Addendum to the Final Feasibility Study Report for AOC 9: Weapons Storage Area (WSA) Landfill

October 2009

Prepared for:

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List of Abbreviations and Acronyms

1,2-DCB	1, 2-dichlorobenzene
1,3-DCB	1,3-dichlorobenzene
1,4-DCB	1, 4-dichlorobenzene
AOC 9	Area of Concern 9
ARAR	Applicable or Relevant and Appropriate Requirement
AS/SVE	air sparging/soil vapor extraction
CB	chlorobenzene
COC	contaminant of concern
CY	cubic yard
FS	feasibility study
LUC	land use control
mg/kg	milligram per kilogram
OSHA	Occupational Safety and Health Administration
PDI	Predesign Investigation
POTW	Publicly Owned Treatment Works
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
RAO	remedial action objective
RI	remedial investigation
SSHASP	Site-specific Health and Safety Plan
SVOC	semivolatile organic compound
VOC	volatile organic compound
WSA	Weapons Storage Area

1 Introduction

This addendum provides supplemental information to the Area of Concern 9 (AOC 9) *Final Feasibility Study Report for AOC 9: Weapons Storage Area (WSA) Landfill* (Final FS; E & E 2004a). After publication of the Final FS, three Pre-Design Investigations (PDIs) were undertaken to better determine the extent of the contamination. After the first PDI, a potential source of groundwater contamination was found in the soil upgradient of Six Mile Creek and Perimeter Road. The second and third PDIs focused on determining the extent and nature of this source. The purpose of this FS addendum is to reconsider the proposed remedy based on the results of the PDIs and recommend a remedy that will meet Remedial Action Objectives (RAOs).

For the AOC 9 groundwater contamination, the RAOs are as follows:

1. Reduce the potential for human risk of exposure to contaminants of concern (COCs) found in on-site groundwater by reducing the potential for ingestion of contaminated groundwater and inhalation of vapors.

2. Achieve the proposed cleanup goals for COCs as specified in Table 1-1.

3. Reduce further off-site migration of contaminated groundwater above the cleanup goals to the extent practical.

Table 1-1 Cleanup Goals for Contaminants of Concern

Contaminants of Concern[1]	Groundwater Cleanup Goal[2] (µg/L)
1,2-dichlorobenzene	3
1,2-dichloroethane	0.6
1,3,5-trimethylbenzene	5
1,3-dichlorobenzene	3
1,4-dichlorobenzene	3
acetone	50
benzene	1
chlorobenzene	5
cis-1,2-dichloroethene	5
ethylbenzene	5
isopropylbenzene	5

Table 1-1 Cleanup Goals for Contaminants of Concern

Contaminants of Concern[1]	Groundwater Cleanup Goal[2] (µg/L)
methylene chloride	5
naphthalene	10
n-butylbenzene	5
n-propylbenzene	5
sec-butylbenzene	5
trichloroethene	5
tert-butylbenzene	5
tetrachloroethene	5
vinyl chloride	2
xylene (total)	5

Notes:
1 From the *Final Feasibility Study Report for AOC 9* (E & E 2004a).
2 NYSDEC Class GA Groundwater Standard.

Key:
µg/L = Micrograms per liter.

2 Summary of Previous Investigations

Several site investigations have been performed at AOC 9 after the 2004 Remedial Investigation (RI) Report (E & E 2004b). These investigations are summarized in the following reports:

- *Final Predesign Investigation Data Summary Report at Landfill 6, Building 817/WSA, Building 775/Pumphouse 3, and AOC 9* (EEEPC 2007a);
- *2007 Technical Memorandum for Predesign Investigation 2 (Additional Investigations at Landfill 6, and AOC 9)* (Parsons 2007); and
- *2007 Additional AOC 9 Predesign Investigation Data Summary Report* (EEEPC 2007b).

The key findings of the studies completed after the 2004 RI are summarized in the following paragraphs.

During the Final Predesign Investigation performed in September through November 2006 (PDI; EEEPC 2007a), four additional groundwater monitoring wells (AOC9-MW14 through AOC9–MW17) were installed at the site to better characterize the groundwater contamination at the site. Figure 2-1 shows the overview of the site, including the location of these four monitoring wells. Twenty-three different volatile organic compounds (VOCs) were detected in groundwater samples collected during this investigation. The highest concentration of total VOCs (1,2-dichlorobenzene [1,2-DCB], 1,4-dichlorobenzene [1,4-DCB], chlorobenzene [CB], and benzene) were detected in upgradient wells AOC9-MW15 and AOC9-MW14 (see Figure 2-2 for location) at 2,081 parts per billion (ppb) and 1,984 ppb, respectively. Monitoring well AOC9-MW15 is located just south of Perimeter Road and AOC9-MW14 is located north of the WSA fence line (EEEPC 2007b). The concentration of VOCs at the upgradient wells prompted further investigation.

Predesign Investigation 2 (PDI 2) was performed by Parsons in February through April 2007 (Parsons 2007). This investigation included the installation of 25 temporary monitoring wells and identified areas containing significantly higher levels of CB and related compounds east of Building 913. Monitoring wells

AOC9-TW39 and AOC9-TW32 (see Figure 2-2) showed groundwater CB concentrations of 14,400 ppb and 8,580 ppb, respectively. These concentrations were five to ten times higher than the highest concentrations historically measured at AOC 9.

