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United States Environmental Protection Agency Region 6

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Treatability Test Plan
Version 2.1

American Creosote Works Site
Feasibility Study
Winnfield, Louisiana
Task Order No. 0051-RIFS-06G3
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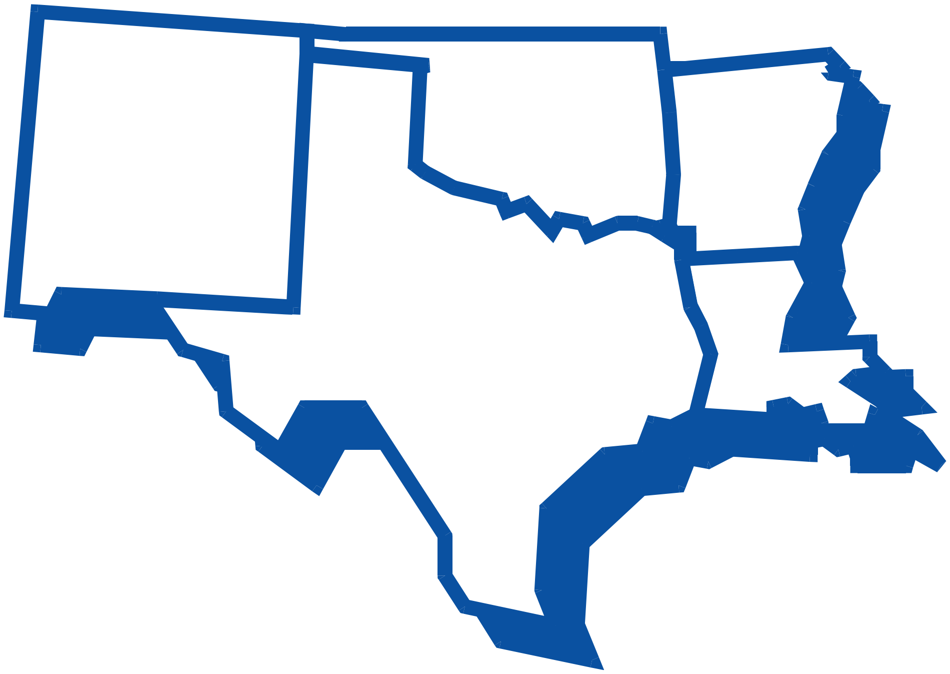

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American Creosote Works Site Feasibility Study

Treatability Test Plan

Prepared for

U.S. Environmental Protection Agency

Contract No. EP-W-06-021
Task Order 0051-RIFS-06G3
CH2M HILL Project No. 411242
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Preface

The U.S. Environmental Protection Agency (EPA) Region 6 has retained CH2M HILL under Remedial Action Contract No. EP-W-06-021, Task Order No. 0051, to perform treatability study (TS) activities in support of the Feasibility Study (FS) for the American Creosote Works (ACW) Superfund Site (Site) in Winnfield, Louisiana. As part of this effort, site-specific planning documents are required to provide the detail necessary to implement the associated fieldwork. The site-specific planning documents consist of the following six separately bound documents:

- Field Operations Plan (FOP) (CH2M HILL, 2006a)
- Quality Assurance Project Plan (QAPP) (CH2M HILL, 2011a)
- Site Management Plan (SMP) (CH2M HILL, 2006b)
- Transportation and Disposal Plan (TDP) (CH2M HILL, 2006c)
- Health and Safety Plan (HSP) (CH2M HILL, 2010a)
- Treatability Test Plan (TTP) - This document

The FOP provides detailed methods and procedures to be used during implementation of the field activities. The QAPP provides quality assurance/quality control requirements to ensure that the data obtained are suitable for their intended purpose. The SMP provides detailed procedures for site access, site security, traffic and noise control, and management of investigation-derived waste (IDW) to be followed during implementation of the TS field activities. The HSP provides health and safety procedures to be followed during implementation of the TS field activities and a HSP Addendum describing tasks specific to the treatability testing (TT) has been included as **Appendix A**. The TDP provides information regarding the labeling, storage, transportation, and disposal of IDW.

This TTP provides detailed procedures for three TS tests: (1) in situ chemical oxidation (ISCO), (2) surfactant-enhanced product recovery (S-EPR), and (3) in situ solidification/ stabilization (ISS). The first two tests will be conducted at the field scale while the third test will be performed as a bench-scale test. Bench-scale testing of the S-EPR technology was performed previously as described in the *Engineering Optimization/Treatability Study for the American Creosote Works Superfund Site, City of Winnfield, Winn Parish, Louisiana* (VeruTEK, 2008). This TTP serves as the primary site-specific plan, supported by the other documents listed above.

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Abbreviations and Acronyms

ACW	American Creosote Works
BaP	benzo(a)pyrene
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CHP	catalyzed hydrogen peroxide
cm/sec	centimeter per second
CO_2	carbon dioxide
COC	contaminant of concern
DNAPL	dense nonaqueous phase liquid
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ERGI	Evergreen Resources Group, Inc.
FOP	Field Operations Plan
FS	feasibility study
GCI	Geo-Cleanse International, Inc.
HSP	health and safety plan
IDW	investigation-derived waste
ISCO	in situ chemical oxidation
ISS	in situ solidification/stabilization
kg	kilogram
L	liter
LDEQ	Louisiana Department of Environmental Quality
µg/kg	microgram per kilogram
µg/L	microgram per liter
mg/kg	milligram per kilogram
MCL	maximum contaminant level
ml	milliliter

NAPL	nonaqueous phase liquid
oz	ounce
PAH	polycyclic aromatic hydrocarbon
PCP	pentachlorophenol
PLTS	process liquid treatment system
psi	pound per square inch
PRG	preliminary remedial goal
PTD	Prairie Terrace deposits
QAPP	quality assurance project plan
RI	remedial investigation
ROD	Record of Decision
ROI	radius of influence
S-EPR	surfactant-enhanced product recovery
SVOC	semivolatile organic compound
SARA	Superfund Amendments and Reauthorization Act of 1986
Site	American Creosote Works Superfund Site
SMP	site management plan
SPLP	synthetic precipitation leaching procedure
TDP	transportation and disposal plan
TMV	toxicity, mobility, and volume
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TS	treatability study
TTP	treatability test plan
TT	treatability testing
UCS	unconfined compressive strength
VOA	volatile organic analysis
VOC	volatile organic compound

SECTION 1

Project Description

This Treatability Test Plan (TTP) has been prepared for the U.S. Environmental Protection Agency (EPA) Region 6 under Remedial Action Contract No. EP-W-06-021, Task Order No. 0051. This TTP describes treatability study (TS) activities to be performed in support of the Feasibility Study (FS) for the American Creosote Works (ACW) Superfund Site (Site) in Winnfield, Louisiana.

1.1 Purpose

Under the Superfund Amendments and Reauthorization Act of 1986 (SARA), EPA is required to select remedial actions involving treatment that permanently and significantly reduce the toxicity, mobility, and volume (TMV) of the hazardous substances present at a site. Uncertainties associated with respect to the performance, reliability, and cost of treatment technologies, especially those that may be innovative, underscore the need for treatability studies during the FS. Treatability studies provide valuable site-specific data necessary to support Superfund remedial actions. They serve two primary purposes: (1) to aid in the selection of the remedy, and (2) to aid in the implementation of the selected remedy.

This TTP provides detailed procedures that will be used to test three different technologies for treatment of creosote-contaminated soil and groundwater. The three technologies include: (1) in situ chemical oxidation (ISCO), (2) surfactant-enhanced product recovery (S-EPR), and (3) in situ solidification/stabilization (ISS). The first two technologies will be tested at the field scale, while the third will use a bench-scale approach. The findings from the TTP will be used to determine if these technologies should be retained as a component(s) of a site-wide remedial alternative to be evaluated in the FS, and if so, to develop conceptual design and cost estimate information to support the detailed and comparative evaluation of alternatives in the FS.

This document, together with the Field Operations Plan (FOP) (CH2M HILL, 2006a) and the Quality Assurance Project Plan (QAPP) (CH2M HILL, 2011a), provides the sampling and analysis instruction necessary to carry out the TS. The TTP will also be used in conjunction with the Site Management Plan (SMP) (CH2M HILL, 2006b), Transportation and Disposal Plan (TDP) (CH2M HILL, 2006c), and the Health and Safety Plan (HSP) (CH2M HILL, 2010a), each provided separately, to fully execute all elements of this work. An addendum to the HSP is provided in **Appendix A**.

1.2 Site Background

1.2.1 Facility Description and History

The Site (see **Figure 1-1**) is a 34-acre former wood treating facility that used creosote and pentachlorophenol (PCP) to treat various wood products between 1901 and 1984. The facility (Comprehensive Environmental Response, Compensation, and

Liability Information System [CERCLIS] No. LAD000239814) was placed on the EPA's National Priorities List in 1992 and has undergone extensive remediation since the Record of Decision (ROD) was signed in April 1993 (EPA, 1993). CH2M HILL is currently operating a fluids extraction and in situ bioremediation system to treat the subsurface soil and groundwater contamination remaining at the Site. This system comprises 28 recovery wells and trench sumps, several injection wells and injection trenches, an onsite process liquid treatment system (PLTS), and an extensive array of underground piping to convey fluids to and from the PLTS (see **Figure 1-2**). The PLTS includes an oil-water separator and lamella clarifier for free-phase and emulsified oil removal, and biological and granular activated carbon for dissolved-phase contaminant treatment.

In addition to installation of the PLTS, remedial actions completed at the Site to date include incineration of highly contaminated material present in the former Tar Mat Area with burial of the incinerator ash in an onsite geotextile-lined, clay-covered cell identified as the Tar Mat Ash Disposal Area, and consolidation of 7,000 cubic yards of low-level contaminated soil with material stabilized during pre-ROD removal actions in a waste cell (see **Figure 1-2**). The waste cell is covered with 1 to 3 feet of clay and underlain with a visqueen-plastic liner. The soil incineration and consolidation actions were completed in 1995. The deep subsurface soil and groundwater component of the remedy, including the PLTS, was implemented in October 1996. Through September 2010, the deep subsurface soil and groundwater remedy has recovered approximately 196,000 gallons of free-phase and emulsified creosote and treated 80 million gallons of groundwater.

1.2.2 Conceptual Site Model

Complete details of the conceptual site model can be found in the Subsurface Investigation Report (CH2M HILL, 2008).

Hydrogeologic Setting

The primary geologic strata underlying the Site include, in descending order, fill material, the Prairie Terrace deposits (PTD), and the Cockfield Formation. The fill material comprises primarily 1 to 3 feet of silty-clay that was placed over large portions of the Site during remedial construction. In other portions of the Site that were disturbed by historical site activities, clayey-gravelly fill extends to depths between 3 and 8 feet.

The PTD, also referred to as the shallow aquifer, comprises a clay, silt, and fine sand mixture that forms a semiwedge beneath the Site (see **Figure 1-3**). The thickness of the PTD ranges from 20 to 37 feet, and the depth to groundwater typically averages 8 feet below ground surface (bgs). Under natural (non-pumping) conditions, groundwater flows radially outward from the south end of the Site to the west and north where it enters Creosote Branch Creek, a groundwater flow boundary. A majority of the soil and groundwater contamination at the Site occurs within the PTD.

The Cockfield Formation lies beneath the PTD and is informally referred to as the deep aquifer. This unit is characterized as an interbedded clay, silt, and sand with some lignite (organic material). In the central and northern portions of the Site, the contact between the PTD and Cockfield Formation is marked by the presence of pebble gravel and a transition to a very dense, fine- to medium-grade sand with thin beds of lignite. At the south end of the Site, a thin bed of pink clay was observed at the contact between the PTD and Cockfield

Formation. The Cockfield Formation outcrops at the south end of the Site in the vicinity of the pond and extends to depths of at least 65 feet in some areas.

Groundwater occurs in the Cockfield Formation. Under non-pumping conditions, groundwater flows radially outward from the south to the west and northeast. Groundwater elevations in the Cockfield Formation are, on average, about 8 feet higher than present in the overlying PTD resulting in an upward vertical hydraulic gradient. It is unknown if Creosote Branch Creek represents a groundwater flow boundary for the deep aquifer.

Given the apparent absence of a laterally contiguous silt or clay unit between the PTD and Cockfield Formation, and presence of an upward vertical hydraulic gradient, it is presumed that groundwater moves freely from the Cockfield Formation to the overlying PTD.

Contaminant Sources

Releases of creosote and PCP wood-treating oil during the facility's 80-year history resulted in extensive subsurface soil and groundwater contamination at the Site. From information compiled during the 1991 to 1992 remedial investigation (RI)/FS) (CDM, 1992), it was determined that wood treating operations occurred in a process area located in the north-central portion of the Site.

A tank farm with no visible secondary containment was also located near the process area. The earliest site photographs (1940 and 1947) provided visual evidence (soil staining and stressed vegetation) that wood treating oil flowed unimpeded from the process area toward Creosote Branch Creek. A surface drainage pathway that discharged to Creosote Branch Creek is visible on a 1940 aerial photograph.

Four unlined impoundments (see **Figure 1-2**) received liquid wood-treating process wastes that reportedly contained water, tree sap, creosote, petroleum distillates, and PCP (CDM, 1992).

Wood treating oil released to the ground surface and liquid waste placed in the unlined impoundments infiltrated into the subsurface where it now resides as a separate, nonaqueous phase liquid (NAPL) residual (immobile) phase within the soil column, and as a free (mobile)-phase NAPL pooled at the base of the PTD. The soluble organic compounds present in the oil dissolve into shallow aquifer groundwater, resulting in the formation of a plume that is transported toward Creosote Branch Creek.

Preliminary evaluation of data obtained from a comprehensive re-baseline investigation performed in January and February 2008 indicates a majority of the residual and free-phase oil lies within the central portion of the Site bounded by recovery wells R-6 to the east, R-14 to the south, R-4 to the west, and R-20 to the north (see **Figure 1-4**). This area is informally referred to as the NAPL source area. The oil generally occurs within discontinuous lenses of a fine-to medium-grain sand that lies above the base of the PTD. Significant amounts of dry, creosote-stained soil also occur in this area at depths of 3 to 8 feet.

Contaminant Characteristics

The coal-tar-derived creosote used at the Site was a complex mixture containing nearly 300 different organic compounds. Approximately 85 percent of these compounds are classified as polycyclic aromatic hydrocarbons (PAH), and 2 to 17 percent as phenols

(Bedient et al., 1984). To improve penetration during the treatment process, creosote and PCP were mixed with a carrier oil as evidenced by the benzene, toluene, ethylbenzene, and xylenes (BTEX) detected in soil and groundwater samples collected at the Site.

Laboratory analysis indicates that naphthalene and phenanthrene account for a majority of the PAH content in the oil. These two compounds are also the most prevalent in Site groundwater. Historically, these compounds have been detected in Site groundwater at concentrations up to 304,000 and 176,000 micrograms per liter (µg/L), respectively. In July and December 2009, the maximum detected concentration of these two constituents in groundwater samples collected from the monitor wells was 18,400 and 9,550 µg/L, respectively. In a recent influent sample, the concentration of these two constituents was 30,800 and 19,400 µg/L, respectively.

There are 16 different PAH compounds (see **Table 1-1**) typically associated with creosote-based wood treating sites, seven of which have been identified as probable human carcinogens. The low molecular weight PAH compounds (less than 210 grams per mole) have higher aqueous solubilities and are more amenable to removal via groundwater extraction and in situ biotreatment. The high molecular weight PAH compounds (greater than 210 grams per mole) have significantly lower aqueous solubilities and are therefore more difficult to remove and treat in situ.

TABLE 1-1
Recovered Creosote (NAPL) Characteristics
American Creosote Works Superfund Site
Winnfield, LA

Constituent	**Recovered NAPL Concentration (mg/kg)**	**Maximum Observed Concentration in Site Groundwater**				
		2006	**2007**	**2008**	**2009 - Wells**	**2009 - Influent**
Low Molecular Weight PAHs						
Acenaphthene	21,000	85,600	62,300	1,800	3,850	8,201
Acenaphthylene	970	4,800 U	3,140	280	206	395
Anthracene	5,400	32,500	18,600	1,100	1,080	2,820
Fluorene	14,000	87,700	69,900	2,200	3,180	9,520
Fluoranthene	22,000	113,000	85,700	4,500	6,620	9,830
Naphthalene	70,000	290,000	304,000	23,000	18,400	30,800
Phenanthrene	57,000	214,000	176,000	7,900	9,550	19,400
Pyrene	15,000	55,900	54,300	2,700	7,670	4,360
High Molecular Weight PAHs						
Benzo(aAnthracene	3,900	20,500	18,500	900	1,300	1,740
Benzo(b)Fluoranthene	2,300	13,700	11,300	660	665 J	1.05
Benzo(k)Fluoranthene	1,300	8,920 J	8,010	250 LJ	610 J	440
Benzo(ghi)Perylene	510	5,400 U	2,670	190 LJ	142	254

TABLE 1-1
Recovered Creosote (NAPL) Characteristics
American Creosote Works Superfund Site
Winnfield, LA

Constituent	**Recovered NAPL Concentration (mg/kg)**	**Maximum Observed Concentration in Site Groundwater**				
		2006	**2007**	**2008**	**2009 - Wells**	**2009 - Influent**
Benzo(a)Pyrene	420	11,800	9,880	430 LJ	575 J	748
Chrysene	3,800	19,500	15,400	760	1,440	1,470
Dibenzo(a,h)Anthracene	260	5,800 U	1,090	60 LJ	62 J	79.7
Indeno(123-cd)Pyrene	490	5,000 U	3,070	180 LJ	127 J	253
Others						
Bis(2-ethylhexyl)Phthalate	100	Not Tracked	Not Tracked	Not Tracked	Not Tracked	100 U
Dibenzofuran	11,000	Not Tracked	Not Tracked	Not Tracked	Not Tracked	Not Tested
2-Methylnaphthalene	14,000	Not Tracked	Not Tracked	Not Tracked	Not Tracked	Not Tested
Pentachlorophenol	1,100	285	360	110 J	144	500 U
Benzene	Not Measured	362	330	327	271	20 U

Notes:

[a]Recovered oil testing performed in November 2007 revealed a specific gravity of 1.03.

Italicized compounds are identified as carcinogenic.

B = Indicates analyte found in associated method blank

J = estimated concentration

mg/kg = milligrams per kilogram

U = not detected

Receptors

There are no complete current human exposure pathways within the fence-enclosed portion of the Site. A layer of clean fill material, varying in thickness between 1 and 3 feet, prevents direct contact with contaminated subsurface soil by onsite remedial action workers. A perimeter fence and locking gate restrict access to the Site by offsite residents. An electronic surveillance system monitors the Site entrance gate, building, and grounds when remedial action workers are not onsite. There is no indication that shallow aquifer groundwater is being used in the immediate vicinity of the Site. Drinking water for nearby residents is supplied by the City of Winnfield from deep water supply wells constructed in the Sparta aquifer. Sampling of the City's water supply well during the 1992 RI showed no evidence of Site-related contaminants (CDM, 1992).

Ecological exposure pathways, specifically those associated with Creosote Branch Creek, have not been directly evaluated since completion of the 1992 RI/FS. As indicated in the ROD, the selected remedy is to perform ecological monitoring for an estimated 5- to 10-year period after completion of remedial activities. The recent risk assessment update, *Risk Assessment American Creosote Works Superfund Site* (CH2M HILL, 2011b), compared contaminant concentrations detected in surface water and sediment samples collected in February 2008 to ecological protection screening levels. Several site-related contaminants were present at concentrations greater than the screening levels deemed protective of benthic invertebrate species.

1.2.3 Long-term Treatment Goals

The primary long-term goal is to protect human health and the environment by reducing PAH concentrations in soil and groundwater to levels that protect future site, groundwater, and surface water uses.

Remedial Goals in Current ROD

According to the ROD, the remedial goals for soils are 3,000 micrograms per kilogram (µg/kg) for carcinogenic PAHs expressed as benzo(a)pyrene (BaP) equivalents and 50,000 µg/kg for PCP. For groundwater, the remedial goals are 0.2 µg/L for PAHs expressed as BaP equivalents and 5 µg/L for benzene (EPA, 1993). These remedial goals were developed to be protective of site soils assuming a residential land use scenario and groundwater as a future drinking water source.

The ROD did not specify a remedial goal for PCP in groundwater. A 1-µg/L concentration has been assumed for the purposes of evaluating overall remedy performance. The 1-µg/L concentration corresponds to the federal drinking water standard or maximum contaminant level.

Year 2009 groundwater monitoring results indicate that PAH concentrations below the remedial goal were present at 15 of 18 active monitor well locations that lie outside the NAPL source zone footprint (see **Figure 1-4**). Within the NAPL source zone footprint, PAH concentrations less than the remedial goal were present at one of seven active monitor well locations (CH2M HILL, 2010b). These data indicate that NAPL removal or stabilization would improve the ability to attain the Site remedial goals.

PCP was detected in 8 of the 26 samples taken in December 2009 at concentrations between 0.22 and 96.8 µg/L. Benzene concentrations observed in the December 2009 samples ranged from less than 0.5 to 271 µg/L. Benzene concentrations greater than the 5-µg/L ROD standard were detected at 7 of 26 shallow aquifer monitor well locations.

Preliminary Remedial Goals in ROD Amendment

The risk assessment update (CH2M HILL, 2011b) reassessed current and future potential risks to human health assuming that the Site would be redeveloped in the future for industrial purposes. Restoration of groundwater quality to allow for future drinking water beneficial use was also presumed based on classification of the Site’s shallow and deep aquifers using State of Louisiana Risk Evaluation Corrective Action Plan (RECAP) regulations. Based on these proposed land and groundwater uses, preliminary remedial goals (PRG) were proposed in the Draft *Feasibility Study – Remedial Action Technology*

Screening and Preliminary Remedial Action Alternatives (CH2M HILL, 2011c). The proposed PRGs are compared with the remedial goals specified in the ROD in **Table 1-2**.

TABLE 1-2
Comparison of ROD Remedial Goals with Proposed Feasibility Study PRGs for Selected Contaminants
American Creosote Works Superfund Site
Winnfield, LA

	Remedial Goal in ROD[a]		Proposed PRG[b]	
Contaminant	**Soil (µg/kg)**	**Groundwater (µg/L)**	**Soil (µg/kg)**	**Groundwater (µg/L)**
Total PAHs in BaP Equivalents	3,000	0.2	2,100	0.2
PCP	50,000	Not Specified	0.04	1
Benzene	Not Specified	5	Not Determined	5

Notes:

[a] A soil PRG based on leaching to groundwater or vapor intrusion has not been assessed because volatile organic compounds (VOC) have not been recently measured in soil. The leaching to groundwater based PRG provided in the Regional Screening Levels is 2.6 µg/kg.

[b] The proposed PRGs were developed in Draft *Feasibility Study – Remedial Action Technology Screening and Preliminary Remedial Action Alternatives* (CH2M HILL, 2011c).

1.2.4 Treatability Testing Technology Demonstration Areas

Laboratory analysis results from subsurface soil sampling performed in February 2008 were reevaluated to aid in the identification of two demonstration areas. This evaluation determined that a majority of the PAH contamination occurs within the fine-grained soil present at depths between 0 and 20 feet bgs. Coarser-grained materials present at depths below 20 feet have been remediated in many portions of the Site except within two distinct areas identified as Area 1 and Area 2.

Area 1 is located in the north-central portion of the Site (see **Figure 1-5**) and is one of the more highly contaminated zones with soil contamination at the groundwater surface exceeding 200,000 µg/kg BaP equivalents. The vertical zone requiring treatment during the pilot test extends from approximately 10 to 27 feet bgs. Mobile dense nonaqueous phase liquid (DNAPL) is present in this area and is currently being recovered by a network of extraction wells. Over time, as the fraction of mobile DNAPL decreases, a large fraction of the DNAPL will remain. This residual or immobile fraction is more difficult to recover and often requires enhanced recovery methods. For creosote, the immobile fraction may be as much as 30 to 50 percent (Lowe et al., 1999) of the original DNAPL volume. Previous bench-scale testing of the S-EPR technology has shown that this technology can increase the mobility of the residual fraction, thereby enhancing its removal via extraction wells. The S-EPR technology may also accelerate removal of the mobile fraction. Therefore, Area 1 was selected as the site for conducting the S-EPR treatability testing (TT).

Area 2 is located in the south-central portion of the Site (see **Figure 1-5**) and is expected to be contaminated primarily with residual (immobile) DNAPL contaminated soil exceeding 100,000 µg/kg BaP equivalents. PCP is also present in groundwater within Area 2. The DNAPL in this area exists as ganglia and may not flow as readily. The vertical zone requiring treatment in this area extends from approximately 15 to 25 feet bgs. The TT in Area 2 will evaluate ISCO as a thermal enhancement technology to improve flow (recovery) of the residual DNAPL and a contaminant destruction technology to treat dissolved-phase contaminants.

The ISS TT will be conducted on the bench scale and will use material obtained from Area 2 as this is the area of the Site where the technology is most like to be employed, and the area where the highest concentration of PAH-contaminated media occurs.

SECTION 2

Treatment Technology Description

As described in Draft *Feasibility Study – Remedial Action Technology Screening and Preliminary Remedial Action Alternatives* (CH2M HILL, 2011c), an array of preliminary remedial action alternatives have been developed to address: (1) vadose zone soil, (2) the NAPL source area, and (3) shallow aquifer groundwater. The remedial technologies employed by the vadose zone soil and shallow aquifer groundwater remedial action alternatives do not require additional site-specific information prior to their development and evaluation in the feasibility study. However, three of the NAPL source area remedial action alternatives rely on innovative technologies that require additional site-specific evaluation prior to development for feasibility study purposes. These three alternatives are: Enhanced NAPL Recovery (Alternative SG-3), Solidification/Stabilization (Alternative SG-4), and In Situ Thermal Destruction (Alternative SG-6).

This TTP will evaluate the technologies that would be employed under the Enhanced NAPL Recovery and Solidification/Stabilization remedial action alternatives. Consultations with the vendor that markets the In Situ Thermal Destruction technology have determined that field-scale pilot testing of this technology is not cost-effective at this time. Therefore, pilot test results from comparable sites and/or vendor recommendations will be used to develop the technical and cost information necessary for this remedial action alternative. This section presents a description of the enhanced NAPL recovery and solidification/stabilization technologies to be evaluated by the TTP.

The site-wide remedy for ACW selected in a ROD amendment will likely include a vadose zone component, an NAPL source area component, and a groundwater component. The information obtained from this TTP will not only determine how well the enhanced NAPL recovery and solidification/stabilization technologies will perform in the NAPL source area, but will also provide information that will help in selecting vadose zone and groundwater remedial action alternatives that are complementary.

2.1 In Situ Chemical Oxidation

ISCO is an aggressive technology used for the rapid in situ treatment of a variety of organic contaminants in groundwater. ISCO is implemented through the subsurface injection of chemical oxidants, resulting in contaminants being oxidized to carbon dioxide (CO_2) and other innocuous compounds. The most widely used oxidants include catalyzed hydrogen peroxide (CHP), permanganate as either sodium permanganate or potassium permanganate, sodium persulfate, and ozone.

ISCO is typically employed for the degradation of chlorinated ethenes, such as trichloroethene (Siegrist et al., 2001), and is most effective in source zone treatment. CHP has been demonstrated to effectively oxidize creosote-related compounds (Valderrama et. al., 2009; Lundstedt et. al., 2006). In addition, CHP has been used to elevate the subsurface temperature, resulting in enhanced PAH desorption and creosote mobility. Therefore, PAH concentrations in the dissolved phase are increased, where they are susceptible to destruction via chemical oxidation, and the oil is more readily extracted. CHP can also directly oxidize DNAPL. Although ISCO may temporarily impact the microbial population in the injection area, microbial activity rebounds quickly as the aquifer returns to baseline conditions. Byproducts of the ISCO degradation of PAHs may include shorter-chained compounds, which are, generally, more easily degraded by biological processes than the parent compounds. For the purposes of this TT, the use of ISCO to thermally enhance DNAPL recovery will be evaluated.

The ISCO reagents are usually distributed in the aquifer using either permanently or temporarily installed injection wells or the drill rods of a direct-push technology rig. Though ISCO is generally used to address dissolved-phase contaminants, some vendors such as Geo-Cleanse International, Inc. (GCI), have employed CHP combined with extraction technology to treat NAPL contaminated media.

2.1.1 Key Uncertainties

Key uncertainties for this technology include the following:

- **Ability to Inject Oxidant.** ISCO effectiveness is highly dependent on the ability to distribute the oxidant throughout the subsurface because it must come into direct contact with the contaminants. Formations with low permeability may not allow sufficient distribution of chemical outwardly from the injection point (radius of influence [ROI]) or over an entire vertical interval because of heterogeneity. Also, low permeability formations may impact application costs by limiting chemical injection rates or requiring a more closely spaced array of injection points.

- **Ability to Make Contaminant-Oxidant Contact.** In addition to the challenges associated with delivering the oxidant, the success of the treatment depends on being able to attain the proper concentrations of oxidant at the site of the contaminant.

- **NAPL Extraction.** It is not known how much of the DNAPL mass can be removed using ISCO and extraction well recovery or what the final residual saturation content will be in the subsurface following the ISCO application and extraction. Furthermore, there is some uncertainty on how much DNAPL mass remains at the Site. So an estimate of DNAPL removed as a function of unit area treatment may not reliably estimate total treatment costs for DNAPL removal in the remaining portions of the Site.

- **Optimal Chemical Dose Rates and Frequency of Application.** Aquifer geochemistry significantly impacts oxidant performance and determines whether catalyzing or sequestering agents will be required to optimize peroxide longevity in the subsurface. In addition, multiple ISCO applications will likely be necessary to achieve the desired results.

- **Impact to the PLTS.** The PLTS effectiveness may be impacted in a positive and/or negative manner, such as improved or diminished efficiency resulting from chemical compatibility issues, degradation byproducts, slugs of NAPL coming into the system, and so forth.

2.2 S-EPR

S-EPR entails the use of a proprietary solution, VeruSOL, to increase solubility of organic compounds, making them more mobile for recovery purposes. VeruSOL, which is biodegradable, is a combination of food-grade, citrus-based co-solvents and plant oil-based surfactants. VeruSOL has been shown to increase total concentrations of NAPL in solution between one and three orders of magnitude. In a bench test conducted by VeruTEK in 2008, using materials from the Site, the total concentration of volatile organic compounds (VOC) was increased by 5-fold, semivolatile organic compounds (SVOC) by 24-fold, and total petroleum hydrocarbons (TPH) by 65-fold (VeruTEK, 2008).

2.2.1 Key Uncertainties

Key uncertainties for this technology include the following:

- **Ability to Inject Surfactant.** The effectiveness of S-EPR is highly dependent on the distribution of chemicals (ROI) in the subsurface because the surfactant must come into direct contact with contaminants. Formations with low permeability may not allow sufficient distribution of fluids to attain reasonable ROI or over an entire vertical interval because of formation heterogeneity. Also, low permeability formations may impact application costs by limiting chemical injection rates.

- **DNAPL Extraction.** It is not known how much of the DNAPL mass can be removed using S-EPR or what the final residual saturation content will be in the subsurface following the S-EPR application and extraction. Furthermore, there is some uncertainty on how much DNAPL mass remains at the Site. Therefore an estimate of DNAPL removed as a function of unit area treatment may not reliably estimate total treatment costs for DNAPL removal in the remaining portions of the Site.

- **Optimal Chemical Dose Rates.** The amount of S-EPR required per application and the number of applications required to achieve the desired results have not been tested at the field scale. During the 2008 bench testing, an 86% reduction in TPH mass associated with creosote oil was achieved using a 10 g/L VeruSOL-10 solution followed by a 4% hydrogen peroxide solution. The treatability test will not include hydrogen peroxide treatment because field testing conducted at other sites since the bench test was completed indicate these same results can be achieved without the use of hydrogen peroxide (CH2M HILL, 2011d).

- **Impact to the PLTS.** The PLTS effectiveness may be impacted in a positive and/or negative manner, such as improved or diminished efficiency resulting from chemical compatibility issues, degradation byproducts, slugs of NAPL coming into the system, and so forth.

2.3 In Situ Solidification/Stabilization

ISS entails the injection and mixing of solidifying reagents with the soil to form a monolithic, low-permeability, solid mass with high structural integrity, which reduces the mobility and solubility of contaminants originally present in the soil. Prior to full-scale field application, competent design of an ISS application requires a bench-scale test to collect design data, including stabilization reagent mix ratios, injection quantity required for stabilization, and volume increase of the stabilized material.

