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DUNN FIELD SOURCE AREAS
FLUVIAL SOIL VAPOR EXTRACTION
REMEDIAL ACTION WORK PLAN

Defense Depot Memphis, Tennessee

Prepared for:

Defense Logistics Agency

engineering-environmental Management, Inc.

AFCEE Contract FA8903-04-D-8722
Task Order No. 0019

May 2007

Revision 1

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Prepared by:

engineering-environmental Management, Inc.
510 East Ramsey
Suite 5
San Antonio, Texas 78216

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LIST OF ACRONYMS AND ABBREVIATIONS

acfm	actual cubic feet per minute
AFCEE	Air Force Center for Environmental Excellence
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Material
AWS	air/water separator
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
CCE	Certifying Construction Engineer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	chloroform
COC	Chemical of Concern
CQAP	Construction Quality Assurance Plan
CT	carbon tetrachloride
CVOCs	chlorinated volatile organic compounds
CWM	Chemical Warfare Material
CWN	compliance well network
cDCE	cis-1,2-dichloroethene
DCA	1,2-dichloroethane
1,2-DCE	1,2-dichloroethene
DDMT	Defense Depot Memphis, Tennessee
DLA	Defense Logistics Agency
DO	dissolved oxygen
DOC	dissolved organic carbon
DoD	Department of Defense
DRC	Depot Redevelopment Corporation
DRI	Design Related Investigation
EBT	Enhanced Bioremediation Treatment
ECD	electron capture detector
EE/CA	engineering evaluation and cost analysis

LIST OF ACRONYMS AND ABBREVIATIONS
(CONTINUED)

e^2M	engineering-environmental Management, Inc.
EISR	Early Implementation of Selected Remedy
ESD	Explanation of Significant Difference
ET&D	excavation, transportation and disposal
FID	flame ionization detector
FS	Feasibility Study
FOST	Finding of Suitability to Transfer
FSP	Field Sampling Plan
GAC	granular activated carbon
gpm	gallon per minute
HASP	Site Specific Health and Safety Plan
HDPE	high density polyethylene
HDPE	high density polyethylene
Hg	mercury
HSA	Health and Safety Addendum
IDW	Investigation Derived Waste
LDR	Land Disposal Restrictions
LTM	Long Term Monitoring
LUC	Land Use Controls
LUCIP	Land Use Control Implementation Plan
MCL	Maximum Contaminant Level
μg/L	micrograms per liter
mg/kg	milligram/kilogram
MI	Main Installation
MIP	membrane interface probe
MNA	monitoring natural attenuation
MLGW	Memphis Light Gas & Water
msl	mean sea level
mV	millivolts
MW	monitoring well
NPL	National Priorities List

LIST OF ACRONYMS AND ABBREVIATIONS
(CONTINUED)

NTU	nephelometric turbidity units
O&M	Operation and Maintenance
OPS	Operating Properly and Successfully
ORP	oxidation-reduction potential
OSWER	Office of Solid Waste and Emergency Response
PCA	1,1,2,2 tetrachloroethane
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PMP	Project Management Plan
POL	petroleum/oil/lubricants
POTW	publicly owned treatment works
PPE	personal protective equipment
PRB	permeable reactive barrier
psi	pounds per square inch
PTFE	polytetrafluoroethylene
PVC	polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RA-C	Remedial Action Construction
RACR	Remedial Action Completion Report
RAO	Remedial Action Objectives
RA-O	Remedial Action Operation
RA SAP	Remedial Action Sampling and Analysis Plan
RD	Remedial Design
RG	Remediation Goal
RGOs	remedial goal objectives
RI	Remedial Investigation
ROD	Record of Decision
ROW	right-of-way

LIST OF ACRONYMS AND ABBREVIATIONS
(CONTINUED)

RPM	rotations per minute
scfm	standard cubic feet per minute
SDR	standard dimension ratio
SOP	standard operating procedure
SU	standard units
SVE	Soil Vapor Extraction
SVOCs	semivolatile organic compounds
SWMU	Solid Waste Management Unit
TA	treatment area
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
THM	trihalomethane
TM	Technical Memorandum
USACE	United States Army Corps of Engineers
USAESCH	United States Army Engineering and Support Center, Huntsville, Alabama
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
µg/L	micrograms per liter
VC	vinyl chloride
VMP	vapor monitoring point
VOC	volatile organic compound
WMP	Waste Management Plan
WTP	Work and Test Procedure
ZVI	zero valent iron

1.0 INTRODUCTION

This Remedial Action Work Plan (RAWP) was prepared by engineering-environmental Management, Inc. (e^2M) to describe the site-specific tasks necessary for the Dunn Field Source Areas Fluvial Soil Vapor Extraction (SVE) Remedial Action (RA) at Defense Depot Memphis, Tennessee (DDMT). The RAWP is based on the Dunn Field Record of Decision (ROD) (CH2M HILL, 2004) and the Source Areas Remedial Design (RD) (CH2M HILL, 2006). e^2M prepared this RAWP for the Defense Logistics Agency (DLA) under Air Force Center for Environmental Excellence (AFCEE) contract number FA8903-04-D-8722, Task Order 19.

This RAWP is intended to comply with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance for RA, as presented in the Remedial Design/Remedial Action Handbook (United States Environmental Protection Agency [USEPA], 1995a), as well as to satisfy requirements outlined by the Base Realignment and Closure (BRAC) Act set forth by the BRAC Cleanup Team (BCT) for DDMT. The BCT, which is composed of representatives of the DLA, Tennessee Department of Environment and Conservation (TDEC), and the USEPA, will monitor the progress of the RA and will review all documents prior to issuance. The DLA and the Department of Defense (DoD) will implement the selected remedy and will incur all associated costs. DDMT's USEPA Identification Number is TN4210020570.

1.1 RAWP OVERVIEW

This RAWP provides relevant background information and data, and a plan of action for completing RA activities in a safe and efficient manner. This RAWP includes only the Fluvial SVE component of the Source Areas remedy. The BCT concurred at their November meeting that the Fluvial SVE component of the Source Areas remedial action should be implemented on an expedited basis. Although the Final Sources Areas RD is not scheduled for final approval until 30 April 2007, no major changes to the Fluvial SVE are expected based on BCT comments to the Pre-final Source Areas RD. Revisions made to the RD will be incorporated in the final RAWP. A second RAWP will be prepared to describe implementation of the remaining Source Areas RA components.

The RAWP describes the work to be performed to implement the Fluvial SVE and includes a schedule for implementation of the RA. Specifically, the RAWP addresses:

- Description of Site Conditions (Section 1.0)
- Description of the selected Source Areas remedy (Section 2.0)
- RA Planning activities (Section 3.0)
- RA Construction (RA-C) of the Fluvial SVE system (Section 4.0)
- RA Operation (RA-O) of the Fluvial SVE system (Section 5.0)
- Contingencies (Section 6.0)

Secondary documents developed in conjunction with this RAWP include the Project Management Plan (PMP), Waste Management Plan (WMP), and Construction Quality Assurance Plan (CQAP), which are included as Appendices A, B and C respectively. The PMP includes a schedule for implementation of the Fluvial SVE RA and addresses activities and elements cited in the RD/RA Handbook (USEPA, 1995a). Sampling and analytical activities necessary for the RA will be performed in accordance with the *Remedial Action Sampling and Analysis Plan* (RA SAP) prepared by MACTEC (MACTEC, 2004). The *Remedial Action Health and Safety Plan* (HSP) (e^2M, 2006) will provide the basis for protection of site workers; a Fluvial SVE Health and Safety Addendum (HSA) has been prepared for activities not addressed in the HSP (in preparation). To ensure consistency with the design, much of the text within this RAWP has been taken for the Source Areas RD and the construction drawings relevant to the Fluvial SVE are included in Appendix D.

1.2 SITE HISTORY AND DESCRIPTION

DDMT is located in southeastern Memphis, Tennessee (Figure 1). DDMT originated as a military facility in the early 1940s. Its initial mission and function was to provide stock control, material storage, and maintenance services for the U.S. Army (Memphis Depot Caretaker Division, 2003). DDMT is located approximately 5 miles east of the Mississippi River and just northeast of Interstate 240. The property consists of approximately 642 acres and includes two components: the Main Installation (MI), which includes open storage areas, warehouses, military family housing, and outdoor recreational areas; and Dunn Field, which includes former mineral storage and waste disposal areas. In 1995, DDMT was placed on the list of DoD facilities to be closed under BRAC. Storage and distribution activities continued until DDMT closed in September 1997.

In 1990, USEPA identified 49 Solid Waste Management Units (SWMUs) and 8 Areas of Concern (AOCs) at DDMT during a Resource Conservation and Recovery Act (RCRA) Facility Assessment;

25 SWMUs and 7 AOC were located on the MI and 24 SWMUs and 1 AOC were located at Dunn Field. During this same period, a Hazardous Ranking System Scoring Package for the facility was prepared and in 1992, the Depot was added to the National Priorities List (NPL) (57 Federal Register 47180 No. 199). In March 1995, a Federal Facilities Agreement (FFA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 120, and Resource Conservation and Recovery Act, Sections 3008(h) and 3004(u) and (v), was entered into by USEPA, TDEC, and DLA. The FFA outlined the process for site investigation and cleanup at DDMT under CERCLA. The lead agency for environmental restoration activities at DDMT is the DLA. The regulatory oversight agencies are USEPA Region IV and TDEC.

DDMT is divided into four Operable Units (OUs): Dunn Field, OU 1; Southwest Quadrant MI, OU 2; Southeastern Watershed and Golf Course, OU 3; and North-Central Area MI, OU 4. The Record of Decision (ROD) for the MI (CH2M HILL, 2001) includes OUs 2, 3, and 4. The ROD for Dunn Field (CH2M HILL, 2004a) addresses OU 1, the only known and documented waste burial area.

Dunn Field comprises approximately 64 acres of undeveloped land bounded by the Illinois Central Gulf Railroad and Person Avenue to the north, Hays Road to the east, and Dunn Avenue to the south. To the west, Dunn Field is bounded by Kyle Street, undeveloped property, a light industrial/warehouse facility, and a Memphis Light, Gas, and Water (MLGW) power line corridor, which bisects Dunn Field. Approximately two-thirds of Dunn Field is covered with grass, and the remaining area is covered with crushed rock and paved surfaces. Dunn Field is currently zoned for Light Industrial (I-L) use.

For investigation purposes, Dunn Field was divided into three exposure areas: Northeast Open Area, Disposal Area, and Stockpile Area (Figure 2). Sites listed under the Defense Sites Environmental Restoration Tracking System (DSERTS) located within these areas at Dunn Field are listed on Table 1.

Northeast Open Area – The Northeast Open Area (approximately 20 acres) consists of a grassy area with a number of interspersed mature trees in the northeast quadrant of Dunn Field.

Disposal Area – The Disposal Area (approximately 14 acres) consists of former disposal pits and trenches in the northwestern quadrant of Dunn Field.

Stockpile Area – The Stockpile Area (approximately 30 acres) encompasses the former bauxite and fluorspar storage and burial areas in the eastern and southwestern portions of Dunn Field.

The Northeast Open Area was originally identified as future public open space while the remainder of Dunn Field was targeted for light industrial land use (The Pathfinders et al., 1997). The eastern portion of Dunn Field, including most of the Northeast Open Area, was designated for unrestricted use in the ROD and has been approved for transfer. The Finding of Suitability to Transfer (FOST) Number 4 document for this parcel was completed in February 2005 (MACTEC, 2005a). The City of Memphis declined to accept the FOST 4 property for public recreational use and it is currently being offered for public sale.

1.3 HYDROGEOLOGY

The geologic units of interest at Dunn Field are (from youngest to oldest): loess, including surface soil; fluvial deposits; Jackson Formation/Upper Claiborne Group; and Memphis Sand.

The loess consists of wind-blown and deposited, brown to reddish-brown, low-plasticity clayey silt to silty clay. The loess deposits are about 20 to 30 feet thick and are continuous throughout the Dunn Field area.

The fluvial (terrace) deposits consist of two general layers. The upper layer is a silty, sandy clay that transitions to a clayey sand and ranges from about 10 to 36 feet thick. The lower layer is composed of interlayered sand, sandy gravel, and gravelly sand, and has an average thickness of approximately 40 feet. The uppermost aquifer is the unconfined fluvial aquifer, consisting of saturated sands and gravelly sands in the lower portion of the deposits. The saturated thickness of the fluvial aquifer ranges from 3 feet to 50 feet and is controlled by the configuration of the uppermost clay in the Jackson Formation/Upper Claiborne Group.

The Jackson Formation/Upper Claiborne Group (J/UC) consists of clays, silts, and sands. The upper clay unit appears to be continuous, except in the southwestern area of Dunn Field. Off-site, to the west and northwest of Dunn Field, there are possible gaps in the clay. Where present, these gaps create connections to the underlying intermediate aquifer from the fluvial deposits. The intermediate aquifer is locally developed in deposits of the J/UC. Several wells at DDMT have been drilled into sands within the J/UC to monitor water quality within the intermediate aquifer. Well MW-37 is the closest of these wells to the Source Areas and is located approximately 400 feet west of Dunn Field. The upper clay unit was approximately 90 feet thick at that location; the well boring was drilled approximately 20 feet into the underlying sand before the well was installed. Similar conditions were observed in well MW-67, located approximately 1000 feet west of Dunn Field.

The Memphis Sand primarily consists of thick-bedded, white to brown or gray, very fine-grained to gravelly, partly argillaceous and micaceous sand. Lignitic clay beds constitute a small percentage of the total thickness. The Memphis Sand ranges from 500 to 890 feet in thickness and begins at a depth of approximately 120 to 300 feet below ground surface (bgs). The only monitoring well at DDMT screened in the Memphis sand is MW-67, where the top of the Memphis sand was encountered at 255 feet bgs (21 feet above mean sea level). The Memphis aquifer is confined by overlying clays and silts in the Cook Mountain Formation (part of the Jackson/Upper Claiborne Group) and contains groundwater under strong artesian (confined) conditions regionally. The City of Memphis obtains the majority of its drinking water from this unit. The Allen Well Field, which is operated by Memphis Light, Gas and Water (MLGW), is located approximately 2 miles west of Dunn Field.

1.4 NATURE AND EXTENT OF CONTAMINATION

Historical information concerning disposal sites at Dunn Field is included in the Dunn Field RI (CH2M Hill, 2002) and FS (CH2M Hill, 2003a). Records indicate that chemical warfare material (CWM), chlorinated lime, super tropical bleach, and calcium hypochlorite, food stocks, paints/thinners, petroleum/oil/lubricants (POL), acids, herbicides, mixed chemicals, and medical waste were reportedly destroyed or buried in pits and trenches at the Dunn Field disposal sites.

1.4.1 Subsurface Soil Contamination

Subsurface soil samples collected in 1999 for the remedial investigation (RI) showed significant levels of chlorinated volatile organic compounds (CVOCs): 1,1,2,2 tetrachloroethane (PCA); 1,2-dichloroethane (DCA); total 1,2-dichloroethene (1,2-DCE); carbon tetrachloride (CT); chloroform (CF); methylene chloride; tetrachloroethene (PCE); trichloroethene (TCE); and vinyl chloride. The highest concentrations detected in 1999 were from boring SBLEE in the northwest corner of Dunn Field: TCE at 460 milligrams per kilogram (mg/kg); PCA at 160 mg/kg and 1,2-DCE at 190 mg/kg. These samples were collected within the loess at depths of 30 feet or less.

Further soil sampling was conducted October 2000 to February 2001 to delineate potential source areas. Sixteen soil borings were installed in the Disposal Area, with all but one installed in Treatment Area 2. The borings were drilled to the top of the clay below the water table, approximately 80 to 95 feet below ground surface (bgs), and soil samples were collected from the loess and fluvial deposits. TCE and PCA were the CVOCs most frequently detected in soil samples at concentrations above the remedial goals; the highest concentrations within the fluvial deposits were PCA at 22.6 mg/kg in boring SBLCA-SB2 (at a depth of 44 feet) and TCE at 0.888 mg/kg in boring SBLCA-SB11 (at a depth of 81 feet).

A passive soil gas survey was conducted at Dunn Field to provide screening information on the potential sources of volatile organic compound (VOC) contamination in groundwater at Dunn Field. Phase 1 in August 1998 focused on the Disposal Area and Phase 2 in October 1998 expanded the soil gas sampling grid to the east and north to further delineate soil gas anomalies identified in Phase 1. The investigation findings are provided in the *Dunn Field RI Report* (CH2M HILL, 2002). A soil gas investigation was also conducted by Parsons Engineering Science, Inc. (Parsons) in October 2000. Parsons collected soil gas samples using a SimulProbe^{TM}. This work was reported in the *Remedial Process Optimization (RPO) Phase II Evaluation Report, Defense Depot Memphis, Tennessee* (Parsons, 2001).

An investigation for the disposal sites remedial design was conducted to supplement existing chemical and physical data on the 17 former disposal sites on Dunn Field previously identified by the BCT as Priority Level A and Level B based upon the quantity of material within each site, potential hazards of the material, and form of the material (solid versus liquid). A geophysical survey was used to estimate the location and depths of the disposal sites. Trenches or test pits were excavated across the length of each site to collect soil samples and make visual observations of the buried materials. A total of 48 trenches and 7 test pits were excavated to depths of 10 feet or less; excavation locations were based on available historical information and the geophysical survey data. While soil samples from the excavations were analyzed for VOCs, the results were not used to determine excavation limits since SVE was the selected remedy for VOCs in subsurface soils. The highest VOC concentrations were detected in a sample from Disposal Site 10 in the northwest corner of Dunn Field: PCA at 2,850 mg/kg; TCE at 671 mg/kg and PCE at 35.7 mg/kg. Investigation results were presented in the Disposal Sites Pre-Design Investigation Data Collection Plan Technical Memorandum Rev. 2, (TM) (CH2M Hill, 2004c).

1.4.2 Groundwater Contamination

The nature and extent of contamination in groundwater underlying Dunn Field were assessed based on chemical analyses of groundwater samples collected since January 1996. Groundwater samples have been analyzed for explosives, herbicides, metals (total), pesticides, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), and CVOCs. Groundwater samples were also analyzed for CWM breakdown products, including thiodiglycol, 1,4-oxathiane, and 1,4-dithiane, and various geochemical and geotechnical parameters. CVOCs, SVOCs, and total metals were the most frequently detected analytical constituents in groundwater samples. Only CVOCs were determined to require remedial action for subsurface soils and groundwater.