An additional AOC 9 PDI was performed by Ecology and Environment Engineering, P.C. (EEEPC 2007b) in June through October 2007 to better define the groundwater plume and further identify the potential soil source area. During this investigation, a total of 56 new temporary monitoring wells and 42 boreholes were installed around the site. Twenty-two different VOCs were detected in the groundwater samples collected from the monitoring wells at concentrations exceeding groundwater standards. The highest total VOC concentrations were detected in groundwater samples collected from temporary wells AOC9-TW45 (3,100 ppb), AOC9-TW71 (3,300 ppb), and AOC9-TW100 (3,400 ppb). Eleven different VOCs (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene [mesitylene], 1,2-DCB, 1,3-dichlorobenzene [1,3-DCB], 1,4-DCB, CB, ethylbenzene, naphthalene, n-propylbenzene, sec-butylbenzene, and toluene) were also detected at concentrations exceeding screening criteria in the soil samples collected from 42 soil borehole locations. Borehole locations are shown on Figure 2-3 and a summary of the VOCs exceeding screening criteria is presented in Table 2-1. The highest total VOC concentrations were detected in soil samples collected from boreholes SB01 (1,100 parts per million [ppm]) and SB12 (1,600 ppm). CBs represented the largest fraction of VOCs. CBs include CB, 1,2-DCB, 1,3-DCB, and 1,4-DCB. From these soil boring data, the contaminated soils were found to be located in an approximate 6-foot smear zone at the top of the saturated zone that is located 8 to 17 feet below grade.

Based on these data from the three PDIs, the source of the AOC 9 groundwater contamination is impacted soils located east of Building 913. Groundwater becomes contaminated as it flows through the impacted soil from upgradient locations. The contaminated groundwater flows from the source area toward Six Mile Creek. Contaminant concentrations in groundwater decrease between the source area and Six Mile Creek due to mixing with uncontaminated groundwater and infiltration of uncontaminated water (see Figure 2-1 and Figure 2-4).

Remediation of the groundwater should focus on removal of the source of groundwater contamination. Groundwater exposure mechanisms and receptors remain the same as described in the Final FS. A soil risk assessment was not performed because the source removal component of the remedy will remove contaminated soil to meet the RAO to restore groundwater to Class GA standards. Excavation of the soil mass will remove contaminated soil above regulatory screening levels appropriate for the future land use of this AOC (commercial/industrial).

Table 2-1 Compounds Exceeding Standards And Guidance Values AOC 9 Plume 2007 AOC 9 Additional Pre-Design Investigation Soil Samples

Compound	Range of Detected Concentrations	Frequency of Detection Above Most Stringent Criterion	Most Stringent Criterion
Soil Borings: VOCs (mg/kg)			
1,2,4-Trimethylbenzene	0.0006J – 394J	21/49	3.6 [1]
1,2-Dichlorobenzene	0.0007J – 1000J	12/49	1.1[1]
1,3,5-Trimethylbenzene	0.0006J – 174J	15/49	8.4 [1]
1,3-Dichlorobenzene	0.0009J – 24J	4/49	2.4 [1]
1,4-Dichlorobenzene	0.0009J – 170J	18/49	1.8 [1]
Chlorobenzene	0.0006J – 440J	18/49	1.1 [1]
Ethylbenzene	0.0006J – 6.96J	5/49	1 [1]
n-Propylbenzene	0.0006J – 29.4J	6/49	3.9 [1]
Naphthalene	0.0082 – 57J	5/49	12 [1]
sec-Butylbenzene	0.0007J – 20.9J	1/49	11 [1]
Toluene	0.0006J – 3.4J	1/49	0.7 [1]

Note::
1 New York State Department of Environmental Conservation, 6 NYCRR Part 375-6 Remedial Program Soil Cleanup Objectives, December 14, 2006 Unrestricted Use of Soil Cleanup Objectives.

Key:
J = Estimated concentration.
mg/kg = Milligrams per kilogram.
VOC = Volatile organic compound.