To complete treatment, the stabilization reagents are mixed with soil in situ and allowed to cure. The ISS reagents may include Portland cement, fly ash, blast furnace slag, and organic sorbents, such as granular activated carbon, Zeolite, and organophilic clay. The organic sorbents adsorb organic contaminants within their structure, which is encapsulated into a cementitious matrix created by cement-based agents (that is, Portland cements and blast furnace slag). This process results in a solidified stable mass with high structural strength and low leaching potential.

During the soil mixing, large-diameter (approximately 8 to 10 feet) augers with mixing paddles and grout ports are drilled into the ground as a grout is pumped through the shaft. The grout, containing solidifying reagents, acts as an aid to drilling and is mixed into the soil column, creating a treated soil mass. The auger mixes the soil and grout by vertically passing the soil column through the auger multiple times. Treated soil must fully cure, typically for 7 days, before being covered with clean soil.

2.3.1 Key Uncertainties

Key uncertainties for this technology include the following:

- **Design Parameters.** Optimal reagent mix ratios, the injection quantity, and increase in volume of mixed material are uncertain.
- **Resulting Leaching Potential.** It is not known how much contamination will leach from the final stabilized monolith.
- **Permeability.** It has not been demonstrated that the permeability goals can be achieved with the site-specific media.

SECTION 3

Test Objectives

The objectives for the TT were developed using the Data Quality Objectives (DQO) process (EPA, 2006). The DQO process resulted in the test objective of determining if one or more of the technologies included in the TT (ISCO, S-EPR, and ISS) should be retained for further evaluation in the FS. The recommendation to retain the technologies will be based on determination of the following:

- The percent reduction in residual DNAPL mass that can be attained using ISCO via CHP
- The percent reduction in DNAPL mass that can be attained using S-EPR
- The reduction in DNAPL mobility and leachability that can be attained through ISS of DNAPL-impacted media
- The cost to complete full-scale implementation of each technology, as estimated by interpretation of pilot study results and the conceptual site model (Note: Considerable uncertainty is expected in this cost estimate, because it is technically very difficult to estimate the total volume of creosote in the subsurface.)
- Overall effectiveness of the technology in reducing risks to human health and the environment

TT objectives associated with reducing the toxicity, mobility, and volume (TMV) of dissolved-phase contaminants were not specifically addressed for this TTP. Due to the timeframes that may be required for these reductions to become evident, they will be assessed through semiannual groundwater monitoring conducted under the long-term remedial action task order, and the information will be incorporated into the TT or FS Report.

The DQO process used for the TT is summarized in the following subsections.

3.1 Step 1 – State the Problem

Project Objectives

The objective of the TT is to evaluate performance of three technologies (ISCO, S-EPR, and ISS) to treat areas of residual (immobile) and/or mobile DNAPL present at the Site. By destroying (ISCO), removing (ISCO and S-EPR), or immobilizing (ISS) NAPL source material, the longevity of the dissolved plume is reduced by minimizing the contribution of contaminants from the DNAPL.

Project Assumptions

If one or more of these technologies is selected for full-scale application, it will likely be coupled with one or additional technologies (that is, combined remedy) to address the current dissolved-phase PAH plume or areas with very low concentrations of residual DNAPL.

Project Issues

CH2M HILL will provide the technical and labor resources required to implement the TT, conduct performance monitoring during the TT, and evaluate the TT results. Based on the data evaluation, CH2M HILL will make recommendations on which technologies should be retained for the FS.

DQO Planning Team Members and Key Decision Makers

The planning team will include CH2M HILL, the Louisiana Department of Environmental Quality (LDEQ), and the EPA.

Contaminants of Concern

Contaminants of concern (COC) include PAHs, PCP, and benzene with naphthalene selected as a primary PAH indicator contaminant. On average, naphthalene, which is highly mobile in the dissolved phase, accounts for 35 percent of the total PAH concentration in the groundwater sample data set (CH2M HILL, 2011e), and 20 percent of the total PAH concentration in the year 2008 subsurface soil investigation data set (CH2M HILL, 2008).

Dioxins and furans will not be evaluated specifically, because their fate in each of the three TT tests is expected to be comparable to the high molecular weight PAH constituents.

Current and Potential Future Land Use

The initial baseline risk assessment assumed a residential land use. Restoration of the Site to allow for a future residential use may be impracticable (cost prohibitive). Therefore, the FS will evaluate restoration to allow for future industrial land use or recreational land use with residential land use retained as a baseline for comparison. Future land use options will be explored further with EPA, the City of Winnfield, and LDEQ.

Statement of the Problem

Can one or more of these technologies effectively address residual and/or mobile DNAPL such that future concentrations of COCs in Site soil and groundwater can be reduced to allow for conditional reuse?

3.2 Step 2 – Identify the Goals of the Study

Principal Study Questions

- What percentage of reduction in DNAPL mass will ISCO achieve during the pilot-scale testing?
- What percentage of reduction in DNAPL mass will S-EPR achieve during the pilot-scale testing?
- How will ISS reduce contaminant leachability during the bench-scale testing?
- What is the cost to complete full-scale implementation of the technology per treatment volume?

Alternative Actions

- Evaluation of an alternative technology
- Additional pilot-scale testing

Decision Statement

If one or more of these technologies is able to perform as specified, they will be retained for consideration during the FS.

3.3 Step 3 – Identify Information Input

Information Required to Address the Problem

- ***Ability to Implement.*** Is it possible to inject sufficient amounts of oxidant or surfactant in the ground or attain adequate subsurface mixing?
- ***Contaminant Reduction.*** What percentage of reduction in DNAPL TMV can be reasonably achieved through implementation of these technologies such that the longevity of the dissolved-phase plume is reduced or eliminated?
- ***Cost Parameters.*** Were all design criteria determined to the extent required to budget for a full-scale application?

Source of Required Information

Sources of the required information will include historical data, data collected during the pilot-scale and bench-scale tests, performance data collection events, and the current conceptual site model.

Action Levels for Contaminants of Concern

The action levels for COCs in groundwater specified in the ROD (EPA, 1993) are 0.2 µg/L for PAHs expressed as BaP equivalents and 5 µg/L for benzene. A 1-µg/L action level for PCP corresponding to the federal maximum contaminant level (MCL) is assumed. For COCs in soil, the cleanup levels included 50,000 µg/kg for PCP; 3,000 µg/kg for PAHs expressed as BaP equivalents; and less than 10 µg/kg for 2,3,7,8-tetrachlorodibenxop-dioxin. As indicated previously, the TT will not specifically evaluate the performance of these technologies with respect to dioxin. The analytical methods are outlined in Section 4.

The updated draft risk assessment report (CH2M HILL, 2011b) and Draft *Feasibility Study – Remedial Action Technology Screening and Preliminary Remedial Action Alternatives* (CH2M HILL, 2011c) proposed a new set of PRGs based on an industrial land use and potable groundwater beneficial use. A comparison of the proposed PRGs versus the ROD remedial goals is provided in **Table 1-2**.

3.4 Step 4 – Define the Boundaries of the Study

Target Population of Interest

The target population consists of all validated soil and groundwater data collected from the test areas or during bench-scale testing.

Spatial Boundaries of the Test Areas

The spatial boundary for the ISCO (Area 1) and S-EPR (Area 2) pilot-scale tests are shown on **Figure 1-5**. Soil samples for the ISS bench-scale test will be collected from within the S-EPR test area (Area 2).

Temporal Boundaries of the Test Areas

The performance monitoring sampling parameters and frequency are summarized in **Section 4**.

Conditions Most Favorable for Collecting Data

There are no specific weather or time conditions that are more favorable for collecting data. However, because the TT will be conducted within highly contaminated zones, sampling to evaluate the ability of the technology to treat contaminants should be completed quickly after completion of the injection/extraction processes, before contamination from adjacent, untreated areas migrates into the treatment cell. Because the ISS bench-scale test will be conducted in a laboratory setting, there are no special conditions for data collection.

Practical Constraints Affecting Data Collection

Constraints include holding times for the analyses. The field sampling procedures, including equipment and monitor well purging requirements, will be outlined in **Appendix B**.

Scale of Decision Making

For the field pilot-scale tests, soil and groundwater throughout the thickness of the shallow aquifer will be sampled. The data from the baseline sampling event will be compared to the performance monitoring data to determine if the test objectives/uncertainties were achieved. For the bench-scale test, solidified materials will be tested for strength, permeability, and leachability.

3.5 Step 5 – Develop the Analytic Approach

Statistical Parameter of Interest for Decision Making

The average and maximum contaminant concentrations in groundwater and soil within the test areas (Areas 1 and 2) of the Site will be used for decision making. Also, field data describing the ability to inject and extract ISCO and S-EPR materials will be evaluated. The ISS bench-scale test will take the average and highest contaminant concentrations in soil and monolith permeate, as well as strength and permeability, into consideration.

Decision Rules

If the physical application of ISCO or S-EPR cannot be achieved, then these technologies will either not be retained in the FS or missing information required to improve or carry the technology forward will be provided.

If DNAPL in either test area is not reduced by a reasonable amount compared to the cost of implementation, then that technology will either not be retained for the FS or missing information required to improve or carry the technology forward will be provided.

If it is determined that the technology does not reduce risks to human health and the environment, then the technology will not be retained for the FS.

3.6 Step 6 – Specify Performance or Acceptance Criteria

Acceptance of analytical data will be based on data validation conducted by CH2M HILL. All data will be considered useable unless specified during the data validation process. The results of the data validation will be provided in data validation reports.

3.7 Step 7 – Plan for Obtaining Data

The sampling plan is summarized in **Section 4**.

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SECTION 4

Experimental Design and Procedures

The TT will be include the following phases of work:

- Pre-test mobilization activities
- Baseline sampling
- Technology testing
- Performance and post-treatment sampling

All fieldwork will be conducted according to the HSP and HSP Addendum (see **Appendix A**).

4.1 Pre-test Mobilization Activities

The pre-test mobilization activities will consist of coordination/scheduling with subcontractors (VeruTEK/Evergreen Resources Group, Inc. [ERGI], and GCI); review of subcontractor work plans, HSPs, and job hazard analyses; review of test area layouts, delivery of holding tanks, plumbing of extraction wellheads to the frac tanks, and construction of wellhead adapters for the injection wells.

- **Subcontractor Coordination.** CH2M HILL will coordinate with the ISCO, S-EPR, ISS field, and laboratory subcontractors to finalize the test schedule. CH2M HILL will also review and approve subcontractor work plans and HSPs.

- **EPA Houston Laboratory Coordination.** CH2M HILL has developed a list of pre- and post-testing analysis to be performed, the approximate dates the samples will be taken, and the required laboratory analytical methods and detection limits. This information will be compiled and submitted to the EPA Task Order Manager and EPA Laboratory Managers.

- **Site Setup.** CH2M HILL will lay out the two field test areas, mark sample and well drilling locations using handheld global positioning system (GPS) equipment, and receive equipment, such as the frac tanks. One or two holding tanks will be delivered to each test area.

- **Utility Clearance.** After the pilot-scale test areas have been layed out and the drilling locations have been flagged, onsite operations staff will perform utility clearance of the drilling locations for underground PLTS conveyance piping.

- **Plumbing.** As needed, CH2M HILL will plumb the appropriate extraction wells to frac tanks for water recovery during the well rehabilitation and S-EPR and ISCO pilot-scale tests. Also, clean water for chemical mixing will be plumbed from either the PLTS or a City water supply to the two test areas.

Because hazardous chemicals will be injected into the shallow aquifer during the field-scale TT, the Louisiana Office of Conservation – Underground Injection Control Section will be notified of the planned TT activities.

4.2 Baseline Sampling and Well Rehabilitation

4.2.1 Baseline Sampling

Baseline sampling will be conducted at the two test areas prior to starting the technology testing. The baseline sampling will include collection of soil and groundwater samples to characterize pre-test conditions and provide a basis of comparison for post-treatment samples. Also, soil and groundwater samples will be collected for the ISS bench-scale test. The locations of samples to be collected are shown on **Figures 4-1** and **4-2**. The sample parameters and quantity of materials to be collected are summarized in **Table 4-1**. Samples will be collected and analyzed according to the procedures outlined in the FOP, Draft QAPP, and **Appendix B**.

Shelby tube samples will be collected from Area 2 for evaluation of soil density in the stabilization treatability study. Shelby tubes will be collected at two intervals, 17 to 20 feet bgs and 22 to 25 feet bgs. Locations of the samples are summarized in **Table 4-1**. The boring locations are shared with the S-EPR borings. The two Shelby tubes can be collected from two different borings if one boring does not provide sufficient soil. If the Cockfield Formation is reached above the required 28 feet sample depth, the sample will be taken from the next boring at a shallower depth. The samples will be shipped to the stabilization treatability subcontractor's laboratory for testing.

TABLE 4-1
Baseline Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Number of Samples and Volume Requirements
ISCO Pilot-scale Test			
ISCOB1AS (15 to 18 feet bgs)	Soil	SVOCs	One 4-oz jar
ISCOB1BS (19 to 22 feet bgs)		BTEX	One 4-oz jar
ISCOB1CS (23 to 26 feet bgs)		SPLP	One 4-oz jar
ISCOB2AS (15 to 18 feet bgs)		TOC	One 4-oz jar
ISCOB2BS (19 to 22 feet bgs)		TPH	Three VOA vials (cores extruded from Terracore)
ISCOB2CS (23 to 26 feet bgs)			
ISCOB3AS (15 to 18 feet bgs)			
ISCOB3BS (19 to 22 feet bgs)			
ISCOB3CS (23 to 26 feet bgs)			
ISCOB4AS (15 to 18 feet bgs)			
ISCOB4BS (19 to 22 feet bgs)			
ISCOB4CS (23 to 26 feet bgs)			
ISCOB5AS (15 to 18 feet bgs)			
ISCOB5BS (19 to 22 feet bgs)			

TABLE 4-1
Baseline Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Number of Samples and Volume Requirements
ISCOB5CS (23 to 26 feet bgs)			
ISCOB6AS (15 to 18 feet bgs)			
ISCOB6BS (19 to 22 feet bgs)			
ISCOB6CS (23 to 26 feet bgs)			
ISCOB1AW (19 to 22 feet bgs)	Groundwater	SVOCs	One 1-L amber
ISCOB1BW (23 to 26 feet bgs)		BTEX	Three 40-mL VOA
ISCOB2AW (19 to 22 feet bgs)		TOC	One 500-mL plastic
ISCOB2BW (23 to 26 feet bgs)		TPH	Two 40-mL VOA
ISCOB3AW (19 to 22 feet bgs)			
ISCOB3BW (23 to 26 feet bgs)			
ISCOB4AW (19 to 22 feet bgs)			
ISCOB4BW (23 to 26 feet bgs)			
ISCOB5AW (19 to 22 feet bgs)			
ISCOB5BW (23 to 26 feet bgs)			
ISCOB6AW (19 to 22 feet bgs)			
ISCOB6BW (23 to 26 feet bgs)			
I-5			
S-EPR Pilot-Scale Test			
SEPRB1AS (15 to 18 feet bgs)	Soil	SVOCs	One 4-oz jar
SEPRB1BS (19 to 22 feet bgs)		BTEX	One 4-oz jar
SEPRB1CS (23 to 26 feet bgs)		SPLP	One 4-oz jar
SEPRB2AS (15 to 18 feet bgs)		TOC	One 4-oz jar
SEPRB2BS (19 to 22 feet bgs)		TPH	Three VOA vials (cores extruded from Terracore)
SEPRB2CS (23 to 26 feet bgs)			
SEPRB3AS (15 to 18 feet bgs)			
SEPRB3BS (19 to 22 feet bgs)			
SEPRB3CS (23 to 26 feet bgs)			
SEPRB4AS (15 to 18 feet bgs)			
SEPRB4BS (19 to 22 feet bgs)			
SEPRB4CS (23 to 26 feet bgs)			
SEPRB5AS (15 to 18 feet bgs)			
SEPRB5BS (19 to 22 feet bgs)			
SEPRB5CS (23 to 26 feet bgs)			
SEPRB6AS (15 to 18 feet bgs)			
SEPRB6BS (19 to 22 feet bgs)			
SEPRB6CS (23 to 26 feet bgs)			
SEPRB7AS (15 to 18 feet bgs)			
SEPRB7BS (19 to 22 feet bgs)			

TABLE 4-1
Baseline Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Number of Samples and Volume Requirements
SEPRB7CS (23 to 26 feet bgs)			
SEPRB8AS (15 to 18 feet bgs)			
SEPRB8BS (19 to 22 feet bgs)			
SEPRB8CS (23 to 26 feet bgs)			
SEPRB9AS (15 to 18 feet bgs)			
SEPRB9BS (19 to 22 feet bgs)			
SEPRB9CS (23 to 26 feet bgs)			
SEPRB1AW (19 to 22 feet bgs)	Groundwater	SVOCs	One 1-L amber
SEPRB1BW (23 to 26 feet bgs)		BTEX	Three 40-mL VOA
SEPRB2AW (19 to 22 feet bgs)		TOC	One 500-mL plastic
SEPRB2BW (23 to 26 feet bgs)		TPH	Two 40-mL VOA
SEPRB2AW (19 to 22 feet bgs)			
SEPRB2BW (23 to 26 feet bgs)			
SEPRB3AW (19 to 22 feet bgs)			
SEPRB3BW (23 to 26 feet bgs)			
SEPRB4AW (19 to 22 feet bgs)			
SEPRB4BW (23 to 26 feet bgs)			
SEPRB5AW (19 to 22 feet bgs)			
SEPRB5BW (23 to 26 feet bgs)			
SEPRB6AW (19 to 22 feet bgs)			
SEPRB6BW (23 to 26 feet bgs)			
SEPRB7AW (19 to 22 feet bgs)			
SEPRB7BW (23 to 26 feet bgs)			
SEPRB8AW (19 to 22 feet bgs)			
SEPRB8BW (23 to 26 feet bgs)			
SEPRB9AW (19 to 22 feet bgs)			
SEPRB9BW (23 to 26 feet bgs)			
I-7			
R-5			
R-9			
R-10			
R-12			
R-15			
R-17			
R-18			
ISS Bench-Scale Test			
ISS1 (collected from same boring as SEPRB2) (2 to 32 feet bgs)	Soil	Bench testing	150 kg packed in 1-gallon metal buckets with no

TABLE 4-1
Baseline Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Number of Samples and Volume Requirements
ISS2 (collected from same boring as SEPRB3) (2 to 32 feet bgs)			head space
ISS3 (collected from same boring as SEPRB7) (2 to 32 feet bgs)			
ISS4 (Shelby tube collected from same boring as SEPRB1, 22 to 24 feet bgs)		Soil density conducted by treatability study subcontractor	Shelby tube samples sealed and shipped with the other soil samples to the treatability study laboratory
ISS5 (Shelby tube collected from same boring as SEPRB5, 26 to 28 feet bgs)			
ISSNAPL (collected from trench sump well R-12)	DNAPL	Bench testing	10 L in 500-mL jars
PLTS			
Effluent samples	Treated water	SVOCs	One 1-L amber
		BTEX	Three 40-mL VOA
		TOC	One 500-mL plastic
		TPH	Two 40-mL VOA

Notes:

kg = kilogram
L = liter
mL = milliliter
oz = ounce
SPLP = Synthetic precipitation leaching procedure
VOA = volatile organic analysis
TOC = total organic compounds

4.2.2 Well Rehabilitation

Two weeks before the S-EPR test, recovery wells in the S-EPR test area (R-5, R-9, R-10, R-12, R-15, R-17, and R-18) will be rehabilitated to remove potential NAPL/sludge and biological/chemical encrustation. Prior to the rehabilitation, the wells will be operated for 72 hours to establish baseline operating parameters. Groundwater and NAPL recovered from each well during this time will be measured and temporarily stored in separate holding tanks, and CH2M HILL will determine the amount of NAPL recovered from each well.

CH2M HILL will rehabilitate each recovery well using approximately 200 gallons of S-EPR per well. After the S-EPR has been introduced to the well, the well will be surged for 20 minutes. The recovery wells will remain off until the first phase of the S-EPR test. CH2M HILL will conduct specific capacity tests at each well before and after the well rehabilitation step to estimate changes in the well's specific capacity. The capacity tests will be completed according to the procedures outlined in the FOP and **Appendix C**.

If necessary, the temporary tank will be drained prior to starting the field tests by transferring the contents to the PLTS equalization tank.

Each of the four existing injection wells will also be rehabilitated by alternately swabbing and pumping the wells with the aid of a chemical dispersant. This step will help ensure that the recovery wells are functional for the ISCO and S-EPR testing.

4.3 Technology Testing

4.3.1 ISCO

The ISCO pilot-scale test fieldwork will be conducted by GCI at Area 1 with oversight by CH2M HILL. Eight injection wells and four vent wells will be installed prior to the pilot test, as shown on **Figure 4-1**. The injection wells will be placed on 12-foot centers and screened across two injection intervals: 17 to 20 feet bgs and 22 to 25 feet bgs. The vent wells will be screened from the top of the confining layer (approximately 25 feet bgs) to 4 feet bgs. Drill cuttings will be containerized and characterized (if necessary) for offsite disposal. The drums will be labeled and stored according to the TDP (CH2M HILL, 2006c).

After installation, the injection and vent wells will be developed using standard well development methods. Following development, the vent wells will be pumped for 72 hours and all groundwater, and possibly NAPL, will be accumulated in the frac tank. CH2M HILL will evaluate the amount of NAPL collected during this time as a basis of comparison for the NAPL mobilized by the ISCO injection.

GCI will then inject approximately 15,300 pounds hydrogen peroxide over a 10-day period. The hydrogen peroxide will be shipped and staged as a 34 percent solution and will be mixed onsite to a maximum injection concentration of 11 percent. Process monitoring and data recording during the ISCO injection will be conducted by GCI. During this time, GCI will collect NAPL passively from the vent wells. If sufficient NAPL is present to warrant active NAPL recovery, GCI will coordinate use of a vacuum truck. The NAPL collected by GCI during pilot-scale testing will be measured to establish recovery volumes and transferred to the NAPL thickening tank at the PLTS.

Offgas (temperature and total VOC concentration) from the vent wells will be monitored for health and safety purposes using a photoionization detector, but will not be captured during the pilot testing. The frac tank contents will be monitored frequently to ensure there is sufficient capacity for recovered creosote/groundwater. The level of liquid in the frac tank will be kept to a minimum by transferring contents to the PLTS on a daily basis after measuring the creosote and water levels.

4.3.2 S-EPR

The S-EPR pilot-scale test will be conducted by VeruTek and ERGI at Area 2 with oversight by CH2M HILL. Three injection wells will be installed prior to the pilot test, as shown on **Figure 4-1**. The injection wells will be screened from 17 to 27 feet bgs. Drill cuttings will be containerized and characterized (if necessary) for offsite disposal. The drums will be labeled and stored according to the TDP (CH2M HILL, 2006c).

The S-EPR test will use the existing PLTS recovery wells to recover NAPL and will require approximately 9 weeks of injection and operation of the PLTS to complete. The injections will include the following phases of work:

Phase 1: Direct injection of S-EPR into injection wells and recovery wells. Phase 1 will encompass the first 2 weeks of the pilot testing schedule. Daily injections of S-EPR will be conducted, alternating between the injection wells and recovery wells. On days when injection is being conducted at the three injection wells, 500 gallons of S-EPR will be injected at each of the wells. On days when injection is being completed at the recovery wells, 300 gallons of S-EPR will be injected at each of the seven existing wells (R-5, R-9, R-10, R-12, R-15, R-17, and R-18). The recovery wells will be brought back online in extraction mode at the completion of each injection.

Phase 2: During this phase of work, the delivery method will be transitioned to use of the PLTS process lines. The injection well network will be shifted to include recovery wells R-5 and R-17, in addition to the three new injection wells. Additionally, the injection frequency will be reduced while the injection volumes will be increased. At the end of Week 3, 2,800 gallons of S-EPR (approximately 700 gallons per injection well) will be injected using the PLTS process lines into the revised injection array including the three new injection wells and existing recovery wells R-5 and R-17. The injection of S-EPR into the remaining recovery wells will continue during this phase. The recovery wells will be brought back online in extraction mode at the completion of each injection.

Phase 3: Weekly injections of 2,800 gallons of S-EPR will be conducted using the PLTS process lines into the injection array. The remaining recovery wells will operate in extraction mode, and no recovery well injections will be conducted.

Phase 4: Soil and groundwater performance sampling will be conducted during this phase (see **Section 4.4**), as well as continued standard operation of the PLTS with observation of creosote recovery.

The S-EPR process is detailed in **Table 4-2**.

TABLE 4-2
S-EPR Pilot Study Process
American Creosote Works Superfund Site
Winnfield, LA

Day	Injection Volume	Injection Location	Notes
Phase 1			
1 (Well Rehab)	200 gal per well	Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Inject directly at wellheads. Chase with enough water to displace S-EPR from wells.
2	500 gal per well	New Injection Wells	Chase with enough water to flush injection lines and wells. Bring recovery wells back online at injection conclusion.
3	300 gal per well	Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Chase with enough water to displace S-EPR from wells. Place injection and recovery wells back online at injection conclusion and operate

TABLE 4-2
S-EPR Pilot Study Process
American Creosote Works Superfund Site
Winnfield, LA

Day	Injection Volume	Injection Location	Notes
			in standard mode.
4	500 gal per well 300 gal per well	New Injection Wells Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Chase with enough water to flush injection lines and wells. Bring recovery wells back online at injection conclusion.
5	300 gal per well	Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Chase with enough water to displace S-EPR from wells. Place injection and recovery wells back online at injection conclusion and operate in standard mode. May recirculate clean S-EPR from the settling tank at this point.
6 to 7	0 gal per well	None	Operate injection and recovery wells in standard mode.
8	500 gal per well 300 gal per well	New Injection Wells Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Chase with enough water to flush injection lines and wells. Bring recovery wells back online at injection conclusion.
9	0 gal per well	None	Operate injection and recovery wells in standard mode. May recirculate clean S-EPR from the settling tank at this point.
10	500 gal per well 300 gal per well	New Injection Wells Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Chase with enough water to flush injection lines and wells. Bring recovery wells back online at injection conclusion.
11	300 gal per well	Recovery Wells (R-5, R-9, R-10, R-12, R15, R-17, and R-18)	Chase with enough water to displace S-EPR from wells. Place injection and recovery wells back online at injection conclusion and operate in standard mode. May recirculate clean S-EPR from the settling tank at this point.
12 to 14	0 gal per well	None	Operate injection and recovery wells in standard mode. May recirculate clean S-EPR from the settling tank at this point.
Phase 2			
15	4,100 gal total (varying amounts per well)	Injection Array (New injection wells, R-5, and R-17)	Inject using PLTS process lines. Chase with enough water to flush injection lines and wells. Bring recovery wells back online at injection conclusion.

TABLE 4-2
S-EPR Pilot Study Process
American Creosote Works Superfund Site
Winnfield, LA

Day	Injection Volume	Injection Location	Notes
		Recovery Wells (R-9, R-10, R-12, R15, and R-18)	
16	0 gal	None	Operate injection and recovery wells in standard mode. May recirculate clean S-EPR from the settling tank at this point.
17	2,100 gal total (varying amounts per well)	Recovery Wells (R-9, R-10, R-12, R15, and R-18)	Chase with enough water to displace S-EPR from wells. Place injection and recovery wells back online at injection conclusion and operate in standard mode. May recirculate clean S-EPR from the settling tank at this point.
17 to 18	0 gal	None	Operate injection and recovery wells in standard mode. May recirculate clean S-EPR from the settling tank at this point.
21	2,800 gal total (varying amounts per well)	Injection Array (New injection wells, R-5, and R-17)	Chase with enough water to flush injection lines and wells. Operate injection wells in standard mode after injection.
22 to 27	0 gal	None	Operate injection and recovery wells in standard mode.
28	2,800 gal total (varying amounts per well)	Injection Array (New injection wells, R-5, and R-17)	Chase with enough water to flush injection lines and wells. Operate injection wells in standard mode after injection.
29 to 34	0 gal	None	Operate injection and recovery wells in standard mode.
Phase 3			
Weeks 5 to 9	2,800 gal total (varying amounts per well)	Injection Array (New injection wells, R-5, and R-17)	Chase with enough water to flush injection lines and wells. Operate injection wells in standard mode after injection. One injection will be conducted per week.
Phase 4			
Week 10	0 gal	None	Collect performance samples.
Weeks 10 to 16	0 gal	None	Operate injection and recovery wells in standard mode with continued observation of creosote recovery.

Notes:

gal = gallon

Process monitoring and data recording during the S-EPR injection phases will be conducted by VeruTEK, ERGI, and CH2M HILL.

Contents of the holding tanks will be monitored frequently to ensure there is sufficient capacity for recovered creosote/groundwater. The level of liquid in the holding tanks will be kept to a minimum by transferring contents to the PLTS on a daily basis after measuring the creosote level.

4.3.3 Demobilization

At the conclusion of both the ISCO and S-EPR pilot-scale tests, groundwater and NAPL stored in the frac tanks will be transferred to the PLTS in 2,000- to 5,000-gallon increments. Water/NAPL levels in the tanks will be checked hourly during the work day, and material will be transferred to the PLTS as needed to maintain a safe working volume. The site will be restored to pre-testing conditions prior to leaving the site. All personnel and equipment will be removed from the site at the conclusion of testing and site restoration.

4.3.4 ISS

The ISS bench-scale test will be conducted by GeoSolutions, Inc., including the following activities:

- Preparation and characterization of the untreated soil prior to the bench-scale test
- Evaluation of local availability and price of reagents
- Baseline mix development – development of physical strength by cement
- Mix development by addition of other reagents
- Final mix development – performance improvement in the long term

Preparation and Characterization of the Untreated Soil

All soil samples, including the whole vertical zone from 2 to 35 feet bgs will be blended to create a composite for use during the bench-scale testing. This composite is expected to be representative of the vertical mixing that occurs during the soil mixing in the field. Thus, average moisture content of saturated and unsaturated soil will be representative of a single soil mixing column on the field. The blended soil will be sampled by the cone and quartering method, and the samples will be analyzed for the following:

- Screen analysis to quantify the level of fines
- Atterberg limits to measure the plasticity index and determine the composition of the clays
- Total concentrations of moisture, PAHs (including naphthalene), benzene, PCP, and total organic carbon (TOC)
- Synthetic precipitation leaching procedure (SPLP) for PAHs (including naphthalene), benzene, PCP, and TOC

Approximately one quarter of the composite soil sample will be blended with DNAPL to create a high-concentration sample that will measure the effectiveness of stabilization reagents if the auger intercepts a pool of DNAPL during the soil mixing. The high-concentration sample will be analyzed for the following:

- Total concentrations of moisture, PAH (including naphthalene), BTEX, PCP, and TOC
- SPLP concentrations of PAH (including naphthalene), BTEX, PCP, and TOC

Evaluation of Local Availability and Price of Reagents

The key issues in reagent selection include the following:

- Local availability
- Chemical characteristics
- Strength and permeability development results
- Consistency of supply
- Cost

An optimum reagent mix will be able to develop the required strength in the treated soil of 50 pounds per square inch (psi) (EPA, 1997) both in the vadose zone and aquifer, reduce permeability to minimize groundwater flux through the stabilized matrix, and reduce contaminant mobility in groundwater in a cost-effective way. Typical reagents that provide these features include the following:

- Portland cement (to develop short-term strength)
- Bentonite (required as a drilling lubricant for in situ applications)
- Blast furnace slag (to increase long-term strength and reduce permeability)*
- Type C fly ash (may reduce cement requirements when added to cement and increase long-term strength at reduced cost)*
- Zeolite (may provide organic adsorption to reduce contaminant leachability and contribute to overall strength development)
- Granular activated carbon (to reduce organic leachability)
- Organophilic clay (to replace bentonite as a lubricant and absorb organic contaminants and reduce leachability)

*These amendments represent amendments with low carbon footprints.

This step of the bench-scale test will identify four stabilization reagents, in addition to Portland cement, to carry forward for additional bench-scale testing.

Baseline Mix Development – Development of Physical Strength by Cement

The purpose of this step is to determine the injectability of the grout mix by measuring water addition requirements and viscosity, and to measure the physical and chemical characteristics of the stabilized soil after curing. Performance goals for ISS projects usually are based on SPLP (chemical characterization) and physical tests including hydraulic conductivity and unconfined compressive strength (UCS). Typically, the physical performance goals are a UCS of 50 psi and a permeability of less than 10^{-6} centimeters per second (cm/sec) (EPA, 1997), and these values will be used for this TT. Portland cement is used in this step to determine the level of cementitious reagent that needs to be added to achieve the performance goals.

