apply to the closure of the monitoring wells.

No location-specific ARARs would apply to Alternative 1.

Alternative 2 – A full spectrum of potential ARARs for the subsite are discussed in Section 2.2, and set out in Tables 2-3, 2-5, and 2-6 of the FS. The chemical-specific ARARs specific to the present quality of the groundwater include the National Primary Drinking Water Standards. No chemical-specific ARARs were identified for the soils at OU4.

This alternative would meet ARARs, but would most likely fail to achieve a permanent cleanup. A containment remedy such as this one would be limited to preventing migration of contamination above cleanup levels.

Alternative 3 – The potential ARARs for the subsite are discussed in Section 2.2, and set out in Tables 2-3, 2-5, and 2-6 of the FS. No chemical-specific ARARs were identified for the soils at OU4.

The chemical-specific ARARs specific to the present quality of the groundwater include the National Primary Drinking Water Standards.

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[4] There are three types of ARARs: (1) Chemical-specific ARARs are health or risk-based values or methodologies that establish the acceptable amount or concentration of a hazardous substance that may be found in or discharged to the ambient environment, (2) Location-specific ARARs are restrictions placed on the concentration of a hazardous substance or activity solely because they occur in a specific location, and (3) Action-specific ARARs are technology or activity-based requirements pertaining to the treatment or management of hazardous substances.

The concentrations PCE, TCE, cis-DCE, and VC in the groundwater currently exceed the MCL and MCLGs. Because the present and potential future quality of the groundwater does not and will not meet all of these standards, this alternative would not comply with chemical-specific ARARs unless a waiver is received.

A complete discussion of location-specific and action-specific ARARs can be found in Section 4.3.2 of the FS.

Long-term Effectiveness and Permanence

Alternative 1 – The residual risk to human health and the environment associated with this alternative would be the same as the current risk. Alternative 1 does not include any mechanisms of warning the local population of the risks from the OU4 contamination. The concentrations of PCE, TCE, cis-DCE, and trans-DCE in the groundwater currently exceed their respective MCLs. Because groundwater monitoring would not be conducted, there would be no analytical data to determine the effectiveness of this alternative. Therefore, the long-term effectiveness of the current protective factors is uncertain. Because contamination above cleanup goals would remain at the subsite, five-year reviews would be required.

Alternative 2 – The residual risk to human health and the environment from contaminated soils would be reduced by eliminating the threat of direct contact with the soils. The cap/sheet pile rock grouting enclosure would minimize infiltration and the transfer of contaminants from the soils and shallow bedrock to the groundwater.

In this alternative, the contaminated groundwater would not be actively restored so there would be a long-term risk from the contaminants remaining in the aquifer.

Alternative 3 – In this alternative, the contaminated soils would be actively restored so there would be a substantial decrease in the long-term risk from the contaminants remaining in soils and groundwater. All the contaminated soil exceeding the migration to groundwater levels would be treated by in situ chemical oxidation. The period of remediation of the soils would be less than ten years. Five-year reviews would be conducted until the RAOs are met to ensure protection of human health and the environment.

Implementation of this alternative would reduce the long-term risk to health that is associated with the potential use of the contaminated groundwater. However, because contaminated groundwater would remain in the aquifer, a long-term risk would continue to exist for the environment. The environmental risk would remain until natural attenuation processes (dispersion, advection, and sorption) reduce the groundwater contamination levels to MCLs.

Because monitoring would be conducted, there would be analytical data from groundwater sampling to evaluate the contaminant levels in the plume, future migration of the plume, and the attenuation of contaminants from natural processes.

Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Alternative 1 – Because no remedial activities would be conducted, there would be no reduction in the toxicity, mobility, or volume of the contaminants except by natural fate and transport processes. Monitoring would not be conducted and therefore no mechanism would exist to determine the reductions, if any, of the toxicity, mobility, or volume of the contaminants in the soil and groundwater.

Alternative 2 – This alternative meets the statutory preference for treatment as a principal element. Extraction and treatment of contaminated groundwater would effectively reduce the mobility of the contaminants in the groundwater. Capping, sheet-piling, and rock grouting would minimize the movement of contaminants from the soil and shallow bedrock to the groundwater.

Alternative 3 – This alternative meets the statutory preference for treatment as a principal element for the soil. In situ chemical oxidation of contaminated soil would effectively reduce the toxicity and volume of the contaminants in the source area soils. Chemical oxidation of PCE and the other VOCs is an irreversible treatment.

Groundwater monitoring and ICs including the Special Area 3 well construction requirements would not reduce the toxicity, mobility, or volume of the contaminants except by natural fate and transport processes. Monitoring would be effective in determining the reductions, if any, of the toxicity, mobility, or volume of the contaminants in the groundwater.

Short-term Effectiveness

Alternative 1 – Because the only action that would be conducted is well closure, there would be no increase in the short-term risk to the community. The amount of time required for the contaminants in the groundwater and soil to degrade or dilute to concentrations at or below the MCLs or risk-based levels is unknown, but it is expected to be significantly greater than 30 years..

Alternative 2 – Community risk associated with this alternative would be relatively low during construction of this alternative. Proposed activities include building demolition, cap and sheet piling installation, rock grouting, groundwater treatment system construction, and installation of the extraction wells and new monitoring wells.

Environmental impacts resulting from the installation of the cap, sheet piling, rock grouting, and the groundwater extraction and treatment system would include noise pollution during building demolition, cap construction, sheet piling installation, and well installation with minimal fugitive dust emissions during construction.

Because of the uncertainties about the contaminants' migration velocity and how effectively the contaminated soils would be contained, there is considerable uncertainty about the time required to achieve cleanup levels through the natural attenuation processes, but it is expected to be greater than 30 years.

Alternative 3 – Community risk associated with this remedial alternative would be low during the application of the oxidizing chemical to the soil.

Environmental impacts resulting from the groundwater remediation activities would include: noise pollution and fugitive dust emissions during well construction. The amount of time required for the contaminants in the groundwater to degrade or dilute to concentrations at or below the MCLs or risk-based levels is unknown, but it is expected to be significantly greater than 30 years.

Implementability

Alternative 1 – Monitoring well closure, the only on-site activity required in this alternative, is easily implemented. Well closure vendors and the material needed to close the wells are readily available.

Alternative 2 – Implementation of this alternative would be moderately difficult. Demolition of the existing garage could be easily implemented. Installation of the sheet piling would require re-routing of utilities which would require coordination with state and local entities. Cap construction is readily implemented and contractors are readily available. Installation of wells and rock grouting and construction of a treatment facility are relatively simple activities. Building demolition, sheet pile installation, capping, rock grouting, and well installation activities would create noise and inconvenience to nearby citizens. Electricity would be required at each extraction well location as well as the treatment plant.