F:\GRIFFISS\AOC9 TW Surveyed 7-5-07\FS OCT 09\Combined VOC 9-15-09.dwg

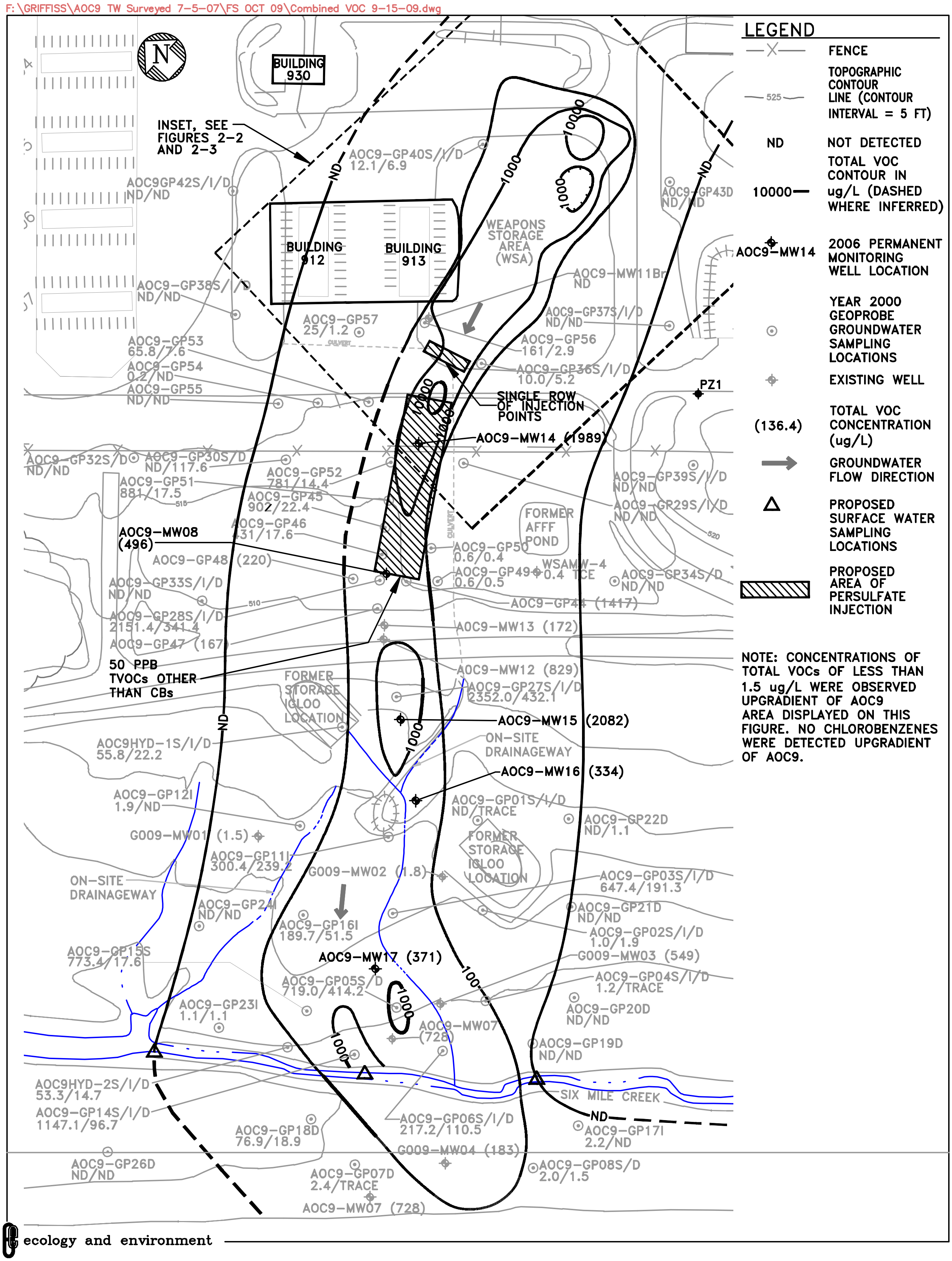


FIGURE 2-1: TOTAL VOC