The Dunn Field ROD (CH2M HILL, 2004a) identified three primary contaminant plumes in the fluvial aquifer underlying Dunn Field. Mixing and intermingling of the plumes have occurred due to the active groundwater extraction system and natural groundwater flow. The nine CVOCs listed below have been detected most frequently in past groundwater sampling events:

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- 1,2-cis-Dichloroethene (cDCE)
- 1,2-trans-Dichloroethene
- 1,1-Dichloroethene (DCE)
- 1,1,2,2-Tetrachloroethane (PCA)
- 1,1,2-Trichloroethane
- Carbon tetrachloride
- Chloroform

The highest groundwater contaminant concentrations have been detected in the central plume. The individual VOCs with the highest concentrations are PCA and TCE, with maximum concentrations up to 40,800 micrograms per liter (µg/L) for PCA and 7,110 µg/L for TCE (MW-73; 22 October 2003).

1.5 PAST REMEDIAL ACTIONS AT DUNN FIELD

1.5.1 Interim Groundwater Remedial Action

An interim ROD was signed in April 1996, with the objective of hydraulic containment to prevent further contaminant plume migration and reduce contaminant mass in groundwater. At the time, Dunn Field contaminants of concern (COCs) included CVOCs and metals. A groundwater extraction system consisting of seven recovery wells was installed along the western Dunn Field boundary and began operation in November 1998. Four additional recovery wells were installed in late 1999 and early 2000.

From system startup in 1998 through November 2006, the extraction system pumped nearly 260 million gallons of groundwater from the fluvial aquifer and discharged to the City of Memphis publicly owned treatment works (POTW). Also through November 2006, approximately 810 pounds of CVOCs were removed (MACTEC, 2006b), including approximately 322 pounds of TCE. Despite the contaminant mass removal, the Five-Year Review for Dunn Field concluded that the extraction system does not provide adequate control over groundwater flow and the westward spread of CVOCs in the fluvial aquifer (CH2M HILL, 2003a).

1.5.2 Chemical Warfare Materiel Removal Action

Following completion of an engineering evaluation and cost analysis (EE/CA), a non-time critical removal action was conducted to reduce or eliminate the potential risk posed by CWM wastes at Sites 1, 24-A, and 24-B. The removal action was completed in March 2001 and documented in the Final Chemical Warfare Materiel Investigation/Removal Action Report (UXB, 2001). Approximately 914 cubic yards (yd^3) of soil contaminated with mustard degradation by-products and 19 yd^3 of mustard-contaminated soil were excavated, transported, and disposed offsite. Twenty-nine bomb casings were recovered from Site 24-A.

1.5.3 Soil Removal Action at Site 60, Former Pistol Range

A non-time critical removal action to address lead-contaminated surface soil at Site 60, a former pistol range in the Northeast Open Area, was completed in March 2003, pursuant to an EE/CA completed in July 2002. Approximately 930 yd^3 of lead-contaminated surface soil was excavated, transported, and disposed offsite at an approved, permitted landfill.

1.6 REMEDIAL ACTION OBJECTIVES AND SELECTED REMEDY

Remedial action objectives (RAOs) are medium-specific goals that the RAs are expected to accomplish to protect human health and the environment. The RAOs were developed to reflect the anticipated future land use for Dunn Field in accordance with EPA Policy, *Land Use in the CERCLA Remedy Selection Process* (OSWER Directive No. 9355.7-04). The RAOs were developed during the RI phase and presented in the ROD. The development of the RAOs took into consideration the remedial goal objectives (RGOs) (permissible exposures to industrial workers and potential on-site residents assuming redevelopment of Dunn Field) and the clean up concentrations based upon the RGOs. The following are the RAOs presented in the ROD:

<u>Surface Soil</u>

- Limit use of the surface soil in the Disposal Area to activities consistent with light industrial land use and prevent residential use through land controls.

<u>Disposal Sites</u>

- Prevent groundwater impacts from a release of buried containerized hazardous liquids and the leaching of contaminants from buried hazardous solids.

- Prevent unacceptable risk of direct contact with buried hazardous liquids and/or solids due to intrusive activities during future land use or site development.

Subsurface Soil Impacted with VOCs

- Prevent direct inhalation of indoor air vapors from subsurface soils in excess of industrial worker criteria.
- Reduce or eliminate further impacts to the shallow fluvial aquifer from VOCs in the subsurface soil.

Groundwater

- Prevent human exposure to contaminated groundwater (i.e., exceeding protective target concentrations).
- Prevent further off-site migration of VOCs in excess of protective target levels.
- Remediate fluvial aquifer groundwater to drinking water quality to be protective of the deeper Memphis aquifer.

The major components of the selected remedy for Dunn Field are:

- Excavation, transportation, and disposal of soil and material contained within disposal sites based upon results from a pre-design investigation.
- Soil vapor extraction (SVE) to reduce VOC concentrations in subsurface soils to levels that are protective of the intended land use and groundwater.
- Injection of zero valent iron (ZVI) within Dunn Field to treat CVOCs in the most contaminated part of the groundwater plume, and installation of a permeable reactive barrier (PRB) to remediate CVOCs within the off-site areas of the groundwater plume.
- Monitored natural attenuation (MNA) and long-term monitoring (LTM) of groundwater to document changes in plume concentrations, to detect potential plume migration to off-site areas or into deeper aquifers, and to track progress toward remediation goals.
- Implementation of land use controls, which consist of the following institutional controls: deed and/or lease restrictions; Notice of Land Use Restrictions; City of Memphis/Shelby County zoning restrictions and the Memphis and Shelby County Health Department groundwater well restrictions.

Three RAs were planned to implement the selected remedies for OU 1, Dunn Field:

- Disposal Sites RA to address excavation, transportation, and disposal;
- Source Areas RA to address SVE in subsurface soils, ZVI injections at Dunn Field, and implementation of land use controls; and
- Off-Depot Groundwater RA to address installation of a PRB, MNA, and LTM.

The Disposal Sites RA has been completed, as described in the following section. Plans for implementation of the remaining RAs have been revised since completion of the ROD. The sequencing of the Source Areas RA has been revised with the Fluvial SVE component expedited, and the other components (thermal-enhanced SVE in the loess, ZVI injections and LUCs) to follow. The Off Depot remedy selection is under review with enhanced bioremediation treatment being considered as an alternative to the ZVI PRB. A revised Proposed Plan and an amendment to the ROD will be prepared to document the revision, when the review is completed.

1.7 POST-ROD REMEDIAL ACTIONS

1.7.1 Disposal Sites Remedial Action

In accordance with the Disposal Sites RD Rev. 1 (CH2M HILL, 2004b), RAWP Rev. 1 (MACTEC, 2004a), and RAWP Addendum 1 Rev. 1 (MACTEC, 2006a), soil and debris including potential principal threat wastes (primarily drums and glass bottles) from Disposal Sites 3, 4.1, 10, 13, and 31 were excavated and transported for offsite disposal. Five Disposal Sites were determined to require RA based on the results of the Pre-Design Investigation.

- Disposal Site 3 – Mixed chemical burial site (ortho-toluidine dihydrochloride)
- Disposal Site 4.1 – POL Burial Site (32 55-gallon drums of oil, grease, and paint)
- Disposal Site 10 – Solid Waste Burial Site (metal, glass, trash)
- Disposal Site 13 – Mixed Chemical Burial (900 pounds of unnamed acid, 8,100 pounds of unnamed solids)
- Disposal Site 31 – covered by the bauxite storage pile (Site 64), used for burning/disposal of smoke pots, tear gas grenades, and souvenir ordnance

The Disposal Sites RA was performed during two separate mobilizations. During the first mobilization from 14 March 2005 through 7 May 2005, Disposal Sites 4.1, 13, 31, and the majority of Disposal Site 10 were completed. An area of burn pit material that extended to the west of Disposal Site 10 and the presence of intact, unlabeled glass bottles encountered in Disposal Site 3 required additional remedial measures beyond the initial scope of work. The glass bottles contained a clear liquid that required further analysis to determine proper handling and disposal procedures; the liquid was identified as ortho-toluidine. Disposal Site 3 and the remaining materials from Disposal Site 10 were completed during the second mobilization performed from 27 February 2006 through 8 March 2006. A total of 4,051 tons (approximately 2,700 yd^3) of non-hazardous materials from Disposal Sites 3, 4.1, 10, 13, and 31 were transported off-site and disposed of at the BFI South Shelby County Landfill. A total of 351 tons (approximately 234 yd^3) of hazardous materials from Disposal Site 3 was transported to the Clean Harbors Lambton Secure Landfill in Canada for disposal. The RAOs outlined in the ROD for these sites were achieved based on the confirmation sample results for each excavation. The RA is described in the *Dunn Field Disposal Site Remedial Action Completion Report* (MACTEC, 2006).

1.7.2 Early Implementation of Selected Remedy

DLA determined that an Early Implementation of Selected Remedy (EISR) using the ZVI process should be taken at the leading edge of the high-concentration portion of the central plume in the fluvial aquifer. The EISR was a response to levels of contamination not observed at this distance from Dunn Field during the RI. The rationale and scope for this action were described in a technical memorandum, *Early Implementation of Selected Remedy Component to Address Groundwater Contamination West of Dunn Field* (CH2M HILL, 2004c), which was approved by the BCT on 21 October 2004. The overall objective of the EISR was to reduce contaminant mass downgradient of the planned PRB location in order to ensure that the portion of the plume slated for MNA in the ROD was not unduly extensive or high in concentration.

ZVI injections were made following procedures in the *EISR Work Plan* (MACTEC, 2004c) from 18 November 2004 through 8 January 2005. Injections were made in 14 borings at 2-foot intervals over the fluvial aquifer thickness, which averaged 21 feet; the injection locations were spaced approximately 60 to 80 feet apart. The depth of injection ranged from approximately 70 to 100 feet bgs. The total mass of ZVI injected was approximately 192,500 pounds.

The EISR is described in the *Early Implementation of Selected Remedy Interim Remedial Action Completion Report* (MACTEC, 2005).The injections did not achieve the goal of 90 percent or greater reduction of TCE and PCA. TCE concentrations were reduced approximately 46 percent in the central injection area and up to 42 percent near the area boundary. PCA concentrations were reduced approximately 65 percent in the central injection area and up to 77 percent near the area boundary. Further treatment of CVOCs within the injection area is expected as groundwater comes into contact with ZVI over its effective life (up to two years). Groundwater monitoring in the EISR area is continuing. The report included recommendations for decreased spacing between injection locations to achieve increased reduction in CVOCs. Significant CVOC reduction appears to require ZVI injection at a suitable mass-to-soil ratio throughout the treatment area.

1.8 PLANNED REMEDIAL ACTIONS

Implementation of two additional RAs is planned for Dunn Field: Source Areas and Off-Depot Groundwater. RD reports are currently being prepared for each RA. The following RA components are planned:

Source Areas

- Injection of ZVI to remediate CVOCs in groundwater beneath onsite vadose zone source areas.
- Use of thermal-enhanced SVE in the loess and conventional SVE in the fluvial deposits to reduce CVOCs to levels that are protective of the intended land use and groundwater..
- Excavation, transportation, and offsite disposal (ET&D) of VOC-impacted soil from two shallow areas in the northeast portion of the Disposal Area. Treatment of excavated soils as part of the SVE RA will be considered as an alternative to offsite disposal.
- Implementation and enforcement of land and groundwater use controls in accordance with the Dunn Field Land Use Controls Implementation Plan (LUCIP).

Off-Depot Groundwater

- Installation of a groundwater remedy to reduce groundwater CVOC concentrations in the Off-Depot plume.
- MNA for portions of the plume with individual CVOC concentrations less than 50 micrograms per liter (µg/L) and long-term groundwater monitoring to document remedy performance as indicated by changes in CVOC concentrations and/or changes in the lateral or vertical extent of the CVOC plume.

As noted previously, this RAWP includes only the Fluvial SVE component of the Source Areas remedy. Two additional RAWPs will be prepared to describe implementation of the remaining Source Areas RA components and the Off Depot Groundwater RA, respectively.

1.9 FLUVIAL SVE DESIGN

Two studies were performed during development of the *Source Areas RD* (CH2M HILL, 2006), which influenced the design of the Fluvial SVE system. An initial SVE pilot study was performed to collect site-specific data for both the loess deposits and the unsaturated fluvial sands. A later remedial design investigation (RDI) was performed to delineate CVOC concentrations in the loess and to collect additional groundwater samples; the results were used to estimate the extent of CVOC concentrations above Remediation Goals (RGs) in the fluvial sands. Soil analytical data from the RDI and previous investigations were used to estimate the CVOC mass in the fluvial sands, which can be used to evaluate effectiveness of the RA.

1.9.1 SVE Pilot Study and Estimated Treatment Time

The SVE treatability study was conducted in four phases to collect site-specific data for design of a full-scale system. Only the Phase I study addressed the fluvial sands. The later phases were directed at effectiveness of SVE in the loess.

Phase I included two separate tests for the loess deposits and the unsaturated portion of the fluvial sands. The loess deposits test was conducted continuously over 72 hours on 18 to 21 December 2001. Vapor extraction from the loess was compromised by atmospheric air short-circuiting, poor vacuum distribution (after 72 hours), limited flow (25 standard cubic feet per minute [scfm] or less), and high vacuum (25 inches mercury [Hg]). The fluvial sands test was conducted for a period of 96 hours from 7 to 11 January 2002. The test results indicate remediation of the unsaturated fluvial deposits via SVE will be effective. A large vacuum distribution profile (at least 100 ft radially) was established in the subsurface at high flow rates, greater than 250 scfm (2.2. inches Hg vacuum). At lower flow rates, with a minimum of 96 scfm, the vacuum radius of influence (ROI) decreased non-linearly to approximately 68 ft.

Treatability study results were used to estimate the time needed to achieve cleanup goals. The estimate for the fluvial sands was based on analytical results from the area with the highest CVOC concentrations. The estimates considered two CVOC concentrations, the geometric mean and maximum concentrations for PCA and TCE, and two vapor concentrations, the equilibrium vapor concentration and the measured vapor concentration during Phase I of the SVE treatability study. The estimated treatment times were from 22 to 1725 days for PCA and 2 to 23 days for TCE.

As another method of estimating treatment time, numerical vapor-flow modeling was performed to analyze the long-term effectiveness of the proposed Fluvial SVE system. A multi-layer finite element model (MicroFEM) was used to examine subsurface airflow in the area of the Fluvial SVE system. The data from the SVE treatability study were used to calibrate the model. After model calibration, the model was used to evaluate subsurface pressure distribution, as well as subsurface horizontal and vertical flux.

The model parameters for the fluvial sands were 16.55 feet per day for air permeability and 50 for the ratio of horizontal-to-vertical air permeability. The modeled well screen length was 30 feet (>5 feet above water table) and the extraction flow rate 100 scfm. The model results at the midpoint of the SVE well screen suggested that about one year would be required to flush the target treatment zone with clean air 1,000 times. The results were considered to support the Fluvial SVE system being able to achieve the RGs within the time estimated in the ROD (up to 5 years).

1.9.2 Remedial Design Investigation

As described in the *Results of the Memphis Depot – Dunn Field Remedial Design Investigation* (CH2M HILL, 2006a), the objectives for the RDI were:

- Increase soil data density for the four onsite soil treatment areas (TAs) to delineate CVOC soil contamination laterally and down to a depth of approximately 30 ft, where the loess deposits transitions to the fluvial sands.
- Further delineate the CVOC groundwater plumes and provide additional monitoring locations for the full-scale groundwater remedy.
- Collect additional data from the fluvial and intermediate aquifers to support the groundwater model that is being developed to estimate the effect of natural attenuation on the CVOC plumes and to determine the potential points of compliance for Dunn Field.
- Collect additional lithologic and hydrogeologic data along a potential ZVI PRB alignment.

A membrane interface probe (MIP) investigation was conducted to characterize the magnitude and extent of elevated CVOCs in the loess by using the semi-quantitative electron capture detector (ECD). A 40-foot by 40-foot grid was used to locate and identify the 237 proposed MIP locations in each of the 4 treatment areas. Based on the real-time results and the site's history not all of the proposed locations were probed. Soil samples were collected from select MIP locations for laboratory analysis to correlate the data sets and adequately delineate the areas with CVOC concentrations below the MIP detection limit but above the established Dunn Field RGs. Because the RG for PCA is relatively low, soil samples were also collected specifically to delineate the extent of PCA. Many of the perimeter soil samples were collected to complete the delineation of the treatment areas where the MIP response was inconclusive. More than 160 locations were investigated with the MIP and more than 80 soil samples were collected during the two RDI phases conducted from October 3 to November 18, 2005, and August 29 to 30, 2006. The second phase of confirmatory soil sampling was conducted to further define the extent of contamination in a few areas, particularly the PCA concentrations.

Nine new monitoring wells were installed on Dunn Field and five monitoring wells were installed off-Depot west of Dunn Field from October 10 to November 11, 2005. Three additional monitoring wells were installed on Dunn Field in March 2006.

The RDI resulted in better delineation of the loess deposits requiring SVE treatment. The total area within the four treatment areas was reduced from 5.5 acres as shown in the ROD to 1.25 acres. Because the CVOCs in the unsaturated portion of the fluvial deposits are derived from the overlying loess, the reduction in the loess treatment area resulted in a corresponding reduction in the treatment area within the fluvial sands. The loess treatment areas are shown on Figure 3.

The highest concentrations detected in the loess soil samples from the four treatment areas are shown below:

Treatment Area	Depth Interval	CVOC Concentrations (µg/kg)					
	(feet, bgs)	PCA	PCE	TCE	cDCE	CT	CF
TA1	6 - 12	953,000	20,800	564,000	174,000	3,350	8,080
TA2	10 - 14	1,850,000	21,100	170,000	2,240	ND	6
TA3	28 - 29	3,110	6	1,560	3,350	6	35
TA4	14 - 15	190,000	2,360	4,280	ND	1,850	96,200

1.9.3 CVOC Mass Estimate

Soil data from the RI and the RDI were used to estimate the mass of CVOCs in the *Source Areas RD* (CH2M HILL, 2006). Thirteen soil borings were advanced to the water table in TA2 (around MW-73) during the October 2000 source area investigation. Soil samples were collected at multiple vertical intervals in the fluvial sands below the impacted loess deposits. In nearly all of the fluvial soil samples, only TCE and PCA exceeded the fluvial RGs. The maximum and geometric mean concentrations were used to estimate the mass of PCA and TCE in the fluvial sands in TA2.