The Portland cement mixes with various cement levels will be developed in 1 day and cast in 2-inch-diameter brass tubes. Six cylinders will be prepared for each mix, giving a total of 30 cylinders for a total of 5 mixes. Five cylinders from each group will be cured at ambient temperature under moist conditions, and one will be cured in water at a temperature of 65 degrees Celsius to accelerate curing. The accelerated curing test simulates hardness development with longer curing times allowing comparison of strength development in the mixes over time. Cylinder testing is summarized in **Table 4-3**.

TABLE 4-3
ISS Bench-scale Test Analyses
American Creosote Works Superfund Site
Winnfield, LA

Test Description	Test Method	No. of Samples
Baseline Mix Development		
Treated Soil (A total of 5 mixes and 6 duplicates or cylinders per mix)		
Moisture Content	ASTM D2216	5
Slump and Density	ASTM C143 mod.	5
Accelerated Cure	ASTM C684 mod.	5
Treated Soil pH	API RP 13B-1	5
Penetration Resistance (1, 3, and 5 days)	ASTM D1558	5
UCS (7 days and Accelerated Cure)	ASTM D1633/D4832	10
Hydraulic Conductivity	ASTM D5084	1
Slake Immersion	ASTM D4644 mod	1
SPLP (TOC, PAHs [including naphthalene], Benzene, and PCP)	EPA 1312/SW-846	3
Mix Development by Addition of Other Reagents		
Treated Soil (A total of 15 mixes and 6 duplicates or cylinders per mix)		
Moisture Content	ASTM D2216	15
Slump and Density	ASTM C143 mod.	5
Accelerated Cure	ASTM C684 mod.	15
Treated Soil pH	API RP 13B-1	5
Penetration Resistance (1, 3, and 5 days)	ASTM D1558	15
UCS (7 days and Accelerated Cure)	ASTM D1633/D4832	30
Swell (theoretical and measured)	Weight & Volume	5
Hydraulic Conductivity	ASTM D5084	5
SPLP (TOC, PAHs, Benzene, and PCP)	EPA 1312/SW-846	10
Permeate Analyses (PAHs [including naphthalene], Benzene, and PCP)	SW-846	10

TABLE 4-3
ISS Bench-scale Test Analyses
American Creosote Works Superfund Site
Winnfield, LA

Test Description	Test Method	No. of Samples
Final Mix Development		
Treated Soil (A total of 2 mixes and 6 duplicates or cylinders per mix)		
Moisture Content	ASTM D2216	2
Slump and Density	ASTM C143 mod.	2
Treated Soil pH	API RP 13B-1	2
Penetration Resistance (1, 3, and 5 days)	ASTM D1558	2
UCS (7 and 28 days)	ASTM D1633/D4832	4
Swell (theoretical and measured)	Weight & Volume	2
Slake Immersion	ASTM D4644 mod	2
Hydraulic Conductivity	ASTM D5084	2
SPLP (TOC, PAHs, Benzene, and PCP)	EPA 1312/SW-846	2
Permeate Analyses (PAHs [including naphthalene], Benzene, and PCP)	SW-846	1
Volume Swell	NA	2

Notes:

API = American Petroleum Institute

ASTM = ASTM International (formerly American Society of Testing and Materials

SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Method

The pocket penetrometer measurements are used to compare strength development rates, but are not quantitative in terms of UCS. The UCS measurements will be made after a 7-day curing period for both the ambient and accelerated cure samples. The results of the baseline mix development tests will establish the conditions for the remaining tests in the next steps.

Mix Development by Addition of Other Reagents

Additional and/or substitute reagents can potentially improve the performance of the Portland cement mix by lowering physical permeability, leachability, and cost. The remaining bench-scale testing will be conducted to ensure the selected final mix is optimal for the site conditions. Fifteen additional mix ratios will be tested where each mix will consist of Portland cement, bentonite, and one of the five short-listed materials. Various combinations of the mix reagents will be tested.

A total of 6 cylinders per mix or 90 cylinders will be prepared in this step. All of the samples will be tested for UCS, and 10 mixes will also be tested for SPLP. Five samples will be tested for permeability after a 14-day cure. In the five permeability tests, the permeate generated will be analyzed for PAHs, including naphthalene, BTEX, and PCP, to compare the concentrations of the permeate water with the SPLP results. SPLP for naphthalene is normally higher than the results from the permeate water samples, because SPLP involves crushing the samples prior to the leaching procedure, while permeate sample is collected from the monolith of the treated soil. Finally, a long-term test will be conducted by immersing one or two stabilized samples in groundwater to demonstrate that the stabilized monolith maintains its physical integrity with time. This test will last approximately 84 days.

Analyses will be conducted on the grout and treated soil as detailed in **Table 4-3**. In addition, permeate from approximately five mixes will be collected during the permeability tests and analyzed for PAHs, including naphthalene, benzene, and PCP. Results of all of the analyses will provide data to determine which formula is most efficient at reducing permeability and organic compound leaching. Two formulas will be selected to proceed for final tests of refinements in the next step.

Final Mix Development – Performance Improvement in the Long Term

The purpose of this step is to gather volume, strength, permeability, and leachability data on two final mixes with longer curing times (14 and 28 days), to demonstrate duplication of the results of previous tests and quantify improvements in these parameters over time. A final mix will be selected and recommended for the in situ soil mixing and stabilization. A cost comparison will also be conducted during this step to evaluate the cost effectiveness of the mixes.

A total of 12 cylinders will be prepared for the 2 mixes with 6 cylinders per mix. Analyses will be conducted as summarized in **Table 4-3**. In addition, the volume increase of the stabilized soils will be evaluated by mixing the soil and reagents and placing the mix in volume-specific containers. The volume of the cured material will be compared to the original soil volume.

4.4 Field Test Performance Sampling

Performance sampling will be conducted at the two test areas as outlined in **Sections 4.4.1** and **4.4.2.** Performance sampling at Test Area 2 will be conducted after 10 weeks of injection while groundwater at Test Area 1 will be monitored periodically for presence of peroxide using field test kits. When oxidant is no longer present, the performance monitoring will be conducted. Performance sampling at both sites will include collection of soil and groundwater samples to characterize post-test conditions and provide data for comparison to pre-treatment samples. The locations of samples to be collected are shown on **Figures 4-1** and **4-2**. The sample parameters and quantity of materials to be collected are summarized in **Table 4-4.** Samples will be collected and analyzed according to the procedures outlined in the QAPP and **Appendix B**.

TABLE 4-4
Performance Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Sample Number and Volume Requirements
ISCO Pilot-scale Test			
ISCOP1AS (15 to 18 feet bgs)	Soil	SVOCs	One 4-oz jar
ISCOP1BS (19 to 22 feet bgs)		BTEX	One 4-oz jar
ISCOP1CS (23 to 26 feet bgs)		SPLP	One 4-oz jar
ISCOP2AS (15 to 18 feet bgs)		TOC	One 4-oz jar
ISCOP2BS (19 to 22 feet bgs)		TPH	Three VOA vials (cores extruded from Terracore)
ISCOP2CS (23 to 26 feet bgs)			
ISCOP3AS (15 to 18 feet bgs)			
ISCOP3BS (19 to 22 feet bgs)			
ISCOP3CS (23 to 26 feet bgs)			
ISCOP4AS (15 to 18 feet bgs)			
ISCOP4BS (19 to 22 feet bgs)			
ISCOP4CS (23 to 26 feet bgs)			
ISCOP5AS (15 to 18 feet bgs)			
ISCOP5BS (19 to 22 feet bgs)			
ISCOP5CS (23 to 26 feet bgs)			
ISCOP6AS (15 to 18 feet bgs)			
ISCOP6BS (19 to 22 feet bgs)			
ISCOP6CS (23 to 26 feet bgs)			
ISCOP1AW (19 to 22 feet bgs)	Groundwater	SVOCs	One 1-L amber
ISCOP1BW (23 to 26 feet bgs)		BTEX	Three 40-mL VOA
ISCOP2AW (19 to 22 feet bgs)		TOC	One 500-mL plastic
ISCOP2BW (23 to 26 feet bgs)		TPH	Two 40-mL VOA
ISCOP3AW (19 to 22 feet bgs)			
ISCOP3BW (23 to 26 feet bgs)			
ISCOP4AW (19 to 22 feet bgs)			
ISCOP4BW (23 to 26 feet bgs)			
ISCOP5AW (19 to 22 feet bgs)			
ISCOP5BW (23 to 26 feet bgs)			
ISCOP6AW (19 to 22 feet bgs)			
ISCOP6BW (23 to 26 feet bgs)			
I-5			
S-EPR Pilot-Scale Test			
SEPRP1AS (15 to 18 feet bgs)	Soil	SVOCs	One 4-oz jar
SEPRP1BS (19 to 22 feet bgs)		BTEX	One 4-oz jar
SEPRP1CS (23 to 26 feet bgs)		SPLP	One 4-oz jar
SEPRP2AS (15 to 18 feet bgs)		TOC	One 4-oz jar
SEPRP2BS (19 to 22 feet bgs)		TPH	Three VOA vials (cores extruded from
SEPRP2CS (23 to 26 feet bgs)			

TABLE 4-4
Performance Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Sample Number and Volume Requirements
SEPRP3AS (15 to 18 feet bgs)			Terracore)
SEPRP3BS (19 to 22 feet bgs)			
SEPRP3CS (23 to 26 feet bgs)			
SEPRP4AS (15 to 18 feet bgs)			
SEPRP4BS (19 to 22 feet bgs)			
SEPRP4CS (23 to 26 feet bgs)			
SEPRP5AS (15 to 18 feet bgs)			
SEPRP5BS (19 to 22 feet bgs)			
SEPRP5CS (23 to 26 feet bgs)			
SEPRP6AS (15 to 18 feet bgs)			
SEPRP6BS (19 to 22 feet bgs)			
SEPRP6CS (23 to 26 feet bgs)			
SEPRP7AS (15 to 18 feet bgs)			
SEPRP7BS (19 to 22 feet bgs)			
SEPRP7CS (23 to 26 feet bgs)			
SEPRP8AS (15 to 18 feet bgs)			
SEPRP8BS (19 to 22 feet bgs)			
SEPRP8CS (23 to 26 feet bgs)			
SEPRP9AS (15 to 18 feet bgs)			
SEPRP9BS (19 to 22 feet bgs)			
SEPRP9CS (23 to 26 feet bgs)			
SEPRP1AW (19 to 22 feet bgs)	Groundwater	SVOCs	One 1-L amber
SEPRP1BW (23 to 26 feet bgs)		BTEX	Three 40-mL VOA
SEPRP2AW (19 to 22 feet bgs)		TOC	One 500-mL plastic
SEPRP2BW (23 to 26 feet bgs)		TPH	Two 40-mL VOA
SEPRP2AW (19 to 22 feet bgs)			
SEPRP2BW (23 to 26 feet bgs)			
SEPRP3AW (19 to 22 feet bgs)			
SEPRP3BW (23 to 26 feet bgs)			
SEPRP4AW (19 to 22 feet bgs)			
SEPRP4BW (23 to 26 feet bgs)			
SEPRP5AW (19 to 22 feet bgs)			
SEPRP5BW (23 to 26 feet bgs)			
SEPRP6AW (19 to 22 feet bgs)			
SEPRP6BW (23 to 26 feet bgs)			
SEPRP7AW (19 to 22 feet bgs)			
SEPRP7BW (23 to 26 feet bgs)			
SEPRP8AW (19 to 22 feet bgs)			
SEPRP8BW (23 to 26 feet bgs)			

TABLE 4-4
Performance Sampling Requirements
American Creosote Works Superfund Site
Winnfield, LA

Sample ID	Media	Analyte	Sample Number and Volume Requirements
SEPRP9AW (19 to 22 feet bgs)			
SEPRP9BW (23 to 26 feet bgs)			
I-7			
R-5			
R-9			
R-10			
R-12			
R-15			
R-17			
R-18			
PLTS			
Effluent Samples	Treated Water	SVOCs	One 1-L amber
		BTEX	Three 40-mL VOA
		TOC	One 500-mL plastic
		TPH	Two 40-mL VOA

4.4.1 ISCO

Soil samples will be collected from three vertical ranges (15 to 18, 19 to 22, and 23 to 26 feet bgs), and groundwater samples will be collected within the same vertical range as the injection well screen intervals (19 to 22 feet bgs and 23 to 26 feet bgs). The locations of samples to be collected are shown on **Figure 4-1**. The sample parameters and quantity of materials to be collected are summarized in **Table 4-3**. Samples will be collected and analyzed according to the procedures outlined in the FOP, Draft QAPP, and **Appendix B**.

4.4.2 S-EPR

Soil samples will be collected from three vertical ranges (15 to 18, 19 to 22, and 23 to 26 feet bgs), and groundwater samples will be collected within the vertical range of the injection well screen intervals. The injection wells will be screened from 17 to 27 feet bgs, and groundwater samples will be collected 19 to 22 feet bgs and 23 to 26 feet bgs. The locations of samples to be collected are shown on **Figure 4-2**. The sample parameters and quantity of materials to be collected are summarized in **Table 4-3**. Samples will be collected and analyzed according to the procedures outlined in the FOP, Draft QAPP, and **Appendix B**.

4.4.3 PLTS Effluent

Water samples will be collected from the PLTS effluent on a once to twice per week basis during discharge of the frac tanks.

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SECTION 5

Data Analysis and Interpretation

5.1 ISCO and S-EPR Pilot-Scale Tests

Process and performance monitoring data will be used to evaluate the following parameters:

- **Ability to distribute chemicals and ROI.** Process data, such as flow rate and pressure, collected during the injection phases will be used to determine if it is possible to get adequate physical distribution of either oxidants or surfactants in the formation using either existing injection wells or new injection wells, and what the ROI around each injection point is. If it is not possible to inject chemicals efficiently, the injection well spacing may be reduced or alternative methods identified to allow for technology development and evaluation in the FS.

- **DNAPL recovery.** The data will be used to determine the ability of the ISCO and S-EPR processes to enhance DNAPL recovery at the Site. If little or no increase in the DNAPL mass recovery rate is observed, the technology may not be retained for further consideration in the FS.

- **DNAPL removal.** Visual soil logging and laboratory analysis data will be used to determine if the mass/volume of mobile and/or residual DNAPL has been reduced in the aquifer. If there is little or no change in the DNAPL mass/volume present within the treatment area, the technology may not be retained for further consideration in the FS.

- **Dissolved-phase treatment.** The data will be used to determine if either the ISCO or S-EPR processes are able to reduce dissolved-phase contaminant concentrations. If a change in the dissolved-phase contaminant concentrations is not immediately observed, or detected through routine groundwater monitoring conducted under the LTRA task order, the technology may not be retained for further consideration in the FS.

- **Impact to the PLTS.** If adverse conditions develop in the PLTS as a result of the application, the PLTS treatment modifications will be identified.

5.2 ISS Bench-scale Test

The ISS test program is a procedure of screening and improving of reagent mixes as tests proceed. Thus, the data from one step will be used to evaluate the performance and refine reagent mixes for the next step. By the end of the test program, a final mix that meets the following performance goals will be generated:

- **UCS.** If the final mix is not able to attain a UCS greater than 50 psi after curing, the technology may not be retained for further consideration in the FS.

- **Permeability.** If a monolith permeability less than 10^{-6} cm/sec cannot be attained after curing, the technology may not be retained for further consideration in the FS.

The treated soil that meets the above performance goals will reduce the NAPL mobility and contribution to the dissolved-phase concentrations. Permeate concentrations of the contaminants will be used to evaluate the leachability of the treated soil, which may be used in the consideration of other technology being coupled with the stabilization to reach overall project goals.

SECTION 6

Reports

A report describing the TT processes and results will be issued at the conclusion of the testing. The Project Manager will update the Task Order Manager on testing progress through monthly status reports.

A draft report outline is provided below:

1 Introduction
    1.1 Overview of Work Performed
        1.1.1 ISCO Pilot Test
        1.1.2 S-EPR Pilot Test
        1.1.3 ISS Bench Test
    1.2 Summary of Findings
2 ISCO Pilot Test
    2.1 Field Activities
    2.2 Results
3 S-EPR Pilot Test
    3.1 Field Activities
    3.2 Results
4 ISS Bench Test
    4.1 Test Methods
    4.2 Results
5 Recommendations
6 Works Cited

Tables

Figures

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SECTION 7
Schedule

The overall project schedule is provided in the FS Work Plan (CH2M HILL, 2010b). The TT is tentatively scheduled to begin the last week of November 2011 and continue through the last week of March 2012. Baseline sample collection will occur during field activities scheduled to start the second week of November 2011 and last 10 days. Preparation of the TT report will begin during the TT and require approximately 1 month to complete. Refinements to the schedule are likely based upon observations as the work progresses and will be communicated by the Project Manager to the TT personnel and the EPA Remedial Project Manager/Task Order Manager. The baseline schedule is provided in **Appendix D**.

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SECTION 8

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Figures

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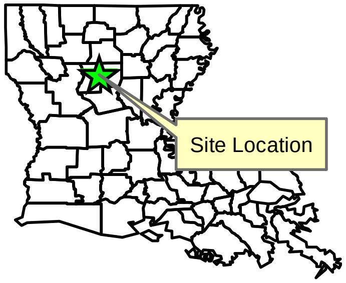

LEGEND

Location of CSM Section Shown in Figure 1-3

FIGURE 1-1
Facility Map
American Creosote Works
Superfund Site
Winnfield, LA

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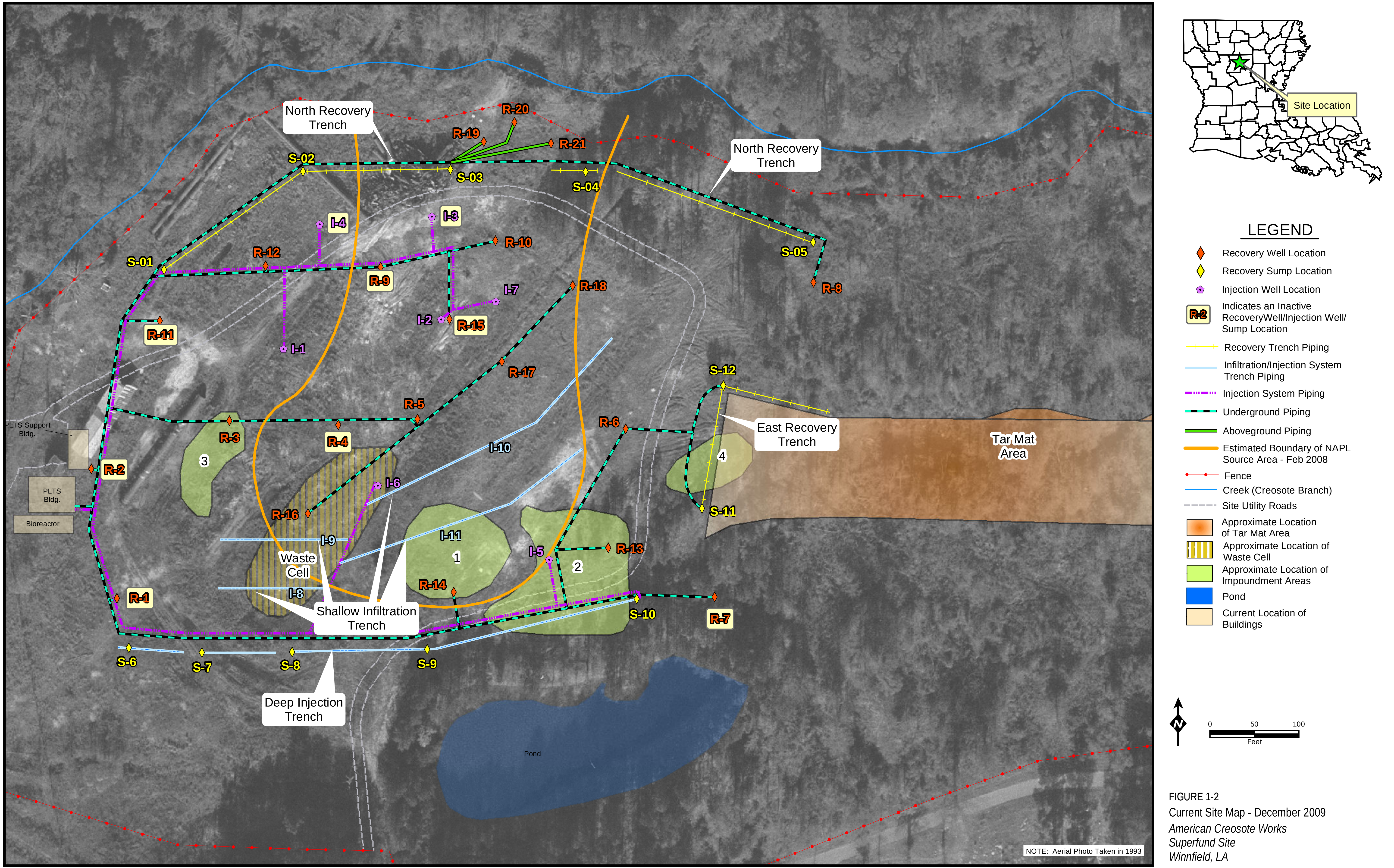

FIGURE 1-2
Current Site Map - December 2009
American Creosote Works
Superfund Site
Winnfield, LA

\\HOLLISTER\GROUPS\IS\PROJ\AMERICAN_CREOSOTE\APR-MXD\CURRENT_SITE_MAP.MXD GTWIGG 10/7/2010 12:40:14

CH2MHILL

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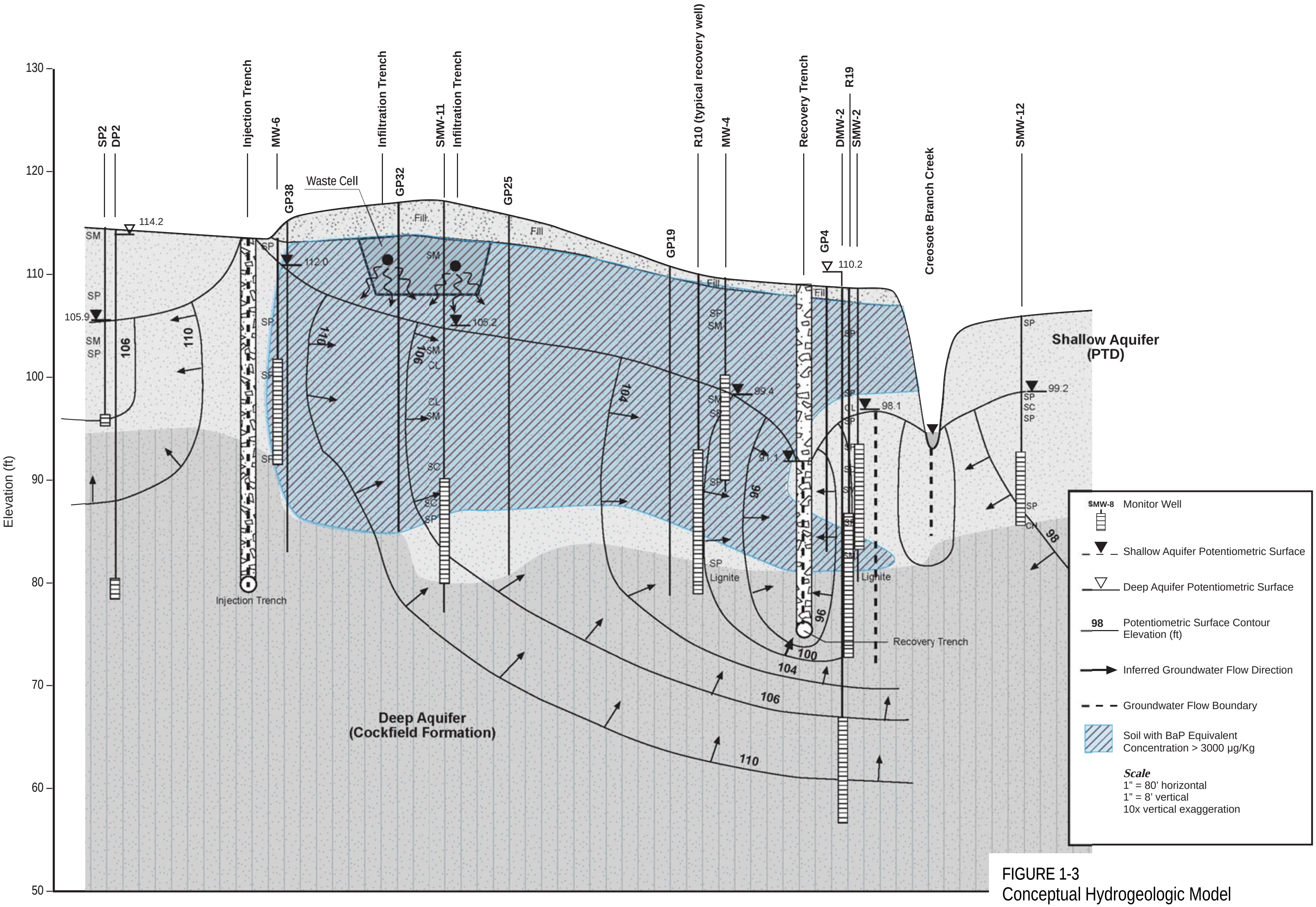

FIGURE 1-3
Conceptual Hydrogeologic Model
American Creosote Works Superfund Site
Winnfield, LA

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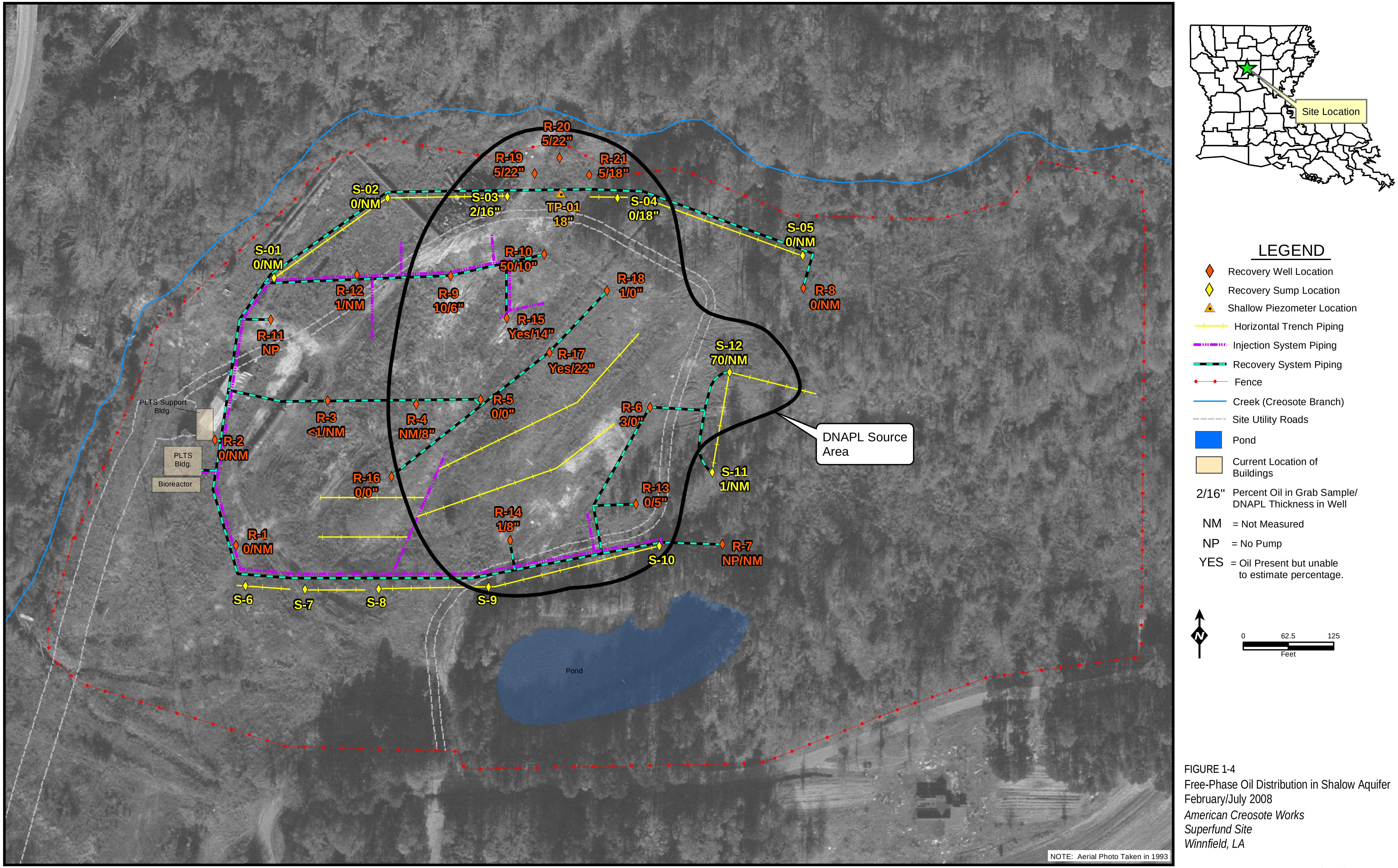

FIGURE 1-4

Free-Phase Oil Distribution in Shalow Aquifer

February/July 2008

American Creosote Works

Superfund Site

Winnfield, LA

CH2M**HILL**

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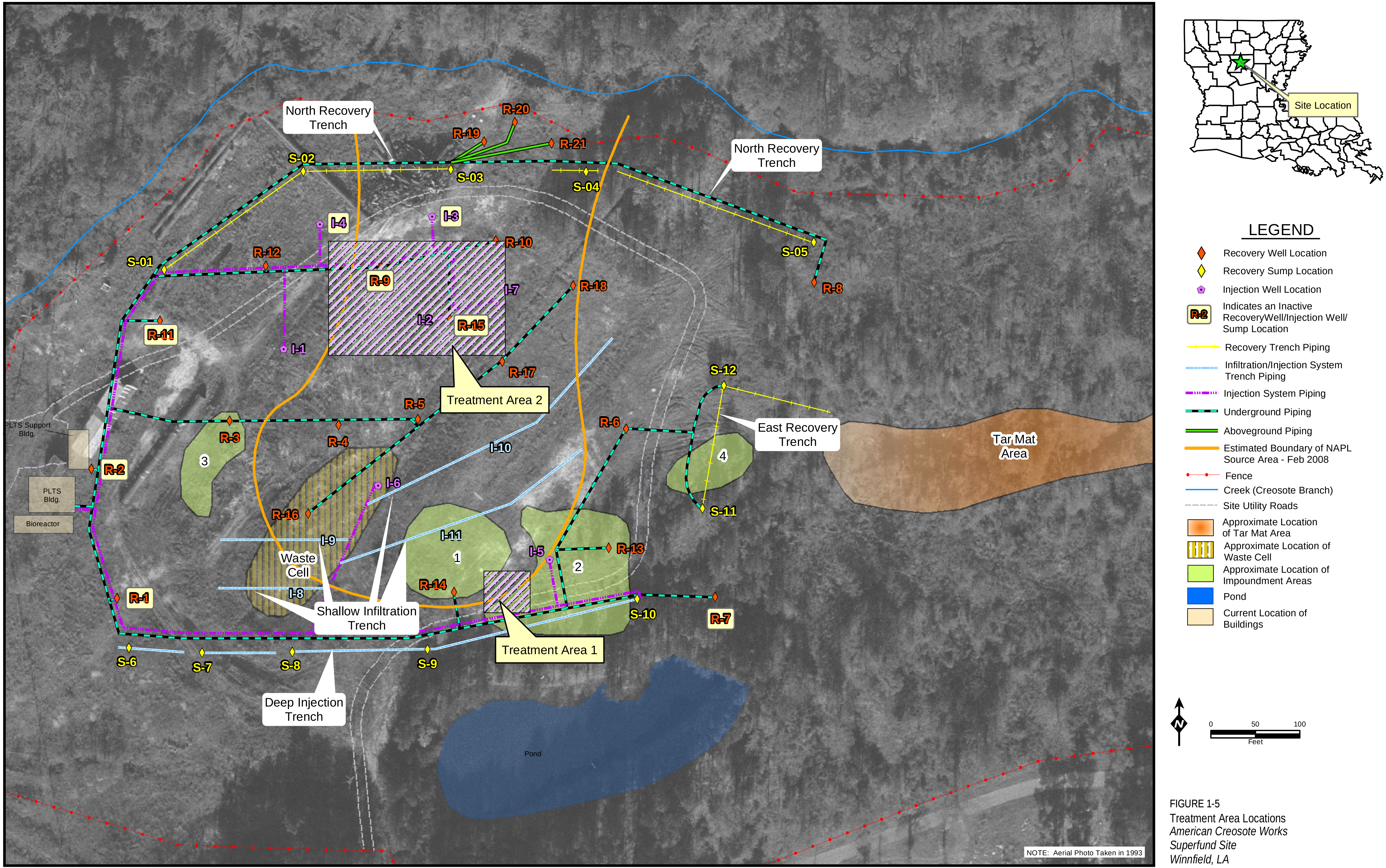