CONCENTRATIONS IN GROUNDWATER

SCALE IN FEET

0 150 300 450

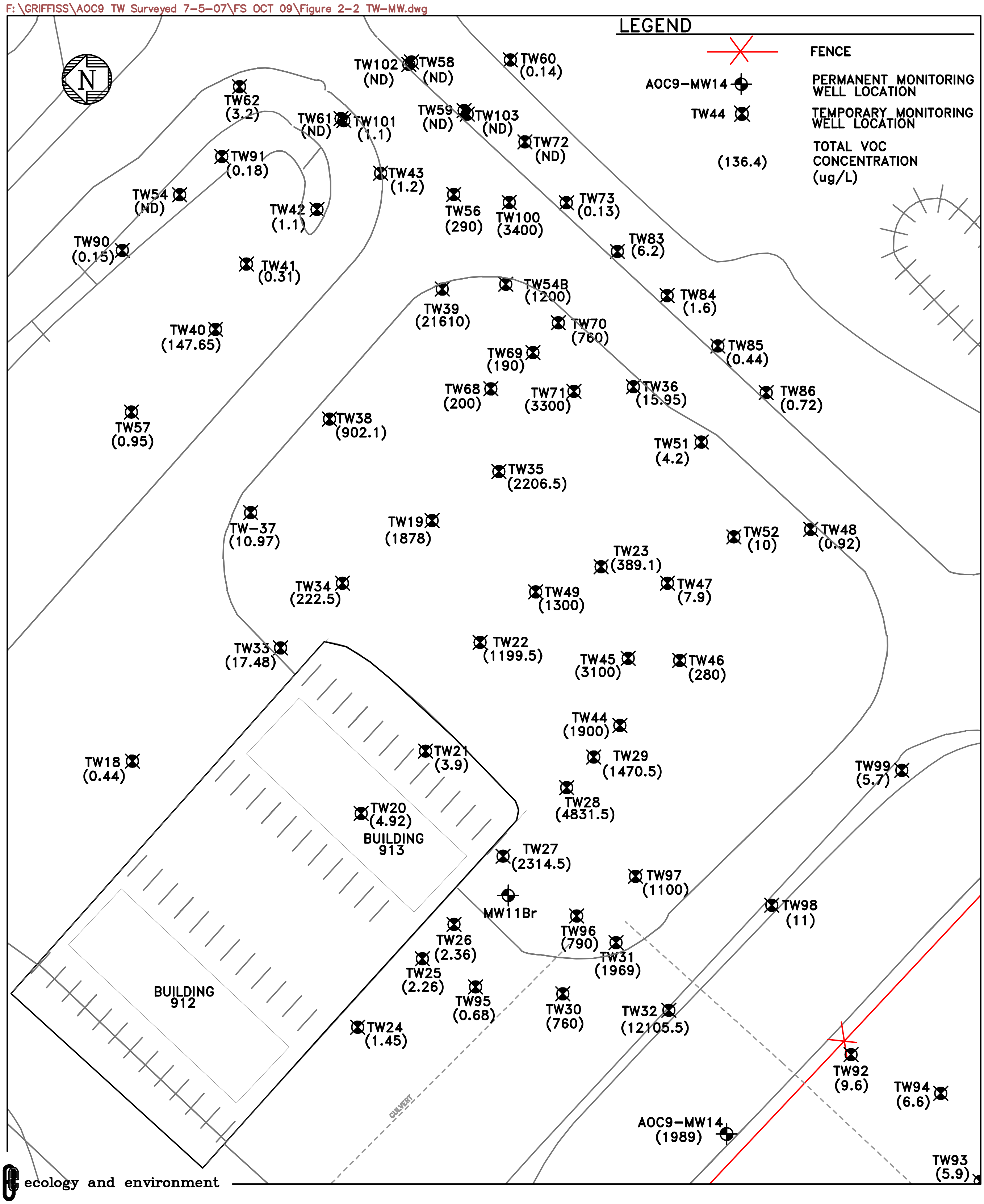
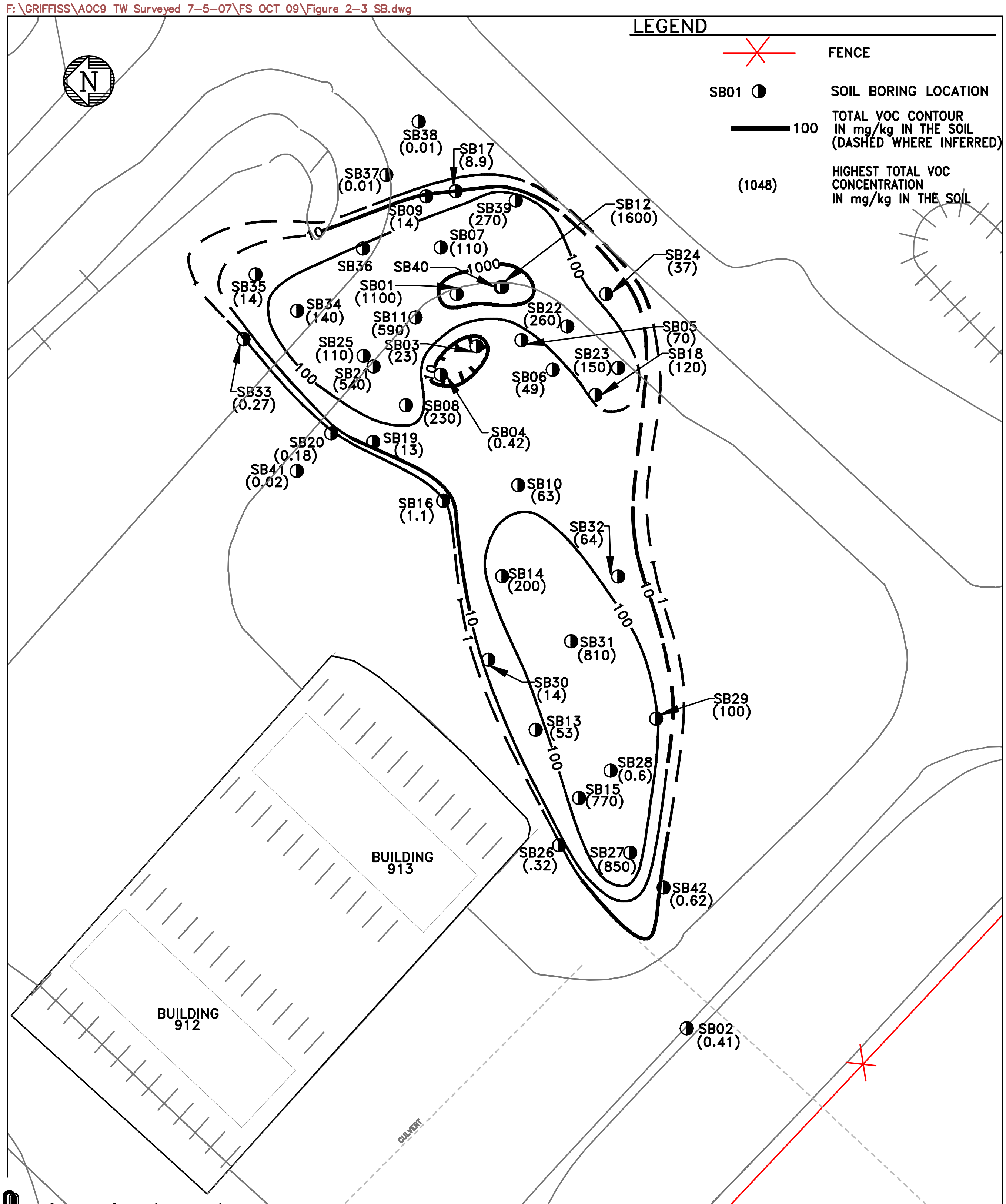