CVOC Concentrations (mg/kg)	PCA	TCE
Geometric Mean	0.289	0.091
Maximum	22.6-	0.888

Using the geometric mean concentrations, the same surface area as the impacted loess (14,000 ft^2), the fluvial vadose zone treatment interval thickness of 40 ft, and a bulk soil density of 100 lb/ft^3, the combined mass of PCA and TCE in TA2 is 21 pounds. The other CVOCs are relatively insignificant.

As an alternative calculation, the CVOC mass in the fluvial sands was estimated in all four treatment areas using a ratio of the maximum concentrations in TA2 and the estimated CVOC mass in the loess based on the RDI data. The maximum concentrations at TA2 in the loess and fluvial deposits and the ratios are shown below:

CVOC Concentrations (mg/kg)	Loess	Fluvial	F/L Ratio
PCA	1,850	22.6	0.012
TCE	170	0.888	0.005

The CVOC mass in the fluvial is calculated by multiplying the estimated CVOC mass in the loess by the concentration ratios and a volume factor (1.33) to account for the difference in treatment depth.

	CVOC Mass (pounds)	
Treatment Area	Loess	Fluvial
TA1	10,100	60 – 165
TA2	4,000	25 - 65
TA3	20	0.1 – 0.3
TA4	200	1 - 3
Total	**14,320**	**90 - 230**

The mass estimates are based on the following assumptions:

- The highest CVOC concentrations in the fluvial vadose zone will be directly below the highest CVOC concentrations in the loess.
- The ratio between the loess and fluvial CVOC concentrations is relatively consistent.
- Vertical migration mechanisms are consistent among the four TAs.

1.9.4 SVE System Revisions

The impacted vadose zone at Dunn Field consists of two distinct geological units: (1) a shallow, relatively low-permeability loess, and (2) a deep, relatively high-permeability alluvium composed of sands, sands and gravels, and discontinuous layers of silt and clay that collectively have been referred to as the fluvial deposits. The loess, a semi-cohesive eolian deposit composed of silt, silty clay, silty fine sand, and mixtures thereof, extends from the ground surface to a depth of about 30 feet, bgs. Underlying the loess are several feet of sandy clay, followed by 30 to 75 ft of the fluvial sands, silt, and gravel.

Based on a comparative technology analyses compiled by USEPA (EPA, 1993), SVE was selected by DLA, USEPA, and TDEC in the Dunn Field ROD (CH2M HILL, 2004a) as the presumptive remedy for CVOCs in subsurface soil at Dunn Field. As this technology is commonly applied, air flow is induced through contaminated soil by applying a vacuum to SVE wells to create a pressure gradient in the targeted areas. As soil vapor migrates toward the extraction vents, contaminants are volatilized, transported out of subsurface soil, and collected and treated aboveground. Per the Dunn Field ROD (CH2M HILL, 2004a), SVE treatment was expected to meet the RAOs in less than 5 years.

The subsurface soil remedy has evolved since completion of the ROD based on the SVE treatability study, the RDI, and estimated time to achieve cleanup goals using conventional SVE. Conventional SVE is not considered likely to achieve the RGs for the loess in a reasonable time frame (5 years). Therefore, thermal-enhanced SVE will be used for treatment of the loess and conventional SVE will be applied to the unsaturated portion of the fluvial deposits.

2.0 DESCRIPTION OF REMEDIAL ACTION

The Fluvial SVE system will be installed before the other Source Areas RA components to accelerate the RA process. Operation of the system will significantly reduce continuing migration of CVOCs to groundwater while planning for the other components (ET&D of VOC-impacted soil; thermal-enhanced SVE in the loess; injection of ZVI to remediate CVOCs in groundwater; and land and groundwater use controls) is completed. The Fluvial SVE RA is summarized below; detailed discussion of the RA is provided in Section 4.0.

2.1 PRELIMINARY ACTIVITIES

2.1.1 Site Preparation

The project area will be surveyed and marked by a Registered Professional Land Surveyor. The boundaries of the loess treatment areas, excavation areas, drilling locations (groundwater wells, SVE wells and vapor monitoring points), and staging and stockpile areas will be surveyed to guide field activities. The ground surface elevations along the planned pipe runs from the treatment building to the SVE wells will be surveyed.

Brush and vegetation will be cleared as necessary to provide unobstructed access to the SVE and monitoring well locations. The loess treatment areas will also be cleared to expedite that RA. Site controls such as access barricades, flagging, fencing and signs will be installed to control access to the site. Work areas will be clearly marked.

Temporary access roads will be installed for access to the treatment areas. Erosion control measures will be implemented for disturbed areas and soil stockpiles. This should only be required for the removal of the soil/rubble pile in Treatment Area 3.

All drilling locations will be cleared for underground utilities, general access and overhead obstructions.

The soil/rubble pile in Treatment Area 3 contains approximately 8,000 cubic yards of soil and concrete rubble. The concrete will be removed from the site to a construction landfill or concrete recycling facility and the soil will be spread in the southwest area of Dunn Field outside the treatment areas. The newly placed soil will be graded and seeded with grass.

2.1.2 Baseline Groundwater Sampling and Well Abandonment

Baseline groundwater sampling will be collected from new and existing monitoring wells prior to implementation of the Fluvial SVE. The results will be compared with groundwater samples to be collected during and after implementation of the loess thermal-enhanced SVE and after ZVI injections to evaluate overall Source Areas remedy effectiveness. Only the baseline sampling will performed as part of the Fluvial SVE RA. Further groundwater sampling will be described in the Loess/Groundwater RAWP and performed as part of that RA.

The total CVOC concentrations based on samples collected in November 2005 and April 2006 are shown on Figure 4. Twenty-six existing monitoring wells are to be included in the baseline sampling event. Eight wells located within and adjacent to the loess treatment areas will be abandoned following sample collection because the PVC wells will be destroyed by the high temperatures to be generated during the loess treatment. Nine new wells will be installed to replace the abandoned wells and to improve the distribution of groundwater data. The new wells will be constructed with stainless steel and high temperature grout to withstand the high temperatures during treatment of the loess.

Following development of the new wells, the new and existing wells will be sampled using low-flow sampling methods as described in Work and Test Procedure (WTP) 4 of the RA SAP. Groundwater samples will be analyzed for VOCs and MNA parameters listed on Table 2. Following review of the analytical data, the selected wells will be abandoned.

2.2 SVE SYSTEM CONSTRUCTION

2.2.1 SVE Wells and Conveyance Piping

The Fluvial SVE well locations are based on analytical results for soil samples collected during the RI and the RDI and results of the SVE treatability study. The extent of the impacted fluvial sands is assumed to be comparable to the footprint of the impacted loess deposits. Closer spaced wells than suggested by the treatability study results will be used for the Fluvial SVE system; a design flow rate of 100 scfm and a conservative design SVE ROI of 60 ft was selected. Seven SVE wells are planned at the locations shown on Figure 5.

Two-inch, inside-diameter (ID) stainless steel wells will be installed with 25 to 35 feet of 0.010-inch slotted screen, depending on the thickness of the fluvial vadose zones. The well screens will extend from just above boring termination to approximately 5 feet below the loess/fluvial contact. The wellheads will be completed below the surface; temporary fittings will extend the casing approximately 2 feet above ground surface for above ground connection with the conveyance piping until loess treatment is completed. Once loess treatment is complete, the piping from the Fluvial SVE wells will be buried.

Individual conveyance piping will be routed to each extraction well to provide maximum system operational flexibility and to allow flow to be balanced between each well from a central location. Piping will consist of 4-inch diameter high density polyethylene (HDPE) and the pipe runs will range from 200 to 1,000 feet. The piping will be installed above ground surface in the treatment areas initially; after loess treatment is completed, the conveyance piping will be buried. Outside the treatment areas, the piping will be trenched from the SVE wells to the equipment compound. The initial ground survey of the pipe runs will be used to install the piping in a manner to avoid low points where condensate could accumulate. All conveyance piping will be tagged and matched with the proper manifold leg.

2.2.2 Control Building and Treatment Compound

The treatment compound will have a concrete base and will be enclosed with a chainlink fence with 3-strand barbed wire. The control building within the compound will contain the individual SVE manifold legs, blowers, aftercoolers, moisture separator and system controls. The vapor treatment system will be located outside the building.

Two vacuum blowers will be used to generate a total flow of 1,160 actual cubic feet per minute (acfm), allowing the system to operate at a higher extraction rate than the 100 scfm design flow per well. The dual blower system also permits uninterrupted SVE system operation at lower extraction rates if one of the units is offline for maintenance. The extracted vapor will be treated using granular activated carbon (GAC) in two epoxy-coated steel vessels. Vapor treatment is not expected to be necessary after Year 1; however, treatment will continue after Year 1 if necessary to meet air discharge limits. If CVOC concentrations in influent vapor are significantly higher than anticipated in the RD, other treatment technologies will be considered.

A condensate recovery system will also be installed. The condensate flow rate from the Fluvial SVE system is expected to be less than 1 gallon per minute and to decrease over time; the condensate is not expected to require treatment prior to discharge to the City of Memphis sewer system. Samples will be collected and analyzed as necessary for discharge through the existing IRA groundwater discharge following approval from the city. If CVOC concentrations in condensate are higher than anticipated in the RD and the condensate requires treatment prior to discharge, treatment and disposal alternatives will be considered. If CVOC concentrations in condensate exceed toxicity characteristic limits, it will be disposed as hazardous waste.

2.3 SVE SYSTEM OPERATION AND MONITORING

2.3.1 SVE System Operation

The SVE system will be operated continuously, with periodic downtime as necessary for maintenance and monitoring. During system start-up in the first two weeks of operation, manifold valve adjustments will be made to optimize contaminant removal by concentrating vacuum pressure on the SVE wells with higher CVOC vapor concentrations.

System operational checks of operating parameters will be made weekly for the first month of operation after system start-up, and monthly thereafter. Adjustments to flow rates and pressures at individual wells will be made to improve system performance. The operational checks may be changed to quarterly after a year of operation or system stabilization. Maintenance of the SVE blowers and other equipment will be described in an O&M Manual to be prepared after construction.

2.3.2 SVE System Monitoring

Vapor/vacuum monitoring points (VMPs) will be installed at ten locations to assess the vacuum ROI and vapor extraction effectiveness. Two 2-inch ID stainless steel VMPs with 5-foot screens will be installed at each location; one screened approximately 5 feet above the bottom of the associated SVE well and the other screened approximately 5 feet below the top of the SVE well screen.

System monitoring will include field measurements of vacuum, velocity and volume flow rates; screening measurements of VOC concentrations with a flame ionization detector (FID); and laboratory analysis of air samples for VOCs. Ambient air screening measurements of VOC concentrations will also be made with air sampling conducted if screening measurements exceed action levels provided in the HSA.

During start-up in the first two weeks of system operations, daily field measurements and VOC screening will be performed at the seven SVE wells, the vapor treatment system inlet and outlet, and the VMPs. Once initial adjustments to the SVE system have been made and within the first two to four days of operation, baseline air samples for laboratory analysis will be collected at the SVE well manifolds and the vapor treatment system inlet and outlet.

Following system start-up, field measurements and VOC screening will be performed weekly for the first month and monthly thereafter. Air samples for laboratory analysis will be collected monthly during the first quarter and quarterly thereafter. Ambient air screening measurements will be made weekly. The SVE monitoring schedule will be reviewed after the first year of operations.

When the reduction in VOC concentrations in an SVE well becomes asymptotic, system operations will be evaluated to increase mass removal rates by pulsing. If mass removal rates remain asymptotic in a treatment area, the SVE well will be shutdown and confirmation soil sampling will be performed. If soil concentrations are below the RGs, the SVE wells and VMPs in that treatment area will be de-activated; if soil concentrations are above RGs, the system will continue to be operated while enhancements are evaluated.

2.4 FIVE-YEAR REVIEWS

Five-Year Reviews will evaluate:

- Whether the Fluvial SVE remedy is functioning as intended
- Whether the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection are still valid
- Whether additional information has come to light that could call into question the protectiveness of the remedy

A Five-Year Review was completed in January 2003 for Dunn Field. To comply with guidance from USEPA, the next Five-Year Review for DDMT will be completed by January 2008.

3.0 REMEDIAL ACTION PLANNING

The following section presents a summary of the remedial action planning to be completed prior to implementation of the RA. This section includes a discussion of the planning documents, subcontractor and vendor procurement and permitting.

3.1 PLANNING DOCUMENTS

Implementation of the RA will begin following BCT concurrence with the RA planning documents, which include this RAWP and the PMP, WMP, CQAP, RA SAP, and HSA.

3.1.1 Project Management Plan

The PMP is Appendix A to this RAWP and describes the project organization and responsibilities. The PMP also addresses administrative procedures, such as communications, records maintenance, quality control and reporting, and includes a schedule for implementation of the RA.

3.1.2 Waste Management Plan

The WMP is Appendix B to this RAWP and describes waste management and waste minimization activities during the installation of SVE wells, VMPs and groundwater monitoring wells, and SVE operations. The WMP identifies the waste streams that will be generated during implementation of the RA and details plans for waste minimization, waste management strategies, and waste disposition.

3.1.3 Construction Quality Assurance Plan

The CQAP is Appendix C to this RAWP and presents the quality assurance/quality control (QA/QC) procedures for RA construction activities and procedures to monitor and document the acceptability of construction of the SVE system components (SVE wells and conveyance piping, control building and treatment compound). The CQAP includes information on project meetings, construction activities, and document submittals.

3.1.4 Sampling and Analysis Plan

The RA SAP (MACTEC, 2005) documents the procedural and analytical requirements for activities conducted during the RA. Volume I of the RA SAP presents the FSP with information on project organization and responsibilities, field activities, field measurement, sample handling and documentation, and nonconformance/corrective actions for situations (if any) when requirements of the RA SAP are not met. Specific RA field activities addressed by the FSP are:

- Site reconnaissance, preparation, and restoration
- Borehole construction and soil sampling
- Well installation and development
- Groundwater sampling
- Surveying
- Equipment decontamination
- Disposal of investigation derived waste (IDW)

The field-measurement section of the FSP addresses calibration and quality control of field measurement equipment and procedures for field monitoring measurements. Field performance and systems audits are also addressed in Volume I.

Work and Test Procedures (WTPs) in Appendix B of Volume I provide specific procedures for field activities and the formulation of project-related documents. Besides the field activities listed above, the WTPs include sample control and documentation, sample containers and preservation, sample packing and shipping, decontamination of personal protective equipment, and health and safety monitoring.

Volume II of the RA SAP includes the QAPP and addresses:

- Data quality program objectives
- Sampling procedures
- Screening and definitive analytical methods and calibration
- Methods for data reduction, review, verification, reporting, validation, and record keeping

Volume II also addresses performance/systems audits, preventive maintenance, and nonconformance/ corrective actions for situations (if any) when requirements of the QAAP are not met. Appendices to Volume II include the analytical laboratory quality manual and standard operating procedures (SOPs), calibration and QC procedures, and data quality SOPs.

3.1.5 Health and Safety Plan

The *Remedial Action Health and Safety Plan* (HSP) (e^2M, 2006) will provide the basis for protection of site workers. The Fluvial SVE Health and Safety Addendum (HSA) will be prepared for activities not addressed in the HSP. The HSA includes a description of potential risks, responsible on-site personnel, site safety program(s) and procedures, contingency procedures, air monitoring plan(s), personnel monitoring, area and perimeter monitoring, spill prevention, control and countermeasures plan.

3.1.6 Community Relations Plan

Community relations activities during the RA will be conducted in accordance with the Community Information Plan (MACTEC, 2005). The primary objectives relative to the RA are to notify nearby members of the community prior to construction activities and to provide routine updates on progress. These activities will be performed by e^2M and its subcontractor, Frontline Corporate Communications, under the direction of the DLA project manager.

3.2 SUBCONTRACTOR AND VENDOR PROCUREMENT

e^2M will solicit, evaluate, select, and award the necessary subcontracts to implement the RA. Subcontracts will be awarded for:

- Initial and as-built surveys of treatment areas, drilling locations and the control building
- Location of utilities at drilling locations and treatment compound (as necessary)
- Removal of soil/rubble pile
- Installation of the SVE wells, VMPs and groundwater monitoring wells
- Abandonment of existing wells
- Installation of SVE conveyance piping

- Installation of electric power
- Construction of the control building and treatment area
- Laboratory analyses of vapor and groundwater samples

3.3 PERMITTING

As this site is under CERCLA authority, permits are not required from local or state entities for actions that occur entirely onsite; however, CERCLA Section 121(d) specifies, in part, that remedial actions for cleanup of hazardous substances must either comply with, or justify waiver of, requirements and standards under federal or more stringent state environmental laws and applicable or relevant and appropriate regulations (ARARs) (see also 40 Code of Federal Regulations [CFR] 300.430(f)(1)(ii)(B)). ARARs include only federal and state environmental or facility siting laws and/or regulations and do not include occupational safety or worker protection requirements. In accordance with 40 CFR 300.400(g), the DLA, TDEC, and EPA have identified the specific ARARs for the selected remedy. Activities planned to meet ARARs are discussed below.

Requirements for the control of fugitive dust at TDEC Rule 1200-3-8-.01(1) and storm water runoff potentially provide ARARs for all construction, excavation, trenching, and site preparation activities. Reasonable precautions must be taken and include the use of best management practices for erosion control to prevent runoff and the application of water on exposed soil/debris surfaces to prevent particulate matter from becoming airborne.

Well installation may result in the generation of remediation wastes that are considered Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste due to elevated concentrations of hazardous constituents. The toxicity characteristic leaching procedure (TCLP) test, along with tests for reactivity, corrosivity and ignitability, will be conducted on representative remediation/secondary waste samples to determine whether they are considered RCRA characteristic hazardous waste. RCRA hazardous waste will be managed in accordance with the applicable TDEC hazardous waste management regulations, including those related to temporary storage of waste in containers and transportation offsite. Movement of hazardous remediation waste that contains RCRA-restricted waste offsite for disposal will trigger the RCRA LDRs. These wastes must meet the specified treatment standards at 40 CFR 268 et seq. prior to disposal in a RCRA Subtitle C hazardous waste landfill.