Groundwater monitoring, including installation of additional monitoring wells, is easily implemented. Additional coordination activities would be needed to ensure that any monitoring wells installed in the New Haven Residential Historical District comply with the National Historic Preservation Act. Placement of additional monitoring wells would have to be coordinated with the private citizens and the city of New Haven.

Alternative 3 – Implementability of the soil remediation efforts would be relatively easy given the source areas location (behind four residences). Chemical oxidation of the COCs at OU4 is technically and administratively feasible.

Groundwater monitoring, including installation of additional monitoring wells, is easily implemented. Additional coordination activities would be needed to ensure that any monitoring wells installed in the New Haven Residential Historical District comply with the National Historic Preservation Act. Placement of additional monitoring wells would have to be coordinated with the private citizens and the city of New Haven.

The implementation of ICs at OU4 should be simple. The Special Area 3 regulations have already been finalized for the entire Site, not just OU4. Public education/information could be easily implemented through public notices in the newspaper, through direct mailings, and through public meetings.

Cost

Alternative 1 – The costs for this alternative are presented in Table A-1. While no remedial actions would be conducted, the existing groundwater monitoring wells must be closed. Therefore, capital costs have been included for the wells' closure. Because five-year reviews of the subsite are required, there are also operation and maintenance (O&M) costs. The total present worth of Alternative 1 is estimated to be approximately $121,000.

Alternative 2 – The detailed cost summary of the capital and O&M costs associated with the implementation of this alternative is presented in Table A-2.

The capital costs include both direct and indirect capital costs. The direct capital costs include: building demolition, installation of sheet piling and rock grouting, cap construction, installation of additional monitoring wells and extraction wells, construction of the treatment facility and associated supply and discharge piping, and the purchase of process equipment

The O&M costs associated with implementing this alternative include groundwater monitoring, maintenance of the groundwater extraction and treatment system, equipment replacement, cap maintenance, and five-year reviews. The total present worth is estimated to be approximately $2,563,000.

Alternative 3 – The detailed summary of the costs associated with the implementation of Alternative 3 is presented in Table A-3.

The capital costs include both direct and indirect capital costs. This alternative would have capital costs consisting of the installation of five new groundwater monitoring wells and soil monitoring.

The O&M costs associated with implementing this alternative include groundwater monitoring and placement of the chemical oxidant in the soil. The duration of the alternative is assumed to be 30 years. The total present worth of Alternative 3 is estimated to be approximately $1,401,000.

The present worth cost represents the amount of money that would have to be invested at the beginning of a remedial action at a given interest rate to pay for all expenditures throughout the life of the alternative. A seven percent discount rate was used to calculate the present worth costs.

The actual cost of the project would depend on the final scope of the remedial action and on other variables.

State/Support Agency Acceptance

The state of Missouri is currently reviewing the information regarding the Preferred Alternative.

Community Acceptance

Community acceptance of the Preferred Alternative will be evaluated after the public comment period ends and will be described in the Record of Decision for OU4.

SUMMARY OF THE PREFERRED ALTERNATIVE

The Preferred Alternative for addressing OU4 is Alternative 3 which includes injection of a chemical oxidant to address soil contamination and the imposition of ICs. Because this alternative would not actively restore the groundwater, it does not comply with all ARARs. Therefore, a TI waiver for chemical-specific ARARs will be issued.

Also, an additional five new monitoring wells would be installed for a total of 24 monitoring wells that would be sampled quarterly for the first two years, twice a year for years three through five, and annually thereafter. Soils will be sampled until

RAOs are attained. The frequency of the monitoring could be reevaluated and modified after the five-year review or after review of the monitoring data.

Alternative 3 was selected over the other alternatives because it provided the most practicable approach to the protection of human health and the environment based on two current site-specific factors: (1) the city of New Haven provides potable water to residents in and areas surrounding OU4 so no one is currently exposed to the contaminated groundwater. In addition, all of OU4 is within Special Area 3. Special Area 3 is a designation given to the area by MDNR pursuant to the Missouri Well Drillers' Act. The special area designation resulted from the PCE contamination in the area and imposes enforceable, stringent standards on the installation of wells within the area. If any new water supply wells are installed in OU4, they must comply with the well construction requirements listed in the Special Area 3 regulations. These existing factors combined with the monitoring of the contaminant plume and the public education on the dangers of using the contaminated groundwater that would occur under Alternative 3 should prevent current and future human exposure to the contaminated groundwater.

The Preferred Alternative can change in response to public comment or new information.

Based on the information available at this time, EPA believes the Preferred Alternative would be protective of human health and the environment, would comply with ARARs, would be cost effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

COMMUNITY PARTICIPATION

EPA and MDNR provide information regarding the cleanup of OU4 at the Site through public meetings, the Administrative Record file for the Site, and announcements published in the *New Haven Leader* Newspaper. EPA and MDNR encourage the public to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted at the Site.

The dates for the public comment period, the date, location, time of the public meeting, and the locations of the Administrative Record file are provided on the front page of this Plan.

GLOSSARY OF TERMS

Specialized terms used in this Plan are defined below:

Administrative Record (AR): The body of documents that "forms the basis" for selection of a particular response at a site. An AR is available at or near the site to permit interested individuals to review the documents and to allow meaningful public participation in the remedy selection process.

Aquifer: An underground layer of rock, sand, or gravel capable of storing water within cracks and pore spaces or between grains. When water contained within an aquifer is of sufficient quantity and quality, it can be used for drinking or other purposes. The water contained in the aquifer is called groundwater.

Applicable or Relevant and Appropriate Requirements (ARARs): The federal and state environmental laws that a selected remedy will meet.

Capital Costs: Expenses associated with the initial construction of a project.

Chemical Oxidation Treatment: The use of chemicals called "oxidants" to destroy pollution in soil and groundwater. Oxidants help change harmful chemicals into harmless ones.

Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA): The law enacted by Congress in 1980 to evaluate and clean up abandoned, hazardous waste sites. EPA was charged with the mission to implement and enforce CERCLA.

Contaminant Plume – A column of contamination with measurable horizontal and vertical dimensions that are suspended in and move with groundwater.

Groundwater – Underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

Maximum Contaminant Levels (MCLs): The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Monitoring: Continued collection of information about the environment that helps gauge the effectiveness of a cleanup action. Monitoring wells drilled at different levels at OU4 would be used to detect any migration of the plume.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal regulations that guide the Superfund program.

Operable Unit (OU): Term for each of a number of separate activities undertaken as part of a Superfund site cleanup.

Operation and Maintenance (O&M): Activities conducted at a site after the construction phase to ensure that the cleanup continues to be effective.

Plume: A body of contaminated groundwater flowing from a specific source.

Present Worth Analysis: A method of evaluation of expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different remedial actions can be compared on the basis of a single figure for each alternative.