FIGURE 2-2: LOCATION OF TEMPORARY AND PERMANENT MONITORING WELLS AT EXCAVATION SITE

SCALE IN FEET

0 60 120 180

F:\GRIFFISS\AOC9 TW Surveyed 7-5-07\FS OCT 09\Figure 2-3 SB.dwg



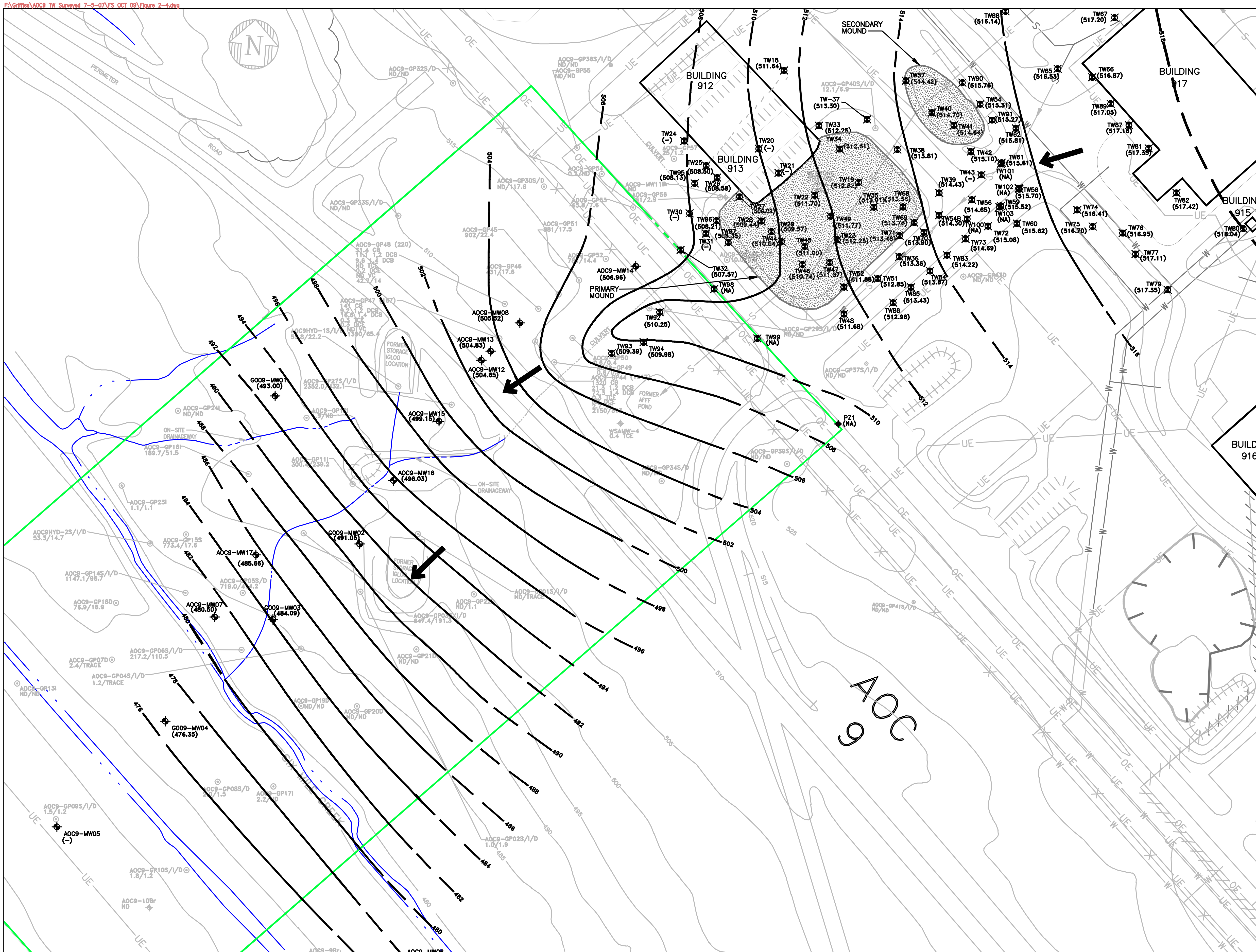
ecology and environment

FIGURE 2-3: LOCATION OF SOIL BORINGS AND VOC CONCENTRATIONS AT EXCAVATION SITE

SCALE IN FEET

0 60 120 180

F:\Griffiss\AOC9 TW Surveyed 7-5-07\FS OCT 09\Figure 2-4.dwg



LEGEND

X	FENCE
525	TOPOGRAPHIC CONTOUR LINE (CONTOUR INTERVAL = 5 FT)
UE	UNDERGROUND ELECTRIC
W	WATER LINE
S	SANITARY SEWER
OE	OVERHEAD ELECTRIC
	ABANDONED UNDERGROUND ELECTRIC
AMSL	ABOVE MEAN SEA LEVEL
CB	CHLOROBENZENE
NA	NOT AVAILABLE
ND	NOT DETECTED
476	GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
	DIRECTION OF GROUNDWATER FLOW
	AOC9 LAND USE BOUNDARY
AOC9-GP43D ND/ND	YEAR 2000 GEOPROBE GROUNDWATER SAMPLING LOCATIONS.
G009-MW01	PERMANENT MONITORING WELL LOCATION
TW44	TEMPORARY MONITORING WELL LOCATION
PZ-1	PIEZOMETER LOCATION
(517.35)	JUNE 27, 2007 GROUNDWATER ELEVATION (FEET AMSL) (NOT AVAILABLE FOR TW98 THROUGH TW103 OR PZ-1).

NOTES:
1. ALL CONCENTRATIONS PRESENTED IN ug/L.

120 0 120 240

SCALE: 1"=120'

GRIFFISS AFB
AOC 9 SITE
ROME, NEW YORK

Prepared by:
parsons

In Association with:
ecology and environment engineering p.c.