Any remediation wastes that are transferred offsite or transported in commerce along public rights-of-way (ROWs) must meet requirements for packaging, labeling, marking, manifesting, and placarding for hazardous materials. In addition, CERCLA Section 121(d)(3) provides that the offsite transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA RAs be sent to a treatment, storage, or disposal facility that is in compliance with applicable federal and state laws and has been approved by EPA for acceptance of CERCLA waste (see also the "Off-Site Rule" at 40 CFR 300.440 et seq.). e^2M will verify with the appropriate EPA regional contact that any needed offsite facility is acceptable for receipt of CERCLA wastes before transfer and will obtain written evidence of valid EPA Off-site Rule approval (40 CFR 300.440) from the offsite disposal facility.

Installation and operation of the SVE systems will require a construction/operating application. The SVE systems was designed to meet the substantive requirements of the air permit, which will likely have the following operating conditions:

- SVE systems can be operated only if the vapor treatment is functioning as designed.
- Emissions to be determined by source testing.
- Routine annual inspection to be conducted by the Minor Sources Branch of TDEC.
- No emissions limit considered necessary.
- Permit to be rescinded once actual pre-treatment emission rate drops below 0.1 lb/hr.

4.0 REMEDIAL ACTION CONSTRUCTION

RA construction activities include site preparation; mobilization of personnel, equipment, and supplies; construction of the Fluvial SVE system components; and reporting. The SVE components include:

- Groundwater monitoring wells;
- SVE wells;
- Vapor monitoring points;
- Conveyance piping; and
- Treatment compound including treatment building, Fluvial SVE extraction system (blowers, air/water separator (AWS), transfer pump, freestanding condensate tank, and associated piping, hardware, and controls) and vapor treatment system GAC vessels.

4.1 NOTICE TO PROCEED

Award of a Task Order for the Fluvial SVE system by AFCEE will serve as notice to proceed with construction activities. The award will mark the formal beginning of the construction phase of the fluvial sands SVE system and progress within the construction schedule will be measured by the date of the notice. The BCT will be notified when the award is made.

4.2 PRE-CONSTRUCTION CONFERENCE

A pre-construction conference will be held at the DDMT facility approximately two weeks after notice to proceed and before construction work begins. The conference will be attended by DLA, USEPA, TDEC, e^{2}M, Depot Redevelopment Corporation (DRC), subcontractors and other invited attendees. The pre-construction conference will include:

- Introducing team members and identifying the roles, relationships, and responsibilities of parties involved with the RA;
- Discussing expectations of the BCT for the RA-C;
- Reviewing the general project scope, final CQAP, HSA, work area security and safety, and project schedule;
- Establishing a schedule for meetings and briefings;

- Reviewing methods for documenting and reporting observation data and documenting control procedures; and

- Reviewing procedures for project completion including final system construction inspection.

A site reconnaissance may be conducted as part of the pre-construction conference to view construction and staging areas. Specific areas to be viewed will include drilling locations, treatment areas and material and equipment storage areas; site access issues will also be reviewed. e^2M will document the names of conference attendees, issues discussed, clarifications made, special instructions issued, and other pertinent information and discussions.

4.3 MOBILIZATION AND SITE PREPARATION

e^2M will provide oversight of equipment mobilization, supplies, and personnel and will coordinate the schedules and progress of subcontractors and vendors. A construction kick-off meeting will be held with subcontractors prior to the onset of construction activities. The meeting will occur at the Memphis Depot, Building 265 (e^2M Field Office) or at Dunn Field. The purpose of the meeting is to verify that design criteria and specifications presented in this RAWP, site access issues, contract documents, and other pertinent project information are understood by all parties. e^2M will document the names of conference attendees and the discussion items.

4.3.1 Site Preparation

e^2M will oversee the construction of temporary facilities at Dunn Field, including:

- Decontamination pads and facilities
- Equipment and supply staging area(s)
- IDW storage facilities or staging areas

Most field and construction activities will occur at Dunn Field, which is predominantly undeveloped. Construction activities should not interfere with Memphis Depot Business Park tenants; limited RA activities (staging of equipment, sub-contractor meetings, etc) will occur on the Main Installation at Building 265 (e^2M's Field Office).

Brush and vegetation will be cleared as necessary to provide unobstructed access to the SVE and monitoring well locations. The loess treatment areas will also be cleared to expedite that RA. The vegetation on the soil/rubble pile in Treatment Area 3 will be cleared to allow its removal. Small trees and shrubs will be cut and mulched onsite. Larger brush and debris will be disposed at an appropriate off-site facility.

4.3.2 Site Survey and Utility Clearance

The project area will be surveyed and marked by a Registered Professional Land Surveyor. The boundaries of the loess treatment areas, excavation areas, drilling locations (groundwater wells, SVE wells and vapor monitoring points), control building/treatment compound, and staging and stockpile areas will be surveyed to guide field activities. All locations will be marked in accordance with the construction drawings and specifications (Appendix D), be highly visible, and have sufficient permanence to be identified for several weeks following completion of surveying task. The Site Survey will be performed by a Registered Professional Land Surveyor licensed in the State of Tennessee.

Utilities at drilling locations (SVE wells, VMPs and groundwater monitoring wells) and at construction areas (trenching and treatment compound) will be located through liaison with DRC staff and utility operators. All locations will be cleared for underground utilities, general access and overhead obstructions. The Tennessee One-Call System, Inc. will be utilized along with a private utility locator as necessary. Utilities to be located include, but are not limited to, underground and overhead power, telephone, cable television, fiber optic, and computer lines; and underground storm and sanitary sewers, water and gas lines. Clearance from the transmission lines crossing Dunn Field will be confirmed for all drilling locations with Memphis Light Gas & Water (MLGW). No intrusive activities will be conducted until utilities have been located.

All location adjustments will be reviewed by the Certifying Construction Engineer (CCE). The BCT will be informed of adjustments greater than 15 feet prior to construction activity at that location.

Work limits will be established following the site survey and utility clearance. Work limits at drilling and construction locations will include the exclusion, contaminant reduction, and support zones; and space for equipment lay down.

4.3.3 Temporary Access Road Construction

Access to the Site will be via the existing asphalt/gravel road running north from Dunn Avenue. This access road is adjacent to the future SVE treatment compound and is anticipated to be adequate for heavy equipment access. Existing site access roads will be used to reach the individual SVE wells, VMP and monitoring well locations to the extent possible. If required, temporary access roads will be constructed. Existing site roads will be upgraded for heavy equipment use before the construction of new access roads. The need to improve existing access roads and/or construct temporary construction roads will be reviewed at the pre-construction meeting.

If constructed, temporary access roads will be approximately 20 feet wide and constructed with a 6-inch crusher run layer overlying a stabilizing, geotextile fabric. All access roads will be constructed to allow surface water to drain and minimize the incidence of ruts.

4.3.4 Soil/Rubble Pile Removal

The soil/rubble pile in Treatment Area 3 measures approximately 90 feet by 160 feet and 30 feet high. The pile contains approximately 8,000 in place cubic yards of soil and concrete rubble, with an estimated 25% concrete rubble. The concrete rubble will be removed from the soil pile and separated from the soil to the extent practical. The concrete will be removed from the site to a construction landfill or concrete recycling facility and the soil will be spread in the southwest area of Dunn Field outside the treatment areas. The newly placed soil will be graded and seeded with grass. Erosion control measures will be implemented on slopes exceeding 25 degrees and in areas that are prone to run-off leaving the site.

4.3.5 Temporary Erosion and Sediment Controls

Erosion and sediment control measures will be taken to minimize erosion during construction activities in disturbed and soil stockpile areas. Erosion controls may include the use of silt fences, hay bales, grade work, diversion berms, and/or other measures to minimize storm water runoff and site erosion. Potable water will be sprayed on haul roads to limit dust, if considered necessary based on site observations.

4.4 BASELINE GROUNDWATER MONITORING

Baseline groundwater conditions in the treatment areas will be established prior to implementation of the Fluvial SVE by collecting groundwater samples from 26 existing monitoring wells as indicated in the RD. The baseline groundwater analyses will be used to evaluate overall Source Areas remedy effectiveness. Existing monitoring wells located within and adjacent to the loess treatment areas will be abandoned after baseline sampling, and review and acceptance of the baseline analytical results. In order to provide a consistent set of groundwater analytical data for evaluation of remedy effectiveness, new monitoring wells will be installed to replace the wells to be abandoned; the new wells will be installed and sampled during the baseline sampling event.

Based on the loess treatment areas outlined in the RD, eight monitoring well will have to be abandoned: two wells in TA1 (MW-11 and MW-181); five wells in TA2 (MW-73, MW-131, MW-133, MW-177 and MW-188) and one well in TA4 (MW-173). The final determination of wells to be abandoned will be made when the treatment area locations are marked by the registered surveyor; wells within 10 feet of a treatment area will be abandoned and replaced.

Three wells planned to be abandoned (MW-73, MW-173 and MW-177) will be replaced with a new well located approximately 5 to 10 feet from the existing well. The five remaining wells had total CVOC concentrations of 1 to 121 μg/L in recent samples, as shown on Figure 4; these concentrations are well below the total CVOCs target concentration of 1,000 μg/L for ZVI injections during a later phase of the Source Areas RA. The replacement wells will be located more centrally within the estimated groundwater treatment areas to improve the distribution of groundwater data. An additional well will be installed in the central portion of TA4. The wells to be abandoned and the new well locations are shown on Figures 6, 7 and 8; the location coordinates for the wells are shown on Table 3.

Additional well installation and groundwater sampling will be performed prior to implementation of the ZVI injection component of the Source Areas RA. Those activities will be described in the Loess/Groundwater RAWP and performed as part of that RA.

4.4.1 Well Installation and Development

Nine wells will be installed and developed in the treatment areas. The top of clay marking the base of the fluvial aquifer is approximately 75 to 90 feet below ground surface (bgs) and the aquifer thickness is 4 to

18 feet at Dunn Field. The monitoring wells will be installed in 6-inch boreholes advanced using rotasonic drilling method. Lithologic samples will be collected continuously in 10-foot intervals beginning at the ground surface. The borings will be drilled 7 to 10 feet into the gray clay of the Jackson Formation/Upper Claiborne Group to confirm that the base of the fluvial aquifer is reached. The boreholes will be backfilled to approximately 1 foot below the top of the clay and 1 foot of filter sand will be placed in the borehole before installing the well. The estimated boring depths and screen locations based on observations in nearby wells are shown on Table 4.

Wells will be constructed with stainless steel casing and riser and high temperature grout to withstand high subsurface temperatures during thermal-enhanced SVE treatment of the loess. The high temperature grout will consist of API Class H cement and 30% silica flour. The monitoring wells will be constructed of new 2-inch diameter casing and 0.010-inch wire wrapped screens using flush-fitting, internally-threaded joints. The well screens will be 15 to 20 feet long and span the fluvial aquifer. Centralizers will be used above and below the well screen.

Filter pack will be placed in the annular space around the well screen. The filter pack material will be washed and bagged sand with a grain-size distribution curve that meets the 4-20 gradation specification. The filter pack will be gravity-placed through the 6-inch outer drill casing in lifts of 1 to 2 feet. Care will be taken to prevent bridging by measuring the thickness of the filter pack as it is placed. The drill casing will be vibrated as it is withdrawn between lifts to compact the sand filter pack. The filter pack will extend from the bottom of the borehole below the screen interval to approximately 5 feet above the top of the well screen.

A seal of hydrated bentonite with a thickness of approximately 5 feet will be placed above the filter pack at each well. The 100 percent sodium bentonite seal will consist of ¼-inch- or ⅜-inch-diameter dry bentonite pellets or chips. The bentonite seal will be placed using gravity methods, or by the tremie method if the pellets or chips bridge in the borehole annulus. If the bentonite seal is placed above the water table, sufficient water will be added to allow complete hydration of the bentonite. The bentonite seal will be allowed to hydrate for 2 to 4 hours prior to the installation of cement grout.

A grout seal made using API Class H cement and 30% silica flour will be placed in the annular space above the bentonite seal. The grout will be placed using a side-discharge tremie pipe and will be continuously pumped until grout returns to the ground surface. The grout will be allowed to cure for a minimum of 8 hours before further grouting or well construction. Prior to installation of the surface completion, grout in the borehole will be topped-off to approximately 6 inches below ground surface. Well development will be performed at least 24 hours after grouting is completed.

Well casings will extend approximately 2 feet above ground surface. Casings will be protected by a 6-inch protective standpipe with locking lid set in a 2-foot by 2-foot concrete pad. The pad will be approximately 4-inch thick and slope away from the well casing.

Monitoring wells will be developed using a combination of pumping and surging until clear, sand-free formation water is produced. No air, detergents, soaps, bleaches, or additives will be used during well development. Development will continue until well water is clear to the unaided eye and measurements of pH, temperature, turbidity, and specific conductance have stabilized. In general, field parameters are stable when nephelometric turbidity units (NTUs) are less than 10, pH is within 0.1 standard unit (SU) on three consecutive readings, and temperature and specific conductance are within 10 percent of the three previous readings. Well development will be discontinued after six hours of pumping and surging or bailing the well (including recharge time for wells with slow recharge), with the concurrence of the field team leader.

The e2M field geologist will prepare boring logs, construction diagrams, and development records for the newly constructed wells. The soil core from the capillary fringe and aquifer will be archived in labeled cardboard core boxes.

4.4.2 Groundwater Sampling

The new and existing wells will be sampled using low-flow sampling methods not sooner than 24 hours after development of new wells. Groundwater samples will be analyzed for VOCs and MNA parameters as listed on Table 2.

Groundwater level measurements will be made in wells at Dunn Field and the surrounding Off Depot area prior to sampling. Measurements will be taken using Solinist Model 101 water-level meters with electronic sensors and tapes graduated in 0.01-foot increments. Monitoring wells to be included in the baseline monitoring event for either sampling or water level measurement are listed on Table 5.

Wells will be sampled using a stainless steel bladder pump equipped with disposable Teflon® bladders and tubing using low-flow purging methods to minimize sample turbidity. Water quality parameters will be measured at 10-minute intervals using a flow-through cell. Purging will continue until parameters meet stabilization criteria, three successive readings within: ±0.1 for pH; ±10 millivolts (mV) for oxidation-reduction potential (ORP); ±3 percent for specific conductance; <20 NTUs for turbidity; ±10 percent for dissolved oxygen (DO). Temperature will also be recorded but will not be used as a stabilization parameter. Samples will be collected as soon as stabilization criteria are met. If stabilization criteria are not met after two hours purging, the field team leader will determine whether to collect the sample or to continue purging.

Hanna Instruments field test kits will be used to measure ferrous iron and carbon dioxide in groundwater. The samples will be collected according to the manufacturer's instructions included in the test kits.

4.4.3 Well Abandonment

Eight monitoring wells located within and adjacent to the loess treatment areas are planned to be abandoned following the baseline monitoring event: two wells in TA1 (MW-11 and MW-181); five wells in TA2 (MW-73, MW-131, MW-133, MW-177 and MW-188) and one well in TA4 (MW-173).

The total depth of each well will be measured to confirm that no obstructions are present that might interfere with placement of the tremie pipe and grout. One-half gallon of bleach will be poured into each well in accordance with Memphis Shelby County Health Department regulations. The wells will be filled with high temperature grout (for example, Halliburton Class G grout) from the bottom up until undiluted grout is visible at the surface. The grout will be tremied into the casing, keeping the side-discharge tremie pipe approximately 1 foot below the grout surface. Since the wells to be abandoned are within the loess treatment areas, the limited volume of water to be displaced by the grout will not be contained. After allowing at least two days for grout settlement, the grout will be topped off with concrete. The well pad, manhole and bollards, if present, will be removed and disposed as solid waste. The wellhead location will be restored to match the surrounding area.

4.5 FLUVIAL SVE CONSTRUCTION ACTIVITIES

Fluvial SVE system construction will include the following major components:

- SVE and VMP Wells;
- SVE System Conveyance Piping and Trenching; and

- Treatment Compound, Control Building, and Interior Piping

4.5.1 Fluvial SVE Well and VMP Construction

Seven SVE wells and ten VMPs will be constructed in the four treatment areas with stainless steel casing and riser and high temperature grout to withstand high subsurface temperatures during thermal-enhanced SVE treatment of the loess. One or two VMPs will be installed to monitor the vacuum influence at each SVE well. The VMP locations were modified slightly from the locations in the RD; the VMPs will be located 15, 30, 45, 60 or 80 feet from the associated SVE well. The SVE well and VMP locations are shown on Figure 5; the location coordinates and rationale for the SVE wells and VMPs are shown on Table 6. The estimated boring depths and screen locations based on observations in nearby wells are shown on Table 7.

4.5.1.1 SVE Well Construction

The SVE wells are to be constructed in 6-inch diameter soil borings advanced using rotasonic drilling methods. Lithologic core samples will be collected continuously in 10-foot intervals beginning at the ground surface. All soil borings will be advanced to approximately 5 feet above the base of the vadose zone (approximately 60 to 65 feet below ground surface depending on location). The borehole will be drilled approximately 0.5- to 1-foot below the target depth and backfilled with filter sand before installing the well. Depending on the thickness of the fluvial unsaturated zone, a 25- to 35-ft section of 0.006-inch slot stainless steel screen will be installed to span the fluvial sands formation from 5 feet above the water table to 5 feet below the bottom of the loess. Stainless steel riser will extend to an elevation of approximately two feet below ground surface in accordance with the specifications (Appendix D). Centralizers will be used at the top and bottom of the screened section. Well screen and riser will be new, unused, decontaminated, 2-inch inside-diameter 304 stainless steel, with internal flush-jointed threaded joints.

Water level elevations from the baseline monitoring event and surveyed ground surface elevations at the SVE well locations will be used to determine the final depth prior to drilling. The bottom of the loess will be determined during drilling based on the transition from the silty and clayey loess to a fine-medium grained, orange-red, loose silty sand with or without gravel.