FIGURE 1-5
Treatment Area Locations
American Creosote Works
Superfund Site
Winnfield, LA

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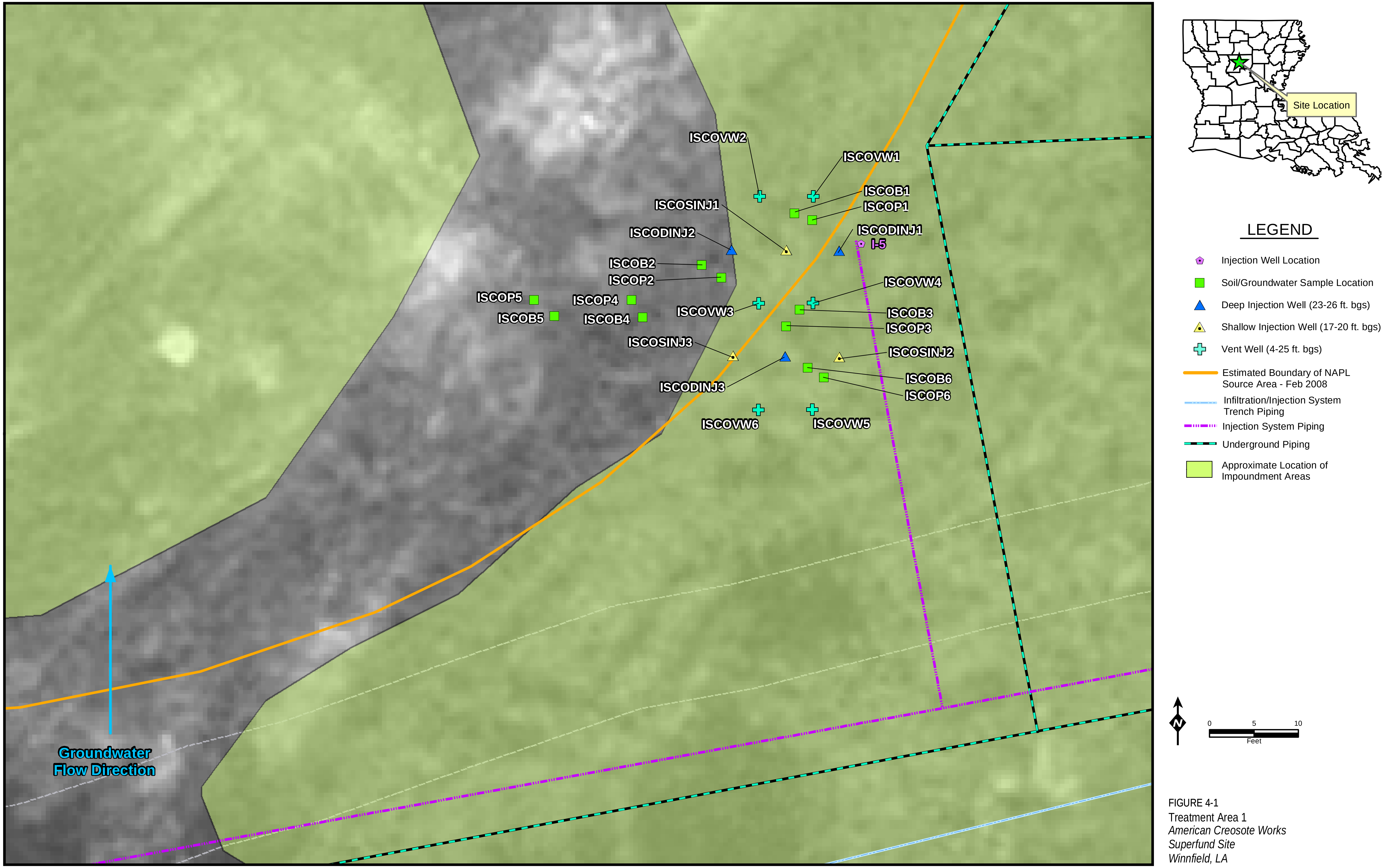

FIGURE 4-1
Treatment Area 1
American Creosote Works
Superfund Site
Winnfield, LA

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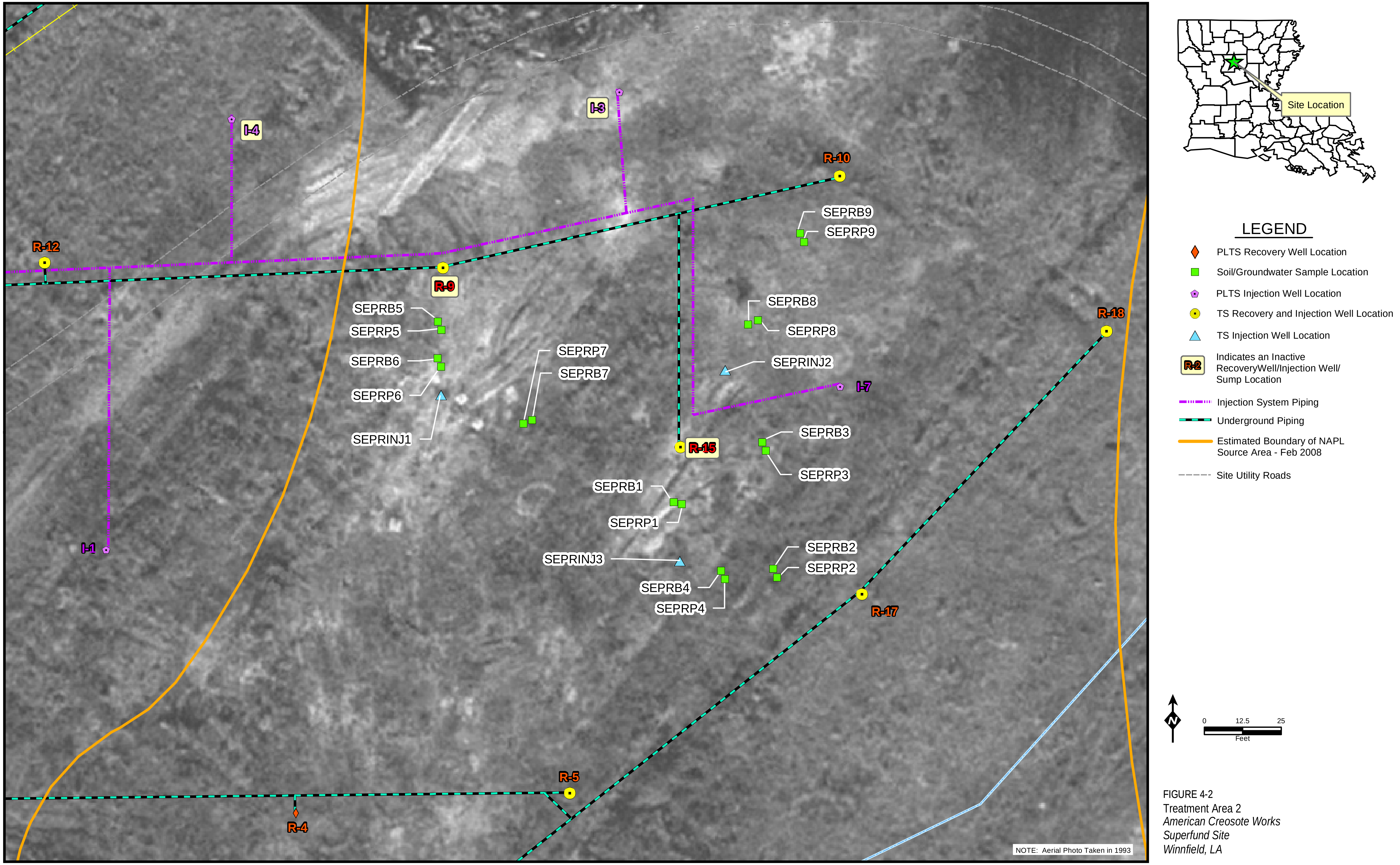

FIGURE 4-2
Treatment Area 2
American Creosote Works
Superfund Site
Winnfield, LA

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Appendix A
Health and Safety Plan Addendum

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REMEDIAL ACTION CONTRACT

United States Environmental Protection Agency Region 6

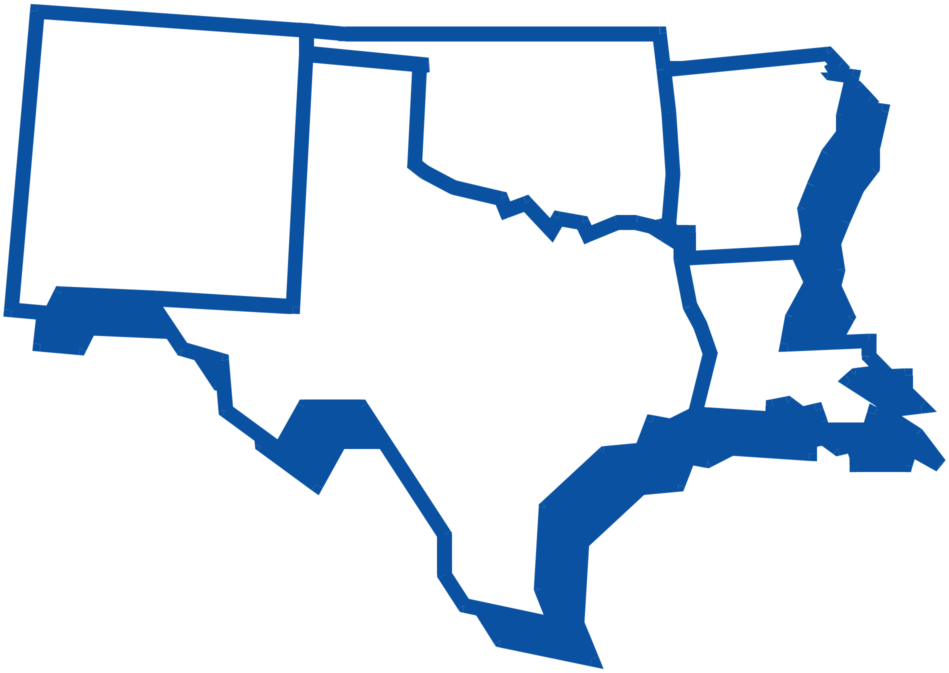
Contract No. EP-W-06-021

Health and Safety Plan
Addendum

American Creosote Works Site
Feasibility Study
Winnfield, Louisiana

Task Order No. 0051-RIFS-06G3
Document Control No. 0051-02001

October 2010



CH2MHILL

In Association With:
Weston Solutions
Geo-Marine, Inc.
E2 Consulting Engineers, Inc.
Arrowhead Contracting, Inc.

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American Creosote Works Site
Feasibility Study

Health and Safety Plan Addendum

Prepared for

U.S. Environmental Protection Agency

Contract No. EP-W-06-021
Task Order 0051-RIFS-06G3
CH2M HILL Project No. 411242
DCN 0051-02001

October 2010

CH2MHILL
12377 Merit Drive
Dallas, Texas 75251

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Contents

Tables

Figures

Attachments

Approval Sheet

This site-specific Health and Safety Plan (HSP) Addendum has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this HSP, the Responsible Health and Safety Manager (RHSM) certifies that the personal protective equipment has been selected based on the project-specific hazard assessment.

Original Plan

RHSM Approval: **Date:**

Field Operations Manager Approval: **Date:**

Revisions

Revisions Made By: **Date:**

Description of Revisions to Plan:

Revisions Approved By: **Date:**

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SECTION 1

Introduction

This Addendum to the Health and Safety Plan (HSP) American Creosote Works (CH2M HILL, 2010) was developed to address Treatability Study specific activities not already covered in the HSP. For complete understanding of the health and safety issues at the site, both documents must be used.

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SECTION 2

Applicability

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 3

General Project Information

3.1 Project Information and Background

Project Number: 411242

Client: EPA Region VI Dallas, Texas

Project/Site Name: American Creosote Works, Winn Parish, Winnfield, Louisiana

Site Address: 1109 Front Street, Winnfield, LA

CH2M HILL Project Manager: John Knott

CH2M HILL Office: Dallas-Fort Worth

DATE HSP Addendum Prepared: October 5, 2010

Date(s) of Site Work: November 1, 2010 through May 30, 2011

SITE ACCESS: The site is surrounded by a chain link fence and has a locked gate. A remedial action is currently ongoing at the site, which includes a groundwater treatment system building with full-time operators.

SITE SIZE: 34 acres

SITE TOPOGRAPHY: The site is flat and typical of central Louisiana. It has a gravel access road from the gate to the groundwater treatment plant. Access is by car and foot. The wellfield area has a 1-foot clay cover over all remaining contaminated soil. The surface is defined clean due to the cover.

PREVAILING WEATHER: Average temperatures in the summer range between 70°F to 95° F with high humidity. Rainfall should be anticipated in the afternoons. Winter conditions are mild to cool with temperatures ranging from the low 40s °F overnight to the 60s °F in daylight hours.

SITE DESCRIPTION AND HISTORY: The earliest records of the American Creosote Site date back to the turn of the century (early 1900s) when it was reportedly developed as a creosote wood-treating facility. Over the years the plant operated under the ownership of various companies. The first, which was Bodeau Lumber Co., began operations in 1901. Louisiana Creosoting Co. acquired 22 acres of the property in 1922 and resold the parcel of land to American Creosote Works of Louisiana, Inc. in 1938. In 1950, the entire property, along with 12 additional acres, was sold to American Creosote, which was bought out by Dickson Lumber Co. in 1977. The property was seized by the City of Winnfield for back taxes after Dickson declared bankruptcy. Wood treatment operations were taken over by Stallworth Timber in 1980, which abandoned the site in 1985.

During the operating history of the plant, there were apparently numerous releases of creosote and creosote- bearing wastes onto the site and into a series of pits connected to a neighboring creek. Sources of contamination at the site include five unlined pits used for the disposal of wastes generated by the wood-treating process, storage areas containing creosote, treated and untreated wood, and the plant at which the wood-treating operations took place. Contamination was also caused by discharges into onsite drainage ditches that received surface water run-off from the facility. The site was included on the National Priorities List by the EPA in 1992 with a HRS Score of 50.70. A Remedial Investigation (RI) was conducted in 1992, the Feasibility Study (FS) was completed in 1992, and the Record of Decision was signed on April 28, 1993.

The remedial action contract for incineration, bio-remediation of waste left in place, and pump-and-treat of the ground water was signed in June 1994. The U.S. Army Corps of Engineers (USACE) resident office was established at the site in December 1994. The USACE was the contracting officer for EPA during construction. The remedial design was completed in May 1996 and the onsite mobile incinerator was installed and tested in December 1996. The incineration phase for the 25,000 cubic yards of heavily contaminated material was completed in February 1998.

Construction of the fluids extraction and treatment system (PLTS) was completed and operations commenced in October 1996. The system has operated continuously since October 1996 recovering approximately 192,000 gallons of creosote and creosote emulsion from 79 million gallons of total fluids pumped. The system is expected to operate for the foreseeable future.

CH2M HILL assumed responsibility for site operations on September 30, 1999, hiring the onsite staff from IT Corporation when the contract was transferred.

3.1.1 General Wastes and Waste Volumes

The principal contaminants in site soil include pentachlorophenol (PCP) detected at concentrations up to 6,000 parts per million (ppm) in tar residue, and carcinogenic polynuclear aromatic hydrocarbons (PAHs) detected at concentrations up to 500 ppm. These are pre-treatment concentrations and such values would only be found today in the waste material lying beneath the clay cover undergoing treatment via in situ bioremediation. Groundwater contaminants are of the same type with total PAH concentrations ranging from less than 0.0002 ppm to 100 ppm, PCP concentrations ranging from less than 0.05 ppm to 0.9 ppm, and total benzene, toluene, ethylbenzene and xylene (BTEX) concentrations ranging from less than 0.001 parts per billion (ppb) to 150 ppb. Benzene concentrations generally range from less than 0.001 ppm to 0.3 ppm. Several recovery wells and trench sumps also contain free-phase creosote. Additional information on these contaminants is provided in Section 2.5.

Remedial actions conducted since 1993 include excavation and incineration of 25,000 cubic yards of heavily contaminated soil from Tar Mat area, consolidation of less contaminated surface soil in Waste Cell area, and installation of a fluids (groundwater and free phase oil) extraction and treatment system. Deep subsurface contaminated soil and material consolidated in the Waste Cell is currently undergoing in situ biodegradation treatment. The fluids extraction and treatment system will address approximately 24 million gallons of contaminated ground water and 400,000 gallons of immobile and free phase creosote product within the shallow aquifer, present at depths between about 15 and 30 feet below ground surface.

3.1.2 Present Status and Issues

The U. S. Environmental Protection Agency, Region 6 (EPA) has retained CH2M HILL, Inc., under the EPA Region 6 Response Action Contract EP-W-06-021, Task Order No. 0042, to perform Treatability Study (TT) activities. The TT Study consists of three tests: in-situ chemical oxidation (ISCO), surfactant-enhanced product removal (SEPR) product removal, and in-situ stabilization. The objective of the TT study is to evaluate performance of three technologies (ISCO, SEPR, and stabilization) to address areas of residual (immobile) and/or mobile DNAPL present at the Site.

Process monitoring and data recording during the ISCO injection will be conducted by Geocleanse International, Inc. (GCI). Similarly, the SEPR/S-ISCO test field work will be conducted by VeruTEK and Evergreen Resources Group Inc. (ERGI) with oversite by CH2M HILL.

3.1.3 CH2M HILL Project Activities

CH2M HILL project activities during the TT Study will include operation and maintenance (O&M) of the PLTS, fluid extraction equipment (wells, trench and pumps) and bioremediation, chemical oxidation, and surfactant injection systems (wells and trench), site maintenance and security, performance monitoring, well installation, and subsurface investigation. This work generally requires the following field activities:

Normal Operations

- Monitoring and injection well sampling/bailing, extraction wellhead sampling, and water level measurements
- PLTS and tank liquids sampling
- On-going PLTS operational tasks
  - Tank/Bioreactor water level checks/meter readings
  - Pumping down sludge/lamella/NAPL concentrator tanks
  - Transfer of recovered creosote (NAPL) from storage tank to tanker transfer truck.
- Handling/mixing pilot test chemicals: hydrogen peroxide, and surfactant-enhanced product recovery chemicals.
- Monitor well and piezometer installation, subsurface investigations (soil borings),
- Surface water and sediment sampling, stormwater sampling, biosolids sampling.

Maintenance Operations

- Well system equipment repairs/replacements (pumps and piping)
- PLTS and pilot test equipment repairs/replacement
- Electrical/pumps and motor repair
- Oil/water separator drive chain repair
- Sand/carbon filter change-out

- Grounds maintenance (mowing and trimming) that includes heavy and light equipment operation

3.2 Site Background and Setting

A current map of the ACW site and TT Study locations are provided in Figure 1-2 and 1-4 of the main text.

3.3 Description of Tasks

Refer to project documents (i.e., Field Sampling Plan, Quality Assurance Project Plan, Site Management Plan, and TT Study Plan and other site-specific plans) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Additional TT Study activities require an approved amendment or revision to this plan before tasks begin. Subcontractors will provide these additional task-specific hazard controls and requirements prior to TT Study activities. Refer to Section 3.3.2 for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

3.3.1 Hazwoper-Regulated Tasks

The Treatability Study will be comprised of several phases of work, performed by CH2M Hill and Subcontractors including:

- Pre-test mobilization activities
- Baseline sampling
- Technology testing
- Performance sampling

The following tasks will be included in each phase:

Pre-Test Operations

- Monitoring, vent/recovery and piezometer installation
- Well system equipment repairs/replacements (pumps and piping)
- Plumbing of existing system wells to pilot testing equipment
- Well rehabilitation activities, including injection of preliminary S-EPR™
- Staging of frac tanks, water level checks, storage and sampling of well rehabilitation groundwater

Baseline and Performance Testing Operations

- Subsurface soil and groundwater sampling
- DNAPL sample collection

Technology Testing Operations

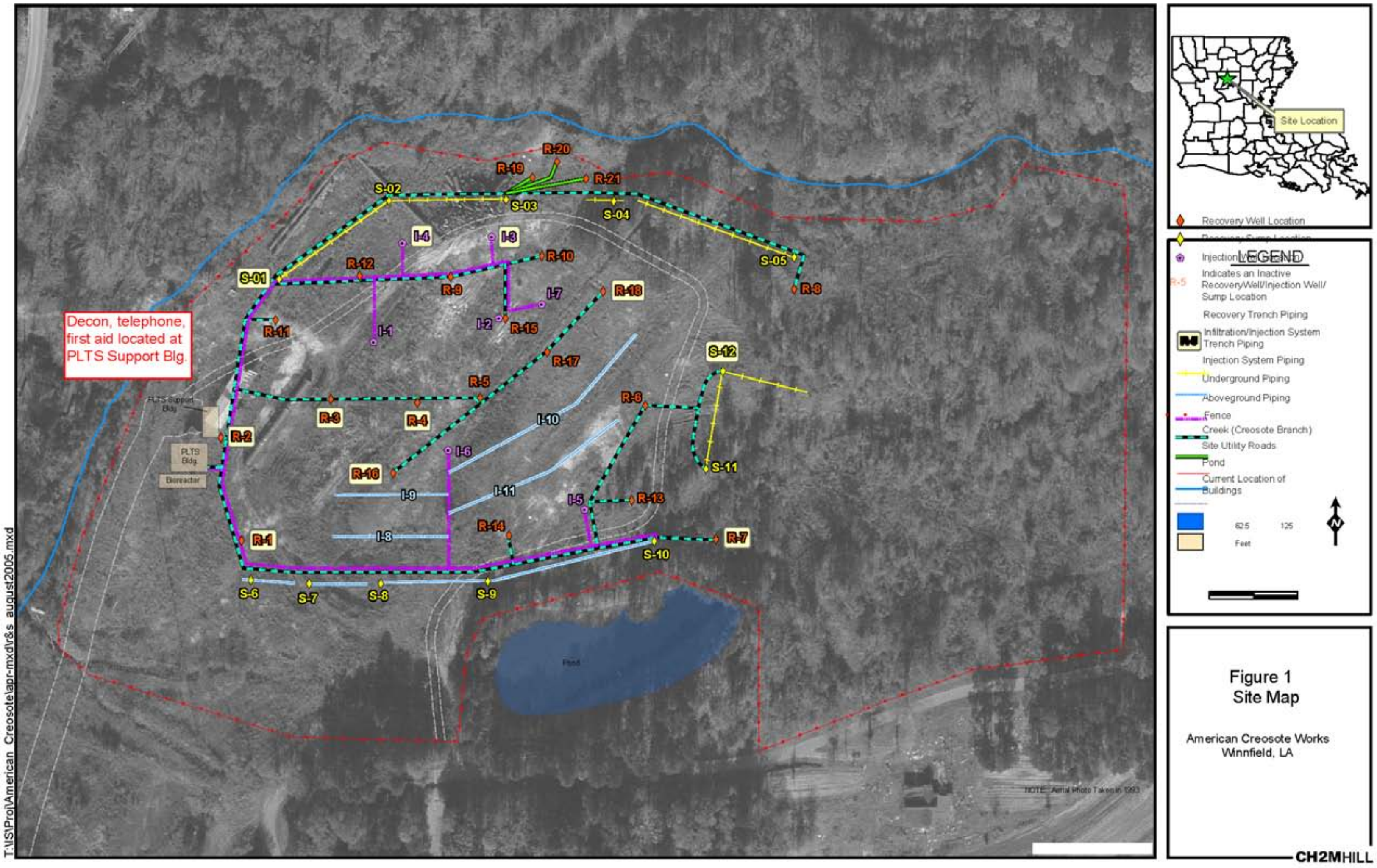
- Handling/mixing pilot test chemicals: hydrogen peroxide, S-EPR™, and S-ISCO®
- Load-out and decon of NAPL and chemical storage tanks
- Tank water level measurements
- PLTS and pilot test equipment repairs/replacement
- Transfer of contaminant laden groundwater

3.3.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. Contact the Responsible Health and Safety Manager prior to using non-Hazwoper-trained personnel for the following tasks when working on a regulated hazardous waste site.

Tasks	**Controls**
• Utility locate activities • Surveying TT Study Areas • Onsite administration (billing, reporting, training)	• A trained Hazwoper person must be onsite during these actions

FIGURE 3-1
Site Map



SECTION 4

Project Organization and Responsibilities

4.1 Client

See the HSP American Creosote Works (CH2M HILL, 2010).

4.2 CH2M HILL

See the HSP American Creosote Works (CH2M HILL, 2010).

4.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts and Subcontracts)*

CH2M HILL subcontractors performing onsite Hazwoper activities for the TT Study include VeruTEK, Evergreen Resources Group Inc. (ERGI), and Geo-Cleanse International, Inc (GCI). Associated personnel provide drilling, injection and extraction oversite, performance evaluation, and groundwater monitoring support. From time to time, subcontractors may be contracted to support specific activities, such as surveying or transportation and disposal. When this occurs, the subcontract terms and conditions require subcontractor staff to adhere to the CH2M HILL HSP and addendums.

Subcontractors must comply with the following activities, and are responsible to:

- Comply with all local, state, and federal safety standards;
- Comply with project and owner safety requirements;
- Actively participate in the project safety program and either hold or attend and participate in all required safety meetings;
- Provide a qualified safety representative to interface with CH2M HILL;
- Maintain safety equipment and PPE for their employees;
- Maintain and replace safety protection systems damaged or removed by the subcontractor's operations;
- Notify the SC of any accident, injury, or incident immediately and submit reports to CH2M HILL within 24 hours;
- Install contractually required general conditions for safety (for example, handrail, fencing, fall protection systems, floor opening covers);
- Conduct and document weekly safety inspections of project-specific tasks and associated work areas;

- Conduct site-specific and job-specific training for all subcontractor employees, including review of the CH2M HILL HSP, subcontractor HSPs, and subcontractor AHAs and sign appropriate sign-off forms; and
- Determine and implement necessary controls and corrective actions to correct unsafe conditions.

The subcontractors listed above may be required to submit their own site-specific HSP and other plans such as lead or asbestos abatement compliance plans. Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit their plans to CH2M HILL for review and acceptance before the start of field work.

Subcontractors are also required to prepare AHAs before beginning each activity posing hazards to their personnel. The AHA shall identify the principle steps of the activity, potential health and safety hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements, and training requirements for the safe operation of the equipment listed must be identified.

4.4 Employee Responsibilities

See the HSP American Creosote Works (CH2M HILL, 2010).

4.5 Client Contractors

See the HSP American Creosote Works (CH2M HILL, 2010).

SECTION 5

Standards of Conduct

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 6

Safety Planning and Change Management

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 7

Project Hazard Analysis

See the HSP American Creosote Works (CH2M HILL, 2010).

7.1 Activity Hazard Analysis

See the HSP American Creosote Works (CH2M HILL, 2010).

7.2 Subcontractor Activity Hazard Analysis

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor shall submit AHAs for their field activities, as defined in their scope of work, along with their project-specific safety plan and/or procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

The following AHAs have been provided by Subcontractors and are appended to this HSP as **Appendix 6**:

- Process Monitoring
- Vacuum Truck Operation
- Well Installation
- Injection of Peroxide

TABLE 7-1
Task Hazard Analysis(Refer to Section 8 for hazard controls)

POTENTIALHAZARDS	**TASKS**								
	Well system equipment repairs replacements	**PLTS pump/ equipment repairs replacement**	**Handling/mixing treatment plant chemical**	**Onsite laboratory measure-ments**	**Process/GW sampling**	**Observation of loading material for offsite disposal**	**Other Media Sampling**	**ISCO Injection and Extraction**	**SEPR Injection and Extraction**
Flying debris/objects	X	X	X	X	X		X	X	
Noise > 85dBA	X				X			X	
Electrical	X	X	X	X					
Suspended loads									
Buried utilities, drums, tanks	X							X	
Slip, trip, fall	X	X	X	X	X	X	X	X	X
Back injury	X	X	X	X	X	X	X		
Confined space entry									
Trenches / excavations									
Visible lightning	X	X	X	X	X	X	X	X	X
Vehicle traffic	X				X	X			
Elevated work areas/falls									
Fires				X					
Entanglement	X	X		X					
Drilling	X						X	X	
Heavy equipment	X	X						X	
IDW Drum Sampling							X		

SECTION 8

General Hazards and Controls

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 9

Project-Specific Hazard Controls

See the HSP American Creosote Works (CH2M HILL, 2010).

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the work or the particular hazard. Each person onsite is required to abide by the hazard controls. Consult the appropriate CH2M HILL SOP to ensure all requirements are implemented. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

Project-specific hazards for the S-ISCO test include: Chemical Delivery, Injection, and Process Monitoring. The following was provided by VeruTek®, who will complete the S-ISCO test.

9.1 S-ISCO® Chemical Delivery

Chemical delivery will be conducted by trained transport professionals. Once safely on site and properly stored within the secondary containment area, batching operations can occur. During S-ISCO® chemical batching, Site personnel working in the immediate area will be trained in the hazards of this operation, using the JSA written for the task. Prior to handling any of the S-ISCO® chemicals all Site personnel will be trained on the hazards and implications of chemical handling. This includes the proper PPE and decontamination procedures. Site personnel will be equipped with protective clothing and respirators when batching S-ISCO® chemicals.

9.2 S-ISCO® Chemical Injection and Process Monitoring

During S-ISCO® injections, treatment chemicals will be fed through an injection system into pressurized lines to individual injection wells. During this process, pressure within product lines may become a safety hazard. To mitigate this risk, relief valves will be strategically placed at appropriate points of the process flow, and whip checks will be installed in specific unions in order to ensure that pressurized lines cannot cause injury if rupture occurs. Process monitoring will include gauging and sampling of wells on site.

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SECTION 10

Physical Hazards and Controls

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 11

Biological Hazards and Controls

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 12

Contaminants of Concern

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 13

Site Monitoring

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 14

Personal Protective Equipment

(Reference CH2M HILL- SOP HSE-117, *Personal Protective Equipment*)

14.1 Required Personal Protective Equipment

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.

A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM that approved this plan. Below are items that need to be followed when using any form of PPE:

- Employees must be trained to properly wear and maintain the PPE;
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area;
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner;
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage;
- PPE must be maintained in a clean and reliable condition;
- Damaged PPE shall not be used and must either be repaired or discarded; and
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

The table below outlines PPE to be used according to task based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the RHSM so this table can be updated.

TABLE 14-1
PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
Pre-Test Operations	D	Work clothes; safety toed leather work boots and gloves	As needed per task-- Hardhat [c] Safety glasses Ear protection [d]	None required
Well Rehabilitation with SEPR	D or Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	As needed per task: Hardhat [c] Safety glasses Ear protection [d] Splash shield [c]	None required

TABLE 14-1
PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
Process liquids sampling **Investigation-derived waste (drum) sampling and disposal**	D or Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	As needed per task: Hardhat [c] Safety glasses Ear protection [d] Splash shield [c]	None required
Handling/mixing pilot test chemicals: hydrogen peroxide, and SEPR chemicals	D or Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	As needed per task: Hardhat [c] Safety glasses Ear protection [d] Splash shield [c]	None required
PLTS and pilot test equipment repairs/ replacement	D or Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	As needed per task: Hardhat [c] Safety glasses Ear protection [d] Splash shield [c]	None required
Baselilne and Performance Testing Operations	D or Modified D	Work clothes or cotton coveralls **Boots**: Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves**: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	As needed per task: Hardhat [c] Safety glasses Ear protection [d] Splash shield [c]	None required
Tasks requiring upgrade	C	**Coveralls:** Polycoated Tyvek® **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
- Request from individual performing tasks. - Change in work tasks that will increase contact or potential contact with hazardous materials. - Occurrence or likely occurrence of gas or vapor emission. - Known or suspected presence of dermal hazards. - Instrument action levels (Section 5) exceeded.	- New information indicating that situation is less hazardous than originally thought. - Change in site conditions that decreases the hazard. - Change in work task that will reduce contact with hazardous materials.