Record of Decision (ROD): The decision document in which EPA selects the remedy for a Superfund site.

Superfund: The nickname given by the press for CERCLA because the program was well funded in the beginning.

Toxicity: A measure of degree to which a substance is harmful to human and animal life.

Volatile Organic Compounds (VOCs): Carbon compounds, such as solvents, which readily volatilize at room temperature and atmospheric pressure. Most are not readily dissolved in water, but their solubility is above health-based standards for potable use. Some VOCs can cause cancer.

Figures

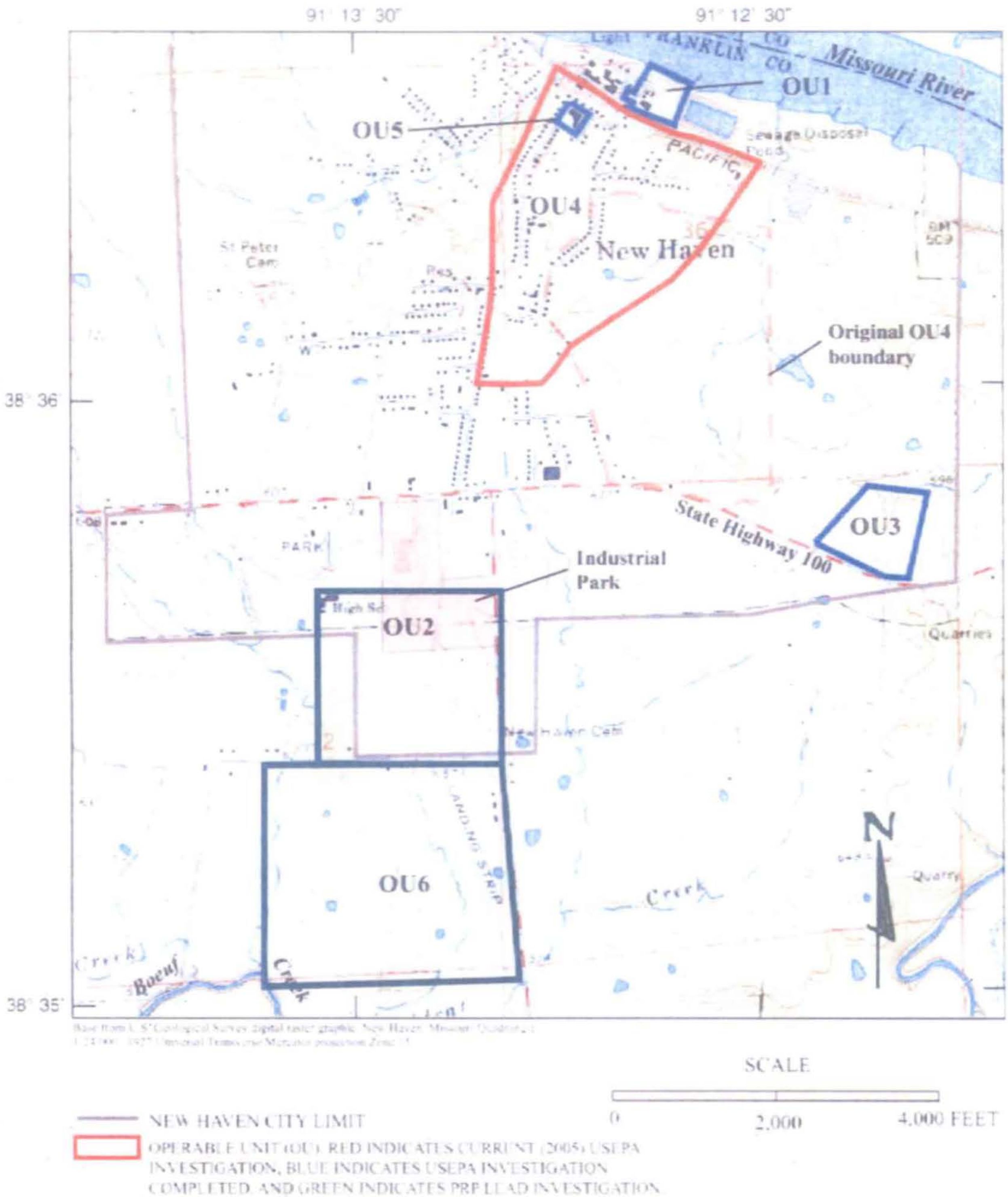

Figure 1: Topography in the New Haven Remedial Investigation (RI) study area and location of RI Operable Units (OUs).