DRAWING TITLE:
AOC 9
GROUNDWATER ELEVATIONS

FIGURE 2-4

3 Alternative Evaluation and Updated Alternative Description

Alternatives from the Final FS and a new alternative were evaluated to recommend the groundwater remedy at AOC 9 considering the data collected from the PDIs. The AOC 9 Final FS considered six remedial alternatives as listed below:

Alternative 1: No Action
Alternative 2: Institutional Controls
Alternative 3: In Situ Chemical Oxidation
Alternative 4: In Situ Air Sparging/Soil Vapor Extraction (AS/SVE)
Alternative 5: Groundwater Extraction Treatment and Disposal
Alternative 6: Constructed Treatment Wetland

The new alternative, referred to as Alternative 7, is treatment of contaminated groundwater using chemical oxidation and removal of the source area.

Alternatives 5 and 6 are no longer considered appropriate because of the presence of a source of continued contamination to groundwater resulting in very long estimated remediation times. The cost estimates for Alternatives 1 through 4 were updated considering the larger area of groundwater impacted, higher contaminant concentrations, and the time since the original estimates were made. The new costs are presented in Table 3-1.

Alternative 3 was the selected alternative in the Final FS. In situ chemical oxidation involves injecting a solution of oxidizing agent into groundwater to destroy dissolved and adsorbed contaminants. The technology is implemented by drilling wells so that the oxidizing solution can be injected into the contaminated zone. In situ chemical oxidation is believed to have a high risk of failure in treating the source area when compared to excavation of the source and, therefore, was not considered further as a stand-alone alternative for the following reasons:

- Treatment efficiency may not be very high because sufficient mixing is hard to achieve between groundwater, the impacted soils, and the oxidant solution; and

- The high organic loading in the source area and large oxidant demand would likely require multiple injections. Each of these injections would require a monitoring period to assess effectiveness. This iterative approach carries a larger risk of remedy failure when compared to excavation.

Table 3-1 Summary of Remedial Alternative Durations and Costs for AOC 9

	Alternative[1]				
	1	2	3	4	7
Description	No Action	Institutional Controls	In Situ Chemical Oxidation	Air Sparging/ Soil Vapor Extraction	Groundwater Treatment, Source Removal, and Land-Use Control
Total Approximate Project Duration (Years)	0	30	30	30	11
Total Present Value (in $ 2009)	**$0**	**$660,000[2]**	**$5,305,000[2]**	**$5,308,000[2]**	**$5,658,000**

Notes:
[1] Alternatives 5 and 6 were eliminated from further consideration in the final FS Addendum.
[2] Values estimated from the R.S. Means Historical Cost Index Method.

Key:
LTM = Long-term monitoring.

Alternative 4, in situ air sparging is a technology in which air is injected through a contaminated aquifer. Injected air flows in channels through the soil that removes VOCs and semivolatile organic compounds (SVOCs) by volatilization. The rate of volatilization is constrained by contaminant properties and the equilibrium relationship that exists between the concentration of contaminants in the groundwater or soil and the soil vapor. Air sparging is also effective at increasing the concentration of dissolved oxygen in groundwater, thereby facilitating aerobic degradation of organic compounds. Treating the source area using air sparging was considered less effective and, therefore, has a higher risk of failure when compared to excavation, for the following reasons:

- Air distribution may be hard to predict since the air flow path is highly sensitive to the material permeability (NAVFAC 2001). In the shallow aquifer at the AOC 9 site, a zone of fine gray/brown to black sand was identified together with the layer of brown sand with little silt (EEEPC 2007b). The material stratification may cause difficulties in predicting the flow path and in getting the injected air into contact with the contaminated soils. These site conditions indicate that further pre-design investigation tracer studies would be required.

- Due to the unpredictable air distribution, the migration of VOC-impacted vapor to human/ecological receptors needs to be carefully considered (NAVFAC 2001). The northern portion of AOC 9 is currently active, and several buildings in the area are used for storage. Several businesses are active within the former WSA, and the employees of these businesses use the roadways to the northern portion of AOC 9. Therefore, the difficulties of air flow management may cause potential human health risks.

- Treatment efficiency may be reduced by diversion of the plume away from the air-sparging influence zone because air injection can produce a zone of reduced hydraulic conductivity (NAVFAC 2001).

3.1 Alternative 7: Groundwater Treatment, Source Removal, and Land-Use Controls

This alternative includes treatment of contaminated groundwater using chemical oxidation and removal of the source area through excavation of contaminated soil. The groundwater contaminant source area is identified as the area within the 1 milligram per kilogram (mg/kg) total VOC contour on Figure 2-3. The groundwater contaminant source area excavation will be followed by in situ chemical oxidation treatment below the source area and chemical oxidation treatment of the downgradient groundwater plume (see Figure 2-1). Figure 2-3 also shows the location of soil borings at the excavation site. Approximately 99% of the total VOCs contaminant mass will be removed during the source area excavation. After the source is removed the concentrations of contaminants in the groundwater plume will decrease due to natural processes including advection, dilution and biodegradation.. In addition, Land Use Controls (LUCs) will be implemented at the site. AOC 9 is currently inactive and access is restricted by Perimeter Road Gates 4 and 11. After excavation, the site topsoil will be replaced and the site will be graded to a free draining condition and seeded.

Application of persulfate oxidant to the bottom of the excavation areas will result in further contaminant destruction. Removal of the source material in the soil will decrease the concentration of VOCs in the groundwater downgradient by decreasing desorption of the VOCs from the soil into the groundwater. Modeling has indicated that removal of the source by excavation will result in a reduction of groundwater contaminant concentration levels satisfying RAOs in 11 years.