---

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

[b] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SSC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[e] **Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.**

[f] **Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.**

14.2 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, *Respiratory Protection*)

During pilot testing, respiratory protection is required if adequate ventilation is unavailable. Implement the following when using respiratory protection:

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APR) use and Level B training is required for supplied-air respirators (SAR) and self-contained breathing apparatus (SCBA) use. Specific training is required for the use of powered air-purifying respirators (PAPR).
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used.
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months.
- Respirator use shall be limited to those activities identified in this plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the RHSM shall be notified to amend the written plan.
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal check before each use.
- Canisters/cartridges shall be replaced according to the change-out schedule specified in this plan. Respirator users shall notify the SC or RHSM of any detection of vapor or gas breakthrough. The SC shall report any breakthrough events to the RHSM for schedule upgrade.
- Respirators in regular use shall be inspected before each use and during cleaning
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators shall be properly stored to protect against contamination and deformation.
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service.
- When breathing air is supplied by cylinder or compressor, the SC or RHSM shall verify the air meets Grade D air specifications.
- The SC or designee shall complete the H&S Self-Assessment Checklist – Respiratory Protection included in as attachment to this plan to verify compliance with CH2M HILL's respiratory protection program.

TABLE 14-2
Respirator Change-Out Schedule

Contaminant	Change-Out Schedule
Acrylonitrile	End-of-service life or end of shift (whichever occurs first)
Benzene	End-of-service life or end of shift (whichever occurs first)
Butadiene	After 4 hours for concentrations up to 5 ppm After 3 hours for concentrations between 5 and 10 ppm After 2 hours for concentrations between 10 and 25 ppm After 1 hour for concentrations up to 50 ppm
Formaldehyde	Cartridges: end-of-service life or after 3 hours (whichever occurs first) Canisters: end-of-service life or after 4 hours for concentrations up to 7.5 ppm (whichever occurs first) Industrial Canisters: end-of-service life or after 2 hours for concentrations up to 75 ppm (whichever occurs first)
Vinyl Chloride	End-of-service life or end of shift (whichever occurs first)
Methylene Chloride	Canisters may only be used for emergency escape and must be replaced after use

SECTION 15

Worker Training and Qualification

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 16

Medical Surveillance and Qualification

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 17

Site-Control Plan

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 18

Decontamination

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 19

Emergency Response Plan

See the HSP American Creosote Works (CH2M HILL, 2010).

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

19.1 Pre-Emergency Planning

- The Emergency Response Coordinator (ERC), typically the SC or designee, performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate. Pre-Emergency Planning activities performed by the ERC include:
- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post the “Emergency Contacts” page and route to the hospital located in this section in project trailer(s) and keep a copy in field vehicles along with evacuation routes and assembly areas. Communicate the information to onsite personnel and keep it updated.
- Field Trailers: Post “Exit” signs above exit doors, and post “Fire Extinguisher” signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital. Drills should take place periodically but no less than once a year.
- Brief new workers on the emergency response plan.

- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

19.2 Emergency Equipment and Supplies

The ERC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	**Location**
• 20 (or two 10) class A,B,C fire extinguisher	PLTS Building
• First aid kit	
• Eye Wash	
• Emergency Shower	
• Potable water	
• Bloodborne-pathogen kit	
• Additional equipment (specify):	

19.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Notify appropriate response personnel.
- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.
- Implement HSE-111, Incident Notification, Reporting and Investigation.
- Notify and submit reports to clients as required in contract.

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in the “Incident Notification, Reporting, and Investigation” section of this HSP.

19.4 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing/heart has stopped). When in doubt if an injury is life-threatening or not, treat it as needing emergency medical treatment.

- Notify 911 or other appropriate emergency response authorities as listed in the “Emergency Contacts” page located in this section.

- The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.

- Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first aid or medical treatment takes priority.

- Initiate first aid and CPR where feasible.
- Notify supervisor and if the injured person is a CH2M HILL employee, the supervisor will call the occupational nurse at 1-866-893-2514 and make other notifications as required by HSE SOP-111, *Incident Notification, Reporting and Investigation*.
- Make certain that the injured person is accompanied to the emergency room.
- Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting and Investigation, and complete incident report using the HITS system on the Virtual Office or if not feasible, use the hard copy forms provided as an attachment to this HSP.
- Notify and submit reports to client as required in contract.

19.5 Evacuation

- Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The ERC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The ERC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The ERC will follow the incident reporting procedures in the "Incident Notification, Reporting and Investigation" section of this HSP.

19.6 Evacuation Signals

Signal	**Meaning**
• Grasping throat with hand	• Emergency-help me.
Thumbs up	• OK; understood.
• Grasping buddy's wrist	• Leave area now.
• Continuous sounding of horn	• Emergency; leave site now.

19.7 Inclement Weather

See the HSP American Creosote Works (CH2M HILL, 2010).

Emergency Contacts

24-hour CH2M HILL Injury Reporting– 1-866-893-2514

24-hour CH2M HILL Serious Incident Reporting Contact – 720-286-4911

Medical Emergency – 911 **Facility Medical Response #:** **Local Ambulance #:** 800/259-9771	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim , CA 92805 800-455-6155/866-893-2514 714-978-7488
Fire/Spill Emergency – 911 **Local Fire Dept #:** 318/628-3922	**CH2M HILL Director – Health, Safety, Security & Environment** Andy Strickland/DEN (720) 480-0685 (cell) or (720) 286-2393 (office)
Security & Police – 911 **Local Police #:** 318/628-3511	**CH2M HILL Responsible Health and Safety Manager (RHSM)** Name: Michael Goldman Phone: (318) 628-4452
Utilities Emergency Phone Numbers Water: (318) 628-4452 Gas: Atmos Energy Louisiana 800-621-1867 Electric: (318) 628-4452	**CH2M HILL Human Resources Department** Name: John Monark/COR Phone: 303/771-0900
CH2M HILL Project Manager Name: John Knott Phone: (972) 980-2188 x52209	**CH2M HILL Worker's Compensation:** Contact Business Group HR dept. to have form completed or contact Jennifer Rindahl after hours: (720)891-5382
CH2M HILL Safety Coordinator (SC) Name: John Nugent Phone: (713) 462-0161	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: (720) 286-2087
CH2M HILL Assistant Project Manager Name: Rebecca Wroebel Phone: (972) 663-2214	**Automobile Accidents** Rental: Jennifer Rindahl/DEN: 720-286-2449 CH2M HILL owned vehicle: Linda George/DEN: 720-286-2057
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**CHEMTEL (hazardous material spills)** **Phone: 800/255-3924**

Federal Agency / Contact Name: USEPA Region 6: Mike Hebert	**Phone: 214.665.8315**
State Agency / Contact Name: LDEQ: John Halk	**Phone: 504.765.0487**
Local Agency / Contact Name: None	**Phone: not applicable**

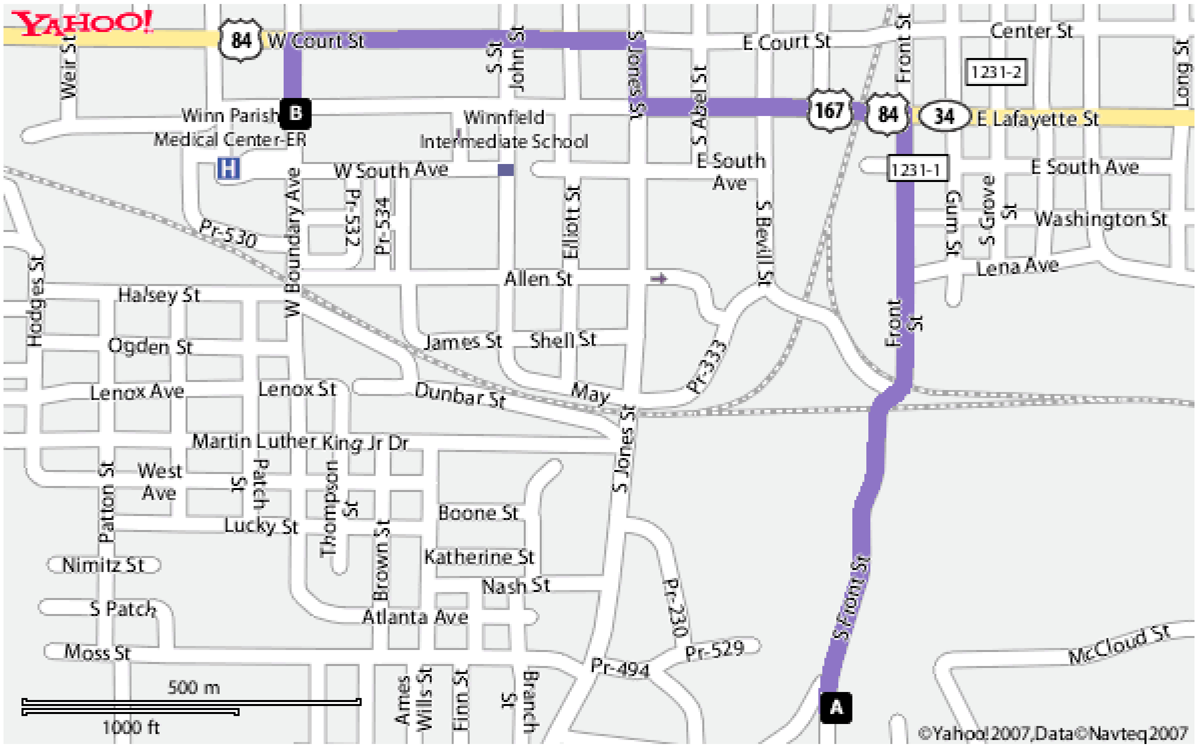
Contact the Project Manager. The Project Manager will contact relevant government agencies.

Facility Alarms: Personal Contact	Evacuation Assembly Area(s): At Front Street gate

Facility/Site Evacuation Route(s): South on site access road to Front Street gate.

Directions to Local Hospital

Driving Directions: From main gate turn North (right) and go north on Front street (SR-1231) for 0.3 miles; Veer left at the "Y" onto Beville street and go .4 miles to Lafayette street; Turn left onto Lafayette street and follow it until it dead ends into the Hospital emergency drive.



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SECTION 20
Spill Containment Procedures

CH2M HILL and subcontractor personnel working at the project site shall be knowledgeable of the potential health, safety and environmental concerns associated with pilot testing chemicals, petroleum, and other hazardous substances that could potentially be released at the project site.

The following is a list of criteria that must be addressed in CH2M HILL's or the subcontractor's plans in the event of a spill or release. In the event of a large quantity spill notify emergency services. Personnel discovering a spill shall (only if safe to do so):

- Stop the spill immediately (if possible) or note source. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. The SC shall be notified immediately.
- Extinguish sources of ignition (e.g., flames, sparks, hot surfaces, cigarettes, etc.). Apply only water when fires involves pilot test chemicals hydrogen peroxide and/or VeruSOLVE ™.
- Clear personnel from the spill location and barricade the area.
- Utilize available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread.
- Use sorbent materials to control the spill at the source.
- Construct a temporary containment dike of sorbent materials, cinder blocks, bricks or other suitable materials to help contain the spill.
- Attempt to identify the character, exact source, amount, and extent of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified.
- Assess possible hazards to human health or the environment as a result of the release, fire or explosion.
- A Spill Report shall be completed, including a description of the event, root causes, and corrective actions.

20.1 Additional ISCO Spill Containment Procedures

The following additional procedures for specific pilot testing chemicals have been provided by Subcontractors completing the ISCO test.

If a chemical spill were to occur on site, GCI personnel will adhere to the procedures described below:

20.1.1 Hydrogen Peroxide Spill:

1. Isolate and ventilate the area. Deny entry and stay upwind.
2. Keep combustible or organic materials away from spill.
3. Spray liberally with water to dilute.

In the event of a large spill call **911** to notify local authorities then call FMC Emergency Response (609) 924-6677.

20.1.2 Sulfuric or Phosphoric Acid Spill:

1. Isolate area. Remove all ignition sources and provide adequate ventilation.
2. Keep water and combustibles away from release.
3. For small spills, absorb with vermiculite, sand or earth.

In the event of a large spill call **911** to notify local authorities.

After any spill, the used vermiculite or other material shall be collected by shovel and placed in five-gallon buckets for proper disposal.

20.1.3 Ferrous Sulfate or Calcium Phosphate Spill:

1. Isolate area and stay upwind.
2. Put on dust mask and sweep powder into a pile.
3. Transfer powder to a container for proper disposal.

For a small spill, **all personnel involved in the cleanup** will be in Modified Level D PPE (tyvek suit, nitrile gloves, and steel-toed rubber boots, safety glasses).

20.2 Additional S-EPR/S-ISCO Spill Containment Procedures

The following additional procedures for specific pilot testing chemicals have been provided by Subcontractors completing the S-EPR/S-ISCO test.

In the event of a release at this site, the Site Manager and/or project manager will activate the site-specific Spill Response Plan. Site employees are only authorized to respond to incidental spills defined by OSHA in 29 CFR 1910.120. These releases shall be contained as close to the source as possible. Whenever possible, the MSDS will be consulted to assist in determining the best means of containment and cleanup.

For small spills, absorbent materials such as sand, sawdust or commercial sorbents should be placed directly on the substance to contain the spill and aid recovery. Berms of earthen or sorbent materials can be used to contain the leading edge of the spills. Drains or drainage areas should be blocked. All spill containment materials will be properly disposed of.

If a release occurs that is not incidental, employees shall immediately leave the affected area and notify the Emergency Coordinator.

The following steps should be taken by the Emergency Coordinator:

1. Determine the nature, identity, and amounts of major spill components;

2. Make sure all unnecessary persons are removed from the spill area;
3. Notify appropriate response teams and authorities;
4. Use proper PPE in consultation with the SM;
5. If a flammable liquid, gas or vapor is involved, remove all ignition sources and use non-sparking and/or explosive-proof equipment to contain or clean up the spill (diesel only vehicles, air operated pumps, etc.);
6. If possible, try to stop the leak with appropriate material;
7. Remove all surrounding materials that can react or compound with the spill; and
8. Notify the Project-Specific Contacts.

Universal spill kits with adequate containment/absorbent material and remote handling equipment shall be available on site and stored in the following locations:

- Injection Area
- Chemical Storage Area

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SECTION 21
Inspections

21.1 Project Activity Self-Assessment Checklists

See the HSP American Creosote Works (CH2M HILL, 2010).

21.2 Safe Behavior Observations

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 22

Incident Notification, Reporting, and Investigation

(Reference CH2M HILL SOP HSE-111, *Incident Notification, Reporting and Investigation*)

See the HSP American Creosote Works (CH2M HILL, 2010).

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SECTION 23

Records and Reports

See the HSP American Creosote Works (CH2M HILL, 2010).

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Attachments

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ATTACHMENT 1

Health and Safety Plan Employee Sign-off Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

ATTACHMENT 2

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location: American Creosote Works, Winn Parish, Winnfield, Louisiana

HCC:

☐ Office ☐ Warehouse ☐ Laboratory ☒ Project:

Project No.: 344582

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)
Hydrogen Peroxide (34% solution)	Process area/chemical storage		
SEPR solution	Process area/chemical storage		
VeruSOL®	Process area/chemical storage		
VeruSOLVE-HP®)	Process area/chemical storage		
GreenCat™	Process area/chemical storage		
Stabilization Chemicals	Lab		

MSDS for the listed products will be maintained at:

ATTACHMENT 3

Chemical-Specific Training Form

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Refer to SOP HSE-107 Attachment 1 for instructions on completing this form.

Location: Project # :

HCC: Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

ATTACHMENT 4

Project Activity Self-Assessment Checklists/Permits/Forms

The Project Activity Self-Assessment checklists, permits and forms will be provided with the final submission of the Work Plan.

ATTACHMENT 5

Behavior Based Loss Prevention System Forms

See the HSP American Creosote Works (CH2M HILL, 2010).

Activity Hazard Analysis

Pre-Task Safety Plans

Safe Behavior Observation

Incident Report and Investigation

(use electronic form when possible)

HITS

ATTACHMENT 6

Material Safety Data Sheets

See the HSP American Creosote Works (CH2M HILL, 2010).

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VeruSOLVE™

MATERIAL SAFETY DATA SHEET

Section 1: PRODUCT AND COMPANY IDENTIFICATION

Manufacturer: VeruTEK Technologies, Inc.
Address: 65 West Dudley Town Road, Suite 100, Bloomfield, CT 06002
Phone Number: (860) 242-9800

Product Name: VeruSOLVE™
Issue Date: January 2010

Section 2: HAZARDS IDENTIFICATION

Emergency Overview

Appearance/Odor: Clear liquid with mild citrus odor.

Stability: Product is stable under normal conditions, but is very sensitive to contamination. Decomposition yields oxygen gas that supports combustion of organic matter and can cause over pressure if confined.

Slippery when spilled.

Potential Health Effects: See Section 11 for more information.

Likely Routes of Exposure: Eye contact, skin contact, inhalation.

Eye:	Causes moderate to severe irritation.
Skin:	May cause slight redness. Prolonged or repeated exposure may cause drying of the skin.
Inhalation:	May cause nose, throat, and respiratory tract irritation, coughing, headache.
Ingestion:	Not likely to be toxic, but may cause vomiting, headache, or other medical problems.

Medical Conditions Aggravated By Exposure: May irritate the skin of people with pre-existing skin conditions.

This product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC, or NTP.

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

	Percent	TLV	Carcinogenic (OSHA,TP,IARC)
Hydrogen Peroxide	< 4		No
VeruSOL® 3	1 – 5		No
Water	91-95		No

Section 4: FIRST AID MEASURES

Eye Contact:
Flush with water for at least 15 minutes. If irritation persists, seek medical attention.

Skin Contact:
Wash affected area with copious amounts of soap and water for at least 15 minutes. Remove contaminated clothing. If irritation develops, seek medical attention.

Inhalation:
Move to fresh air immediately. If breathing is difficult or discomfort persists, seek medical attention.

Ingestion:
Seek medical attention.

Section 5: FIRE FIGHTING MEASURES

Flash Point (Method): N/A **Explosion Limits**: Upper: N/A Lower: N/A

Suitable Extinguishing Media:
Flood area with water. Product is not combustible but during decomposition will produce oxygen gas which may intensify a fire.

.

Protection of Firefighters:
Vapors may be irritating to eyes, skin and respiratory tract. Firefighters should wear self-contained breathing apparatus (SCBA) and full fire-fighting turnout gear.

Section 6: ACCIDENTAL RELEASE MEASURES

Methods for Accidental Release:
Combustible materials exposed to product should be immediately submerged or rinsed with water to ensure that all hydrogen peroxide is removed. Residual peroxide that may be left after evaporation may cause certain materials to ignite and result in a fire.

Dike spill area and cap leaking containers as necessary to prevent further spreading of spilled material. Absorb small spills with suitable material and put into approved containers.
Larger spills should be contained by blocking nearby sewers, drains, or bodies of water. Dilute with large amounts of water and hold in a dike for disposal or until all hydrogen peroxide has decomposed.

Waste Disposal:
Manage in accordance with applicable local, State, and Federal solid/hazardous waste regulations. Material is not a listed waste.

Other Information: Follow local, State and Federal release reporting requirements

Section 7: HANDLING AND STORAGE

Handling
Wear chemical splash goggles and full face shield, impervious clothing, gloves, and shoes. Avoid cotton, wool, and leather. Avoid excessive heat and contamination. Contamination may cause decomposition and generation of oxygen gas which could results in high pressures and possible container rupture. Never return unused material to the original container. Empty drums should be triple rinsed with water before discarding. Utensils used for handling should be made of glass, stainless steel, aluminum, or plastic. Do not allow this material to come in contact with eyes. Avoid prolonged contact with skin. Use in well ventilated areas. Do not breathe vapors. Thoroughly wash hands with soap and water after handling this material.

Storage
Store containers in well-ventilated area, out of direct sun-light, and away from combustibles. Keep away from incompatible materials and heat, sparks, and flame. Open container slowly to release pressure caused by temperature variations. Product may be packaged in phenolic-lined, steel containers, or fluorinated plastic containers. Storage temperature should not exceed 110ºF (43ºC) for extended periods of time. Keep container closed when not in use.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines
VeruSOLVE™ N/E (N/E – Not Established)

Engineering Controls:
Provide ventilation to minimize the release of vapors and mist into the work environment. Spills should be minimized or confined to prevent release from work area. Remove contaminated clothing immediately and wash before reuse. Keep away from sparks and flames.

Eye/Face Protection:
Wear chemical splash-type safety glasses or goggles. Use full face mask if severe splashing is expected during use.

Skin Protection:
Wear chemically resistant clothing, gloves and boots as recommended by the manufacturer.

Respiratory Protection:
If required, use NIOSH approved respiratory protection

Protective Clothing:
Wear impervious clothing as recommended by the manufacturer. (avoid cotton, leather, and wool). Completely submerge any clothing that becomes contaminated with the product in water, before drying. Residual peroxide left to dry on a material such as fabrics, paper, leather, wool, cotton, wood, or other combustible material may cause ignition and result in a fire.

General Hygiene Considerations:
As with any chemical, wash hands thoroughly after handling. Have eyewash facilities immediately available.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Color:	Clear	**Odor:**	Citrus odor.
Physical State:	Liquid	**Boiling Point:**	212ºF (100ºC)
Specific Gravity:	1.0 @ 77ºF (25ºC)	**Vapor Pressure**:	N/A
Flash Point:	>120 °F	**Solubility in Water:**	Soluble.

Volatile Organic Compound (VOC) Content: 1-5% by volume.

Note: These specifications represent a typical sample of this product, but actual values may vary. Certificates of Analysis and Specification Sheets are available upon request.

Section 10: STABILITY AND REACTIVITY

Stability: Contamination may cause decomposition and production of oxygen gas.

Conditions to Avoid: Keep away from heat, sparks, flames, and contamination.

Incompatible Materials: Strong reducing agents, iron and other heavy metals, galvanized iron, copper alloys and caustics

Hazardous Decomposition Products: Possible hazardous decomposition products formed under fire conditions – Nature of products is unknown.

Possibility of Hazardous Reactions: Possible under extreme conditions or in presence of incompatible material.

Section 11: TOXICOLOGICAL INFORMATION

Acute Effects
May cause irritation to eyes, nose, and throat.

Chronic Effects
N/A

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: N/A

Persistence/Degradability: This product is subject to reduction or oxidation process and decomposes in to water and oxygen.

Bioaccumulation/Accumulation: N/A

Mobility in Environment: N/A

Section 13: DISPOSAL CONSIDERATIONS

Disposal:

Dispose of in accordance with applicable local , State, and Federal regulations. Material is not a listed hazardous waste.

Section 14: TRANSPORT INFORMATION

US DOT Shipping Classification

Hazard Class: Not regulated
Identification No.: Not applicable
Packing Group: Not applicable
Label/Placard: Not applicable

TDG Status:
Not regulated

IMO Status:
Not regulated

IATA Status:
Not regulated

Section 15: REGULATORY INFORMATION

Global Inventories

The components of this product are included in the following inventories:
USA (TSCA)
Canada (DSL)
Australia (AICS)
Korea (KECL)
Philippines (PICCS)

Proposition 65: California Safe Drinking Water and Toxic Enforcement Act of 1986

This product is not known to contain any chemicals currently listed as carcinogens or reproductive toxins under California Proposition 65 at levels which would be subject to the proposition.

Section 16: OTHER INFORMATION

NFPA 704: National Fire Protection Association

Health – 0 (minimal hazard)	Fire – 0 (minimal hazard)	Reactivity – 0 (minimal hazard)

Legend

OSHA – United States Occupational Health and Safety Administration
IARC – International Agency for Research on Cancer
NTP – National Toxicology Program
NIOSH – National Institute for Occupational Safety and Health
EPA – United States Environmental Protection Agency

Caution: The user should conduct his/her own experiments and establish proper procedures and control before attempting use on critical parts.

The information contained herein is based on current knowledge and experience: no responsibility is accepted that the information is sufficient or correct in all cases. Users should consider these data only as a supplement to other information obtained by the user. No warranty is expressed or implied regarding the accuracy of this data, the results to be obtained from the use thereof, or that any such use will not infringe any patent. Users should make independent determinations of suitability and completeness of information from all sources to assure proper use and disposal of these materials, the safety and health of employees and customers, and the protection of the environment. This information is furnished upon the condition the person receiving it shall determine the suitability for the particular purpose. This MSDS is to be used as a guideline for safe work practices and emergency response.

VeruSOL

MATERIAL SAFETY DATA SHEET

Section 1: PRODUCT AND COMPANY IDENTIFICATION

Manufacturer: VeruTEK Technologies, Inc.
Address: 628-2 Hebron Avenue, Suite 505, Glastonbury, CT 06033
Phone Number: (860) 633-4900

Product Name: VeruSOL
Issue Date: June 2006

Section 2: HAZARDS IDENTIFICATION

Emergency Overview
Appearance/Odor: Light yellow, slightly viscous liquid with citrus odor.

Product is Combustible.

Slippery when spilled.
Potential Health Effects: See Section 11 for more information.
Likely Routes of Exposure: Eye contact, skin contact, inhalation.
Eye: Causes moderate to severe irritation.
Skin: May cause slight redness. Prolonged or repeated exposure may cause drying of the skin.
Inhalation: May cause nose, throat, and respiratory tract irritation, coughing, headache.
Ingestion: Not likely to be toxic, but may cause vomiting, headache, or other medical problems.
Medical Conditions Aggravated By Exposure: May irritate the skin of people with pre-existing skin conditions.
This product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC, or NTP.

OSHA Regulatory Status
This material is combustible, which is defined as having a flash point between 100ºF (37.8ºC) and 200ºF (93.3ºC). Combustible materials are hazardous according to the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

The specific chemical identity is being withheld as a trade secret.

Section 4: FIRST AID MEASURES

Eye Contact: Remove contact lenses at once. Flush with water for at least 15 minutes. If irritation persists, seek medical attention.
Skin Contact: Wash affected area with copious amounts of soap and water. If irritation develops, seek medical attention.
Inhalation: Move to fresh air. If symptoms persist, seek medical attention.
Ingestion: Seek medical attention immediately. DO NOT induce vomiting. Rinse mouth with water. Offer water to drink. DO NOT administer anything by mouth to an unconscious person.
General: As with any chemical, employees should thoroughly wash hands with soap and water after handling this material.

Section 5: FIRE FIGHTING MEASURES

Suitable Extinguishing Media: Carbon dioxide, foam or dry chemical. Caution: Carbon dioxide will displace air in confined spaces and may create an oxygen deficient atmosphere.
Unsuitable Extinguishing Media: Water.
Products of Combustion: Forms acrid fumes, carbon monoxide, carbon dioxide and oxides of nitrogen.
Protection of Firefighters: Vapors may be irritating to eyes, skin and respiratory tract. Firefighters should wear self-contained breathing apparatus (SCBA) and full fire-fighting turnout gear.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions: Use personal protection recommended in Section 8. Product is slippery when spilled. Isolate the hazard area. Deny entry to unnecessary and unprotected personnel.
Environmental Precautions: Keep out of drains, sewers, ditches and waterways.
Methods for Containment: Dike spill area and cap leaking containers as necessary to prevent further spreading of spilled material. Absorb spilled liquid with suitable material.
Methods for Clean Up: Eliminate all ignition sources. Use equipment rated for use around combustible materials. Oil soaked rags may spontaneously combust; place in appropriate disposal container.
Other Information: There are no special reporting requirements for spills of this material.

Section 7: HANDLING AND STORAGE

Handling
Keep away from heat, sparks, and flame. Open container slowly to release pressure caused by temperature variations. Do not allow this material to come in contact with eyes. Avoid prolonged contact with skin. Use in well ventilated areas. Do not breathe vapors. As with any chemical, employees should thoroughly wash hands with soap and water after handling this material.

Storage
Product may be packaged in phenolic-lined, steel containers or fluorinated plastic containers. Store in well ventilated area. Storage temperature should not exceed 110ºF (43ºC) for extended periods of time. Keep container closed when not in use. Air should be excluded from partially filled containers by displacing with nitrogen or carbon dioxide. Do not cut, drill, grind or weld on or near this container; residual vapors may ignite.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines

VeruSOL	N/E	(N/E – Not Established)

Engineering Controls: Provide ventilation. Keep away from sparks and flames.
Eye/Face Protection: Wear safety glasses or goggles.
Skin Protection: Nitrile gloves are recommended. Boots, apron, or bodysuits should be worn as necessary.
Respiratory Protection: Not normally required. If adequate ventilation is unavailable, use NIOSH approved air-purifying respirator with organic vapor cartridge or canister.
General Hygiene Considerations: As with any chemical, wash hands thoroughly after handling. Have eyewash facilities immediately available.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Color: Light yellow.
Odor: Citrus odor.
Physical State: Liquid.
Boiling Point: >212ºF (>100ºC)
Specific Gravity: 0.968 to 0.985 @ 77ºF (25ºC)
Vapor Pressure: <2mmHg @ 68ºF (20ºC)
Flash Point: 130ºF (54.4ºC)
Solubility in Water: Soluble.
Evaporation Rate: Medium to fast.
Volatile Organic Compound (VOC) Content: 10-30% by volume.

Note: These specifications represent a typical sample of this product, but actual values may vary. Certificates of Analysis and Specification Sheets are available upon request.

Section 10: STABILITY AND REACTIVITY

Stability: Stable.
Conditions to Avoid: Keep away from heat, sparks and flames.
Incompatible Materials: None
Hazardous Decomposition Products: None
Possibility of Hazardous Reactions: None

Section 11: TOXICOLOGICAL INFORMATION

Acute Effects
An ingredient has been shown to have low oral toxicity (LD_{50}>5 g/kg) and low dermal toxicity (LD_{50}> 5g/kg) when tested on rabbits, It also showed low toxicity by inhalation (RD_{50}>1 g/kg) when tested on mice. Product may be a skin and eye irritant. Inhalation may cause irritation of the nose, throat, and respiratory tract.

Chronic Effects
This product is not classified as a carcinogen by OSHA, IARC or NTP. This product has not been shown to produce genetic changes when tested on bacterial or animal cells. This product does not contain known reproductive or developmental toxins. Prolonged or repeated exposure can cause drying or dermatitis of skin. Improper storage and handling may lead to the formation of a possible skin sensitizer.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: There is no information available at this time for this product. However, a spill may produce significant toxicity to aquatic organisms and ecosystems. Some studies have shown that certain bacteria and fungi have the ability to degrade terpenes, decreasing their toxicity to fish. When spilled, this product may act as an oil, causing a film, sheen, emulsion or sludge at or beneath the surface of a body of water.
Persistence/Degradability: Product is expected to be readily biodegradable.
Bioaccumulation/Accumulation: No appreciable bioconcentration is expected in the environment.
Mobility in Environment: Product volatilize rapidly.

Section 13: DISPOSAL CONSIDERATIONS

Disposal: Incinerate or dispose of in accordance with Local, State, and Federal Regulations. Taking regulations into consideration, waste may be incinerated or handled through EPA Spill Control Plan via landfill or dilution. Empty containers must be triple-rinsed prior to disposal.

Section 14: TRANSPORT INFORMATION

US DOT Shipping Classification
Hazard Class: 3
Identification No.: UN2319
Packing Group: III
Label/Placard: exception §173.150(f) applies.

TDG Status: Hazardous
IMO Status: Hazardous
IATA Status: Hazardous

The listed transportation classification does not address regulatory variations due to changes in package size, mode of shipment or other regulatory descriptions.

Section 15: REGULATORY INFORMATION

Global Inventories
The components of this product are included in the following inventories:
USA (TSCA)
Canada (DSL)
Australia (AICS)
Korea (KECL)
Philippines (PICCS)

Proposition 65: California Safe Drinking Water and Toxic Enforcement Act of 1986
This product is not known to contain any chemicals currently listed as carcinogens or reproductive toxins under California Proposition 65 at levels which would be subject to the proposition.

Section 16: OTHER INFORMATION

NFPA 704: National Fire Protection Association

Health – 1 (slight hazard)	Fire – 2 (moderate hazard)	Reactivity – 0 (minimal hazard)

Legend

OSHA – United States Occupational Health and Safety Administration
IARC – International Agency for Research on Cancer
NTP – National Toxicology Program
NIOSH – National Institute for Occupational Safety and Health
EPA – United States Environmental Protection Agency

Caution: The user should conduct his/her own experiments and establish proper procedures and control before attempting use on critical parts.

MATERIAL SAFETY DATA SHEET

Hydrogen Peroxide (20 to 40%)

MSDS Ref. No.: 7722-84-1-3
Date Approved: 06/03/2008
Revision No.: 11

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200 and Canada's Workplace Hazardous Materials Information System (WHMIS) requirements.