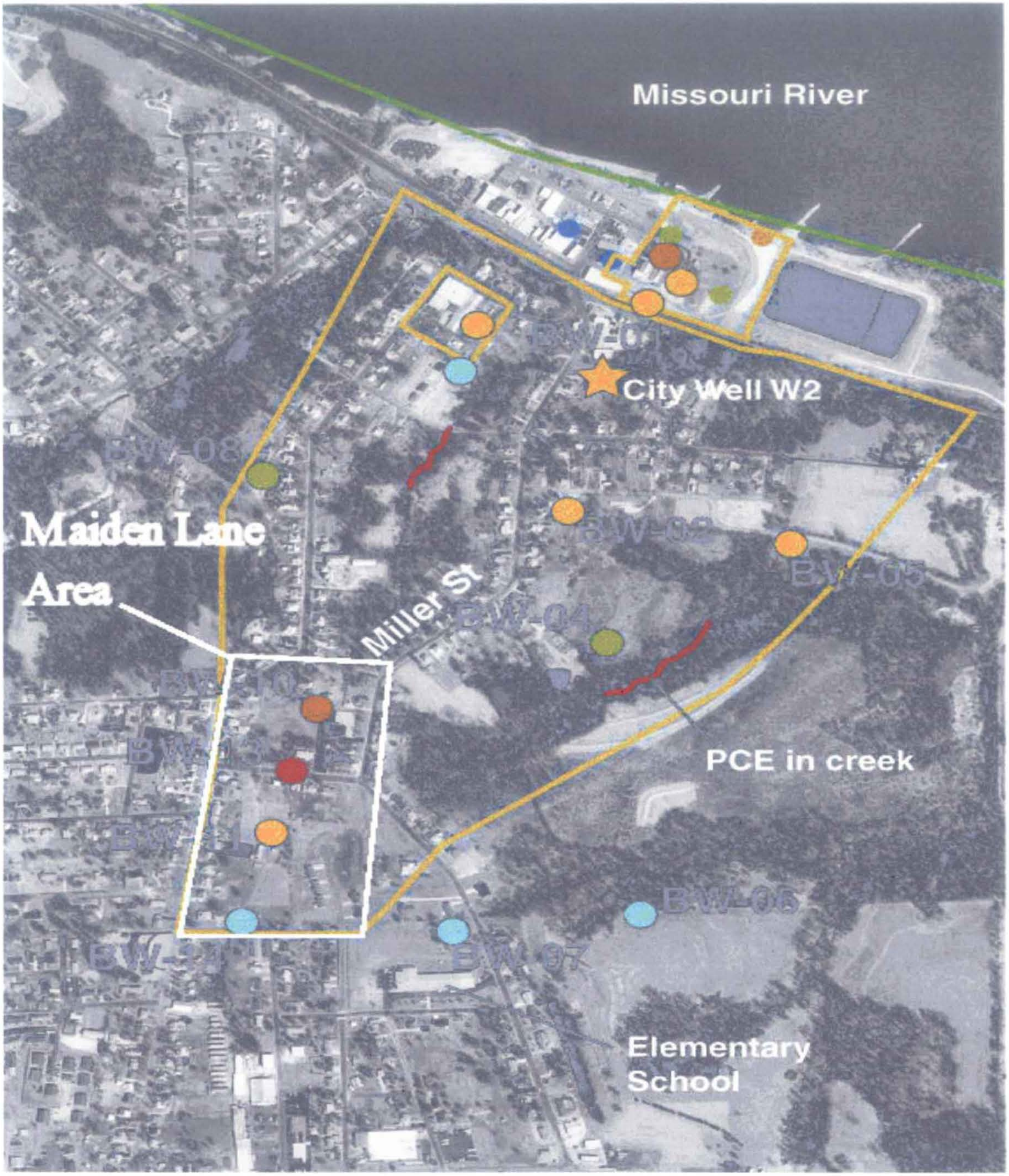

Figure 2: Operable Unit 4 and Maiden Lane Area

[ft, feet; gal/min, gallons per minute; thickness data from geologic logs of production wells in New Haven on file at the Missouri Department of Natural Resources Division of Geology and Land Survey and from Starbuck (2002)]				
System	Formation	Approximate thickness (ft)	General lithology	General hydrologic properties
Ordovician	St. Peter Sandstone	less than 40	Fine-grained cemented quartz sandstone.	Yields of 10 to 50 gal/min where moderately thick.
	Powell Dolomite	0 to 95	Difficult to differentiate. Crystalline cherty dolostone with abundant thin shale partings and occasional thin sandstone beds. Thicker (2 to10 ft thick) sandstone beds in Cotter.	Adequate for small domestic supply. Yields of 5 to 10 gal/min locally. Less permeable than surrounding units and impedes downward water movement.
	Cotter Dolomite	85 to 280		
	Jefferson City	150 to 165		
	Roubidoux Formation	110 to 120	Cherty, sandy dolostone. Middle 20 to 30 ft is clean sandstone.	Normal yields of 15 to 50 gal/min. Target unit for newer domestic wells.
	upper Gasconade Dolomite	35 to 50	Massively bedded, crystalline dolostone.	Lower permeability than surrounding units.
	lower Gasconade Dolomite	200 to 240	Cherty dolostone with massive chert beds.	Combined yields of upper and lower units range from 50 to 75 gal/min.
	Gunter Sandstone Member of Gasconade Dolomite	35 to 50	Dolostone with less than 10 percent sand.	Normal yield of 40 to 50 gal/min, may exceed 200 gal/min in some locations.
Cambrian	Eminence Dolomite	145 to 180	Crystalline dolostone with less than 5 percent chert and sand.	Yields of 75 to 250 gal/min.
	Potosi Dolomite	greater than 170	Crystalline dolostone with abundant small solution cavities and quartz druse.	Target zone of most high capacity wells. Yields 200 to 1,000 gal/min.

Modified from Miller and Vandike (1997).

Figure 3: Geologic units of the Ozark aquifer in the vicinity of New Haven, Missouri.

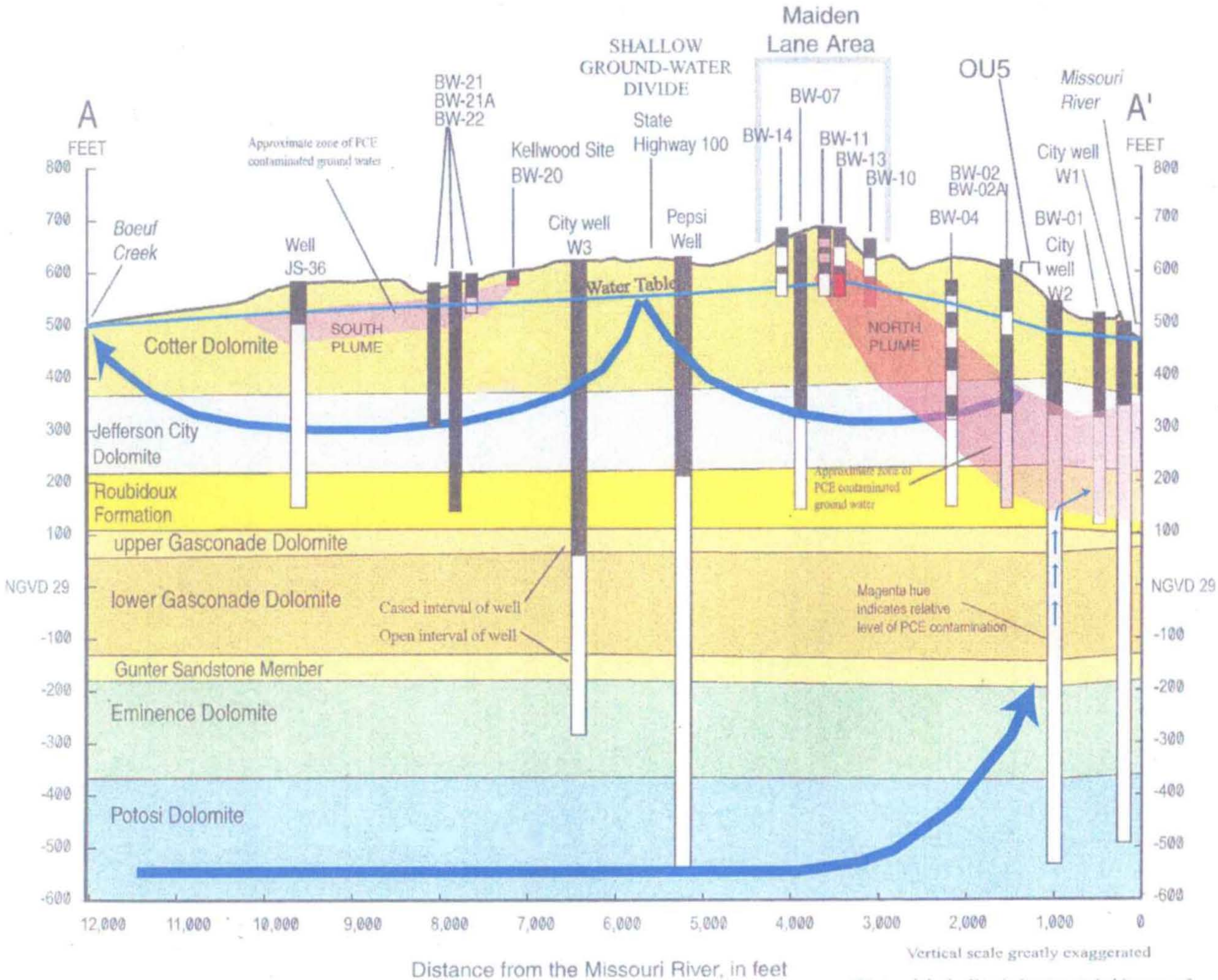

Figure 4: Groundwater flow regime

*Note: pink shading indicates probable area of tetrachloroethene (PCE) contamination. Degree of shade indicates relative PCE concentration.