Uncontaminated overburden soils will be removed to access the contaminated soil. Overburden and contaminated soils removed during excavation will be staged on the concrete areas adjacent to the excavation such that vehicular traffic is not impeded. The overburden will be stockpiled in a location separate from the contaminated soils. Analytical testing will be completed on samples of the contaminated soils so that they can be profiled accordingly for transportation and landfill acceptance. Excavation, hauling, and disposal of contaminated soils will be accomplished with conventional heavy construction equipment (e.g., backhoes, bulldozers). The horizontal and vertical limits of this excavation have been defined based on the selected cleanup objectives and the soil boring analytical results.

After the overburden has been removed, and sheet piling has been installed (sheet piling depth will be determined during the design process), the contaminated soils will be exposed and the excavation will be dewatered with a sump prior to excavation of the contaminated soil. A pump will be used to evacuate the water through a temporary suction set at the depth of the bottom limit of the excavation.

Water collected from the dewatering operation and from inside the soil berms will be pumped into frac tanks stationed on site. It will be allowed to settle, filtered through particulate filters and treated through a granular activated carbon train.

Treated water will be kept separated in a cleaned frac tank. It will be sampled in accordance with the City of Rome Publicly Owned Treatment Works (POTW) requirements and trucked to the POTW for disposal as there are no sanitary sewers in the vicinity of AOC 9.

The design of the excavation calls for the replacement of the backfill soils with no import of new soils. It is expected that the removed contaminated soils will reduce the total elevation of the excavation area by approximately 6 feet. Presently, the elevation of the excavation area is above the surrounding roadways and after construction, is expected that the final grade will still be higher than the adjacent roadways; and that swales and culverts will be restored to their preconstruction elevations to match existing drainage features.

In addition to the removal of the contaminant source in the soil, the adjacent groundwater will be treated with oxidant injected through temporary wells that will be installed approximately 15 to 25 feet deep within the treatment area (see Figure 2-1). Following the installation of these wells, the oxidant will be injected into the treatment zone. Fenton's reagents were injected into the subsurface for a pilot test and the results of that test indicate an effective radius-of-influence of 10 feet. Sodium persulfate with a iron chelate activator was chosen as a more favorable remedy for AOC 9 because it is very stable in the sub-surface, performs better in a neutral pH environment, and can destroy chlorobenzene, and dichlorobenzene. The design of the chemical oxidation injection will be sufficient so that only one injection will be performed. Injection details, well spacing, and associated health and safety issues will be addressed in the remedial design work plan and the associated future documents.

Institutional controls including deed restrictions would be implemented at the site. Deed restrictions would be filed to prevent future users at the site from exposing or contacting contaminated soil and groundwater. Long-term monitoring and performance monitoring will be used to evaluate the long-term performance of these remedial actions. Performance monitoring will occur for two years after the remedial action is complete; four monitoring wells (AOC9-MW14, AOC9–MW15, G009-MW04, and AOC9-MW07) and three surface water locations will be sampled for total VOCs. It is anticipated that monitoring will continue for an additional nine years at the same locations.

3.2 Evaluation of Criteria (Alternative 7)

3.2.1 Overall Protection of Human Health and the Environment

This alternative is considered protective of the environment as it would remove a source of groundwater contamination through excavation and eliminate future potential exposure threats. The institutional controls included in this alternative would restrict the use of contaminated groundwater during and after cleanup and provide some long-term protection of human health and the environment.

3.2.2 Compliance with Applicable Standards, Criteria, and Guidelines

This alternative complies with Applicable or Relevant and Appropriate Requirements (ARARs) since contaminated soils will be removed from the site and properly disposed of. The alternative will reduce groundwater VOC concentrations to below the NYSDEC Class GA groundwater standards, indicating the potential use of this groundwater as a drinking water source; this is the groundwater cleanup goal as decided per the Final FS (E & E 2004a).

Off-site disposal will comply with all applicable land disposal restrictions and analytical requirements. The remedy will be implemented in compliance with action-specific ARARs including noise limitations, wetlands permits (as required), and Occupational Safety and Health Administration (OSHA) regulations.

3.2.3 Long-term Effectiveness and Performance

This alternative includes removal of approximately 99% of the estimated total mass of total VOCs. The remaining groundwater contamination will be treated with persulfate injection. In situ chemical oxidation and dilution of the groundwater due to the recharge of the aquifer following remedial action will reduce groundwater concentrations to cleanup goals; modeling has indicated that this should occur in 11 years.

3.2.4 Reduction in Toxicity, Mobility, or Volume through Treatment

The volume of contamination at the site will be reduced through source excavation and on-site groundwater treatment. The source removal will assist in eliminating concerns associated with toxicity of the groundwater, and in situ chemical oxidation should reduce dissolved phase concentrations.

3.2.5 Short-term Effectiveness

Several short-term impacts to the community and workers may arise during excavation of contaminated soil, dewatering, and water treatment at the site. These short-term impacts include dust, noise, and potential spills during handling and transportation of contaminants. To limit short-term impacts, site access will be restricted during construction and remediation activities. Health and safety measures, including air monitoring, use of appropriate personal protective equipment (PPE), and decontamination of equipment leaving the site, will be in place to protect the workers and surrounding community and will be addressed during the creation of the Site-Specific Health and Safety Plan (SSHASP). Action levels will be set prior to any intrusive activities, and an appropriate correction action will be implemented if these action levels are exceeded. Off-site transportation of contaminated soil to the disposal facility will be performed by a licensed hauler. The construction activities at the site are estimated to last less than one year. After removal of contaminated soils, the source area will be covered with backfill soils and will be reseeded, reducing inhalation exposures. In addition, groundwater concentrations and the subsequent exposure to contaminated groundwater will be reduced through the source excavation and chemical oxidation.