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1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Hydrogen Peroxide (20 to 40%)
ALTERNATE PRODUCT NAME(S):	Durox® Reg. & LR 35%, Oxypure® 35%, Standard 27.5 & 35%, Super D® 25 & 35, Technical 35%, HTP 35%, OHP 35%, Chlorate Grade, 20%, Semiconductor Reg, Seg, RGS, RGS 2, RGS 3, 31%
GENERAL USE:	Durox® 35% Reg. & LR - meets the Food Chemical Codex requirements for aseptic packaging and other food related applications. Oxypure® 35% - certified by NSF to meet NSF/ANSI Standard 60 requirements for drinking water treatment. Standard 27.5 and 35% - most suitable grade for industrial bleaching, processing, pollution abatement and general oxidation reactions. Semiconductor Reg, Seg, RGS, RGS 2, RGS 3, 31% - conform to ACS and Semi Specs. for wafer etching and cleaning, and applications requiring low residues. Super D® 25 and 35% - meets US Pharmacopoeia specifications for 3% topical solutions when diluted with proper quality water. While manufactured to the USP standards for purity and to FMC's demanding ISO 9002 quality standards, FMC does not claim that it's Hydrogen Peroxide is manufactured in accordance with all pharmaceutical cGMP conditions. Technical 35% - essentially free of inorganic metals suitable for chemical synthesis. HTP 35% - specially formulated for aerospace equipment conditioning. OHP 35% - specially formulated for OHP process, advanced oxidation, and activated peroxide applications Chlorate Grade 20% - specially formulated for use in chlorate manufacture or processing.

MANUFACTURER

FMC CORPORATION
FMC Peroxygens
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)
msdsinfo@fmc.com (Email - General Information)

FMC of Canada Ltd.
FMC Peroxygens
PG Pulp Mill Road
Prince George, BC V2N2S6
(250) 561-4200 (General Information)

EMERGENCY TELEPHONE NUMBERS

(281) 474-8750 (Plant: Pasadena, TX, US - Call Collect)
(250) 561-4221 (Plant: Prince George, BC, Canada - Call Collect)
(303) 595-9048 (Medical - U.S. - Call Collect)

For leak, fire, spill, or accident emergencies, call:
(800) 424-9300 (CHEMTREC - U.S.A.)
(613) 996-6666 (CANUTEC - Canada)

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2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- Clear, colorless, odorless liquid
- Oxidizer.
- Contact with combustibles may cause fire.
- Decomposes yielding oxygen that supports combustion of organic matters and can cause overpressure if confined.
- Corrosive to eyes, nose, throat, lungs and gastrointestinal tract.

POTENTIAL HEALTH EFFECTS: Corrosive to eyes, nose, throat and lungs. May cause irreversible tissue damage to the eyes including blindness. May cause skin irritation.

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3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Hydrogen Peroxide	7722-84-1	20 - 40	231-765-0	O, C, Xn; R5- R8-R35-R20/22
Water	7732-18-5	60 - 80	231-791-2	Not classified

4. FIRST AID MEASURES

EYES: Immediately flush with water for at least 15 minutes, lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist immediately.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: Hydrogen peroxide at these concentrations is a strong oxidant. Direct contact with the eye is likely to cause corneal damage especially if not washed immediately. Careful ophthalmologic evaluation is recommended and the possibility of local corticosteroid therapy should be considered. Because of the likelihood of corrosive effects on the gastrointestinal tract after ingestion, and the unlikelihood of systemic effects, attempts at evacuating the stomach via emesis induction or gastric lavage should be avoided. There is a remote possibility, however, that a nasogastric or orogastric tube may be required for the reduction of severe distension due to gas formation.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Flood with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire.

FIRE FIGHTING PROCEDURES: Any tank or container surrounded by fire should be flooded with water for cooling. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: No data available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Dilute with a large volume of water and hold in a pond or diked area until hydrogen peroxide decomposes. Hydrogen peroxide may be decomposed by adding sodium metabisulfite or sodium sulfite after diluting to about 5%. Dispose according to methods outlined for waste disposal.

Combustible materials exposed to hydrogen peroxide should be immediately submerged in or rinsed with large amounts of water to ensure that all hydrogen peroxide is removed. Residual hydrogen peroxide that is allowed to dry (upon evaporation hydrogen peroxide can concentrate) on organic materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

7. HANDLING AND STORAGE

HANDLING: Wear chemical splash-type monogoggles and full-face shield, impervious clothing, such as rubber, PVC, etc., and rubber or neoprene gloves and shoes. Avoid cotton, wool and leather. Avoid excessive heat and contamination. Contamination may cause decomposition and generation of oxygen gas which could result in high pressures and possible container rupture. Hydrogen peroxide should be stored only in vented containers and transferred only in a prescribed manner (see FMC Technical Bulletins). Never return unused hydrogen peroxide to original container, empty drums should be triple rinsed with water before discarding. Utensils used for handling hydrogen peroxide should only be made of glass, stainless steel, aluminum or plastic.

STORAGE: Store drums in cool areas out of direct sunlight and away from combustibles. For bulk storage refer to FMC Technical Bulletins.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of vapor or mist into the work environment.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Hydrogen Peroxide	1 ppm (TWA)	1 ppm (PEL) 1.4 mg/m^3 (PEL)	

ENGINEERING CONTROLS: Ventilation should be provided to minimize the release of hydrogen peroxide vapors and mists into the work environment. Spills should be minimized or confined immediately to prevent release into the work area. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use chemical splash-type monogoggles and a full-face shield made of polycarbonate, acetate, polycarbonate/acetate, PETG or thermoplastic.

RESPIRATORY: If concentrations in excess of 10 ppm are expected, use NIOSH/DHHS approved self-contained breathing apparatus (SCBA), or other approved atmospheric-supplied respirator (ASR) equipment (e.g., a full-face airline respirator (ALR)). DO NOT use any form of air-purifying respirator (APR) or filtering facepiece (AKA dust mask), especially those containing oxidizable sorbants such as activated carbon.

PROTECTIVE CLOTHING: For body protection wear impervious clothing such as an approved splash protective suit made of SBR Rubber, PVC (PVC Outershell w/Polyester Substrate), Gore-Tex (Polyester trilaminate w/Gore-Tex), or a specialized HAZMAT Splash or Protective Suite (Level A, B, or C). For foot protection, wear approved boots made of NBR, PVC, Polyurethane, or neoprene. Overboots made of Latex or PVC, as well as firefighter boots or specialized HAZMAT boots are also permitted. DO NOT wear any form of boot or overboots made of nylon or nylon blends. DO NOT use cotton, wool or leather, as these materials react RAPIDLY with higher concentrations of hydrogen peroxide. Completely submerge hydrogen peroxide contaminated clothing or other materials in water prior to drying. Residual hydrogen peroxide, if allowed to dry on materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

GLOVES: For hand protection, wear approved gloves made of nitrile, PVC, or neoprene. DO NOT use cotton, wool or leather for these materials react RAPIDLY with higher concentrations of hydrogen peroxide. Thoroughly rinse the outside of gloves with water prior to removal. Inspect regularly for leaks.

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9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	Odorless
APPEARANCE:	Clear, colorless liquid
AUTOIGNITION TEMPERATURE:	Non-combustible
BOILING POINT:	103ºC/218ºF (20%); 107ºC/225ºF (31%); 108ºC/226ºF (35%)
COEFFICIENT OF OIL / WATER:	Not available
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	> 1 (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
FREEZING POINT:	-15ºC/6ºF (20%); -26ºC/-15ºF (31%); -33ºC/-27ºF (35%)
ODOR THRESHOLD:	Not available
OXIDIZING PROPERTIES:	Strong oxidizer
PERCENT VOLATILE:	100
pH:	<= 3.7 5.0 - 6.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	100 %
SPECIFIC GRAVITY:	1.07 @ 20ºC/4ºC (20%); 1.11 @ 20ºC/4ºC (31%); 1.13 @ 20ºC/4ºC (35%)
VAPOR DENSITY:	(Air = 1): Not available
VAPOR PRESSURE:	28 mmHg @ 30ºC (20%); 24 mmHg @ 30ºC (31%); 23 mmHg @ 30ºC (35%)

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10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Excessive heat or contamination could cause product to become unstable.
STABILITY:	Stable (heat and contamination could cause decomposition)
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Reducing agents, wood, paper and other combustibles, iron and other heavy metals, copper alloys and caustic.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxygen which supports combustion.

COMMENTS: Materials to Avoid : Dirt, organics, cyanides and combustibles such as wood, paper, oils, etc.

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11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: 35% hydrogen peroxide: Extremely irritating/corrosive (rabbit) [FMC Study Number: I83-748]

SKIN EFFECTS: 35% hydrogen peroxide: Mildly irritating after 4-hour exposure (rabbit) [FMC Study Number: I83-747]

DERMAL LD$_{50}$: 35% hydrogen peroxide: > 2,000 mg/kg (rabbit) [FMC Study Number: I83-746]

ORAL LD$_{50}$: 35% hydrogen peroxide: 1,193 mg/kg (rat) [FMC Study Number: I83-745]

INHALATION LC$_{50}$: 50% hydrogen peroxide: > 0.17 mg/l (rat) [FMC Study Number: I89-1080]

TARGET ORGANS: Eyes, nose, throat and lungs

ACUTE EFFECTS FROM OVEREXPOSURE: Extremely irritating/corrosive to eyes and gastrointestinal tract. May cause irreversible tissue damage to the eyes including blindness. Inhalation of mist or vapors may be severely irritating to nose, throat and lungs. May cause skin irritation.

CHRONIC EFFECTS FROM OVEREXPOSURE: The International Agency for Research on Cancer (IARC) has concluded that there is inadequate evidence for carcinogenicity of hydrogen peroxide in humans, but limited evidence in experimental animals (Group 3 - not classifiable as to its carcinogenicity to humans). The American Conference of Governmental Industrial Hygienists (ACGIH) has concluded that hydrogen peroxide is a ’Confirmed Animal Carcinogen with Unknown Relevance to Humans’(A3).

CARCINOGENICITY:

Chemical Name	IARC	NTP	OSHA	Other
Hydrogen Peroxide	Not listed	Not listed	Not listed	(ACGIH) Listed (A3, Animal Carcinogen)

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12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION: Channel catfish 96-hour LC_{50} = 37.4 mg/L
Fathead minnow 96-hour LC_{50} = 16.4 mg/L
Daphnia magna 24-hour EC_{50} = 7.7 mg/L
Daphnia pulex 48-hour LC_{50} = 2.4 mg/L
Freshwater snail 96-hour LC_{50} = 17.7 mg/L
For more information refer to ECETOC "Joint Assessment of Commodity Chemicals No. 22, Hydrogen Peroxide." ISSN-0773-6339, January 1993

CHEMICAL FATE INFORMATION: Hydrogen peroxide in the aquatic environment is subject to various reduction or oxidation processes and decomposes into water and oxygen. Hydrogen peroxide half-life in freshwater ranged from 8 hours to 20 days, in air from 10-20 hrs. and in soils from minutes to hours depending upon microbiological activity and metal contaminants.

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13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: An acceptable method of disposal is to dilute with a large amount of water and allow the hydrogen peroxide to decompose followed by discharge into a suitable treatment system in accordance with all regulatory agencies. The appropriate regulatory agencies should be contacted prior to disposal.

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14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solutions with not less than 20% but not more than 40% hydrogen peroxide
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 2014
PACKING GROUP:	II
LABEL(S):	Oxidizer, Corrosive
PLACARD(S):	5.1 (Oxidizer)

ADDITIONAL INFORMATION:	DOT Marking: Hydrogen Peroxide, aqueous solution with not less than 20%, but not more than 40% Hydrogen Peroxide, UN 2014 Hazardous Substance/RQ: Not applicable 49 STCC Number: 4918775 DOT Spec: stainless steel/high purity aluminum cargo tanks and rail cars. UN Spec: HDPE drums. Contact FMC for specific details.

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solutions with not less than 20%, but not more than 60% hydrogen peroxide.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solutions with not less than 20%, but not more than 40% hydrogen peroxide (*).

OTHER INFORMATION:

(*) Air regulations permit shipment of Hydrogen Peroxide (20 - 40%) in non-vented containers for Air Cargo Only aircraft, as well as for Passenger and Cargo aircraft. HOWEVER, all FMC Hydrogen Peroxide containers are vented and therefore, air shipments of FMC H_20_2 is not permitted. IATA air regulations state that venting of packages containing oxidizing substances is not permitted for air transport.

Protect from physical damage. Keep drums in upright position. Drums should not be stacked in transit. Do not store drum on wooden pallets.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not listed

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):

The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.: None, (conc. <52%)

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):

Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):

Unlisted (Hydrogen Peroxide 20-40%); RQ = 100 lbs.; Ignitability, Corrosivity

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):

Waste Number: D001, D002

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Hazard Classification / Division:	C E D2B
Product Identification Number:	2014
Ingredient Disclosure List:	Listed
Domestic Substance List:	All components listed

INTERNATIONAL LISTINGS

Hydrogen peroxide:

China: Listed
Japan (ENCS): (1)-419
Korea: KE-20204
Philippines (PICCS): Listed

HAZARD AND RISK PHRASE DESCRIPTIONS:

EC Symbols:	O	(Oxidizer)

	C	(Corrosive)
	Xn	(Harmful)
EC Risk Phrases:	R5	(Heating may cause an explosion.)
	R8	(Contact with combustible material may cause fire)
	R35	(Causes severe burns.)
	R20/22	(Harmful by inhalation and if swallowed.)

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16. OTHER INFORMATION

HMIS

Health	3
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	H

Protection = H (Safety goggles, gloves, apron, the use of a supplied air or SCBA respirator is required in lieu of a vapor cartridge respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe
3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	3
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA (National Fire Protection Association)

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
This MSDS replaces Revision #10, dated April 27, 2006.

Changes in information are as follows:
Section 1 (Product and Company Identification)
Section 3 (Composition / Information on Ingredients)
Section 15 (Regulatory Information)
Section 16 (Other Information)

Durox, Oxypure, Super D and FMC Logo - FMC Trademarks

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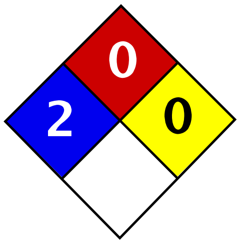

Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Ferrous sulfate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ferrous sulfate

Catalog Codes: SLF1516

CAS#: 13463-43-9

RTECS: Not available.

TSCA: TSCA 8(b) inventory: No products were found.

CI#: Not available.

Synonym: Ferrous Sulfate Hydrate; Ferrous Sulfate Dried Powder

Chemical Name: Ferrous Sulfate

Chemical Formula: $FeSO_4.xH_2O$

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ferrous sulfate	13463-43-9	100

Toxicological Data on Ingredients: Ferrous sulfate LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, liver, cardiovascular system, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes.

Storage:
Hygroscopic. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 151.9 g/mole + H20

Color: Grayish -white to yellowish. (Light.)

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatibles

Incompatibility with various substances: Not available.

Corrosivity: Not available.

Special Remarks on Reactivity:
Hygroscopic.
Loses water at about 300 C.
No other information found.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: May cause damage to the following organs: kidneys, liver, cardiovascular system, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation.
Eyes: May cause eye irritation.
Inhalation: May cause respiratory tract irritation.
Ingestion: Harmful if swallowed. May cause gastrointestinal tract distrubances and irritation with nausea, vomiting, colic, constipation, diarrhea, black stool. May also affect behavior/Central Nervous System (somnolence -general depressed activity), respiration, cardiovascular system, liver, kidneys (pink urine discoloration).
Chronic Potential Health Effects: Repeated exposure via ingestion may increase iron levels in the liver, and spleen. Damage may occur to spleen and liver.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: No products were found.

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R36/38- Irritating to eyes and skin.
S2- Keep out of the reach of children.
S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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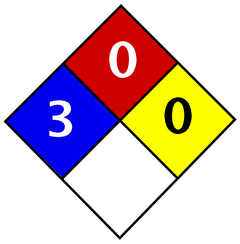
Last Updated: 11/06/2008 12:00 PM



Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Phosphoric acid, 85% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Phosphoric acid, 85%

Catalog Codes: SLP5569, SLP4555, SLP1732

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Phosphoric Acid; Water

CI#: Not available.

Synonym: Phosphoric Acid 85%; Phosphoric Acid; Orthophosphoric acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Phosphoric Acid	7664-38-2	85-88
Water	7732-18-5	12-15

Toxicological Data on Ingredients: Phosphoric Acid: ORAL (LD50): Acute: 1530 mg/kg [Rat]. DERMAL (LD50): Acute: 2740 mg/kg [Rabbit]. DUST (LC50): Acute: >850 mg/m 1 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.

MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to blood, liver, skin, eyes, bone marrow.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Reacts with metals to liberate flammable hydrogen gas.
Formation of flammable gases with aldehydes, cyanides, mercaptins, and sulfides.

Special Remarks on Explosion Hazards: Mixtures with nitromethane are explosive. (Phosphoric Acid)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, alkalis.
May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Phosphoric Acid
TWA: 1 STEL: 3 (mg/m3) from ACGIH (TLV) [United States]
TWA: 1 STEL: 3 (mg/m3) from OSHA (PEL) [United States]
TWA: 1 STEL: 3 (mg/m3) from NIOSH
TWA: 1 STEL: 3 (mg/m3) [Mexico]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Syrupy liquid Viscous liquid.)

Odor: Odorless.

Taste: Acid.

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Acidic.

Boiling Point: 158°C (316.4°F)

Melting Point: 21°C (69.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.685 @ 25 C (Water = 1)

Vapor Pressure: 0.3 kPa (@ 20°C)

Vapor Density: 3.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Easily soluble in hot water.
Soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, alkalis.

Corrosivity:
Extremely corrosive in presence of copper, of stainless steel(304), of stainless steel(316).
Highly corrosive in presence of aluminum.
Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with metals to liberate flammable hydrogen gas.
Incompatible with sodium tetrahydroborate producing a violent exothermic reaction.
Heat generated with: alcohols, glycols, aldehydes, amides, amines, azo-compounds, carbamates, caustics, esters, ketones, phenols and cresols, organophosphates, epoxides, combustible materials, unsaturated halides, organic peroxides.
Formation of flammable gases, with aldehydes, cyanides, mercaptins, and sulfides.

Formation of toxic fumes with cyanides, fluorides, halogenated organics, sulfides, and organic peroxides.
Do not mix with solutions containing bleach or ammonia.
Incompatible with nitromethane, chlorides + staiinless steel.
(Phosphoric Acid)

Special Remarks on Corrosivity:
Minor corrosive effect on bronze.
Severe corrosive effect on brass.
Corrosive to ferrous metals and alloys.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 1530 mg/kg [Rat].
Acute dermal toxicity (LD50): 2740 mg/kg [Rabbit].

Chronic Effects on Humans: May cause damage to the following organs: blood, liver, skin, eyes, bone marrow.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive).
Very hazardous in case of skin contact (irritant), of ingestion, .
Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Corrosive and causes severe skin irritation and can cause severe skin burns. May affect behavior (somnolence or excitement) if absorbed through skin.
Eyes: Corrosive. Liquid or vapor causes severe eye irritation and can cause severe eye burns leading to permanent corneal damage or chemical conjunctivitis.
Ingestion: May be harmful if swallowed. Causes irritation and burns of the gastrointestinal (digestive) tract. Causes severe pain, nausea, vomiting, diarrhea hematemesis, gastrointestinal hemmorrhaging, and shock. May cause corrosion and permanent tissue destruction of the esophagus and digestive tract. May affect behavior and urinary system, liver (hepatocellular damage, hepatic enzymes increased), blood (blood dyscrasia). May also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Phosphoric acid (Phosphoric Acid) UNNA: 1805 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Phosphoric Acid
Illinois toxic substances disclosure to employee act: Phosphoric acid
Illinois chemical safety act: Phosphoric acid
New York release reporting list: Phosphoric acid
Rhode Island RTK hazardous substances: Phosphoric acid
Pennsylvania RTK: Phosphoric acid
Minnesota: Phosphoric acid
Massachusetts RTK: Phosphoric acid
Massachusetts spill list: Phosphoric acid
New Jersey: Phosphoric acid
New Jersey spill list: Phosphoric acid
Louisiana spill reporting: Phosphoric acid
California Director's list of hazardous substances: Phosphoric acid
TSCA 8(b) inventory: Phosphoric Acid; Water
SARA 313 toxic chemical notification and release reporting: Phosphoric acid
CERCLA: Hazardous substances.: Phosphoric acid: 5000 lbs. (2268 kg)

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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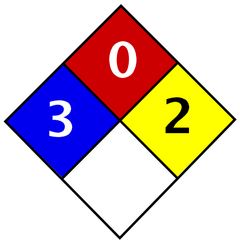
Last Updated: 11/06/2008 12:00 PM



Health	3
Fire	0
Reactivity	2
Personal Protection	

Material Safety Data Sheet
Sulfuric acid 66 Be MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sulfuric acid 66 Be

Catalog Codes: SLS4414, SLS2197

CAS#: 7664-93-9

RTECS: WS5600000

TSCA: TSCA 8(b) inventory: Sulfuric acid

CI#: Not applicable.

Synonym: Oil of Vitriol; Sulfuric Acid

Chemical Name: Hydrogen sulfate

Chemical Formula: H2-SO4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	91 - 95

Toxicological Data on Ingredients: Sulfuric acid: ORAL (LD50): Acute: 2140 mg/kg [Rat.]. VAPOR (LC50): Acute: 510 mg/m 2 hours [Rat]. 320 mg/m 2 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion:
Products of combustion are not available since material is non-flammable. However, products of decompostion include fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas. Reacts with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Fire Hazards in Presence of Various Substances: Combustible materials

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Metal acetylides (Monocesium and Monorubidium), and carbides ignite with concentrated sulfuric acid.
White Phosphorous + boiling Sulfuric acid or its vapor ignites on contact.
May ignite other combustible materials.
May cause fire when sulfuric acid is mixed with Cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phorphorous (III) oxide, and oxidizing agents such as chlorates, halogens, permanganates.

Special Remarks on Explosion Hazards:
Mixtures of sulfuric acid and any of the following can explode: p-nitrotoluene, pentasilver trihydroxydiaminophosphate, perchlorates, alcohols with strong hydrogen peroxide, ammonium tetraperoxychromate, mercuric nitrite, potassium chlorate, potassium permanganate with potassium chloride, carbides, nitro compounds, nitrates, carbides, phosphorous, iodides, picratres, fulminats, dienes, alcohols (when heated)
Nitramide decomposes explosively on contact with concentrated sulfuric acid.
1,3,5-Trinitrosohexahydro-1,3,5-triazine + sulfuric acid causes explosive decompositon.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid.
Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.
May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:
Hygroscopic. Reacts. violently with water. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 STEL: 3 (mg/m3) [Australia] Inhalation
TWA: 1 (mg/m3) from OSHA (PEL) [United States] Inhalation
TWA: 1 STEL: 3 (mg/m3) from ACGIH (TLV) [United States] [1999] Inhalation
TWA: 1 (mg/m3) from NIOSH [United States] Inhalation
TWA: 1 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Thick oily liquid.)

Odor: Odorless, but has a choking odor when hot.

Taste: Marked acid taste. (Strong.)

Molecular Weight: 98.08 g/mole

Color: Colorless.

pH (1% soln/water): Acidic.

Boiling Point:
270°C (518°F) - 340 deg. C
Decomposes at 340 deg. C

Melting Point: -35°C (-31°F) to -32 deg. C

Critical Temperature: Not available.

Specific Gravity: 1.84 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 3.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Easily soluble in cold water.
Sulfuric is soluble in water with liberation of much heat.
Soluble in ethyl alcohol

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability:
Conditions to Avoid: Incompatible materials, excess heat, combustible material materials, organic materials, exposure to moist air or water, oxidizers, amines, bases.

Incompatibility with various substances:
Reactive with oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(316).
Highly corrosive in presence of stainless steel(304).
Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Hygroscopic. Strong oxidizer. Reacts violently with water and alcohol especially when water is added to the product.
Incompatible (can react explosively or dangerously) with the following: ACETIC ACID, ACRYLIC ACID, AMMONIUM HYDROXIDE, CRESOL, CUMENE, DICHLOROETHYL ETHER, ETHYLENE CYANOHYDRIN, ETHYLENEIMINE, NITRIC ACID, 2-NITROPROPANE, PROPYLENE OXIDE, SULFOLANE, VINYLIDENE CHLORIDE, DIETHYLENE GLYCOL MONOMETHYL ETHER, ETHYL ACETATE, ETHYLENE CYANOHYDRIN, ETHYLENE GLYCOL MONOETHYL ETHER ACETATE, GLYOXAL, METHYL ETHYL KETONE, dehydrating agents, organic materials, moisture (water), Acetic anhydride, Acetone, cyanohydrin, Acetone+nitric acid, Acetone + potassium dichromate, Acetonitrile, Acrolein, Acrylonitrile, Acrylonitrile+water, Alcohols + hydrogen peroxide, ally compounds such as Allyl alcohol, and Allyl Chloride, 2-Aminoethanol, Ammonium hydroxide, Ammonium triperchromate, Aniline, Bromate + metals, Bromine pentafluoride, n-Butyraldehyde, Carbides, Cesium acetylene carbide, Chlorates, Cyclopentanone oxime, chlorinates, Chlorates + metals, Chlorine trifluoride, Chlorosulfonic acid, 2-cyano-4-nitrobenzenediazonium hydrogen sulfate, Cuprous nitride, p-chloronitrobenzene, 1,5-Dinitronaphthlene + sulfur, Diisobutylene, p-dimethylaminobenzaldehyde, 1,3-Diazidobenzene, Dimethylbenzylcarbinol + hydrogen peroxide, Epichlorohydrin, Ethyl alcohol + hydrogen peroxide, Ethylene diamine, Ethylene glycol and other glycols, , Ethylenimine, Fulminates, hydrogen peroxide, Hydrochloric acid, Hydrofluoric acid, Iodine heptafluoride, Indane + nitric acid, Iron, Isoprene, Lithium silicide, Mercuric nitride, Mesityl oxide, Mercury nitride, Metals (powdered), Nitromethane, Nitric acid + glycerides, p-Nitrotoluene, Pentasilver trihydroxydiaminophosphate, Perchlorates, Perchloric acid, Permanganates + benzene, 1-Phenyl-2-methylpropyl alcohol + hydrogen peroxide, Phosphorus, Phosphorus isocyanate, Picrates, Potassium tert-butoxide, Potassium chlorate, Potassium Permanganate and other permanganates, halogens, amines, Potassium Permanganate + Potassium chloride, Potassium Permanganate + water, Propiolactone (beta)-, Pyridine, Rubidium aceteylene carbide, Silver permanganate, Sodium, Sodium carbonate, sodium hydroxide, Steel, styrene monomer, toluene + nitric acid, Vinyl acetate, Thalium (I) azidodithiocarbonate, Zinc chlorate, Zinc Iodide, azides, carbonates, cyanides, sulfides, sulfites, alkali hydrides, carboxylic acid anhydrides, nitriles, olefinic organics, aqueous acids, cyclopentadiene, cyano-alcohols, metal acetylides,
Hydrogen gas is generated by the action of the acid on most metals (i.e. lead, copper, tin, zinc, aluminum, etc.).
Concentrated sulfuric acid oxidizes, dehydrates, or sulfonates most organic compounds.

Special Remarks on Corrosivity:
Non-corrosive to lead and mild steel, but dillute acid attacks most metals.
Attacks many metals releasing hydrogen.
Minor corrosive effect on bronze.
No corrosion data on brass or zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 2140 mg/kg [Rat.].
Acute toxicity of the vapor (LC50): 320 mg/m3 2 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH.
May cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive).
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L
Reproductive effects: May cause adverse reproductive effects based on animal data. Developmental abnormalities (musculoskeletal) in rabbits at a dose of 20 mg/m3 for 7 hrs.(RTECS)
Teratogenecity: neither embryotoxic, fetoxic, nor teratogenetic in mice or rabbits at inhaled doses producing some maternal toxicity

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes severe skin irritation and burns. Continued contact can cause tissue necrosis.
Eye: Causes severe eye irritation and burns. May cause irreversible eye injury.
Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestial tract burns. May cause perforation of the stomach, GI bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse(similar to acute inhalation). It may also cause systemic toxicity with acidosis.
Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the repiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Cause corrosive action on mucous membranes. May affect cardiovascular system (hypotension, depressed cardiac output, bradycardia). Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow. Circulatory shock is often the immediate cause of death. May also affect teeth(changes in teeth and supporting structures - erosion, discoloration).
Chronic Potential Health Effects:
Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart (ischemic heart leisons), and respiratory system/lungs(pulmonary edema, lung damage), teeth (dental discoloration, erosion).
Skin: Prolonged or repeated skin contact may cause dermatitis, an allergic skin reaction.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 49 mg/l 48 hours [bluegill/sunfish].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Sulfuric acid may be placed in sealed container or absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Be sure to consult with local or regional authorities (waste regulators) prior to any disposal. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sulfuric acid UNNA: 1830 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sulfuric acid
New York release reporting list: Sulfuric acid
Rhode Island RTK hazardous substances: Sulfuric acid
Pennsylvania RTK: Sulfuric acid
Minnesota: Sulfuric acid
Massachusetts RTK: Sulfuric acid
New Jersey: Sulfuric acid
California Director's List of Hazardous Substances (8 CCR 339): Sulfuric acid
Tennessee RTK: Sulfuric acid
TSCA 8(b) inventory: Sulfuric acid
SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid
SARA 313 toxic chemical notification and release reporting: Sulfuric acid
CERCLA: Hazardous substances.: Sulfuric acid: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R35- Causes severe burns.
S2- Keep out of the reach of children.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S30- Never add water to this product.
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Full suit.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Face shield.

Section 16: Other Information

References:
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

Other Special Considerations: Not available.

Created: 10/09/2005 11:59 PM

Last Updated: 11/06/2008 12:00 PM

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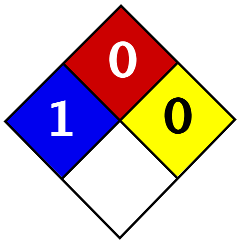


Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Calcium phosphate dibasic MSDS

Section 1: Chemical Product and Company Identification

Product Name: Calcium phosphate dibasic

Catalog Codes: SLC1030, SLC2821, SLC4609

CAS#: 7757-93-9

RTECS: Not available.

TSCA: TSCA 8(b) inventory: Calcium phosphate dibasic

CI#: Not available.

Synonym: Dicalcium Orthophosphate; Dicalcium phosphate; Calcium hydrogen orthophosphate Calcium Hydrogen Phosphate; Calcium monohydrogen phosphaste

Chemical Name: Phosphoric acid, calcium salt (1:1)

Chemical Formula: CaHPO4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Calcium phosphate dibasic	7757-93-9	100

Toxicological Data on Ingredients: Calcium phosphate dibasic: ORAL (LD50): Acute: >10000 mg/kg [Rat]. DERMAL (LD50): Acute: >7940 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe dust. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
For Particlulates Not Otherwise Classified (Nuisance dust):
TWA: 10 (mg/m3) from ACGIH (TLV) [United States] Inhalation Total.
TWA: 3 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 15 (mg/m3) from OSHA (PEL) [United States] Inhalation Total.
TWA: 5 (mg/m3) from OSHA (PEL) [United States] Inhalation Respirable.Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Odorless.

Taste: Tasteless.

Molecular Weight: 136.06 g/mole

Color: White.

pH (1% soln/water): 6 - 7.4 (25% solution)

Boiling Point: Not available.

Melting Point: Decomposition temperature: 230°C (446°F)

Critical Temperature: Not available.