The filter pack, bentonite seal and grout seal in the SVE wells will be constructed with the same materials and installed in the same manner as in the monitoring wells, except that the filter pack will be appropriately sized for the smaller slot size of the SVE wells.

The SVE wells will be completed with a threaded coupling approximately 2 feet, bgs. The 2-inch stainless steel casing will be extended to a few inches above ground surface with a section of threaded stainless steel riser and completed with a stainless steel 'tee' to connect to the high density polyethylene (HDPE) conveyance piping. A threaded plug will be used to seal the 'tee'. Upon completion of the loess treatment, the section of riser will be removed, the 'tee' will be connected at the below ground coupling and the conveyance piping will be buried.

The e2M field geologist will prepare boring logs and construction diagrams for the SVE wells. The soil core from the vadose zone will be archived in labeled cardboard core boxes.

4.5.1.2 VMP Construction

Two, 2-inch ID VMPs will be installed at each of 10 locations. VMPs will be constructed in 6-inch diameter soil borings advanced using rotasonic drilling methods. The VMPs will be installed after the associated SVE well installation. The first VMP boring at each location will be drilled to an elevation approximately 5 feet above the termination of the associated SVE well boring (approximately 60 feet below ground surface). Lithologic core samples will be collected continuously beginning at the ground surface. Discrete soil samples will be collected at three depths in the first VMP boring as described in Section 4.5.1.3. The second VMP boring will be drilled to an elevation approximately 5 feet below the top of the well screen of the associated SVE well (approximately 40 feet below ground surface); no soil sampling will be performed in the second boring. The total boring depth and screen depth for each VMP will be calculated before drilling at that location commences.

Each VMP borehole will be drilled approximately 0.5 foot below the target depth and backfilled with filter sand before installing the VMP. A 5-foot section of 0.010-inch slot stainless steel screen will be installed with stainless steel riser extending to the surface. A centralizer will be used at the top of the screened section. Well screen and riser will be new, unused, decontaminated, 2-inch inside-diameter 304 stainless steel, with internal flush jointed threaded joints.

The filter pack, bentonite seal and grout seal in the VMPs will be constructed with the same materials and installed in the same manner as in the monitoring and SVE wells. Each VMP casing will extend approximately 3 feet above ground surface and be topped with a threaded cap. The VMP casings will be protected by a 6-inch protective standpipe with locking lid set in a 2-foot by 2-foot concrete pad. The pad will be approximately 4-inch thick and slope away from the well casing.

The e2M field geologist will prepare boring logs and construction diagrams for the VMPs. The soil core from the VMP borings will not be archived.

4.5.1.3 Soil Sampling

Limited soil analytical data is available in the fluvial vadose zone. Additional data will be collected to validate the CVOC mass estimates provided in the RD and to provide potential confirmation sample locations following shutdown of the SVE system.

Soil samples will be collected at three depths in each SVE well and VMP boring: at 8 feet, 18 feet and 28 feet below the bottom of the loess. Borings will be halted at each depth, soil removed from the core barrel and a 3-inch diameter split-spoon sampler hydraulically advanced in undisturbed soil below the drill rod. The sampler will be opened at the surface and a soil sample from the middle of the sampler will be collected using an Encore syringe-type sampler. The samples will be submitted for analysis of VOCs. A portion of the remaining soil sample will be placed in a 1-gallon plastic bag and stored for grain size analysis, if warranted based on vacuum measurements during system startup.

4.5.2 Conveyance Piping and Trenching

Conveyance piping from individual SVE wells to the treatment compound will be constructed to provide maximum system operations flexibility and the ability to adjust extraction well flow rates from a central location. All conveyance piping will consist of 4-inch diameter standard dimension ratio (SDR) 11 high density polyethylene (HDPE) piping. Coiled pipe will be used where possible to minimize fused joints. Piping will be butt fusion-welded by a trained professional, where required.

The Fluvial SVE system will be installed before construction of the loess treatment system and piping from the each SVE well head will initially be constructed aboveground so that operations can coincide with the thermal-enhanced SVE treatment of the loess. The 4-inch diameter HDPE conveyance piping will be installed on the ground surface; aboveground connections will consist of the stainless steel 'tee' and 4-inch diameter transition fittings. When loess treatment system construction begins in each area, conveyance piping will be protected and/or temporarily disconnected to allow installation of the system components and the thermal vapor barrier (Appendix D, Sheet 10, Detail 6).

Beginning 5 to 10 feet outside the loess treatment areas, the conveyance piping will be trenched to the equipment compound. Conveyance piping trenches will be routed to the equipment compound as indicated on the construction drawings (Appendix D, Sheets 3 and 4). The pipes will be covered with at least 24-inches of compacted soil, where possible based on pipe depth. Pipes from SVE wells D and E and wells G and H will be placed in a single trench. Trench backfill will consist of native material with stone and debris removed. Trench backfill will be compacted in 1-ft lifts using a vibratory tamping device; compaction tests are not considered necessary. Location marking tape will be placed above the piping in each trench above the first backfill lift. Conveyance piping will be clearly labeled and tagged to ensure proper connections are made to the manifold leg penetrating the side of the treatment system building.

If discolored soil or buried containers are observed during trenching, the material and surrounding soil will be placed on plastic sheeting for additional review prior to disposal. The project manager will be notified and the BCT will be informed. Backfill originating from off-site sources, if needed, will be confirmed to be clean and free of debris.

Trenching activities will be planned so as to limit the length of open trench during times of wet weather. Excavated soil will be placed adjacent to the trench to limit surface water infiltration during wet weather. Backfill material will be allowed to drain sufficiently prior to use.

Following completion of the loess treatment, Fluvial SVE operations will be temporarily suspended and conveyance piping within the treatment areas will be buried. Final (buried) wellhead connection details will be constructed as illustrated on Sheet 10 (Appendix D). A 2-ft square, ¼-inch steel plate will be buried above the wellhead to protect the well and also assist in location it in the future. The wellhead will also be protected below the steel plate with a 2-inch diameter threaded stainless steel plug.

4.5.3 Treatment Compound, Control Building, and Interior Piping

The individual SVE manifold legs, blowers, aftercoolers, moisture separator, and system controls will be located inside the treatment compound building as shown on the construction drawings. Specific details are provided below.

4.5.3.1 Equipment Compound Building

The SVE manifold, blowers, moisture separator, control panel, and office will be located in a pre-fabricated steel frame building measuring 25' by 8' and centered on a concrete foundation measuring 32' by 20' as indicated (Appendix D, Sheets 7 and 8). A 10-milimeter HDPE vapor barrier will underlie the foundation to minimize moisture migration within the concrete pad and building. The concrete foundation will slope away from the building to allow for proper drainage. The building will be constructed with two rooms; the SVE equipment in one room (equipment room) and control panel, desk, and HVAC unit in a second room (office). An interior wall and door will separate the two rooms. The building will be constructed in the north-central portion of Dunn Field as indicated on the Sheet 3 of the Construction Drawings. Building materials will consist of:

- Perimeter Frame – Perimeter tubular 2" x 6" frame members (13 gauge) with structural steel "C" channel (2' x 8') set perpendicular to the side tubular members. Channel will be utilized as forklift slots for handling. All frame parts will be coated with a corrosive resistant (black) paint. The building will be anchored to the concrete foundation as recommended by the manufacturer.
- Metal Weather Shield – Will be constructed from galvanized steel. The shield will cover the entire floor assembly and will be located between the frame and underside of the floor joists.
- Floor Joists – Joists will be constructed from nominal 2 x 4 steel joists spaced in a lateral configuration, 12" o.c.
- Floor Insulation – Fiberglass-batt type insulation (R-11 rating) will fill any and all voids between studs.
- Floor Covering – 3/16" smooth steel floor to be painted black with non-slip floor paint.
- Wall Studs – Studs are 3½", 20 gauge, galvanized steel spaced 16" o.c. top and bottom runner are 3½", 18 gage.
- Wall Insulation – Fiberglass-batt type insulation (R-11 rating) will fill any and all voids between studs.
- Interior Wall Covering – Will be constructed of 5-16" thick gypsum board with laminated vinyl covering and will be fastened to the inside of the studs with screws and gypsum adhesive. Interior wall covering will have a class "A" flame spread rating. A 4" vinyl base cover will be

applied at the base. Expected sound loss for this material is approximately 20 decibels from the outside to inside.

- Exterior Wall Sheathing: – Under steel siding structural sheathing is secured to entire exterior following manufacturing recommendations. Sheathing will be foil laminated (1/8") on both sides.
- Roof Framing – Rafters will be nominal 4" (16 gauge) galvanized steel spaced in lateral configuration at 12" o.c. Roof will slope as indicated in the construction drawings to allow for drainage.
- Interior Ceiling – Ceiling material will be 1-2" gypsum with a white stucco pre-finish and fastened securely to roof rafters with screws. Material will have a class "A" flame spread rating.
- Roof Insulation – Fiberglass-batt type insulation (R-11 rating) will fill any and all voids between studs.
- Exterior Roof Sheathing – The top side of the rafter will be constructed with a smooth steel sheathing (16 gauge) fastened securely to roof rafters. The sheathing will be covered with a polyvinyl vapor barrier (minimum 4 mm.).
- Roof Covering – Will be constructed of galvanized steel (30 gauge). Roof metal will cover the entire roof assembly.
- Exterior Siding – Neutral color constructed of galvanized steel (29 gauge) prefinished commercial type with top and bottom trim securely fastened to studs. Exact color will be approved by CCE prior to construction.
- Exterior Doors – All exterior doors will be made of steel with steel jambs. Jambs will have ball bearing hinges and will have a tempered ½ light and heavy duty closer.
- Full Depth Fork Lift Pockets – All sizes 2½" x 8" structural "C" channel (3½" x 7" opening).
- Interior Light Fixtures – Compound will have five interior light fixtures (three fixtures in equipment room, two fixtures in office). All light fixtures will be 4' twin tube with an acrylic wrap-around type diffuser.
- Interior Ceiling Height – Building ceiling heights (from finished floor to the finished ceiling surface) will be 8'-00".
- Electrical Service Panel – Electrical service entrance panel will be equipped with sufficient breakers necessary to power electrical components. Entrance conduit will be through the exterior wall for ease of hook-up. All electrical components will be U.L. listed and wired to the National Electric Code standard. Standard service is 240-120V, single phase, 60 cycle.
- HVAC System – A single 12,000 BTU HVAC unit (manufactured by General Electric or approved equivalent) will be installed through the south wall and be used to control the temperature of the office.
- Wall Louvers – Four wall louvers (48" x 48") will be installed on the east and west walls on the equipment room for ventilation purposes. The louvers will be constructed of aluminum and with a pleated air filter (25" x 25" x 2").

4.5.3.2 SVE Manifolds

Individual SVE manifolds will be constructed as designed (Appendix D, Sheet 5) and will contain the following components:

- 4-inch diameter HDPE transition fitting
- Differential pressure air flow meter – 3-inch, stainless steel See-Flow® Indicator, 3200 Series by ERDCO®
- Pressure Indicator (Vacuum Gauge):
- Diaphragm Valve
- Ball Valve
- Sample Port

All manifold piping will consist of hot-dip galvanized or epoxy coated steel (coatings applied to pipe exterior only).

4.5.3.3 SVE Blowers

Two Gardner-Denver Turbotron vacuum blowers will installed inside the equipment room of the treatment compound building as designed (Appendix D, Sheet 7). The blowers will be in a parallel arrangement and individually be able to produce 583 actual cubic feet per minute (acfm) at 55 inches of water (4 inches of Hg) and 3,700 revolutions per minute (rpm). Total flow of these blowers will be approximately 1,160. This configuration will allow a higher extraction than the design of 100 acfm per SVE well. The blowers will be anchored to the concrete foundation per manufacture's specifications. Temperature sensors will be installed at the effluent from each blower (prior to the heat exchanger).

A heat exchanger will remove heat from the vapor effluent at each blower. The vapor flow will converge into a single pipeline (6" galvanized steel). The line will contain a pressure transducer, temperature sensor, pressure indicator (vacuum gauge), and temperature indicator. Air stream temperature will be monitored prior to and after each heat exchanger to ensure that the exchangers are functioning properly and that airflow temperature does not exceed specifications for the GAC treatment system.

4.5.3.4 Condensate Collection

Condensate from Fluvial SVE operations will be collected in a 400-gallon air/water separator (AWS). The AWS be constructed of carbon steel, contain two six-inch openings, will enable the separation of moisture from extracted airflow, and be located after merging of individual conveyance lines and before the two vacuum blowers (Appendix D, Sheet 5). A vacuum gauge and pressure transducer will be installed at the effluent line from the AWS tank. Also to be included is an inlet vacuum gage and sample port. A 1-hp pump will be installed near the tank outlet to transfer entrained water from the AWS to a storage tank located adjacent to the treatment building (Appendix D, Sheet 7). The storage tank is located outside the treatment building so as to allow easy transfer of collected condensate from the tank to the City of Memphis POTW via the existing IRA groundwater recovery system. Condensate collection rates are expected to be less than 1 gallon per minute. Effluent piping from the transfer pump to the storage tank will be partially below grade as indicated on the construction drawings (Appendix D, Sheet 7).

The design calls for a 535-gallon free standing storage tank. Due to the distance of several hundred feet from the control building to the discharge point and the limited volume of condensate expected, e^{2}M proposes to use a trailer-mounted storage tank. The tank will be towed to the discharge location, as needed. Provision will be made for a temporary condensate container during the short time necessary for tank discharge. The fence design will be altered to provide a gate for easy access to the tank.

4.5.3.5 Chain Link Fence

An 8-ft high chain link fence will be constructed near the concrete foundation exterior per design (Appendix D, Sheet 9). 3-strand barbed wire will increase the fence height to 11-ft. The barbed wire will angle outward (away from building) 45 degrees. As an enhanced security feature, a top rail will be omitted from the fence and replaced with a 7-gauge coil spring wire secured to the chain link fabric with 9-gauge hog rings spaced no greater than 12-in. Corner posts will be 3-in o.d. and will include brace rail, 12-gauge tension bands secured at a maximum 12" o.c., tension bar, and all necessary fittings, nuts, and bolts. Line posts will be 2" o.d. Fencing will consist of 2" mesh 6 gauge chain link galvanized fabric.

Two access gates will be constructed; a double gate on the north end of the compound and a single gate on the west side (near the southwest corner). The single gate will be 4-ft wide swing-type and predominately used for pedestrian access. The double gate will consist of two 8-ft wide swing gates and predominately allow access for heavy machinery. Chain link fabric for all gates will match that of the perimeter fence including the barbed wire.

4.5.3.6 Fluvial SVE System Controls

The Fluvial SVE system controls will be housed within the treatment compound as indicated on the Construction Drawings (Appendix D). Blowers, heat exchangers, and the transfer pump will be started from switches within the control panel. Light indicators will be installed to represent the machinery operating. Hour meters will also be used to track operations for all mechanical equipment (blowers, heat exchangers, and transfer pump). Manual disconnect switches will allow the operator to isolate power to the blowers, heat exchangers, and transfer pumps.

Level control switches (floats) will be installed in the AWS to allow the operator to monitor condensate collection levels from the office. Water levels in the AWS will be indicated on the control panel with indicator lights representing tank levels at low (near tank bottom), ¼, ½, and ¾ full. A "high-high" level switch will also be installed within the tank indicating water levels are nearing AWS capacity. When tripped, the "high-high" level will shut-down the SVE system by cutting power to the blowers and heat exchangers. A "high-high" alarm indicator light will also be installed within the control panel. The alarm will require a manual override prior to restating the blowers and heat exchangers.

The transfer pump will be operated manually. The "low level" tank indicator will also be used to control transfer pump operation. When the "low level" switch in the AWS tank is tripped, power will be cut to the transfer pump so as to prevent the pump operating when the AWS is empty.

A datalogger will be installed to collect and store pertinent system data. The datalogger will also allow the operator to monitor system performance from the treatment compound office. At minimum, the datalogger will collect and store the following system data:

- Flow rate from individual SVE wells;
- Conveyance line pressure at the influent of the blowers;
- Airflow temperature at the effluent from each blower (influent to heat exchanger);
- Airflow temperature and system flowrate at the effluent of the heat exchangers (once conveyance lines converge into single line and before vapor treatment);
- Conveyance line pressure at the effluent of the heat exchangers; and

- Water level within the AWS tank.

Data will be made accessible via a personal computer (PC) located within the treatment compound office. Storage capacity of the datalogger will be sufficient in size so as to store system parameters on hourly basis for the entire length of this RA (expected treatment time to reach RGs is five years). Telephone service will be provided the treatment compound to allow off-site access to the data via a modem or similar type connection.

4.5.4 Vapor Treatment

Extracted vapor will be treated with 4,000 pounds of GAC contained within two epoxy coated steel vessels. GAC will be a virgin coal-based product with particle size and pore structure designed for adsorption of CVOCs in vapor streams with minimal flow resistance and pressure drop. The vessels will be VFV Series Filter (Model VFV-2000) manufactured by Tetrasolv Filtration (or approved equivalent) and will be placed in a "series" arrangement. Six-inch flexible hosing will connect the two vessels. Sample ports will be installed at the influent of the lead vessel, between the lead and lag vessel, and at the effluent of the lag vessel. Current fluvial mass estimates indicate that treatment of the vapor stream is not expected to be required beyond one year of operation.

4.5.5 IDW Management

The IDW generated during this RA-C will be managed in accordance with the procedures outlined in the WMP (Appendix B of this RAWP). IDW will include, but not be limited to:

- Drill cuttings generated during installation of the SVE wells, VMPs and monitoring wells.
- Purge water generated during development and sampling of monitoring wells
- Runoff collected in trenches.
- Liquids and solids generated during decontamination of drilling rigs and other construction equipment.
- Liquids generated during decontamination of sampling equipment.

4.5.6 As-Built Survey

Upon completion of construction, a Registered Professional Land Surveyor licensed in the State of Tennessee will determine as-built locations for each newly constructed MW, SVE wells, and VMPs; conveyance piping trenches and the treatment compound. The survey will establish the ground surface and top of casing elevations for each well and VMP relative to mean sea level (msl) using standard surveying methods. Horizontal control will be within 0.1 foot and vertical control will be within 0.01 foot.