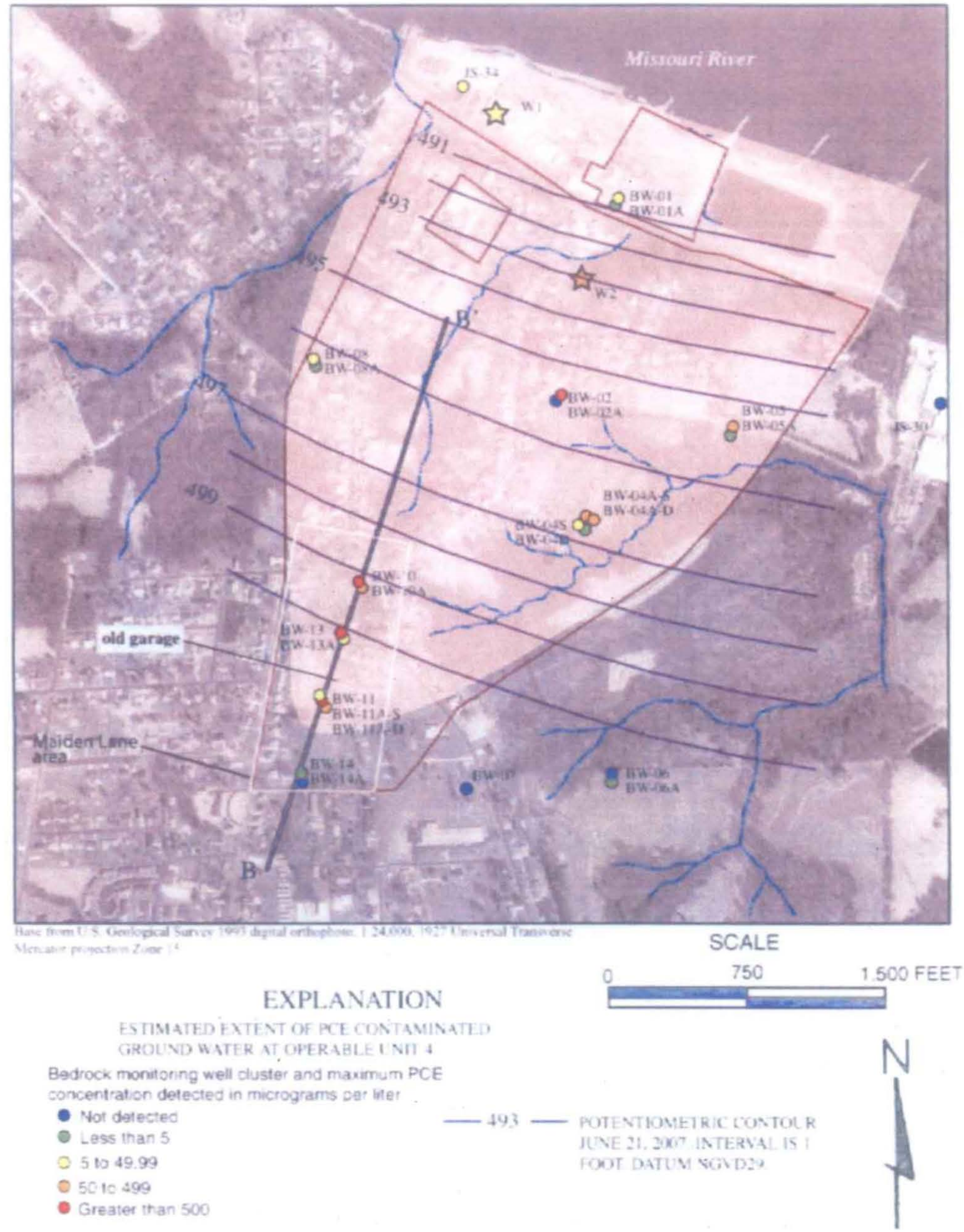

Figure 5. Extent of PCE contamination in the bedrock aquifer and maximum PCE contamination detected in moitoring and supply wells at OU4 and vicinity.