Specific Gravity: Density: 2.89 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Soluble in diluted hydrochloric, nitric, and acetic acids.
Solubility in Water: 0.0316 g/100 ml @ 38 deg. C and 0.075 g/100 ml @ 100 deg. C

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, dust generation

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): >10000 mg/kg [Rat].
Acute dermal toxicity (LD50): >7940 mg/kg [Rabbit].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation. May cause dermatitis
Eyes: Causes eye irritation.
Inhalation: May cause respiratory tract irritation with coughing and sneezing.
Ingestion: Ingestion: May cause mild gastrointestinal tract irritation(distress), flatulence, cramps,nausea, vomiting, constipation or diarrhea. No adverse health effects are expected to develop if only small amounts(less than an mouthful) are swallowed. If ingested in large amounts, Calcium salts may affect cardiovascular system (hypertension, atrial fibrillation, vasodilation), behavior/nervous sytem (confusion, somnolence, coma, decreased tendon reflexes, depression, fatigue, hallucinations, lethargy, weakness, stupor), kidneys (abnormal renal function, renal calculas) depending on the amount and duration of ingestion. May also cause acidosis or alkalosis, hypercalcemia.
Chronic Potential Health Effects:
Skin: Repeated or prolonged contact may cause drying and chapping of the skin.
The toxicological properties of this substance have not been fully investigated.
I

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): >1000 mg/l 96 hours [Daphnia (daphnia)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: Calcium phosphate dibasic

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R36/38- Irritating to eyes and skin.
S24/25- Avoid contact with skin and eyes.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:16 PM

Last Updated: 10/10/2005 08:16 PM

File Name

17273

Your Company

MSDS Summary Sheet

156

Revised: **Mar-28-2005**

Product: HYDROGEN PEROXIDE 30-50%

WHMIS Classification


C - Oxidizing

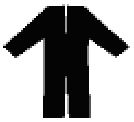

E - Corrosive


D2A - Very Toxic

Personal Protective Equipment


Safety Glasses


Hand Protection


Full Body Protective Clothing

First Aid Requirements

IF IRRITATION PERSISTS SEEK MEDICAL ATTENTION

Inhalation: Immediately remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth. If not breathing, administer artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask. Seek medical attention.

Eye Contact: Extensive irrigation is required (at least 30 minutes), occasionally lifting the upper and lower eyelids. Do not allow person to rub eyes or keep eyes closed. Seek medical attention immediately.

Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Seek medical attention immediately.

Ingestion: Do not induce vomiting. If conscious and alert, give 2-4 cups of milk or water to drink. Never give anything by mouth to an unconscious person. Rinse mouth with water. In the event of spontaneous vomiting, give water. Seek medical attention immediately.

Handling and Storage Requirements

Store and use with adequate ventilation. Store below 35 °C in a cool, dry, well-ventilated area away from incompatibles and combustibles. Keep away from heat, sparks and flame. Keep containers tightly closed. Protect from light. Avoid all contact.

TDG Requirements


Class 5.1


Class 8

Shipping Name: HYDROGEN PEROXIDE, AQUEOUS SOLUTION

Hazard Class: 5.1(8)

UN Number: UN2014

Packing Group: II

Departments:

Laboratory

Production

Emergency Response:

In case of emergency contact your immediate supervisor.

Fisher Scientific
CANADA
A Fisher Scientific International Company

MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MSDS Identification:

- **Key:** 11189
- **Name:** Hydrogen Peroxide 30-50%

Catalog Numbers:

AC9470941, S74876, S74876-1, S748761, S748761MF, S74879, S74882, H323-500, H325-100, H325-30GAL, H325-4, H325-500, H325-500001, H327-500, H327-500LC, NC9839610, WESH325500, ZZH3253015

Synonyms:

- Carbamide Peroxide; Hydrogen Dioxide; Peroxide; Hydroperoxide; Urea
- Peroxide; Hydrogen Peroxide 100 Volumes.

Company Identification:

Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410

For information, call:

- 201-796-7100

Emergency Number:

- 201-796-7100

For CHEMTREC assistance, call:

- 800-424-9300

For International CHEMTREC assistance, call:

- 703-527-3887

SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS

CAS #	Chemical Name	%	EINECS #
7722-84-1	Hydrogen peroxide	30-50	231-765-0
7732-18-5	Water	50-70	231-791-2

Hazard Symbols: O C

Risk Phrases: 34 8

SECTION 3 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Appearance: clear, colorless liquid. Danger! Strong oxidizer. Contact with other material may cause a fire. Corrosive. Light sensitive. May be harmful if swallowed. May cause central nervous system effects. Eye contact may result in permanent eye damage. May cause blood abnormalities. May cause severe respiratory tract irritation with possible burns. Causes eye and skin irritation and possible burns. May cause severe digestive tract irritation with possible burns.

Target Organs: Blood, central nervous system.

POTENTIAL HEALTH EFFECTS

Eye: Contact with liquid is corrosive to the eyes and causes severe burns. Contact with the eyes may cause corneal damage.

Skin: Causes severe skin irritation and possible burns. May cause discoloration, erythema (redness), swelling, and the formation of papules and vesicles (blisters).

Ingestion: Causes gastrointestinal irritation with nausea, vomiting and diarrhea. Causes gastrointestinal tract burns. May cause vascular collapse and damage. May cause damage to the red blood cells. May cause difficulty in swallowing, stomach distension, possible cerebral swelling and death. Ingestion may result in irritation of the esophagus, bleeding of the stomach and ulcer formation.

Inhalation: Causes chemical burns to the respiratory tract. May cause ulceration of nasal tissue, insomnia, nervous tremors with numb extremities, chemical pneumonia, unconsciousness, and death. At high concentrations, respiratory effects may include acute lung damage and delayed pulmonary edema.

Chronic: Prolonged or repeated skin contact may cause dermatitis. Laboratory experiments have resulted in mutagenic effects. Repeated contact may cause corneal damage.

SECTION 4 - FIRST AID MEASURES

Eyes: Get medical aid immediately. Do NOT allow victim to rub eyes or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).

Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Destroy contaminated shoes.

Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Wash mouth out with water. Vomiting may occur spontaneously. If vomiting occurs and the victim is conscious, give water to further dilute the chemical.

Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If breathing is difficult, give oxygen. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.

Notes to Physician: Treat symptomatically and supportively. Attempts at evacuating the stomach via emesis induction or gastric lavage should be avoided. In the event of severe distension of the stomach or esophagus due to gas formation, insertion of a gastric tube may be required. To treat corneal damage, careful ophthalmologic evaluation is recommended and the possibility of local corticosteroid therapy should be considered.

SECTION 5 - FIRE FIGHTING MEASURES

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Water runoff can cause environmental damage. Dike and collect water used to fight fire. Strong oxidizer. Contact with combustible materials may cause a fire. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Use water with caution and in flooding amounts. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas. Some oxidizers may react explosively with hydrocarbons(fuel). May decompose explosively when heated or involved in a fire. May accelerate burning if involved in a fire.

Extinguishing Media: Use water only! Do NOT use carbon dioxide. Do NOT use dry chemical. Do NOT get water inside containers. Contact professional fire-fighters immediately. Cool containers with flooding quantities of water until well after fire is out. For large fires, flood fire area with large quantities of water, while knocking down vapors with water fog.

Autoignition Temperature: Noncombustible

Flash Point: Noncombustible

Explosion Limits, lower: 40 vol %

Explosion Limits, upper: 100 vol %

NFPA Rating: (estimated) Health: 3; Flammability: 0; Instability: 1; Special Hazard: OX

SECTION 6 - ACCIDENTAL RELEASE MEASURES

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Use water spray to disperse the gas/vapor. Remove all sources of ignition. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite. Do not use combustible materials such as sawdust. Flush spill area with water. Provide ventilation. Do not get water inside containers. Keep combustibles (wood, paper, oil, etc.,) away from spilled material.

SECTION 7 - HANDLING AND STORAGE

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Contents may develop pressure upon prolonged storage. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Avoid contact with clothing and other combustible materials. Do not ingest or inhale. Store protected from light. Discard contaminated shoes. Unused chemicals should not be returned to the container. Rinse empty drums and containers thoroughly with water before discarding.

Storage: Keep away from heat, sparks, and flame. Do not store near combustible materials. Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Store protected from light. Keep away form alkalies, oxidizable materials, finely divided metals, alcohols, and permanganates. Store below 35¦C. Store only in light-resistent containers fitted with a safety vent.

SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION

Engineering Controls: Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

EXPOSURE LIMITS

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Hydrogen peroxide	1 ppm	1 ppm TWA; 1.4mg/m3 TWA 75ppm IDLH	1 ppm TWA; 1.4mg/m3 TWA
Water	none listed	none listed	none listed

OSHA Vacated PELs:

Hydrogen peroxide: 1 ppm TWA; 1.4 mg/m3 TWA

Water: No OSHA Vacated PELs are listed for this chemical.

PERSONAL PROTECTIVE EQUIPMENT

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid

Color: clear, colorless

Odor: slight acid odor

pH: 3.3 (30% solution)

Vapor Pressure: 23 mm Hg @ 30C

Vapor Density: 1.10

Evaporation Rate: >1.0 (Butyl acetate=1)

Viscosity: 1.25 cP

Boiling Point: 108 deg C @ 760 mmHg

Freezing/Melting Point: -33 deg C

Decomposition Temperature: Not available.

Solubility in water: Miscible in water.

Specific Gravity/Density: 1.1-1.2 (30-50%)

Molecular Formula: H_2O_2

Molecular Weight: 34.0128

SECTION 10 - STABILITY AND REACTIVITY

Chemical Stability: Decomposes slowly to release oxygen. Unstable when heated or contaminated with heavy metals, reducing agents, rust, dirt or organic materials. Stability is reduced when pH is above 4.0.

Conditions to Avoid: Mechanical shock, incompatible materials, light, ignition sources, dust generation, excess heat, combustible materials, reducing agents, alkaline materials, strong oxidants, rust, dust, pH > 4.0.

Incompatibilities with Other Materials: Activated carbon, tert-butyl alcohol, chlorosulfonic acid, cyclopentadiene, charcoal, formic acid, magnesium, hydrazine, hydrogen selenide, manganese dioxide, mercurous chloride, strong oxidizing agents, strong reducing agents, brass, copper, copper alloys, galvanized iron, nickel, lead, rust, ethers (e.g. dioxane, furfuran, tetrahydrofuran (THF)), carboxylic acids, alcohols, aniline, glycerine, sodium borate, urea, sodium carbonate, triethylamine, sodium fluoride, sodium pyrophosphate, soluble fuels (acetone, ethanol, glycerol), acetic acid, acetic anhydride, nitrogen compounds, wood, wood, alkalies, asbestos, organic matter, finely powdered metals, iron, silver, platinum, palladium, ketones, cyanides (e.g. potassium cyanide, sodium cyanide), hexavalent chromium compounds, nitric acid, potassium permanganate, salts of iron, copper, chromium, vanadium, tungsten, molybdeum, and platinum.

Hazardous Decomposition Products: Oxygen, hydrogen gas, water, heat, steam.

Hazardous Polymerization: Will not occur.

SECTION 11 - TOXICOLOGICAL INFORMATION

RTECS#:

- CAS# 7722-84-1: MX0887000 MX0888000 MX0890000 MX0899000 MX0899500 MX0900000
- CAS# 7732-18-5: ZC0110000

LD50/LC50:

- CAS# 7722-84-1: Draize test, rabbit, eye: 1 mg Severe; Inhalation, rat: LC50 = 2 gm/m3/4H; Inhalation, rat: LC50 = 2000 mg/m3; Oral, mouse: LD50 = 2000 mg/kg; Oral, rabbit: LD50 = 820 mg/kg; Oral, rat: LD50 = 1518 mg/kg;

Oral, rat: LD50 = 910 mg/kg; Oral, rat: LD50 = 376 mg/kg; Oral, rat: LD50 = 4050 mg/kg; Skin, rat: LD50 = 3 gm/kg; Skin, rat: LD50 = 4060 mg/kg.

- CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg. Oral, rat: LD50 = 1232 mg/kg (35% H_2O_2); Oral, rat: LD50 = 841 mg/kg (60 %

Carcinogenicity:

Hydrogen peroxide -

- ACGIH: A3 - Animal Carcinogen IARC: Group 3 carcinogen

Water -

- Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology:

No information available.

Teratogenicity:

No information available.

Reproductive Effects:

No information available.

Neurotoxicity:

No information available.

Mutagenicity:

- CAS#: 7722-84-1 Mutation in Microorganisms: Salmonella typhimurium = 100 ug/plate.; Hyman, embryo = 50 umol/L.; Cytogenetic Analysis: Human, embryo = 20 umol/L. Mutation in Mammalian Somatic Cells: Hamster, lung = 1mmol/L.

Other Studies:

No data available.

SECTION 12 - ECOLOGICAL INFORMATION

Ecotoxicity:

Fish: Carp: LC50 = 42 mg/L; 48 Hr; UnspecifiedFish: Fathead Minnow:

- LC50 = 16.4 mg/L; 96 Hr; Fresh waterFish: Fathead Minnow: NOEC = 5

  mg/L; 96 Hr; Fresh waterWater flea Daphnia: EC50 = 2.4 mg/L; 48 Hr;

  Fresh waterFish: Channel catfish: LC50 = 37.4 mg/L; 96 Hr; Fresh water

SECTION 13 - DISPOSAL CONSIDERATIONS

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series: None listed.

SECTION 14 - TRANSPORT INFORMATION

US DOT

- Shipping Name: HYDROGEN PEROXIDE, AQUEOUS SOLUTIONS
- Hazard Class: 5.1
- UN Number: UN2014
- Packing Group: II

Canadian TDG

- Shipping Name: HYDROGEN PEROXIDE AQUEOUS SOLN
- Hazard Class: 5.1(0.8)
- UN Number: UN2014

SECTION 15 - REGULATORY INFORMATION

US FEDERAL

TSCA

- CAS# 7722-84-1 is listed on the TSCA inventory.
- CAS# 7732-18-5 is listed on the TSCA inventory.

Health & Safety Reporting List

- None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

- None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

- None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

- None of the chemicals in this material have a SNUR under TSCA.

SARA

CERCLA Hazardous Substances and corresponding RQs

- None of the chemicals in this material have an RQ.

SARA Section 302 Extremely Hazardous Substances

- CAS# 7722-84-1: 1,000 lb TPQ (concentration > 52%)

SARA Codes

- CAS # 7722-84-1: acute, flammable.

Section 313

- No chemicals are reportable under Section 313.

Clean Air Act:

- This material does not contain any hazardous air pollutants.
- This material does not contain any Class 1 Ozone depletors.
- This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

- None of the chemicals in this product are listed as Hazardous Substances under the CWA.
- None of the chemicals in this product are listed as Priority Pollutants under the CWA.
- None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

- None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Hydrogen peroxide can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

Water is not present on state lists from CA, PA, MN, MA, FL, or NJ.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

- Hazard Symbols: O C
- Risk Phrases:
  - R 34 Causes burns.
  - R 8 Contact with combustible material may cause fire.
- Safety Phrases:
  - S 3 Keep in a cool place.
  - S 28 After contact with skin, wash immediately with...
  - S 36/39 Wear suitable protective clothing and eye/face protection.
  - S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)

- CAS# 7722-84-1: 0
- CAS# 7732-18-5: No information available.

United Kingdom Occupational Exposure Limits

- CAS# 7722-84-1: OES-United Kingdom, TWA 1 ppm TWA; 1.4 mg/m3 TWA
- CAS# 7722-84-1: OES-United Kingdom, STEL 2 ppm STEL; 2.8 mg/m3 STEL
- CAS# 7722-84-1: OES-United Kingdom, STEL 2 ppm STEL; 2.8 mg/m3 STEL

United Kingdom Maximum Exposure Limits

Canada

- CAS# 7722-84-1 is listed on Canada's DSL List.
- CAS# 7732-18-5 is listed on Canada's DSL List.
- This product has a WHMIS classification of C, E, D2A.
- CAS# 7722-84-1 is listed on Canada's Ingredient Disclosure List.
- CAS# 7732-18-5 is not listed on Canada's Ingredient Disclosure List.

Exposure Limits

- CAS# 7722-84-1: OEL-AUSTRALIA:TWA 1 ppm (1.5 mg/m3)
- OEL-BELGIUM:TWA 1 ppm (1.4 mg/m3)
- OEL-DENMARK:TWA 1 ppm (1.4 mg/m3)
- OEL-FINLAND:TWA 1 ppm (1.4 mg/m3);STEL 3 ppm (4.2 mg/m3)
- OEL-FRANCE:TWA 1 ppm (1.5 mg/m3)
- OEL-GERMANY:TWA 1 ppm (1.4 mg/m3)
- OEL-THE NETHERLANDS:TWA 1 ppm (1.4 mg/m3)
- OEL-THE PHILIPPINES:TWA 1 ppm (1.4 mg/m3)
- OEL-SWITZERLAND:TWA 1 ppm (1.4 mg/m3);STEL 2 ppm (2.8 mg/m3)
- OEL-TURKEY:TWA 1 ppm (1.4 mg/m3)
- OEL-UNITED KINGDOM:TWA 1 ppm (1.5 mg/m3);STEL 2 ppm (3 mg/m3)

SECTION 16 - ADDITIONAL INFORMATION

MSDS Creation Date: 4/21/1999, **Revision #4 Date:** 3/18/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

File No. **Product Name** 156

17273 HYDROGEN PEROXIDE 30-50%

WHMIS Classification

C - Oxidizing E - Corrosive D2A - Very Toxic

Personal Protective Equipment

Safety Glasses Hand Protection Full Body Protective Clothing

FIRST AID: IF IRRITATION PERSISTS SEEK MEDICAL ATTENTION

Inhalation: Immediately remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth. If not breathing, administer artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask. Seek medical attention.

Eye Contact: Extensive irrigation is required (at least 30 minutes), occasionally lifting the upper and lower eyelids. Do not allow person to rub eyes or keep eyes closed. Seek medical attention immediately.

Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Seek medical attention immediately.

Ingestion: Do not induce vomiting. If conscious and alert, give 2-4 cups of milk or water to drink. Never give anything by mouth to an unconscious person. Rinse mouth with water. In the event of spontaneous vomiting, give water. Seek medical attention immediately.

Notes: DANGER! Strong oxidizing agent. Contact with other material may cause fire. Can be explosive when exposed to heat or flame. May cause severe eye, skin and respiratory irritation or burns. Highly reactive and incompatible; see MSDS for complete listing.

Emergency

Contact EH&S coordinator or your immediate supervisor.

Refer to Material Safety Data Sheet For Additional Information

File No. **Product Name** 156

17273 HYDROGEN PEROXIDE 30-50%

WHMIS Classification

C - Oxidizing E - Corrosive D2A - Very Toxic

Personal Protective Equipment

Safety Glasses Hand Protection Full Body Protective Clothing

FIRST AID: IF IRRITATION PERSISTS SEEK MEDICAL ATTENTION

Inhalation: Immediately remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth. If not breathing, administer artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask. Seek medical attention.

Eye Contact: Extensive irrigation is required (at least 30 minutes), occasionally lifting the upper and lower eyelids. Do not allow person to rub eyes or keep eyes closed. Seek medical attention immediately.

Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Seek medical attention immediately.

Ingestion: Do not induce vomiting. If conscious and alert, give 2-4 cups of milk or water to drink. Never give anything by mouth to an unconscious person. Rinse mouth with water. In the event of spontaneous vomiting, give water. Seek medical attention immediately.

Notes: DANGER! Strong oxidizing agent. Contact with other material may cause fire. Can be explosive when exposed to heat or flame. May cause severe eye, skin and respiratory irritation or burns. Highly reactive and incompatible; see MSDS for complete listing.

Emergency

Contact EH&S coordinator or your immediate supervisor.

Refer to Material Safety Data Sheet For Additional Information

File No. **Product Name** 156

17273 HYDROGEN PEROXIDE 30-50%

WHMIS Classification

C - Oxidizing E - Corrosive D2A - Very Toxic

Personal Protective Equipment

Safety Glasses Hand Protection Full Body Protective Clothing

FIRST AID: IF IRRITATION PERSISTS SEEK MEDICAL ATTENTION

Inhalation: Immediately remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth. If not breathing, administer artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask. Seek medical attention.

Eye Contact: Extensive irrigation is required (at least 30 minutes), occasionally lifting the upper and lower eyelids. Do not allow person to rub eyes or keep eyes closed. Seek medical attention immediately.

Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Seek medical attention immediately.

Ingestion: Do not induce vomiting. If conscious and alert, give 2-4 cups of milk or water to drink. Never give anything by mouth to an unconscious person. Rinse mouth with water. In the event of spontaneous vomiting, give water. Seek medical attention immediately.

Notes: DANGER! Strong oxidizing agent. Contact with other material may cause fire. Can be explosive when exposed to heat or flame. May cause severe eye, skin and respiratory irritation or burns. Highly reactive and incompatible; see MSDS for complete listing.

Emergency

Contact EH&S coordinator or your immediate supervisor.

Refer to Material Safety Data Sheet For Additional Information

007334

File No. **Product Name** 156

17273 HYDROGEN PEROXIDE 30-50%

WHMIS Classification

C - Oxidizing E - Corrosive D2A - Very Toxic

Personal Protective Equipment

Safety Glasses Hand Protection Full Body Protective Clothing

FIRST AID: IF IRRITATION PERSISTS SEEK MEDICAL ATTENTION

Inhalation: Immediately remove to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth. If not breathing, administer artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask. Seek medical attention.

Eye Contact: Extensive irrigation is required (at least 30 minutes), occasionally lifting the upper and lower eyelids. Do not allow person to rub eyes or keep eyes closed. Seek medical attention immediately.

Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Seek medical attention immediately.

Ingestion: Do not induce vomiting. If conscious and alert, give 2-4 cups of milk or water to drink. Never give anything by mouth to an unconscious perso Rinse mouth with water. In the event of spontaneous vomiting, give water. Seek medical attention immediately.

Notes: DANGER! Strong oxidizing agent. Contact with other material may cause fire. Can be explosive when exposed to heat or flame. May cause severe eye, skin and respiratory irritation or burns. Highly reactive and incompatible; see MSDS for complete listing.

Emergency

Contact EH&S coordinator or your immediate supervisor.

Refer to Material Safety Data Sheet For Additional Information

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ATTACHMENT 7

Working Alone Standard

See the HSP American Creosote Works (CH2M HILL, 2010).

ATTACHMENT 8

Tick Fact Sheet

See the HSP American Creosote Works (CH2M HILL, 2010).

ATTACHMENT 9

Observed Hazard Form

See the HSP American Creosote Works (CH2M HILL, 2010).

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Appendix B
Soil and Groundwater Sampling Procedures

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APPENDIX B

Soil and Groundwater Sampling Procedures

This appendix provides guidance for collection of soil and groundwater samples from the ACW site in Winnfield, Louisiana. Adherence to these procedures will ensure that samples are representative of conditions and their integrity is maintained throughout the sample collection, handling and analysis process.

Documentation Requirements

Documentation of the field sampling effort shall be performed using a bound notebook with consecutively numbered pages. At a minimum, the following information shall be entered in the logbook:

1. Date and time of field sampling activities.
2. Names of individuals collecting samples.
3. General description of weather conditions during the sample event.
4. Sample location number.
5. Description of field equipment used for sampling with calibration data.
6. Water level (if reached) and total boring depth and volume of water purged (if applicable).
7. Results of field pH, temperature and specific conductance measurements.
8. Time of sample collection and analysis requested.

Field Instrument Calibration and Maintenance

A photo-ionization device (PID) will be used for measuring contaminant vapor levels.

Field instruments to be used for measuring water levels and general water quality parameters such as pH, temperature, specific conductance and dissolved oxygen include:

- Solinst electronic water level meter or equivalent
- Conductivity and temperature meters (Corning or YSI)
- YSI dissolved oxygen meter

Field equipment shall be calibrated on a daily basis during all sampling events and maintained in accordance with the manufacturer's specifications. Calibration information shall be recorded on the calibration logsheets located in the front of the groundwater sampling diary.

The conductivity meter is factory calibrated and tested daily for accuracy using a conductivity calibrator solution. The observed difference between the true value of the calibrator solution and the value measured by meter is the correction factor. Prior to performing this test the Red Line/Battery check test is performed by following the instructions on the face of the meter. When recording the calibrator solution conductivity measurement, make sure the temperature is also recorded in the field logbook.

The YSI dissolved oxygen meter is calibrated to the ambient atmospheric concentration adjusted for elevation and temperature. The YSI pH meter is calibrated daily using a manual or auto-calibration method requiring two buffer solutions: pH 7.0 and either pH 4.0 or pH 10.0. The buffers used depend on the range of pH expected in sampled groundwater or surface water.

The electronic water level indicator is tested for operability on a daily basis using the self-test function on the meter.

Field equipment model and identification numbers are also recorded with calibration measurements in the field notebook to document instrument deviations, which may occur between different model types.

Laboratory Analysis

Samples shall be shipped at least every two days via overnight carrier to the subcontract laboratory. Samples held overnight prior to shipment shall be maintained in a refrigerator or iced cooler at a temperate of 2 to 4 degrees Celsius. Additional laboratory related information is provided in the Field Operations Plan (FOP) (CH2M HILL, 2006) Appendix D.

Sample Custody

The chain-of-custody program is a means to trace the possession and handling of individual samples from the time of field collection through laboratory analysis. The chain-of-custody program includes:

- Sample labels
- Chain-of-custody forms
- Chain-of-custody seals
- Sample packaging and shipment
- Laboratory notebook and report

The chain-of-custody program described in this report is for the field aspects only. Laboratory chain-of-custody and control are mandatory for any laboratories performing environmental testing. Laboratory custody procedures are described in the subcontract laboratoy's Quality Assurance Program Manual.

Sample Labels

A sample label will be affixed to each sample bottle before sample collection. The information contained on each label will include the following:

- Site description

- Sample location
- Date and time sampled
- Name of sample collector
- Preservative type

The sample number will be determined by a coding system identifying the project site, a sample location, and date. An example may be:

ACW-MW3s-0104

Where: ACW = American Creosote Works site

MW3 = Monitor well 3.

0104 = year and month of sampling.

To maintain the integrity of field quality assurance samples, field duplicate, equipment blank, and trip blank samples shall be labeled with fictitious monitor well numbers so that their identity will not be evident to the laboratory. Samples shall be labeled using the following format:

Field Duplicate Sample = ACW-MWDD-0104

Where: DD = well number between 20 and 30

Equipment Blanks = BS-MWBBa-0104

Where: BB = well number between 31 and 40

Trip Blanks = BS-MWTT-0104

Where: TT = well number between 41 and 50

When collecting quality assurance and quality control samples, careful documentation shall be maintained in the field logbook so that the origin of the sample can be traced.

Field Logbook

The sample team shall maintain a logbook for pilot testing activities. This logbook will be a bound notebook with numbered pages. At the start of each day the names of sample team members, weather conditions, and reason for sampling will be recorded. The Site Monitoring Officer will maintain custody of the field logbook at all times.

Data obtained on groundwater samples will be entered into the logbook and may include: the well identification, well depth, static water level depth and measurement technique, water turbidity (estimate) and color, water odor (if present), well yield including changes in pump performance, sample identification numbers, well evacuation procedure and equipment, sample withdrawal procedure and equipment, date and time of collection, well sampling sequence, types of sampling containers and preservative(s) used, parameters requested for analysis, field measurement and calibration data, analysis data and methods, sample distribution and transporter, field observations on sampling event, and name of collector.

All log book entries will be made with nonerasable ink. Any corrections will be made by striking out the incorrect entry with a single line such that the original entry is not obliterated. The person making the correction will also initial and date the crossed out entry. The correct entry will then be made above the crossed-out entry.

Chain-of-Custody

Custody of a sample is defined by the following criteria:

1. The sample is in your possession or in your view after being in your possession.
2. The sample that was in your possession was locked up or transferred to a designated secure area by you.

Each time the sample containers change hands, both the sender and receiver will sign and date the chain-of-custody form and specify what has changed hands. When a sample shipment is sent to the laboratory, the top signature copies are enclosed in plastic with the sample documentation and secured to the inside of the sample cooler lid. The third copy of the custody form will be retained in the project file. The laboratory will be instructed to sign its copy of the chain-of-custody sheet included with the samples and return a copy of the signed sheet along with the analytical results. A chain-of-custody record will be completed for each shipping container.

The following information is included on the chain-of-custody form:

- Sample number
- Signature of sampler
- Date and time of collection
- Place of collection
- Type of sample
- Number and type of container
- Inclusive dates of possession
- Signature of receiver

In addition to the chain-of-custody form, other components of chain-of-custody control may include sample labels, sample seals, field logbook, and the laboratory logbook. The chain-of-custody form includes all elements of a sample analysis request sheet.

Chain-of-Custody Seals

Chain-of-custody seals will be placed on individual coolers at any time the cooler is not in view of the sample team or is stored in an unsecured area. The team will sign and date the chain-of-custody seals and attach them in such a way that is necessary to break the seal in order to open the sample cooler. At least two chain-of-custody seals are attached to the sample cooler, one each on the front and back. Fiber tape may also be placed at each end of the custody seal for additional security.

Laboratory Logbook

Once the sample has been received in the laboratory, the sample custodian or laboratory personnel will clearly document the processing steps that are applied to the sample. The results of the analysis of all quality-control samples will be identified specific to each batch of groundwater samples analyzed. The laboratory logbook will include the time, date, and name of the person who performed each processing step.

Sample Packaging and Shipment

Packaging and shipment of samples to non-local laboratories should follow these guidelines:

1. Sample volume should be limited to the quantity necessary to conduct the requisite analysis and the smallest appropriate container should be used.
2. Samples, for which EPA approved analytical methods require preservation at 4 o C, shall be preserved by placing the sample containers in sturdy coolers filled with ice placed in double bagged one-gallon ziploc bags. Four to six bags of ice shall be placed in each cooler.
3. Shipping containers-All sample containers are to be placed inside a strong outside shipping container. A metal or plastic picnic cooler (ice chest) lined inside with hard plastic complies with the DOT drop test requirement. The container should also be taped shut to achieve as tight a seal as possible around the lid to prevent leakage should the container be accidentally turned over.
4. Glass containers-The container's screw-type lid must be tightened before it is placed in the shipping container. In the shipping container glass bottles should be separated by cushioning or absorbent material (e.g., Styrofoam, blotting paper or newspaper) to prevent contact with other hard objects and prevent breakage. For example, a 1-gallon glass bottle (organic sample) can be placed between two carved out Styrofoam sheets, which secure the bottle at the top and bottom. Small glass bottles (volatile organic samples) can be placed inside a foam cushion vial container to minimize breakage.
5. Plastic containers-Polyethylene bottles or cubit containers do not require cushioning materials to prevent breakage but do need to be protected from puncture by sharp objects. Caps are to be tightly screwed on before the plastic containers are placed in the shipping container.
6. Ice can be placed in separate sealed double plastic bags, or in large-mouthed plastic cubit containers with screwtype lids. Packing material such as bubble wrap or Styrofoam may be added to "top off" the cooler contents.
7. Place a copy of the chain-of-custody inside a plastic bag and secure it to the top of the shipping container lid form before closing and sealing.
8. Secure the cooler lid with several wrappings of fiber tape.

The shipping container must be marked "THIS END UP" and arrows indicating the proper upward position of the container should be affixed. A sticker showing the laboratory's office's name and address must be placed on the outside top of the cooler.

Decontamination

Sampling personnel will assure that all nondisposable sampling equipment, tools, utensils, and other materials that are in contact with the sample or transmitted by secondary contact, are fully decontaminated both initially and between sampling of different wells. The decontamination procedure will, as a minimum, include the following steps:

Disassemble all sampling equipment

Clean all surfaces, both interior and exterior, by scrubbing with bristle brushes and nonphosphate detergent solution. Solution concentration should be 4 ounces of detergent per 10 lbs. of water, or equivalent.

- Rinse all surfaces thoroughly with clean tap water.
- Rinse all surfaces thoroughly with reagent grade methanol.
- Rinse all surfaces thorough with distilled/deionized water.
- Allow all components and equipment to air dry.
- Wearing clean surgical gloves, reassemble sampling equipment.

When applicable, disposable components such as monofilament line for sample bailers will be used. All sampling equipment will be inspected prior to use. Pieces showing signs of contamination will not be used for sample collection without again receiving decontamination.

Decontamination of tygon suction line used when purging a well with a peristaltic pump is more difficult to perform. To minimize the need for decontamination of the suction line, a new length of suction line, will be purchased prior to each sampling event. If it becomes necessary to decontaminate the suction line a nonphosphate detergent wash, tap water rinse, isopropyl alcohol rinse, and a final tap water rinse will be pumped through the suction line. The exterior will be cleaned in the same manner as would other sampling equipment.

Field Quality Assurance and Quality Control

The purpose of the field quality control program is to ensure reliability of data. Field blanks measure the performance of sample containers and sampling equipment. Duplicates provide a measure of laboratory accuracy. The following schedule for collecting blank and duplicate samples will be followed:

Field Duplicates. Field duplicates are collected at specified frequencies and are employed to document laboratory precision. One set of duplicate ground-water samples will be collected for offsite wells and for onsite wells. The duplicate will consist of sampling one well in the same manner as the original sample. Immediately after collecting a given parameter for the original sample, the same parameter will be collected for the duplicate sample. The same number of bottles will be filled and the same analyses performed.