4.6 POST RA CONSTRUCTION ACTIVITIES

4.6.1 Demobilization

During demobilization, temporary facilities such as decontamination pads and equipment storage areas, temporary utility connections, and equipment used for construction of the treatment compound will be removed from the site. Debris and solid waste materials generated during the construction activities will be removed and disposed of properly. Demobilization activities will not be considered complete until final approval is issued by the DLA.

4.6.2 Final Construction Inspection

Upon preliminary completion of RA-C and prior to Fluvial SVE operations, DLA will notify the BCT for the purpose of conducting a final construction inspection. The schedule for the final construction inspection will be tentatively established in the pre-construction meeting and updated as the RA-C progresses. Participants of this inspection will include the Site Superintendent, CCE, construction contractors, and the BCT. The Final Inspection will consist of a walk-through of the entire project site. The objective of the inspection will be to determine whether the RA-C is complete and consistent with the plans. Outstanding items or deficiencies discovered during the inspection will be noted and an itemized list will be prepared for follow-up.

4.6.3 RA-C Report

An RA-C report will be prepared to document construction of the Fluvial SVE system. The report will be submitted after deficiencies identified during the final construction inspection have been corrected and will contain the following information:

- Introduction including brief summaries of site conditions and the Fluvial SVE remedy
- Descriptions of construction activities and a chronology of construction events
- Construction diagrams of SVE wells, VMPs and groundwater monitoring wells
- Record drawings of the control building and treatment compound
- Construction performance standards and descriptions of construction QA/QC procedures
- Final inspection documentation and certification that the SVE system is operational
- Descriptions of required operation and maintenance (O&M) activities

The report will also include design changes and deviations, photographs, waste characterization and disposal documentation, and construction testing results. The CCE will certify that the project has been constructed in compliance with the project specifications and drawings.

4.6.4 Operation and Maintenance Manual

An O&M manual will be prepared to guide system maintenance requirements and operating procedures for the Fluvial SVE system. The O&M package will include record drawings of system components, and specifications and manufacturer equipment manuals provided to the CCE by subcontractors. The O&M manual will address access needed to implement O&M. Standard O&M procedures presented in the manual will include, but will not be limited to, equipment inspections and preventive and corrective maintenance.

The O&M manual will contain the following information:

- Treatment System Operation and Emergency Information - descriptions of the treatment equipment, system operational overview, normal and emergency operating conditions, safety instructions, emergency contact information, and required sample collection and laboratory analyses

- Preventive and Corrective Maintenance - preventive maintenance practices and protocols including scheduled equipment inspections, and corrective maintenance procedures to be implemented as a result of system malfunctions
- Product and Manufacturers' Data - equipment data, recommended operation conditions, recommended maintenance procedures, and warranties
- As-Built Drawings - drawings that detail the initial system configuration and any modifications made to the system

During start-up in the first two weeks of system operations, daily inspections of the system will be made. Each piece of equipment will be inspected to note that it is operating properly and that each associated gauge or meter is within the normal operating conditions specified in the O&M manual. Equipment and material will be visually inspected for damage and leaks.

5.0 REMEDIAL ACTION OPERATION

5.1 SVE OPERATIONS

The start-up phase will include 1 to 2 weeks of manifold valve adjustments. These adjustments should optimize contaminant mass removal by concentrating vacuum pressure on the SVE wells that are producing vapors with higher contaminant concentrations, thereby balancing flow and optimizing contaminant mass removal. Flow measurements, vacuum readings, and vapor concentrations will be recorded daily from each SVE well, the manifold, and the influent and effluent of the vapor treatment system.

The SVE system will be operated continuously, with periodic downtime as necessary for maintenance and monitoring. System operational checks will be made weekly during the first month of operation and monthly thereafter. The checks will include:

- Flow and pressure at each SVE well
- Screening level vapor concentrations and pressures at the VMPs
- Blower run-times and operating parameters
- Mass removal rates based on vapor phase GAC influent and effluent vapor concentrations

If the system is not performing as designed, adjustments may be made to improve performance. These adjustments may include:

- Flow rates and pressures at individual well; and
- Installation of passive vent wells.

Monthly system operational assessments may be changed to quarterly following approximately 1 year of system operation or after the system has stabilized.

Maintenance for the SVE blowers will be addressed in the O&M manual and will include the following routine tasks:

- Quarterly blower oil changes and belt tensioning (direct drive), if necessary, and
- Maintenance of miscellaneous pumps, valves, etc., quarterly or as necessary.

5.2 SYSTEM MONITORING

Monitoring will consist of flow and pressure measurements, field vapor concentration measurements, and vacuum measurements. Vapor samples from the SVE wells and the treatment system influent and effluent will be collected routinely to evaluate the effectiveness of the SVE system and assess the need for system modifications.

During start-up in the first two weeks of system operations, field vapor concentrations will be measured daily with a photo-ionization detector (PID) at the seven SVE wells, the vapor treatment system inlet and outlet, and the VMPs. Field vapor concentration measurements will continue on a weekly basis for the first month and then monthly for the first year of operation. Baseline air samples will be collected for laboratory analysis during the first few days of start-up operations. The air samples will be collected at the SVE well manifolds and the vapor treatment system inlet and outlet. Air samples for laboratory analysis will then be collected monthly during the first quarter and quarterly thereafter.

Ambient air screening measurements will be made weekly. Condensate samples will be collected monthly (or as necessary) and submitted for laboratory analysis in accordance with the discharge agreement with the City of Memphis. The SVE monitoring schedule will be reviewed after the first year of operations.

When the reduction in VOC concentrations in an SVE well becomes asymptotic at a low level, system operations will be evaluated to increase mass removal rates by pulsing. Pulsing involves the periodic shutdown and startup of extraction wells to allow the subsurface environment to come to equilibrium (shutdown); vapor extraction then begins again (startup). If mass removal rates remain asymptotic in a treatment area, the system will be shutdown temporarily and periodic vapor concentration measurements will be made to observe the vapor concentration rebound. If the concentration rebound is sufficiently small, the SVE well will be de-activated and confirmation soil sampling will be performed. If soil concentrations are below the Remedial Goals (RGs) for fluvial soils (Table 8), the SVE wells and VMPs in that treatment area will be abandoned; if soil concentrations are above RGs, continued SVE operation with enhancements, such as installation of additional SVE and/or injection wells will be evaluated.

Confirmation sample locations and depths will be selected based on results from previous samples in the fluvial soils (samples from SVE wells and VMPs) and the loess (RDI soil samples), and observations from SVE system operations. Soil samples will be collected from 4-inch diameter soil borings advanced using rotasonic drilling methods. Borings will be halted at the sample depth, soil removed from the core barrel and a 3-inch diameter split-spoon sampler hydraulically advanced in undisturbed soil below the drill rod. The sampler will be opened at the surface and a soil sample from the middle of the sampler will be collected using an Encore syringe-type sampler. The samples will be submitted for analysis of VOCs.

5.3 INTERIM REMEDIAL ACTION COMPLETION REPORT

An Interim Remedial Action Completion Report (IRACR) will be prepared following construction completion and initial monitoring for the Source Area RA, including Fluvial SVE, thermal-enhanced SVE in loess, ZVI injections and implementation of LUCs. The purpose of the IRACR will be to document that the Source Areas RA components were constructed as designed and that the remedy is operating as intended to meet RAOs established in the ROD. An Operating Properly and Successfully (OPS) determination will be incorporated in the IRACR.

The RA is operating "properly" if it is operating as designed and operating "successfully" if its operation will achieve the clean-up levels or performance goals delineated in the decision document. The USEPA interprets the term OPS to mean that the RA is functioning in such a manner that is expected to ultimately attain clean-up levels that adequately protect human health and the environment. The OPS determination will consider each of the Source Areas RA components.

Metrics for the Fluvial SVE component have been developed to determine whether it is operating both properly and successfully. The metrics for determining that the Fluvial SVE is operating properly will be as follows:

- SVE wells and VMPs are installed at locations and to depths and specifications as indicated in this RAWP.
- Blowers, heat exchangers, AWS, transfer pump, SVE controls, and other components of the treatment compound are installed and operating as specified in the RD and this RAWP.
- Blowers extract subsurface vapor from individual SVE wells near the design flow rate of 100 acfm.
- GAC adsorption capacity is sufficient to remove CVOCs from extracted vapor stream.

The metrics for determining that Fluvial SVE is operating successfully will be as follows:

- Vacuum influence as indicated by measurements from VMPs extends greater than 60 feet from each SVE well (vacuum of at least 0.1 inch water at 60 feet radius is expected based on Phase 1 SVE treatability study results);
- Total extracted CVOC mass is consistent with estimates as indicated in the RD as updated by RA-C soil sample results.

Additional discussion of the IRACR and OPS metrics for thermal-enhanced SVE and ZVI injections will be provided in the Loess/Groundwater RAWP.

5.4 REPORTING DURING REMEDIAL ACTION OPERATION

Quarterly summaries will be submitted to the BCT during RA-O. DLA is required to submit quarterly written summaries as specified in the Federal Facilities Agreement (USEPA, 1995b) to identify and describe completed and scheduled activities. The summaries will include the following information with respect to operation of the SVE system:

- Summary of overall system operations during the quarter, including total flow and estimated mass removal for each well and the system
- Summary of system down-time, if any, and maintenance performed on system components
- Tables of field measurements
    - flow rate, pressure and screening level vapor concentration at manifolds for SVE wells
    - pressure and screening level vapor concentration at VMPs
    - influent and effluent temperature at heat exchanger
    - screening level vapor concentration at influent and effluent of vapor treatment system
    - condensate flow rate
- Estimated vacuum influence from each SVE well based on VMP measurements
- Results of vapor sample analyses
- Results of condensate sample analyses
- Trends in vapor concentrations at individual SVE wells.

- Recommendations for modifications to system operations based on analytical results and system measurements.

Quarterly summaries will be submitted to the BCT within eight weeks of the end of the quarter.

Additional reporting may be required from the City of Memphis for wastewater discharges and/or by TDEC for air permit requirements. Reporting requirements would probably include volume of condensate discharged to POTW and mass emission rates from SVE system, respectively.

6.0 CONTINGENCIES

Some degree of uncertainty exists within environmental restoration projects and contingency planning is conducted so that there is a process for identifying deviations from expected conditions so that the RA can be appropriately modified. Expected conditions and reasonable, potential contingencies to the planned RA were described in the RD and are summarized below.

Potential Contingency	Possible Responses
Fluvial vacuum radius of influence (ROI) is less than expected	Increase extraction rate at SVE wells; install passive or active air injection wells to improve ROI; install additional extraction wells to facilitate air distribution; optimize SVE operation.
System monitoring indicates RGs will not be met after 5 years of operation.	Increase extraction rate at SVE wells; install passive or active air injection wells; install additional extraction wells to facilitate air distribution; optimize SVE operation.
Rebound of soil vapors following asymptotic mass removal and subsequent system shutdown.	Re-activate SVE system and continue optimization program; consider alternative remedies (e.g. surface capping).

7.0 REFERENCES

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TABLES

TABLE 1
DUNN FIELD SITES
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

INSTALLATION RESTORATION SITE NUMBER	DSERTS SITE NUMBER(a)	PRIORITY LEVEL(b)	SITE TYPE	SITE DESCRIPTION
Northeast Open Area				
19	19	C	SS	Former Tear Gas Canister Burn Site [c]
20	20	C	SS	Probable Asphalt Burial Site
21	21	C	SS	XXCC-3 Impregnite Burial Site (300,000 Pounds)
50	50	C	SS	Dunn Field Northeastern Quadrant Drainage Ditch
60	60	Remediated	SS	Pistol Range Impact Area/Bullet Stop
62	62	C	SS	Bauxite Storage
85	85	Remediated	RI	Old Pistol Range Building 1184/Temporary Pesticide Storage
Disposal Area				
1	1	Remediated	CWM	Mustard and Lewisite Training Sets Burial Site (1955)
2	2	C	RI	Ammonia Hydroxide (7 Pounds) and Acetic Acid (1-Gallon) Burial Site (1955)
3	3	B	RI	Mixed Chemical Burial Site (Orthotouidine Dihydrochloride) (1955)
4	4	A	RI	POL Burial Site (13, 55-Gallon Drums of Oil, Grease and Paint)
4.1	90	A	RI	POL Burial Site (32, 55-Gallon Drums of Oil, Grease and Thinner)
5	5	C	RI	Methyl Bromide Burial Site A (3 Cubic Feet) (1955)
6	6	C	RI	40,037 Units of Eye Ointment Burial Site (1955)
7	7	A	RI	Nitric Acid Burial Site (1,700 Quart Bottles) (1954)
8	8	A	RI	Methl Bromide Burial Site B (Burning Pit Refuse) (1954)
9	9	C	RI	Ashes and Metal Burial Site (Burning Pit Refuse) (1955)
10	10	B	RI	Solid Waste Burial Site (Near MW-10) (Metal, Glass, Trash, etc.)
11	11	B	RI	Trichloroacetic Acid Burial Site (1,433, 1-ounce Bottles) (1965)
12 & 12 1	12	B	RI	Sulfuric Acid and Hydrochloric Acid Burial (1967)
13	13	A	RI	Mixed Chemical Burial (Acid, 900 Pounds; Unnamed Solids, 8,100 Pounds)
14	14	C	RI	Municipal Waste Burial Site B (Near MW-12) (Food, Paper Products)
15	15	B	RI	Sodium Burial Sites (1968)
15.1	91	B	RI	Sodium Phosphate Burial (1968)
15.2	92	B	RI	14 Burial Pits Na2PO4, Sodium, Acid, Medical Supplies, and Chlorinated Lime
16	16	B	RI	Unknown Acid Burial Site (1969)
16.1	93	B	RI	Acid Burial Site
17	17	B	RI	Mixed Chemical Burial Site C (1969)
18	18		Proposed NFA	Plane Crash Residue
22	22		Proposed NFA	Hardware Burial Site (Nuts and Bolts)
23	23	C	Proposed NFA	Construction Debris and Food Burial Site
24-A	24	Remediated	CWM	Bomb Casing Burial Site (29 Bomb Casings used to Transport Mustard Agent)
61	61	C	SS	Buried Drain Pipe
63	63	C	Proposed NFA	Aboveground Fluorspar Storage
64	64	C	Proposed NFA	Aboveground Bauxite Storage (1942 to 1972)
86	86	C	RI	Food Supplies
Stockpile Area [d]				
24-A	24	Remediated	CWM	Neutralization Pit for the Contents of the 29 Bomb Casing used to Transport Mustard Agent
62	62	C	SS	Aboveground Bauxite Storage
63	63	C	Proposed NFA	Aboveground Fluorspar Storage
64	64	C	SS	Aboveground Bauxite Storage (1949 to 1972)
--	64[e]	B	--	CC-2 Impregnite Burial Site (86,100 Pounds in 1947)
--	64[e]	B	--	Installation Assessment Site 31 Burning and Disposal Site

Notes:

SS. Screening Site

RI: Remedial Investigation

RA: Remedial Action

NFA: No Further Action

CWM· Chemical Warefare Material

Na2PO4: Sodium Phosphate

POL: Petroleum, Oil, and Lubricants

XXCC-3/CC-2 Stabilized/Unstabilized Impregnite for Inpregnating Clothing Used to Protected Personnel against the Action of Vesicant-Type Chemical Agents

[a] Defense Site Environmental Restoration Tracking System (DoD Database)

[b] Priority levels were established for Installation Restoration Sites Number/DSERT Site Number Areas where remedial action would be required with some investigatory effort to determine extent of area. Levels are as follows A - Highest Priority; B - Medium Priority, C - Lowest Priority (no RA likely). Designation was based on described quantity of material, potential hazard to human health and the environment, and form of material (solid or liquid) A pre-design investigation was conducted at Priority Sites A and B Remedial Action was required at Sites 3, 4 1, 10, 13 and 64 (Installation Assessment Site 31)

[c] According to the available information, burning in this area dated back to the 1940s and included chloroacetophenone (CN) canisters, fuses, and smokes, in addition to sanitary wastes Operations were conducted in pits and incorporated the weekly cleanup of residue and garbage in addition to material. The ash was then allegedly buried in the north end of Dunn Field

[d] According to available information, USATHAMA (1982) Installation Assessment Site 31 is located in the southwest portion of Dunn Field This site was reportedly used for burning/disposal of smoke pots, CN (tear gas) grenades and souvenir ordnance, which included a 3 2 mortar round This area was covered by the bauxite storage pile (Site 64) Installation Site 31 was not designated as an IRP site or given a DSERTS site number However, the site is now included in DSERTS Site 64

[e] According to an April 15, 2003 email from the Defense Logistics Agency - DDC (New Cumberland) to DDC (Memphis) and CEHNC, DSERTS Site 64 will include the CC-2 Impregnite Burial Site and Installation Assessment Site 31 as a result of the proximity of all three sites and because Site 64 encompasses both of the other two sites

TABLE 2
GROUNDWATER ANALYTICAL PARAMETERS
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Method	Analyte
SW8260B	**Volatile Organic Compounds**
	Monitored Natural Attenuation Parameters
E300.0	Anions - Chloride, Nitrate, Nitrite, Sulfate
E310.2	Alkalinity
SW9030	Sulfide
SW9060	Total Organic Carbon
SW6010B	Metals - Arsenic, Manganese, Selenium
RSK175	Dissolved Gases - Ethane, Ethene, Methane

TABLE 3
MONITORING WELL LOCATIONS
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Treatment Area	Existing Well	Northing	Easting	Replacement Well	Northing (ft)	Easting (ft)	Distance (ft)
TA1	MW-181	281600.05	802217.69	MW-A	281613.58	802168.30	51.2
TA1	MW-11	281353.10	802099.00	MW-B	281399.23	802099.54	46.1
TA2	MW-73	280989.42	802144.95	MW-C	280985.76	802144.87	3.7
TA2	MW-131	280972.56	802175.27	MW-E	281017.82	802181.48	45.7
TA2	MW-133	280978.32	802126.31	MW-F	280945.32	802074.64	61.3
TA2	MW-177	280911.35	802097.43	MW-D	280912.92	802104.48	7.2
TA2	MW-188	280916.38	802163.48	MW-G	280927.99	802144.58	22.2
TA4	MW-173	280251.21	802079.28	MW-H	280258.02	802081.25	7.1
				MW-I	280251.43	802157.33	-

TABLE 4
MONITORING WELL DETAILS
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Adjacent Well	Depth (ft)		Elevation (ft, msl)				Aquifer Thickness (ft)	New Monitoring Well	Screen Length (ft)	Screen Interval (ft, bgs)	Estimated Total Well Depth (ft,bgs)
	Top of Clay	Groundwater	Ground	Top of Casing	Top of Clay	Groundwater					
MW-181	79	65.3	291.51	291.14	212.5	225.8	13.3	**MW-A**	15	64.0 to 79.0	80.0
MW-11	85+	74.4	299.59	299.47	<214.6	225.1	10.5+	**MW-B**	15	70.0 to 85.0	86.0
MW-73	91.5	75.0	301.10	300.65	209.6	225.7	16.1	**MW-C**	20	71.5 to 91.5	92.5
MW-177	85	74.4	300.28	300.11	215.3	225.7	10.4	**MW-D**	15	70.0 to 85.0	86.0
MW-131	92	74.6	300.83	300.64	208.8	226.0	17.2	**MW-E**	20	72.0 to 92.0	93.0
MW-177	85	74.4	300.28	300.11	215.3	225.7	10.4	**MW-F**	15	70.0 to 85.0	86.0
MW-131	92	74.6	300.83	300.64	208.8	226.0	17.2	**MW-G**	20	72.0 to 92.0	93.0
MW-173	74	69.2	296.52	296.30	222.5	227.1	4.6	**MW-H**	15	59.0 to 74.0	75.0
MW-173	74	69.2	296.52	296.30	222.5	227.1	4.6	**MW-I**	15	59.0 to 74.0	75.0

Note: 1) MW-11 was terminated at 85 feet bgs prior to encountering a clay marking the bottom of the fluvial aquifer
2) New monitoring wells will be numbered in sequence with other DDMT wells following installation.