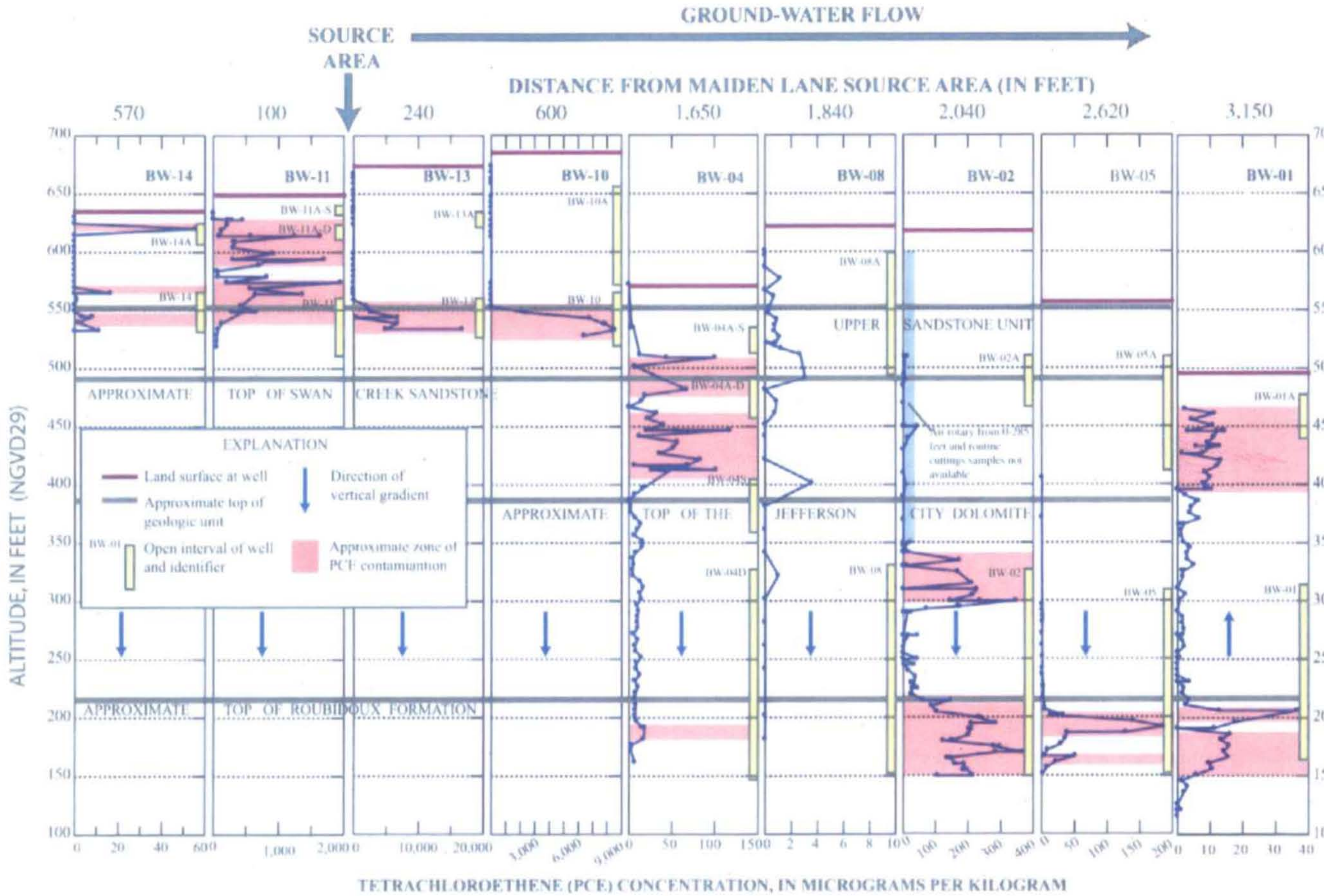

Figure 6. Verticle profiles of PCE concentrations estimated by the portable gas chromatograph in drill cuttings from bedrock monitoring wells at OU4.

Tables

Table A-1
Alternative 1 - No Action / No Action
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
CAPITAL COSTS					
Monitoring Well Closures	4,000	FT	$15	$60,000	
DIRECT CAPITAL COST SUBTOTAL				$60,000	
Bid Contingency (15% of Well Closures)				$9,000	
Scope Contingency (15% Well Closures)				$9,000	
TOTAL DIRECT CAPITAL COST				$78,000	
Permitting and Legal (5%)				$3,900	
Construction Services (10% of Well Closures)				$6,000	
CONSTRUCTION COSTS TOTAL				$87,900	
Engineering Design (8% of Well Closures)				$4,800	
TOTAL CAPITAL COST				$93,000	
ANNUAL OR PERIODIC O&M COSTS					
Five-Year Review @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$13,000		$13,000
TOTAL PRESENT WORTH O&M COST				$28,100	
TOTAL PRESENT WORTH				$121,100	

7 percent discount rate used to calculate present worth.

LS - Lump Sum

FT - Feet

Table A-1 (Continued)
Alternative 1 - No Action / No Action
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

Year	Yearly O&M Cost*	Intermittent O&M Costs	Total Annual O&M Costs	Intermittent O&M Costs Include:
1	$0	$0	$0	
2	$0	$0	$0	
3	$0	$0	$0	
4	$0	$0	$0	
5	$0	$13,000	$13,000	5 yr review
6	$0	$0	$0	
7	$0	$0	$0	
8	$0	$0	$0	
9	$0	$0	$0	
10	$0	$13,000	$13,000	5 yr review
11	$0	$0	$0	
12	$0	$0	$0	
13	$0	$0	$0	
14	$0	$0	$0	
15	$0	$13,000	$13,000	5 yr review
16	$0	$0	$0	
17	$0	$0	$0	
18	$0	$0	$0	
19	$0	$0	$0	
20	$0	$13,000	$13,000	5 yr review
21	$0	$0	$0	
22	$0	$0	$0	
23	$0	$0	$0	
24	$0	$0	$0	
25	$0	$13,000	$13,000	5 yr review
26	$0	$0	$0	
27	$0	$0	$0	
28	$0	$0	$0	
29	$0	$0	$0	
30	$0	$13,000	$13,000	5 yr review
Total Cost of Annual O&M			$78,000	
Present Worth of Annual O&M			$28,100	

* There are no yearly O&M costs for this alternative.

Table A-2

Alternative 2 - Capping, Sheet Piling, and Rock Grouting / Hydraulic Containment and Above Ground Treatment

Present Worth Cost Estimate

Riverfront OU4 Site FS Report

GROUNDWATER MONITORING (Labor only)					
Years 1 and 2 2 Jr. Level person for 7 x 12 hour days per sampling event and 1 Jr. Level person for 5 x 8-hour days per data evaluation	832	HR	$100		$83,200
Quarterly sampling per diem	56	DAY	$730		$40,900
Years 3 through 5 2 Jr. Level person for 7 x 12 hour days per sampling event and 1 Jr. Level person for 5 x 8-hour days per data evaluation	416	HR	$100		$41,600
Semi-annual sampling per diem	28	DAY	$730		$20,400
Years 6 through 30 2 Jr. Level person for 7 x 12 hour days per sampling event and 1 Jr. Level person for 5 x 8-hour days per data evaluation	208	HR	$100		$20,800
Annual sampling per diem	14	DAY	$730		$10,200
INSTITUTIONAL CONTROLS					
Prepare Newsletter @ 5, 10, 15, 20, 25, and 30 yrs	24	HR	$100		$2,400
Newsletter Publication in Local Newspaper and Direct Mailing @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$500		$500
Public Informational Meeting @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$5,000		$5,000
Five-Year Review @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$13,000		$13,000
Monitoring Well Closures (Year 30, only)	6,550	FT	$15		$98,300
TOTAL PRESENT WORTH O&M COST				$1,738,000	
TOTAL PRESENT WORTH				$2,563,000	

7 percent discount rate used to calculate present worth.

* For each groundwater sampling event, include 3 duplicates, 3 matrix spike/matrix spike duplicates, and 3 trip blanks.