Typically, the duplicate will be collected from a well where contamination is expected such that data above the analytical method detection will be obtained and can be used to calculate precision and accuracy.

Equipment Blank. Equipment blank samples will be collected using disposable bailers or dedicated (installed) pumps. Equipment blanks are thus not required unless re-usable equipment is used.

Trip Blank. Trip blanks accompany sample containers to and from the field. These samples can be used to detect any contamination or cross-contamination during handling and transportation. Trip blanks will be prepared at the laboratory supplying the sample containers. For the volatile containers, organic free water will be required, and deionized water will be required for all other container types. These containers will be transported to the sampling locations and returned to the laboratory in a manner identical to the handling procedures used for the groundwater samples. The trip blanks and groundwater samples will each receive the same analyses appropriate to the container type. One set of trip blanks will be sent with each cooler shipped.

Soil Sampling

The following section provides information on subsurface soil samples collected during drilling operations.

Split-Spoon Sampling

Using a drilling rig, a hole is advanced to the desired depth. For split-spoon sampling, the samples are then collected following the ASTM D 1586 standard. The sampler is lowered into the hole and driven to a depth equal to the total length of the sampler; typically this is 24 inches. The sampler is driven in 6-inch increments using a 140-pound weight (“hammer") dropped from a height of 30 inches. The number of hammer blows for each 6-inch interval is counted and recorded. To obtain enough volume of sample for subsequent laboratory analysis, use of a 3-inch ID sampler may be required. Blow counts obtained with a 3-inch ID spoon would not conform to ASTM D 1586 and would therefore not be used for geotechnical evaluations.

Once retrieved from the hole, the sampler is carefully split open. Care should be taken not to allow material in the sampler to fall out of the open end of the sampler. To collect the sample, the surface of the sample should be removed with a clean tool and disposed of. Samples collected for volatiles analysis should be placed directly into the sample containers from the desired depth in the split spoon. Material for samples for all other parameters should be removed to a decontaminated stainless steel tray. The sample for semivolatile organic and inorganic analyses should be homogenized in the field by breaking the sample into small pieces and removing gravel. The homogenized sample should be placed in the sample containers. If sample volume requirements are not met by a single sample collection, additional sample volume may be obtained by collecting a sample from below the sample and compositing the sample for non-volatile parameters only.

Split-spoon samples also will be collected using a tripod rig. When using a tripod rig the soil samples are collected using an assembly similar to that used by the drilling rig.

Thin-Walled Tube Sampling

Undisturbed fine grained samples may be collected for analysis for geotechnical parameters such as vertical hydraulic conductivity. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes) according to ASTM D 1587 (attached). Tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the ends will be sealed with bees wax and then sealed with end caps and heavy tape. The sample designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube shall be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for geochemical analysis normally are not collected from thin-walled tube samples.

Sample containers, including preservative (HCl for VOCs), shall be supplied by the laboratory. The laboratory may provide certification, if requested, that sample containers have been prepared following specified EPA protocol.

Groundwater Sampling

The following section provides information on groundwater samples collected during drilling operations.

Standard Direct-Push (e.g., Geoprobe®) Groundwater Sample Collection

A 4-foot slotted steel lead rod will be driven to the desired sampling depth using a truck-mounted hydraulic percussion hammer. Polyethylene tubing will then be lowered into the rods after a stainless steel foot valve has been inserted into the end of the tubing. The end of the tubing should be placed at least one foot from the bottom of the boring, and should not be above the slotted portion of the lead drive rod (“screen”).

Fill all sample containers, beginning with the containers for VOC analysis. Sample containers should be filled slowly to minimize sample aeration. Do not overfill sample containers that contain preservative.

Remove polyethylene sampling tubing from the rods. Remove the foot valve and discard polyethylene tubing. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required. Verify that the borehole made during sampling activities has been properly backfilled.

Sample containers, including preservative (HCl for VOCs), shall be supplied by the laboratory. The laboratory may provide certification, if requested, that sample containers have been prepared following specified EPA protocol.

Appendix C
Capacity Test SOP

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Standard Test Method for Determining Specific Capacity and Estimating Transmissivity at the Control Well[1]

This standard is issued under the fixed designation D 5472; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

ϵ^1 NOTE—Section 10.2.1 was corrected editorially in August 1999.

1. Scope

1.1 This test describes a procedure for conducting a specific capacity test, computing the specific capacity of a control well, and estimating the transmissivity in the vicinity of the control well. Specific capacity is the well yield per unit drawdown at an identified time after pumping started.

1.2 This test method is used in conjunction with Test Method D 4050 for conducting withdrawal and injection well tests.

1.3 The method of determining transmissivity from specific capacity is a variation of the nonequilibrium method of Theis **(1)** for determining transmissivity and storage coefficient of an aquifer. The Theis nonequilibrium method is given in Test Method D 4106.

1.4 *Limitations*—The limitations of the technique for determining transmissivity are primarily related to the correspondence between the field situation and the simplifying assumptions of the Theis method.

1.5 The values stated in SI units are to be regarded as standard.

1.6 This standard may involve hazardous materials, operations, and equipment. This standard does not address safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 4050 Test Method (Field Procedure) for Withdrawal and Injection Well Tests for Determining Hydraulic Properties of Aquifer Systems[2]

D 4106 Test Method for Analytical Procedure for Determining Transmissivity and Storativity of Nonleaky Confined Aquifers by the Theis Nonequilibrium Method[2]

D 4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *aquifer, confined*—an aquifer bounded above and below by confining beds and in which the static head is above the top of the aquifer.

3.1.2 *aquifer, unconfined*—an aquifer that has a water table.

3.1.3 *control well*—well by which the head and flow in the aquifer is changed by pumping, injecting, or imposing a constant change of head.

3.1.4 *head, static*—the height above a standard datum of the surface of a column of water that can be supported by the static pressure at a given point.

3.1.5 *hydraulic conductivity*—(field aquifer test) the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.

3.1.6 *observation well*—a well open to all or part of an aquifer, and used to make measurements.

3.1.7 *specific capacity*—well yield per unit drawdown at an identified time after pumping started.

3.1.8 *storage coefficient*—the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

3.1.9 *transmissivity*—the volume of water at the existing kinematic viscosity that will move in a unit time under a unit hydraulic gradient through a unit width of the aquifer.

3.1.10 For definitions of other terms used in this method see Terminology, D 653.

3.2 *Symbols:*Symbols and Dimensions:

3.2.1 K—hydraulic conductivity [LT^{-1}]

3.2.2 m—saturated thickness [L]

3.2.3 Q—discharge [L^3T^{-1}]

3.2.4 Q/s—specific capacity [$(L^3T^{-1})L^{-1}$]

3.2.5 r—well radius [L]

3.2.6 s—drawdown [L]

3.2.7 S—storage coefficient [dimensionless]

3.2.8 T—transmissivity [L^2T^{-1}]

3.2.9 T'—provisional value of transmissivity [L^2T^{-1}]

3.2.10 t—elapsed time of pumping [T]

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[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

Current edition approved Nov. 15, 1993. Published January 1994.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

3.2.11 u—$r^2S/4Tt$ [dimensionless]
3.2.12 $W(u)$—well function of “u” [dimensionless]
3.2.13 c_1— $[W(u)/4\pi]$

4. Significance and Use

4.1 Assumptions of the Theis **(1)** equation affect specific capacity and transmissivity estimated from specific capacity. These assumptions are given below:

4.1.1 Aquifer is homogeneous and isotropic.

4.1.2 Aquifer is horizontal, of uniform thickness, and infinite in areal extent.

4.1.3 Aquifer is confined by impermeable strata on its upper and lower boundaries.

4.1.4 Density gradient in the flowing fluid must be negligible and the viscous resistance to flow must obey Darcy’s Law.

4.1.5 Control well penetrates and receives water equally from the entire thickness of the aquifer.

4.1.6 Control well has an infinitesimal diameter.

4.1.7 Control well discharges at a constant rate.

4.1.8 Control well operates at 100 percent efficiency.

4.1.9 Aquifer remains saturated throughout the duration of pumping.

4.2 *Implications of Assumptions and Limitations of Method*.

4.2.1 The simplifying assumptions necessary for solution of the Theis equation and application of the method are never fully met in a field test situation. The satisfactory use of the method may depend upon the application of one or more empirical correction factors being applied to the field data.

4.2.2 Generally the values of transmissivity derived from specific capacity vary from those values determined from aquifer tests utilizing observation wells. These differences may reflect 1) that specific-capacity represents the response of a small part of the aquifer near the well and may be greatly influenced by conditions near the well such as a gravel pack or graded material resulting from well development, and 2) effects of well efficiency and partial penetration.

4.2.3 The values of transmissivity estimated from specific capacity data are considered less accurate than values obtained from analysis of drawdowns that are observed some distance from the pumped well.

5. Apparatus

5.1 Apparatus required for specific capacity testing includes control well, control well pump, discharge measuring equipment and water-level measuring equipment. The description and function requirements of this equipment is given in Test Method D 4050.

6. Conditioning Procedures

6.1 Conditioning procedures are conducted before the test to ensure that the control well is properly equipped and that the well discharge and water-level measuring equipment is operational.

6.1.1 Equip the control well with a calibrated accumulating water meter or another type of calibrated well yield measuring device.

6.1.2 Provide the control well with a system for maintaining a constant discharge.

6.1.3 Equip control well for measuring the pretest water level (prepumping water level) and pumping water levels during the specific capacity test.

6.1.4 Measure static water level immediately before starting the pump.

6.1.5 Start pump and simultaneously measure elapsed time with a stop watch or data recorder. After 3 to 5 minutes well yield and drawdown should be measured and recorded.

6.1.6 If all the equipment is working properly, drawdown measurements can be obtained, and constant discharge maintained, the equipment check can be ended.

6.1.7 Cease pumping and allow the water level to recover to its prepumping level before the specific capacity test procedure (Section 5) is initiated.

7. Test Procedure

7.1 Initiate well discharge.

7.2 Measure the well yield and pumping water level in the control well at predetermined time intervals, for example, 2-, 5-, 10-, 20-, 30-, minutes after discharge is initiated. Adjust the discharge rate during the test to maintain discharge within 5 % of the rate planned.

7.3 While test continues make the following calculations:

7.3.1 Adjust drawdown for effects of desaturation of the aquifer, if applicable (see Section 8).

7.3.2 Determine the specific capacity (see Section 10) and estimate transmissivity (see Section 11). If well bore storage effects are negligible (see Section 9), compare the new value of T' to the value used to calculate c_1, if the value is within 10 %, the test can be terminated.

7.3.3 If control well is not screened through the entire thickness of the aquifer, estimate the transmissivity of the aquifer following procedure in Sections 11 and 12.

8. Correction of Drawdown in an Unconfined Aquifer

8.1 The Theis equation is directly applicable to confined aquifers and is suitable for use with limitations in unconfined aquifers. If the aquifer is unconfined and drawdown is less than 10 percent of the prepumping saturated thickness, little error will be introduced. If drawdown exceeds 25 percent of the prepumping saturated thickness, this test should not be used to estimate transmissivity. For unconfined aquifers with drawdown equal to 10 to 25 percent of the original saturated thickness, correct the drawdown for the effects of reduced saturated thickness by the following formula given by Jacob **(2)**:

$$s' = s - \frac{(s^2)}{2m} \tag{1}$$

where:
s = measured drawdown in the control well,
s' = corrected drawdown, and
m = saturated thickness of the aquifer prior to pumping.

9. Well Bore Storage Effects

9.1 Evaluate the time criterion to determine if well-bore storage affects drawdown at the current duration of the test. Weeks **(3)** gives a time criterion modified after Papadopulos and Cooper **(4)** of $t > 25\,r^2/T$ after which drawdown in the control well is not affected by well-bore storage. For example, a well with a radius of 1 foot and a T of 1000 ft^2/day has a time criterion of $t > 25\ r^2/T = t > 25\ (1)^2/1000 = t > 0.025$ days $= t > 36$ min.

10. Computation of Specific Capacity

10.1 Record the drawdown and the time since pumping started.

10.2 Compute the specific capacity of the control well from the average well yield (Q) and the drawdown (s):

$$\text{Specific Capacity} = Q/s[(L^3T^{-1})L^{-1}] \tag{2}$$

10.2.1 An example of specific capacity where discharge is given in American Standard Units (1000 gallons per minute) and drawdown in feet (50):

Specific Capacity =
[1000 gpm (1440 min/day/7.48 gal/ft^3)]/50 ft =
3850 [(ft^3/day)]ft

11. Estimate Transmissivity from Specific Capacity

11.1 A modification of the Theis **(1)** nonequilibrium equation is used to evaluate transmissivity data derived from specific capacity as follows:

$$T = [W(u)/4\pi]Q/s \tag{3}$$

11.1.1 A general form of the equation is:

$$T' = c_1Q/s \tag{4}$$

where:
c_1 = $W(u)/4\pi$.

11.1.2 Calculate the value of c_1 from a provisional value of transmissivity, T', estimated storage coefficient, S, well radius, r, and duration of the test, t. An example of the computation of c_1 using field values of discharge in American units is as follows:

where:
T' = 11 000 ft^2/day,
S = 2×10^{-5}
r = 0.67 ft (16-in. diameter pipe),
t = 0.50 days

$$C_1 = W(u)/4\pi$$
$$W(u) = (-0.5772 - \mathrm{L}n[u])$$

where:
u = $(r^2S)/(4Tt) = 4.0809 \times 10^{-10}$
C_1 = $(-0.5772 - \mathrm{L}\ n[4.0809 \times 10^{-10})/4\pi]$
C_1 = $(-0.5772 - \mathrm{L}n[4.0809 \times 10^{-10}])/12.5664$
C_1 = $(-0.5772 - [-21.6195])/12.5664$
C_1 = $21.0423/12.5664 = 1.6745$

11.1.3 Calculate transmissivity from Eq 4;

$T = c_1Q/s$,
Assume Q/s = 3850 [(ft^3/day)/ft]
$T = 1.6745 \times 3850 = 6450$ ft^2/day (rounded)

11.1.4 If transmissivity calculated in 11.1.3 is not within 10 % of the provisional transmissivity, T', recalculate c_1 from the new value of transmissivity and recalculate transmissivity by formula. In the example, because 6450 ft^2/day is 59 percent of the initial T' value of the 11 000 ft^2/day, a more accurate c_1 can be computed to match the new T' value.

T' = 6450 ft^2/day
$S = 2 \times 10^{-5}$
$c_1 = W(u)/4\pi$
$W(u) = (-0.5772 - \mathrm{L}n[u])$

where:
u = $(r^2S)/(4Tt) = 8.9780 \times 10^{-6} = 6.9597 \times 10^{-10}$
C_1 = $(-0.5772 - \mathrm{L}n\ 6.9597 \times 10^{-10})/4\pi$
C_1 = $(-0.5772 - \mathrm{L}\ n\ 6.9597 \times 10^{-10})/12.5664$
C_1 = $(-0.5772 - (-21.0857)/12.5664$
C_1 = $20.5085/12.5664 = 1.6320$

thus:
T' = $C_1(Q/s) = 1.6320 \times 3850 = 6300$ ft^2/day (rounded). The new value of transmissivity is within 10 % of the value used to compute transmissivity.

11.1.5 To obtain SI units, multiply American units by 9.290×10^{-2} for m^2/day.

NOTE 1—The initial estimates of transmissivity can be based on values of transmissivity and storage of the aquifer determined at other locations or from a general knowledge of the aquifer properties. The transmissivity could be estimated from driller's logs using methods described by Gutentag and others **(5)**. The storage coefficient can be estimated for unconfined aquifer as 0.2 and for confined aquifers as b $\times 10^{-6}$, where b is the thickness of the aquifer in feet. In areas where aquifer properties are not known and drillers log data are lacking, the following values, modified from Harlan, Kolm, and Gutentag **(6)** can be used as initial estimates of c_1:

Confined aquifers	1.6
Unconfined aquifers	0.8

12. Correction of Transmissivity for Partially Penetrating Well

12.1 If the full aquifer thickness is not screened, the value of T' represents the transmissivity of the screened section of the aquifer. To estimate the transmissivity of the full thickness of the aquifer, divide estimated transmissivity by the length of the screened interval to compute the hydraulic conductivity (K). After computing (K) the hydraulic conductivity value is multiplied by the entire thickness of the saturated thickness (m) of the aquifer to compute an estimate of transmissivity as: $T = Km$.

13. Report

13.1 Prepare a report containing all data, including a description of the field site, well construction, plots of pumping water level and well discharge with time.

13.2 Present analysis of data, using iteration techniques for c, when results differ from initial input values of T and S.

13.3 Compare estimated test conditions with the test method assumptions listed in 4.1.

14. Precision and Bias

14.1 It is not practicable to specify the precision of this procedure because the response of aquifer systems during aquifer tests is dependent upon ambient system stresses. No statement can be made about bias because no true reference values exist.

15. Keywords

15.1 aquifers; aquifer tests; control wells; hydraulic conductivity; observation wells; specific capacity; storage coefficient; transmissivity; unconfined aquifers

REFERENCES

(**1**) Theis, C. V., 1935, The Relation Between the Lowering of Duration of Discharge of a Well Using Ground-Water Storage: *American Geophysical Union Transactions*, v. 16. pt. 2, p. 519–524.

(**2**) Jacob, C. E., "Determining the Permeability of Water-Table Aquifers," in Bentall, Ray, Compiler, "Methods of Determining Permeability, Transmissibility, and Drawdown," U.S. Geological Survey Water-Supply Paper 1536-I, 1963, pp. 245–271.

(**3**) Weeks, E. P., 1978, Aquifer Tests—the State of the Art in Hydrology: in Proceedings Invitational Well-Testing Symposium, October 19–21, 1977, Lawrence Berkeley Laboratory, University of California, LBL-7027, UC-66, TID 4500-R66, p. 14–26.

(**4**) Papadopulos, I. S., and Cooper, H. H., Jr., 1967, Drawdown in a Well of Large Diameter: Water Resources Research, v. 3, no. 1, p. 241–244.

(**5**) Gutentag, E. D., Heimes, F. J., Krothe, N. C., Luckey, R. R., and Weeks, J. B., 1984, Geohydrology of the High Plains Aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Professional Paper 1400-B, 63 p.

(**6**) Harlan, R. L., Kolm, K. E., and Gutentag, E. D., 1989, Water-Well Design and Construction: Elsevier, Amsterdam, 205, p.

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Appendix D
Project Schedule

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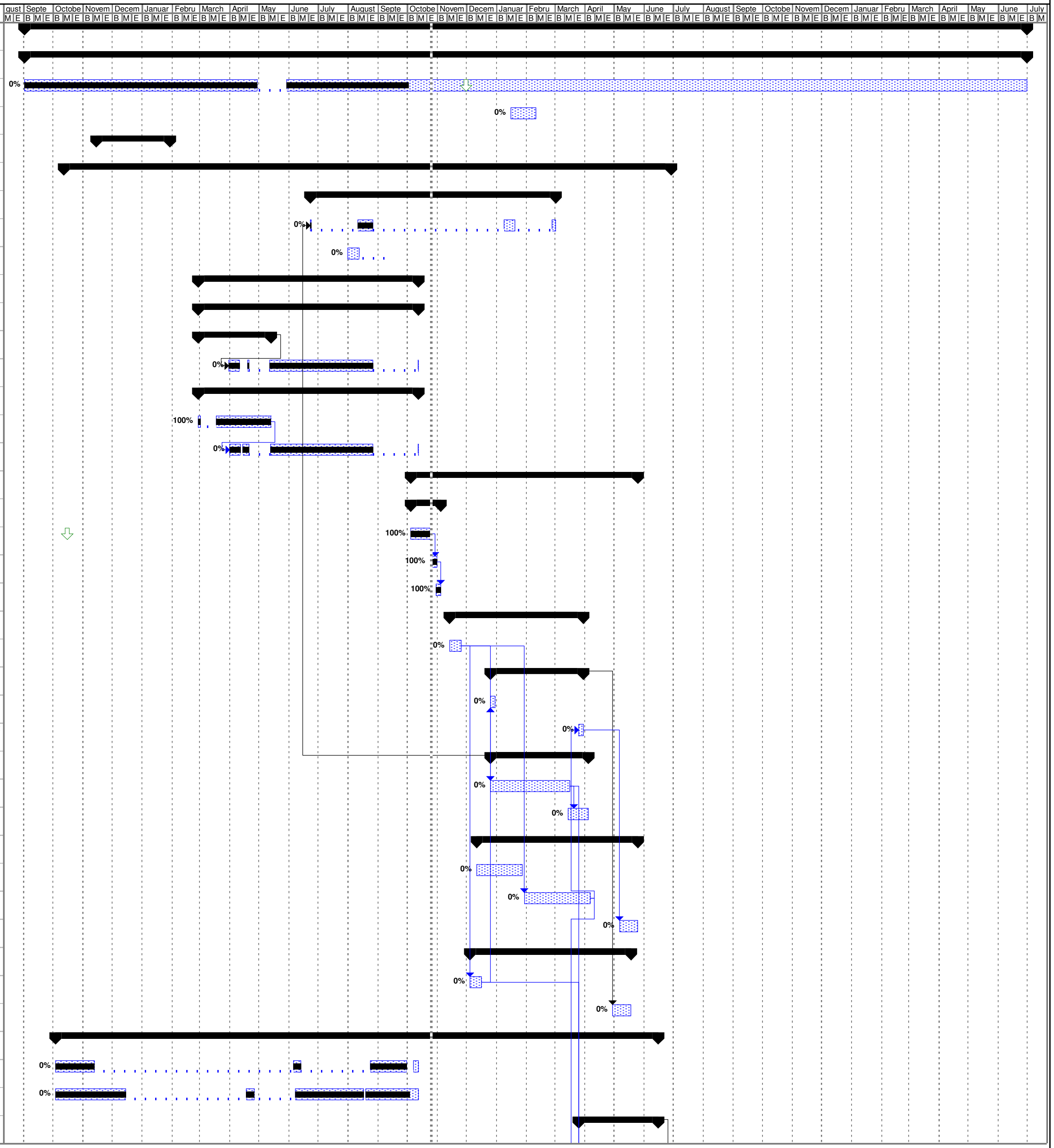
Contract No. EP-W-06-021

ID	Task Name	Duration	Start	Finish
1	**TO51 - American Creosote Feasibility Study**	738 days	Thu 9/2/10	Sun 6/30/13
2	**TASK 1: Project Planning and Support (PP)**	738 days	Thu 9/2/10	Sun 6/30/13
3	**PP.01 Project Management**	718 days	Thu 9/2/10	Sun 6/30/13
4	**PP.02 Prepare Work Plan Amendment**	20 days	Mon 1/16/12	Fri 2/10/12
5	**PP.03 Prepare Site Specific Plans**	55 days	Mon 11/15/10	Sat 1/29/11
10	**PP.04 Project Initiation and Support**	447.6 days	Tue 10/12/10	Fri 6/29/12
13	**TASK 6: DE Data Evaluation (DE)**	180.9 days	Thu 6/23/11	Fri 3/2/12
14	**DE.01 Data Evaluation (combination, reduction, tabulation, and evaluation)**	26 days	Thu 6/23/11	Fri 3/2/12
15	**DE.02 Environmental Fate and Transport Modeling/Evaluation**	10 days	Mon 8/1/11	Fri 9/9/11
16	**TASK 7: Risk Assessment (RA)**	163 days	Mon 2/28/11	Wed 10/12/11
17	**RA.01 Human Health Risk Assessment**	163 days	Mon 2/28/11	Wed 10/12/11
18	**RA.01.01 Review/Revise Existing Human Health Risk Assessment**	55 days	Mon 2/28/11	Fri 5/13/11
23	**RA.01.02 Prepare Human Health Risk Assessment (FS Appendix)**	86.46 days	Thu 3/31/11	Wed 10/12/11
24	**RA.02 Ecological Risk Assessment**	163 days	Mon 2/28/11	Wed 10/12/11
25	RA.02.01 Review/Revise Existing Ecological Risk Assessment	43.25 days	Mon 2/28/11	Fri 5/13/11
26	RA.02.02 Prepare Ecological Risk Assessment (FS Appendix)	89.43 days	Fri 4/1/11	Wed 10/12/11
27	**TASK 8: Treatability Study/Pilot Testing (TT)**	168 days	Wed 10/5/11	Fri 5/25/12
28	**TT.01 Treatability Study Work Plan**	23 days	Wed 10/5/11	Fri 11/4/11
29	Prepare Work Plan	15 days	Wed 10/5/11	Tue 10/25/11
30	EPA Review	5 days	Tue 10/25/11	Mon 10/31/11
31	Revise Treatability Study Work Plan	5 days	Mon 10/31/11	Fri 11/4/11
32	**TT.02 Field Data Collection**	100 days	Mon 11/14/11	Fri 3/30/12
33	Baseline Sampling and Well Installation	10 days	Mon 11/14/11	Fri 11/25/11
34	**Performance Sampling**	70 days	Mon 12/26/11	Fri 3/30/12
35	ISCO Peformance Sampling	5 days	Mon 12/26/11	Fri 12/30/11
36	SEPR Performance Sampling	5 days	Mon 3/26/12	Fri 3/30/12
37	**TT.03 Solidification/Stabilization Treatability Study**	73 days	Mon 12/26/11	Wed 4/4/12
38	TT.03.01 Perform Solidification/Stabilization Treatability Study	60 days	Mon 12/26/11	Fri 3/16/12
39	TT.03.02 Prepare S/S Treatability Study Report (FS Appendix)	15 days	Thu 3/15/12	Wed 4/4/12
40	**TT.04 SEPR Treatability Study**	120 days	Mon 12/12/11	Fri 5/25/12
41	Well Rehab and Baseline Recovery Evaluation	35 days	Mon 12/12/11	Fri 1/27/12
42	TT.04.01 Perform SEPR Treatability Study	50 days	Mon 1/30/12	Fri 4/6/12
43	TT.04.02 Prepare SEPR Treatability Study Report (FS Appendix)	15 days	Mon 5/7/12	Fri 5/25/12
44	**TT.05 ISCO Treatability Study**	120 days	Mon 12/5/11	Fri 5/18/12
45	TT.05.01 Perform ISCO Treatability Study	10 days	Mon 12/5/11	Fri 12/16/11
46	TT.05.02 Prepare ISCO Treatability Study Report (FS Appendix)	15 days	Mon 4/30/12	Fri 5/18/12
47	**TASK 10: Remedial Alternatives Screening (RS)**	445 days	Mon 10/4/10	Fri 6/15/12
48	**RS.01 Revise RAOs and Establish General Response Actions**	66.9 days	Mon 10/4/10	Wed 10/12/11
49	**RS.02 Identify and Screen Applicable Remedial Technologies**	148 days	Mon 10/4/10	Wed 10/12/11
50	**RS.03 Develop and Screen Remedial Alternatives**	60 days	Mon 3/26/12	Fri 6/15/12



Project: Name
Date: Tue 10/25/11

Task ▨	Split	Progress	Milestone ◆	Summary	Project Summary	External Tasks	External Milestone ◆	Deadline ⇩

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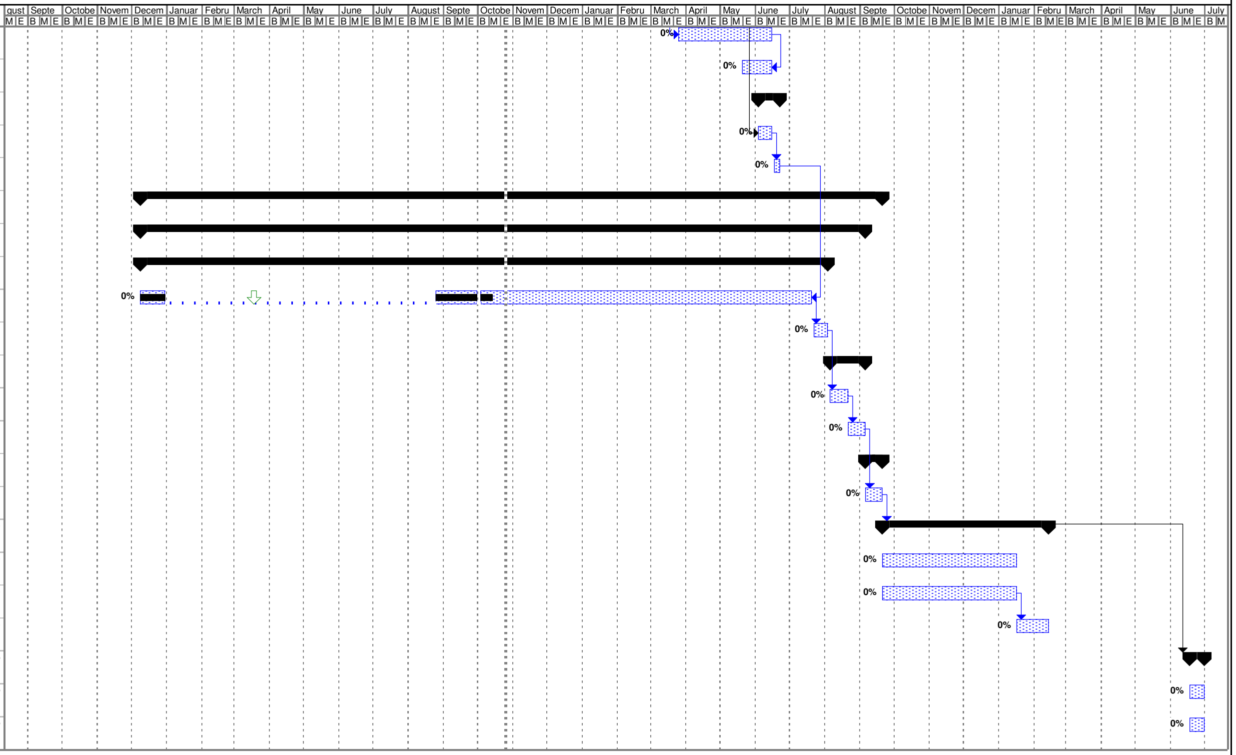
ID	Task Name	Duration	Start	Finish
51	Develop Remedial Alternatives Concepts and Quantities	60 days	Mon 3/26/12	Fri 6/15/12
52	Cost Estimating	20 days	Mon 5/21/12	Fri 6/15/12
53	**TASK 11: Remedial Alternatives Evaluation (RE)**	**15 days**	**Mon 6/4/12**	**Fri 6/22/12**
54	**RE.01 Detailed Analysis of Alternatives**	**10 days**	**Mon 6/4/12**	**Fri 6/15/12**
55	**RE.02 Comparative Analysis of Alternatives**	**5 days**	**Mon 6/18/12**	**Fri 6/22/12**
56	**TASK 12: Feasibility Study Report (FS)**	**466 days**	**Thu 12/9/10**	**Thu 9/20/12**
57	**FS.01 Prepare Draft Feasibility Study Report**	**455 days**	**Thu 12/9/10**	**Wed 9/5/12**
58	**First Draft**	**432 days**	**Thu 12/9/10**	**Fri 8/3/12**
59	Prepare First Draft	251 days	Thu 12/9/10	Fri 7/20/12
60	EPA Review	10 days	Mon 7/23/12	Fri 8/3/12
61	Second Draft	23 days	Mon 8/6/12	Wed 9/5/12
62	Incorporate 1st Draft Comments/Prepare Second Draft	12 days	Mon 8/6/12	Tue 8/21/12
63	EPA Review	11 days	Wed 8/22/12	Wed 9/5/12
64	FS.02 Prepare Final Feasibility Study Report	11 days	Thu 9/6/12	Thu 9/20/12
65	Incorporate 2nd Draft Comments/Prepare Final Draft	11 days	Thu 9/6/12	Thu 9/20/12
66	TASK 13: Post FS Support (PR)	104 days	Fri 9/21/12	Wed 2/13/13
67	PR.01 Provide Post FS Meeting Support	84 days	Fri 9/21/12	Wed 1/16/13
68	PR.02 Provide Post FS Technical Assistance	84 days	Fri 9/21/12	Wed 1/16/13
69	PR.03 Prepare Feasibility Study Addendum	20 days	Thu 1/17/13	Wed 2/13/13
70	Task 15: Task Order Closeout (CO)	10 days	Tue 6/18/13	Sun 6/30/13
71	CO.01 File Closeout and Archiving	10 days	Tue 6/18/13	Sun 6/30/13
72	CO.02 Prepare the Task Order Closeout Report (TOCR)	10 days	Tue 6/18/13	Sun 6/30/13



Task	▨	Split	. . . .	Progress	▬	Milestone	◆	Summary	▬	Project Summary	▬	External Tasks	▬	External Milestone	◆	Deadline	⇩

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