TABLE 5
BASELINE MONITORING EVENT
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Well	Northing	Easting	Ground Elev. (ft msl)	TOC (ft msl)	Well Finish	Length of Riser (ft)	Length of Screen (ft)	Elev. Of Top of Screen (ft msl)	Depth of Boring (ft bgs)	Elev. of Bottom of Boring (ft msl)
Groundwater Samples and Water Level Measurements										
MW-03	281596.25	802100.69	290.40	292.35	2' SU	65 5	10	226.9	75.0	215.4
MW-06	280604.17	802069.13	288.10	289 11	1' SU	51 0	20	238.1	70.0	218.1
MW-07	281839 88	802481.70	293.10	295 10	3' SU	67.0	10	228 1	75 0	218 1
MW-10	281662.55	802201.26	289.20	288.79	FL	58.6	10	230.2	75.0	214.2
MW-11	281353.10	802099.00	299.59	299.47	FL	67.9	15	231.6	85.0	214.6
MW-15	280348.88	801985.36	295.23	295.12	FL	63.4	15	231.7	80.0	215.2
MW-57	280184.05	802006.19	291.10	290.77	FL	60.0	10	230.8	72.5	218.6
MW-68	281500.76	802040 04	291.60	291.69	FL	72.5	10	219.2	83.0	208.6
MW-73	280989.42	802144 95	301 10	300.65	3' SU	72.0	20	228.7	93.0	208 1
MW-74	280991.20	802044.29	304 00	303 68	3' SU	70.0	20	233.7	93.5	210 5
MW-131	280972.56	802175.27	300.83	300.64	FL	76.0	15	224.6	93.0	207.8
MW-132	281006.28	802129.10	301.05	300.73	FL	73.5	15	227.2	92.0	209.1
MW-133	280978 32	802126.31	301.08	300 89	FL	75.0	15	225.9	95.0	206.1
MW-134	281012.74	802102.58	301.05	300.81	FL	75 0	15	225.8	95.0	206.1
MW-135	280983.62	802100.29	300.76	300.53	FL	68 0	15	232.5	95.0	205.8
MW-172	280213.31	802221.98	300 94	300.28	FL	68.0	10	232.3	88.0	212.9
MW-173	280251.21	802079.28	296.52	296.30	FL	62.0	10	234.3	96 0	200.5
MW-174	280352.00	802092.07	296 83	296.56	FL	67.0	10	229.6	96.0	200.8
MW-175	280618.49	802175.36	291 93	291.63	FL	67.5	10	224.1	86.0	205.9
MW-177	280911.35	802097.43	300 28	300.11	FL	85.0	10	215.1	106.0	194.3
MW-178	280982.81	802227.34	300.57	300.26	FL	76.0	10	224.3	96 0	204.6
MW-179	281075.70	802158.65	301.32	301.16	FL	77.0	10	224 2	96.0	205.3
MW-180	281476.43	802131.85	296.39	296.14	FL	72.0	10	224 1	91.0	205.4
MW-181	281600.05	802217.69	291.51	291.14	FL	67 0	10	224.1	96.0	195 5
MW-187	280563.18	802348.09	303 21	302.74	FL	76.0	10	226.7	97.0	206 2
MW-188	280916.38	802163.48	300.50	300.11	FL	78.0	10	222.1	98.0	202.5
MW-A	TBD									
MW-B	TBD									
MW-C	TBD									
MW-D	TBD									
MW-E	TBD									
MW-F	TBD									
MW-G	TBD									
MW-H	TBD									
MW-I	TBD									
Water Level Measurements										
MW-04	281278.87	802369.19	300.00	301.61	1.5' SU	60.0	20	241.6	80.0	220.0
MW-05	281254.49	802084 68	301.30	304.64	3' SU	60.0	20	244.6	80.0	221.3
MW-08	282001.04	802727.91	292 74	292.59	FL	56 5	10	236.1	75.0	217 7
MW-09	281641.18	802516.42	304.66	304.32	FL	70.1	10	234.2	88.0	216.7
MW-13	281033.56	802369.21	300.10	300.01	FL	66.0	15	234.0	85.0	215.1
MW-14	280003.37	802288.95	302.44	302.22	FL	65.0	15	237 2	80.0	222.4
MW-28	281568.58	803154.48	294.89	294.79	FL	54.3	15	240.5	81.5	213.4
MW-29	282104.92	802863.96	273.35	273.22	FL	34.2	20	239.0	56.5	216.9
MW-30	282229.19	802013.96	274.10	275.14	1.5' SU	39.0	20	236.1	66.5	207.6
MW-31	281651.53	801783.90	287.50	290 37	3' SU	64.1	15	226.3	76.5	211.0
MW-32	280834.37	801615 51	285.60	285.38	FL	52.7	15	232.7	71.5	214.1
MW-33	280398.10	801561.30	277.70	280.71	3' SU	44.6	15	236.1	61.5	216.2
MW-35	281072.31	802070.44	301.70	300.46	FL	69 6	20	230.9	92.0	209 7
MW-37	280831.22	801616.58	285.50	284.91	FL	165.7	15	119.2	183.0	102.5
MW-49	280211.84	803051.31	309.52	310.49	FL	80.0	10	230.5	92.5	217.0
MW-51	282345.86	802828.62	275 50	275.23	SU ?	55 0	10	220.2	70.0	205.5
MW-56	279708.26	801971.55	293.50	293.60	FL	59.0	10	234.6	71.5	222.0
MW-58	279845.07	802066.44	290.70	290.51	FL	57.0	10	233.5	68.5	222.2
MW-59	281333.67	802252.00	300.40	300.13	FL	72.5	10	227.6	85.5	214.9
MW-60	281424.39	802282.05	297 20	296.86	FL	72.5	10	224.4	84.0	213.2
MW-61	281585.68	802347.35	294 20	294.04	FL	68.5	10	225.5	79 0	215.2
MW-69	281202.55	802011.49	304.90	307.02	3' SU	82.1	10	224 9	92.2	212.7
MW-70	281029 60	801988.49	302.80	304 99	3' SU	80.8	10	224.2	93.0	209 8
MW-71	280584.68	801804.71	291.90	294.40	3' SU	65.5	10	228.9	77.7	214 2
MW-75	281080.10	802051.10	304.30	303.61	3' SU	71 0	20	232.6	93 5	210.8
MW-76	281311.98	801642.76	303.30	302.71	FL	73.0	20	229 7	94.0	209.3
MW-77	281142.96	801815 29	304.70	304 42	FL	68.0	20	236 4	88.5	216 2
MW-78	282051.71	802065.28	275.40	275 00	FL	44.5	20	230.5	68.0	207 4
MW-87	280696.36	802038 55	292.80	294 93	3' SU	63.0	15	231.9	81.0	211 8

TABLE 5
BASELINE MONITORING EVENT
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Well	Northing	Easting	Ground Elev. (ft msl)	TOC (ft msl)	Well Finish	Length of Riser (ft)	Length of Screen (ft)	Elev. Of Top of Screen (ft msl)	Depth of Boring (ft bgs)	Elev. of Bottom of Boring (ft msl)
MW-91	280474.97	802014.43	289.30	291.99	FL	55.0	15	237.0	70.0	219.3
MW-129	282271.08	803128.53	293.33	293.01	FL	65.0	15	228.0	85.0	208.3
MW-130	282116 23	803242.02	293.69	293.20	FL	59.5	20	233 7	85.0	208.7
MW-144	281138.63	801528 84	291.89	291 60	FL	56.1	20	235.5	86.0	205.9
MW-147	281501 06	801674.04	289 97	289.72	FL	57 6	20	232.1	86.0	204.0
MW-154	280501.53	800919.48	274.07	273.81	FL	51.8	15	222 0	76.0	198.1
MW-157	281050.91	801348.32	286.83	286.78	FL	56.9	20	229.9	86.0	200.8
MW-161	281120.29	801596.82	296.67	296.40	FL	61.7	20	234.7	86.0	210.7
MW-162	281244.22	801596 06	299.89	299.70	FL	66.6	20	233.1	96.0	203.9
MW-163	281152.59	801487 27	290.81	290.63	FL	56.1	20	234 5	86.0	204 8
MW-164	280997.55	801497.47	287.70	287.48	FL	54.8	20	232 7	86 0	201.7

Notes:
ft msl - feet above mean sea level
ft bgs - feet below ground surface
FL - flush mount
SU - stick up
TOC - top of casing
TBD - To be determined - new well

TABLE 6
SOIL VAPOR EXTRACTION WELL AND VAPOR MONITORING POINT LOCATIONS
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Treatment Area	SVE Well or VMP	Northing (ft)	Easting (ft)		Distance (ft)	Location Rationale[1,2]
TA1	SVE-A	281623.51	802283.88		-	Center of TA-1B. Overlying loess treatment area is circular with radius of 20 feet.
TA1	VP1	281609.64	802278.17		15	Near edge of small treatment area, will provide data applicable to the entire area.
TA1	SVE-B	281610.49	802182.71		-	Center of TA-1C. Overlying loess treatment area is square with sides of 80 feet.
TA1	VP2	281631.96	802161.75		30	Near edge of treatment area, will provide data applicable to the entire area.
TA1	SVE-C	281395.20	802107.55		-	Center of TA-1E. Overlying loess treatment area is cruciform with lobes extending up to 80 feet from center.
TA1	VP3	281415.01	802085.02		30	At near edge of treatment area, will provide data applicable to the central treatment area.
TA1	VP4	281339.56	802130.00		60	At edge of conservatively estimated radius of influence, will provide data applicable to vapor response in the lobes.
TA2	SVE-D	281000.56	802169.57		-	Northeast area of TA-2. Overlying loess treatment area is irregularly shaped and aligned notheast to southwest.
TA2	VP5[3]	281002.08	802139.60		30	At near edge of treatment area, will provide data applicable to the central treatment area.
TA2	VP6[3]	280961.13	802147.89		45	Equidistant from SVE-C and SVE-D near center of treatment area. Will provide data on influence/ interference from the SVE wells.
TA2	SVE-E	280923.60	802124.08		-	Southwest area of TA-2. Overlying loess treatment area is irregularly shaped and aligned notheast to southwest.
TA2	VP5[3]	281002.08	802139.60		80	Outside conservatively estimated radius of influence, will provide data applicable to distant sections of treament area.
TA2	VP6[3]	280961.13	802147.89		45	Equidistant from SVE-C and SVE-D near center of treatment area. Will provide data on influence/ interference from the SVE wells.
TA3	SVE-F	280588.78	802211.75		-	Western area of TA-3. Overlying loess treatment area is rectangle-shaped, 40 feet north-south and 180 feet east-west. CVOC concentrations in loess are higher in the western section.
TA3	VP7	280584.61	802197.34		15	West of SVE well, will provide data applicable to central treatment area.
TA3	VP8	280576.51	802290.80		80	Eastern portion of treatment area outside conservatively estimated SVE well radius of influence, will provide data applicable to distant sections of treament area.
TA4	SVE-G	280234.64	802146.71		-	East-central area of TA-4. Overlying loess treatment area is triangle-shaped with maximum extent of 160 feet east-west and 120 feet north-south.
TA4	VP9	280256.30	802107.27		45	West of SVE well, will provide data applicable to central treatment area.
TA4	VP10	280225.70	802206.04		60	On eastern edge of treatment area at conservatively estimated radius of influence, will provide data applicable to distant sections of treament area.

Notes: 1) Two vapor monitoring points with 5-foot screens will be installed at each location, one near the top of the fluvial vadose zone and one near the bottom.

2) A general rationale for all VMP locations is to provide data at a range of distances from the SVE wells. The fluvial sands are considered to be relatively homogeneous and the influence of SVE wells is expected to mainly depend on distance from the SVE wells. There may also be some variation between the upper and lower VMPs since gravel content in the fluvial sands generally increases with depth. The VMPs are located at the following distances from SVE wells: 2 at 15 feet, 3 at 30 feet; 3 at 45 feet; 2 at 60 feet; and 2 at 80 feet. If VMPs at similar distances and depths provide significantly different response to the SVE wells, then the need for additional VMPs will be evaluated.

3) During the start-up phase, the vapor response will be measured with SVE-D and SVE-E in operation together and separately. The results will be used to determine if the vacuum should be applied to each alternately or together

TABLE 7
SOIL VAPOR EXTRACTION WELL AND VAPOR MONITORING POINT DETAILS
FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

Adjacent Well	Depth (ft)		Elevation (ft, msl)				Fluvial Vadose Zone Thickness (ft)	SVE Well	Screen Length (ft)	Screen Interval (ft, bgs)			Total Depth (ft, bgs)
	Top of Fluvial	Groundwater	Ground	Top of Casing	Top of Fluvial	Groundwater							
MW-181	28	65.3	291.51	291.14	263.5	225.8	37.7	**SVE-A**	30	30.7	to	60.7	61.7
MW-181	28	65.3	291.51	291.14	263.5	225.8	37.7	**VP1A**	5	50.7	to	55.7	56.7
								VP1B	5	35.7	to	40.7	
MW-10	30	62.8	289.20	288.79	259.2	226.0	33.2	**SVE-B**	25	33.2	to	58.2	59.2
MW-10	30	62.8	289.20	288.79	259.2	226.0	33.2	**VP2A**	5	48.2	to	53.2	54.2
								VP2B	5	38.2	to	43.2	
MW-180	33	71.0	296.39	296.14	263.4	225.2	38.2	**SVE-C**	30	36.2	to	66.2	67.2
MW-180	33	71.0	296.39	296.14	263.4	225.2	38.2	**VP3A**	5	56.2	to	61.2	62.2
								VP3B	5	41.2	to	46.2	
MW-11	38	74.4	299.59	299.47	261.6	225.1	36.5	**VP4A**	5	56.2	to	61.2	62.2
								VP4B	5	41.2	to	46.2	
MW-73	33	75.0	301.10	300.65	268.1	225.7	42.4	**SVE-D**	35	35.4	to	70.4	71.4
MW-179	32	75.3	301.32	301.16	269.3	225.9	43.5	**VP5A**	5	60.4	to	65.4	66.4
								VP5B	5	40.4	to	45.4	
MW-73	33	75.0	301.10	300.65	268.1	225.7	42.0	**VP6A**	5	60.4	to	65.4	66.4
								VP6B	5	40.4	to	45.4	
MW-177	27	74.4	300.28	300.11	273.3	225.7	47.6	**SVE-E**	35	34.6	to	69.6	70.6
MW-175	26	65.6	291.93	291.63	265.9	226.0	39.9	**SVE-F**	30	30.9	to	60.9	61.9
MW-175	26	65.6	291.93	291.63	265.9	226.0	39.9	**VP7A**	5	50.9	to	55.9	56.9
								VP7B	5	35.9	to	40.9	
MW-175	26	65.6	291.93	291.63	265.9	226.0	39.9	**VP8A**	5	50.9	to	55.9	56.9
								VP8B	5	35.9	to	40.9	
MW-173	31	69.2	296.52	296.30	265.5	227.1	38.4	**SVE-G**	30	34.4	to	64.4	65.4
MW-173	31	69.2	296.52	296.30	265.5	227.1	38.4	**VP9A**	5	54.4	to	59.4	60.4
								VP9B	5	39.4	to	44.4	
MW-172	32	72.6	300.94	300.28	268.9	227.7	41.3	**VP10A**	5	54.4	to	59.4	60.4
								VP10B	5	39.4	to	44.4	

TABLE 8
REMEDIAL GOALS FROM DUNN FIELD RECORD OF DECISION
SOURCE AREAS FLUVIAL SVE RA WORK PLAN
Dunn Field - Defense Depot Memphis, Tennessee

	Remedial Goal Objectives				
	Site-Specific Soil Screening Levels to be Protective of Groundwater		Protective Soil Vapor Concentration		Groundwater Target Concentrations at 10-4 Target Risk Levels and Target HI=1.0 (µg/L)
Parameter	Loess Specific Values (mg/kg)	Fluvial Deposit Specific Values (mg/kg)	Loess Specific Values (ppbv)	Fluvial Deposit Specific Values (ppbv)	
Carbon Tetrachloride	0.2150	0.1086	28.14	14.22	3.0
Chloroform	0.9170	0.4860	61.57	32.63	12.0
Dichloroethane, 1,2-	.00329	0.0189	1.12	0.64	—
Dichloroethene, 1,1-	0.1500	0.0764	57.00	29.03	7/340
Dichloroethene, cis-1,2-	0.7550	0.4040	73.86	39.52	35.0
Dichloroethene, trans-1,2-	1.5200	0.7910	256.53	133.50	50.0
Methylene Chloride	0.0305	0.0169	5.14	2.85	—
Tetrachloroethane, 1,1,2,2-	0.0112	0.0066	0.03	0.55	2.2
Tetrachloroethene	0.1806	0.0920	15.18	0.99	2.5
Trichloroethane, 1,1,2	0.0627	0.0355	0.84	2.03	1.9
Trichloroethene	0.1820	0.0932	10.56	2.06	5.0
Vinyl Chloride	0.0294	0.0150	28.94	14.77	—

Notes:

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

ppbv = parts per billion per volume

MCL = maximum contaminant level

HI = hazard index

— = Not available for groundwater cleanup goals because of low number of detections or detected values consistently less than MCLs.