CY - Cubic Yard
LS - Lump Sum
HR - Hour
EA - Each
SF - Square foot
FT - Foot
YR - Year

Table A-2
Alternative 2 - Capping, Sheet Piling, and Rock Grouting / Hydraulic Containment and Above Ground Treatment
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
CAPITAL COSTS					
10 Extraction Wells (3 - 4" PVC wells to a depth of 20 ft, 7 - 4" wells at an angle to a length of 150 ft, development, pump installation, and well vault)	1,110	FT	$60	$66,600	
Piezometers (5 -2" PVC piezometers to a depth of 20 ft)	100	FT	$30	$3,000	
Submersible Pump (support wire, flow and control devices, electric service to wellhead)	10	EA	$1,000	$10,000	
Groundwater Collection Piping (includes double contained PVC piping, bedding, and trenching)	800	LF	$260	$208,000	
Prefabricated Structure (30' x 30', slab on grade)	1	LS	$60,000	$60,000	
Purchased Package (GAC vessels, Control Panel, Influent Storage Tank, Discharge pump)	1	LS	$60,000	$60,000	
Discharge Piping to Storm Drain (includes PVC piping, bedding and trenching)	200	LF	$260	$52,000	
Multi-layer Cap (includes grading, placement of cap)	5,400	SF	$5	$30,000	
Install Sheet Piling Around Soil Contamination (400 linear feet, 20 feet deep, 38 psf piling)	260	TONS	$500	$130,000	
Demolish 90 sf garage and dispose of rubble	1	LS	$10,000	$10,000	
Direct Push Sampling to Determine Extent/Levels of Soil Contamination (25 Borings, field analysis for VOCs)	1	LS	$35,000	$35,000	
Removal of Power Pole for Access and Replacement	1	LS	$30,000	$30,000	
Pump cement grout to seal bottom and sides (15 wells to a depth of 70 feet each (3 in the middle and 3 on 4 sides). Shallow wells so assume $40/ft, will have to grout up 50 ft to bottom of sheet pile, assume 100 ft length so each side will be 5,000 sq ft, total of 24,600 sq ft at $6/ft	1	LS	$190,000	$190,000	
Site Restoration	4,600	SF	$0.2	$900	
Monitoring Well Installation (8 wells each with 2 sampling depths)	1,340	FT	$60	$80,400	
Place Deed Restrictions (4 properties)	4	EA	$1,500	$6,000	
Place Zoning Notices (4 properties)	4	EA	$1,500	$6,000	
Assist MDNR Well Head Protection Section with Well Certifications	1	LS	$5,000	$5,000	
Preperation of Health and Safety Plan	80	HR	$100	$8,000	
Preparation of O&M Manual	120	HR	$100	$12,000	
Preparation of RA QA/Sampling Plan	120	HR	$100	$12,000	
DIRECT CAPITAL COST SUBTOTAL				$555,300	
Bid Contingency (10%)				$55,500	
Scope Contingency (15%)				$83,300	
TOTAL DIRECT CAPITAL COST				$694,100	
Permitting and Legal (5%)				$34,700	
Construction Services (5%)				$34,700	
CONSTRUCTION COSTS TOTAL				$763,500	
Engineering Design (8%)				$61,100	
TOTAL CAPITAL COST				$825,000	

Table A-2

Alternative 2 - Capping, Sheet Piling, and Rock Grouting / Hydraulic Containment and Above Ground Treatment

Present Worth Cost Estimate

Riverfront OU4 Site FS Report

ANNUAL OR PERIODIC O&M COSTS					
Electrical Costs	53,000	KWh	$0.09		$4,800
Spent Carbon Replacements	4	YR	$10,000		$40,000
Groundwater Treatment Operator (4 hours/week)	208	HR	$75		$15,600
Groundwater Treatment Plant Maintenance Allowance	1	LS	$3,000		$3,000
Cap O&M (includes inspections every 2 months, annual report)	60	HR	$75		$4,500
Cap Maintenance Allowance (includes patching and maintenance)	1	LS	$3,000		$3,000
EXTRACTION WELL MAINTENANCE					
Acid wash every 2 years except years 10, 20, and 30	1	LS	$2,000		$2,000
Redevelopment every 5 years, except year 30	1	LS	$7,000		$7,000
AIR MONITORING (Analysis Only, Labor included with Groundwater Sampling)					
Years 1 and 2 Semi-annual resident soil gas sampling (6 homes)	12	EA	$150		$1,800
GROUNDWATER MONITORING (Analysis Only) *					
Years 1 and 2 Quarterly sampling of 27 monitoring wells with 2 sampling zones for 22 of 27 wells and 7 extraction wells each for VOCs (standard turnaround+QA/QC) - sample using a submersible pump	260	EA	$95		$24,700
Years 3 through 5 Semi-annual sampling of 27 monitoring wells with 2 sampling zones for 22 of 27 wells and 7 extraction wells each for VOCs (standard turnaround+QA/QC) - sample using a submersible pump	130	EA	$95		$12,400
Years 6 through 30 Annual sampling of 27 monitoring wells with 2 sampling zones for 22 of 27 wells eand 7 extraction wells ach for VOCs (standard turnaround+QA/QC) - sample using a submersible pump	65	EA	$95		$6,200
Years 1 through 30 Groundwater Treatment Plant Influent and Effluent NPDES Monitoring (Quarterly-annual monitoring for VOCs, standard turnaround) For each sampling event, include 1 duplicate, 1 matrix spike/matrix spike duplicate, and 1 trip blank.	20	EA	$95		$1,900

Table A-2 (Continued)
Alternative 2 - Capping, Sheet Piling, and Rock Grouting / Hydraulic Containment and Above Ground Treatment
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

Year	Yearly O&M Cost*	Intermittent O&M Costs	Total Annual O&M Costs	Intermittent O&M Costs Include:
1	$70,900	$152,500	$223,400	Sampling.
2	$70,900	$154,500	$225,400	Sampling and acid wash.
3	$70,900	$76,300	$147,200	Sampling.
4	$70.900	$78,300	$149,200	Sampling and acid wash.
5	$70.900	$104,200	$175,100	Sampling, 5-yr review, informational meeting, and redevelopment.
6	$70,900	$41,100	$112,000	Sampling and acid wash.
7	$70.900	$39,100	$110,000	Sampling.
8	$70,900	$41,100	$112,000	Sampling and acid wash.
9	$70.900	$39,100	$110,000	Sampling.
10	$70,900	$67,000	$137,900	Sampling, 5-yr review, informational meeting, and redevelopment.
11	$70,900	$39,100	$110,000	Sampling.
12	$70,900	$41,100	$112,000	Sampling and acid wash.
13	$70,900	$39,100	$110,000	Sampling.
14	$70,900	$41,100	$112,000	Sampling and acid wash.
15	$70,900	$67,000	$137,900	Sampling, 5-yr review, informational meeting, and redevelopment.
16	$70,900	$41,100	$112,000	Sampling and acid wash.
17	$70,900	$39,100	$110,000	Sampling.
18	$70,900	$41,100	$112,000	Sampling and acid wash.
19	$70,900	$39,100	$110,000	Sampling.
20	$70,900	$67,000	$137,900	Sampling, 5-yr review, informational meeting, and redevelopment.
21	$70,900	$39,100	$110,000	Sampling.
22	$70,900	$41,100	$112,000	Sampling and acid wash.
23	$70,900	$39,100	$110,000	Sampling.
24	$70,900	$41,100	$112,000	Sampling and acid wash.
25	$70,900	$67,000	$137,900	Sampling, 5-yr review, informational meeting, and redevelopment.
26	$70,900	$41,100	$112,000	Sampling and acid wash.
27	$70,900	$39,100	$110,000	Sampling.
28	$70,900	$41,100	$112,000	Sampling and acid wash.
29	$70,900	$39,100	$110,000	Sampling.
30	$70,900	$158,300	$229,200	Sampling, 5-yr review, informational meeting, and monitoring well closures.
Total Costs of Annual O&M			$3,921,000	
Present Worth of Annual O&M			$1,738,000	