3.2.6 Implementability

This alternative can be readily implemented using standard construction means and methods. Contaminated soil will be excavated, tested, and disposed of at an appropriate waste disposal facility. Since a chemical oxidation pilot study has already been performed at the site (E & E 2004c), there is a better understanding of the physical and chemical requirements necessary to treat the contaminants of concern at this site.

3.2.7 Costs

The 2009 total present worth cost of the alternative based on an 11-year period to reach cleanup goals (annual costs assumed for this length of time based on modeling) is $5,658,000. Table 3-2 presents the quantities, unit costs, and subtotal costs for the various line items in this alternative. The cost estimating information was obtained from 2008 RS Means Cost Data series and engineering judgment. Groundwater sampling and renewal of institutional controls are included with this alternative.

Capital cost for this alternative is estimated as $3,104,000.

3.3 Recommendation

Considering the RAOs for AOC 9 and the remedial alternative evaluation completed in this FS addendum, the recommended alternative for the AOC 9 site is Alternative 7; treatment of contaminated groundwater using chemical oxidation and removal of the source area. Alternatives 1 through 4 do not deal with the removal of the source of the contaminants and its leaching into the groundwater. Alternative 1, No Action, cannot be implemented because modeling shows that contaminants will not be reduced below federal and state guidelines on their own. Institutional controls will be included in the design, but is not effective as the sole remedy because concentrations are still above state and federal limits. Alternatives 3 and 4 are effective as groundwater treatment remedies, but due to the source in the vicinity of Six Mile Creek, the time to achieve RAOs and cost would be prohibitive.

Table 3-2 Cost Estimate for Excavation and Chemical Oxidation Institutional Controls, and Long-Term Monitoring

Item	Quantity	Unit	Unit Cost	Total Cost
Capital Costs				
Institutional Controls	1	LS	$10,000	$10,000
Mob/Demob	1	LS	$100,000	$100,000
Sheet Piling	14,706	SF	$60	$883,000
Excavation	34,107	BCY	$14	$478,000
Landfill (incl non- hazardous Transportation and Disposal)	7,012	BCY	$60	$421,000
Backfill	27,096	BCY	$10	$271,000
Site Restoration	1	LS	$100,000	$100,000
Profit (25 % of Construction Cost)	1	LS	$565,750	$566,000
Oxidant (under Excavation Area)	1	LS	$25,000	$25,000
Oxidant (Injected Downgradient)	1	LS	$250,000	$250,000
Subtotal				**$3,104,000**
15 % Project Administration:				$466,000
30 % Contingency:				$1,071,000
10% Prime Contractor Profit:				$465,000
Total Capital Cost:				$5,106,000
Annual Costs				
Institutional Control Administration	1	Each	$5,000	$5,000
Long-term Monitoring	1	Each	$30,000	$30,000
Performance Monitoring	1	Each	$40,000	$40,000
Subtotal				**$75,000**
30 % Contingency:				$23,000
Total Annual Cost:				$98,000
Present Value of Annual Costs:				$897,000
Present Value of Performance Monitoring Costs				$77,000
Future Value of Annual Long-Term Monitoring Costs				$232,000
Present Value of Long-Term Monitoring Costs				$217,848
Present Value of Institutional Control Admin. Costs:				$46,000
Present value of contingency:				$211,000
Present Value of Annual Costs:				$551,848
2009 Total Present Value Cost:				**$5,658,000**

Key:

LS = Lump sum.
SF = Square foot.
BCY = Cubic yard.
CF = Cubic foot .

Notes/Assumptions:

1. Sheet piling assumes a perimeter of: 817 LF
   and a total sheet pile depth of:: 18 LF
   for a total area of sheet piling: 14706 SF
2. Excavation assumes an aerial extent of: 31553 SF
   and an overburden depth of: 12 LF
   and a contaminated material depth of (beyond overburden): 6 LF
   for a overburden volume of: 731579 CF
   or (in BCY): 27096 BCY
   for a contaminated material volume of: 189317 CF
   or (in BCY): 7012 BCY
   for a total volume of excavation: 920896 CF
   or (in BCY): 34107 BCY
3. Backfill assumes replacement of the overburden soil (no import).
4. Landfill is assumed to be the Herkimer County Landfill for this estimate. Transport and Disposal includes water and soil.
5. Site restoration assumes seeding and road repair as necessary.
6. Oxidant Costs include product and delivery system.
7. Contingency assumed at: 30%
8. Total Monitoring Time 11 years
   Performance Monitoring occurs twice per year for the first two years after Remedial Action is completed.
   Long-Term Monitoring occurs once a year for nine years after Performance Monitoring occurs.
   total # of groundwater monitoring wells to be sampled: 4 wells
   total # of surface water sample locations: 3 locations
9. Present value costs assumes annual interest rate per "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (EPA 540-R-00-002 July 2000) and the Office of Management and Budget Real Discount Rates for the year 2001 (http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html) at
   Annual interest rate: 3.2%
10. Costs do not consider engineering design, construction management, contract mechanisms, periodic costs such as 5-year

4 References

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