Table A-3
Alternative 3 - In-Situ Chemical Oxidation / Monitoring
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

ANNUAL OR PERIODIC O&M COSTS (Continued)					
INSTITUTIONAL CONTROLS					
Prepare Newsletter @ 5, 10, 15, 20, 25, and 30 yrs	24	HR	$100		$2,400
Newsletter Publication in Local Newspaper and Direct Mailing @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$500		$500
Public Informational Meeting @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$5,000		$5,000
Five-Year Review @ 5, 10, 15, 20, 25, and 30 yrs	1	LS	$13,000		$13,000
MONITORING WELL CLOSURE					
Monitoring Well Closures (Year 30, only) (including Contingency, Permitting, Construction Services, and Engineering Design Costs).	5,500	FT	$15		$82,500
TOTAL PRESENT WORTH O&M COST				$1,178,000	
TOTAL PRESENT WORTH				$1,401,000	

7 percent discount rate used to calculate present worth.

* For each groundwater sampling event, include 5 duplicates, 5 matrix spike/matrix spike duplicates, and 5 trip blanks.

CY - Cubic Yard
LS - Lump Sum
HR - Hour
EA - Each
SF - Square foot
FT - Foot
ISCO - In Situ Chemical Oxidation

Table A-3 (Continued)
Alternative 3 - In-Situ Chemical Oxidation / Monitoring
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

Year	Yearly O&M Cost *	Intermittent O&M Costs	Total Annual O&M Costs	Intermittent O&M Costs Include:
1		$330,500	$330,500	ISCO injection and groundwater sampling
2		$165,500	$165,500	ISCO sampling and groundwater sampling
3		$164,400	$164,400	ISCO injection and groundwater sampling
4		$82,400	$82,400	ISCO sampling and groundwater sampling
5		$135,300	$135,300	5-yr review, informational meeting, ISCO injection, and groundwater sampling.
6		$74,400	$74,400	ISCO sampling and groundwater sampling
7		$64,400	$64,400	Groundwater sampling
8		$64,400	$64,400	Groundwater sampling
9		$104,400	$104,400	ISCO sampling and groundwater sampling
10		$85,300	$85,300	5-yr review, informational meeting, and groundwater sampling
11		$32,200	$32,200	Groundwater sampling
12		$32,200	$32,200	Groundwater sampling
13		$32,200	$32,200	Groundwater sampling
14		$32,200	$32,200	Groundwater sampling
15		$53,100	$53,100	5-yr review, informational meeting, and groundwater sampling
16		$32,200	$32,200	Groundwater sampling
17		$32,200	$32,200	Groundwater sampling
18		$32,200	$32,200	Groundwater sampling
19		$32,200	$32,200	Groundwater sampling
20		$53,100	$53,100	5-yr review, informational meeting, and groundwater sampling
21		$32,200	$32,200	Groundwater sampling
22		$32,200	$32,200	Groundwater sampling
23		$32,200	$32,200	Groundwater sampling
24		$32,200	$32,200	Groundwater sampling
25		$53,100	$53,100	5-yr review, informational meeting, and groundwater sampling
26		$32,200	$32,200	Groundwater sampling
27		$32,200	$32,200	Groundwater sampling
28		$32,200	$32,200	Groundwater sampling
29		$32,200	$32,200	Groundwater sampling
30		$135,600	$135,600	5-yr review, informational meeting, groundwater sampling, and monitoring well closure
Total Costs of Annual O&M			$2,081,000	
Present Worth of Annual O&M			$1,178,000	

* There are no yearly O&M costs for this alternative.

Table A-3
Alternative 3 - In-Situ Chemical Oxidation / Monitoring
Present Worth Cost Estimate
Riverfront OU4 Site FS Report

ANNUAL OR PERIODIC O&M COSTS					
ISCO INJECTION USING DIRECT PUSH					
Year 1 (Entire source area)	1	LS	$200,000		$200,000
Year 3 (Half the source area)	1	LS	$100,000		$100,000
Year 5 (Quarter of the source area)	1	LS	$50,000		$50,000
SOIL SAMPLING AFTER ISCO TREAMENT (USING DIRECT PUSH)					
Year 2 (Entire source area)	1	LS	$35,000		$35,000
Year 4 (Half the source area)	1	LS	$17,500		$18,000
Year 6 (Quarter of the source area)	1	LS	$8,750		$10,000
Year 9 (Entire Source Area)	1	LS	$35,000		$40,000
AIR MONITORING (Analysis Only, Labor included with Groundwater Sampling)					
Years 1 and 2 Semi-annual resident soil gas sampling (6 homes)	12	EA	$150		$1,800
GROUNDWATER MONITORING (Analysis Only) *					
Years 1 and 2 Quarterly sampling of 24 monitoring wells with 2 sampling zones for 15 of 24 wells for VOCs (standard turnaround+QA/QC) - sample using a submersible pump	212	EA	$95		$20,100
Years 3 through 10 Semi-annual sampling of 27 monitoring wells with 2 sampling zones for 22 of 27 wells each for VOCs (standard turnaround+QA/QC) - sample using a submersible pump	106	EA	$95		$10,100
Years 11 through 20 Annual sampling of 27 monitoring wells with 2 sampling zones for 22 of 27 wells for VOCs (standard turnaround+QA/QC) - sample using a submersible pump	53	EA	$95		$5,000
GROUNDWATER MONITORING (Labor only)					
Years 1 and 2 2 Jr. Level person for 6 x 12 hour days per sampling event and 1 Jr. Level person for 5 x 8-hour days per data evaluation	736	HR	$100		$73,600
Quarterly sampling per diem	48	DAY	$730		$35,000
Years 3 through 10 2 Jr. Level person for 6 x 12 hour days per sampling event and 1 Jr. Level person for 5 x 8-hour days per data evaluation	368	HR	$100		$36,800
Semi-annual sampling per diem	24	DAY	$730		$17,500
Years 11 through 30 2 Jr. Level person for 16 x 12 hour days per sampling event and 1 Jr. Level person for 5 x 8-hour days per data evaluation	184	HR	$100		$18,400
Annual sampling per diem	12	DAY	$730		$8,800