FIGURES

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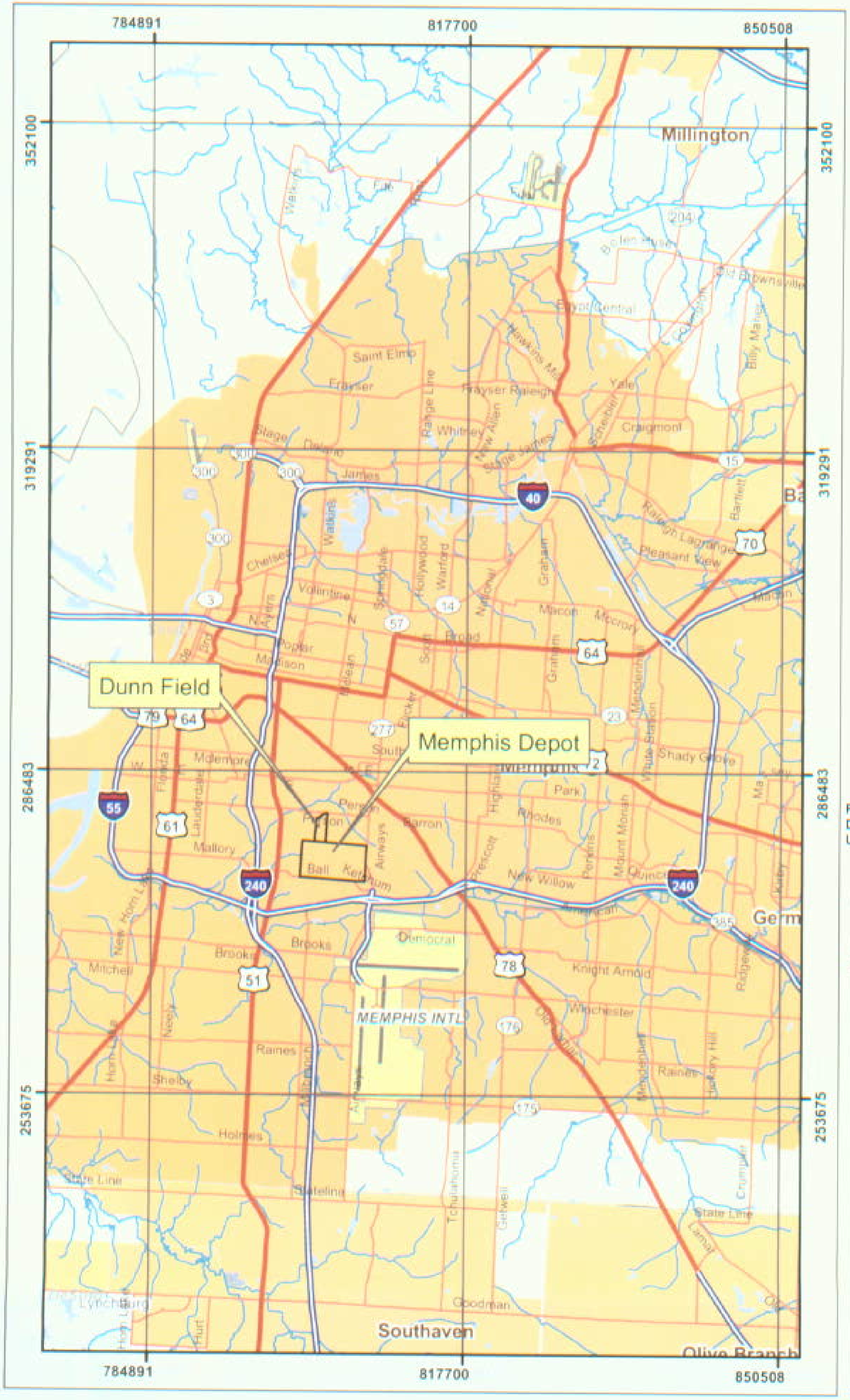
Figure 1

SITE LOCATION MAP

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

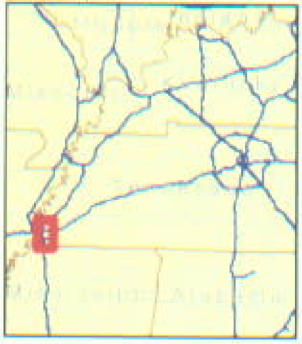
DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE



Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:170,000
0 0.6 1.2 1.8 2.4 3 Miles
0 0.9 1.8 2.7 Kilometers

Installation Location
Memphis, Tennessee



Date: January 2007
Edition: Rev 0

Figure 2

DUNN FIELD AERIAL PHOTOGRAPH

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:3,880

Installation Location
Memphis, Tennessee

Date: January 2007
Edition: Draft

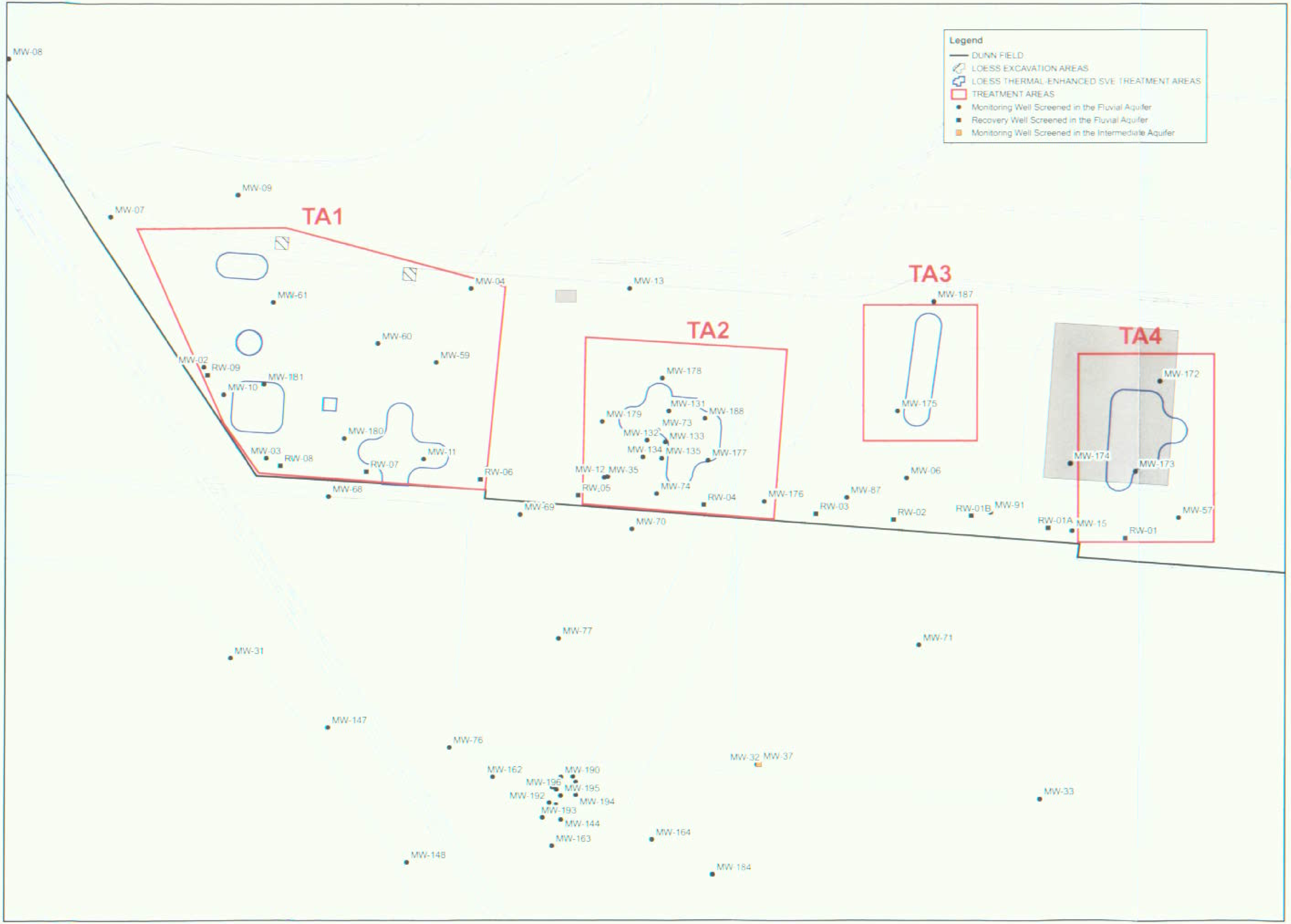


Figure 3

LOESS TREATMENT AREAS

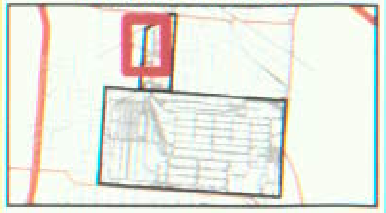
FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:1,800

Installation Location
Memphis, Tennessee



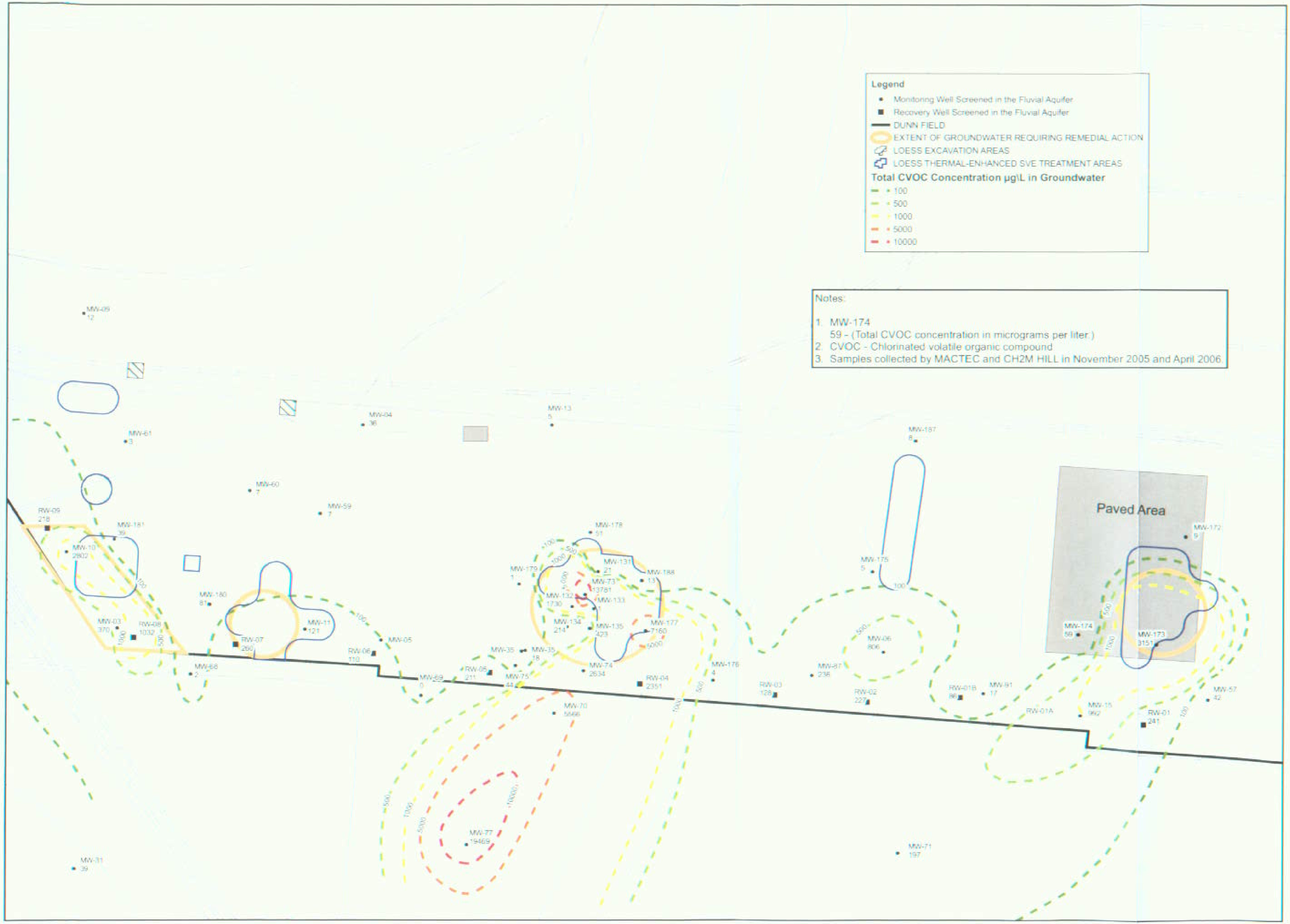
Date: January 2007
Edition: Draft

Figure 4

TOTAL CVOC CONCENTRATIONS

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

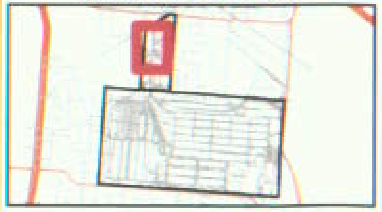


Notes:
1. MW-174
59 - (Total CVOC concentration in micrograms per liter.)
2. CVOC - Chlorinated volatile organic compound
3. Samples collected by MACTEC and CH2M HILL in November 2005 and April 2006

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:1,500

Installation Location
Memphis, Tennessee



Date: January 2007
Edition: Draft

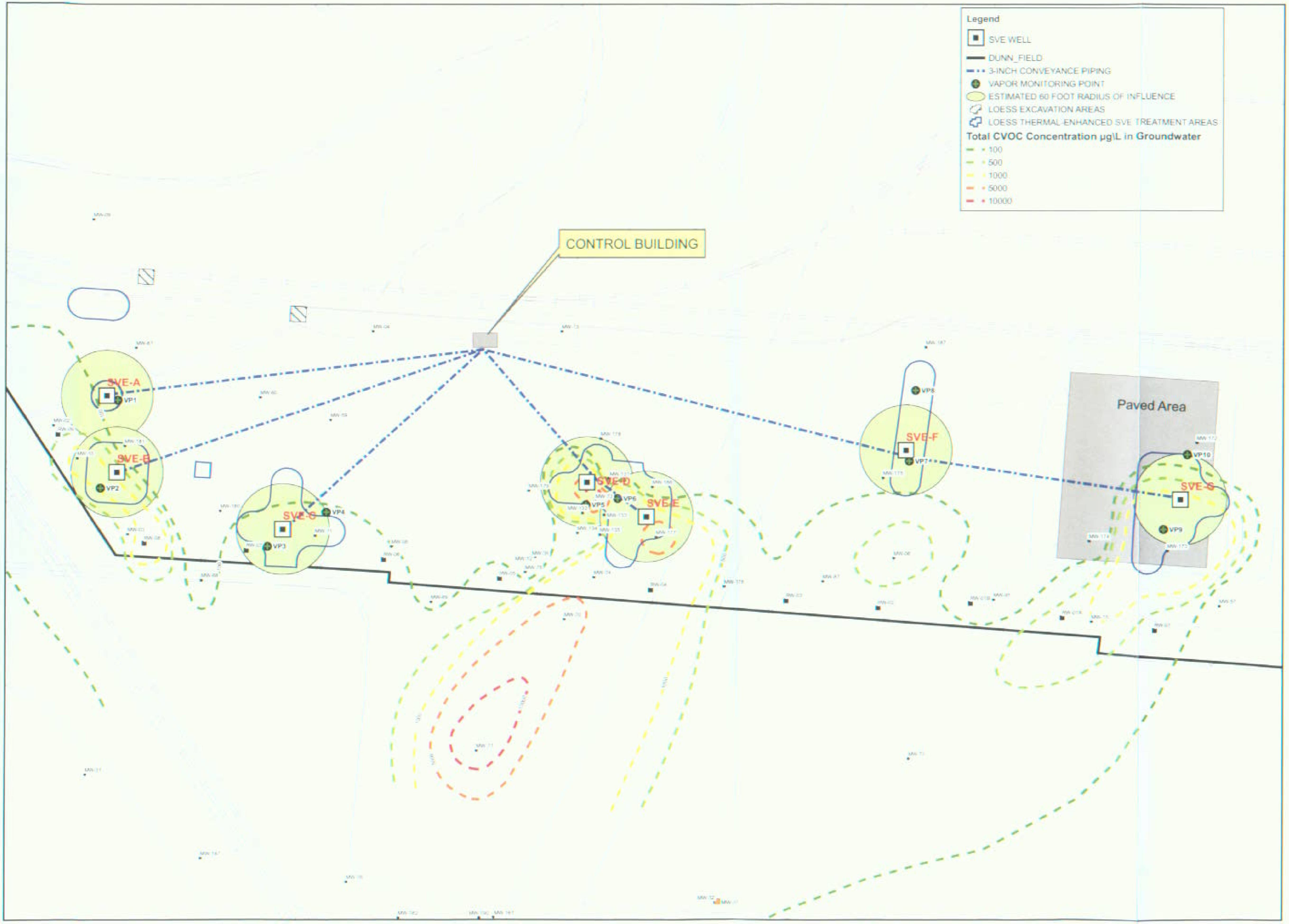


Figure 5

SVE SYSTEM

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

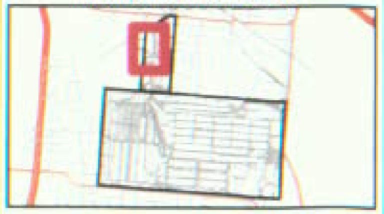
DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:1,500

0 50 100 150 200 Feet
0 10 20 30 Meters

Installation Location
Memphis, Tennessee



Date: January 2007
Edition: Draft

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N E S W

Figure 6

BASELINE GROUNDWATER SAMPLING TREATMENT AREA 1

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

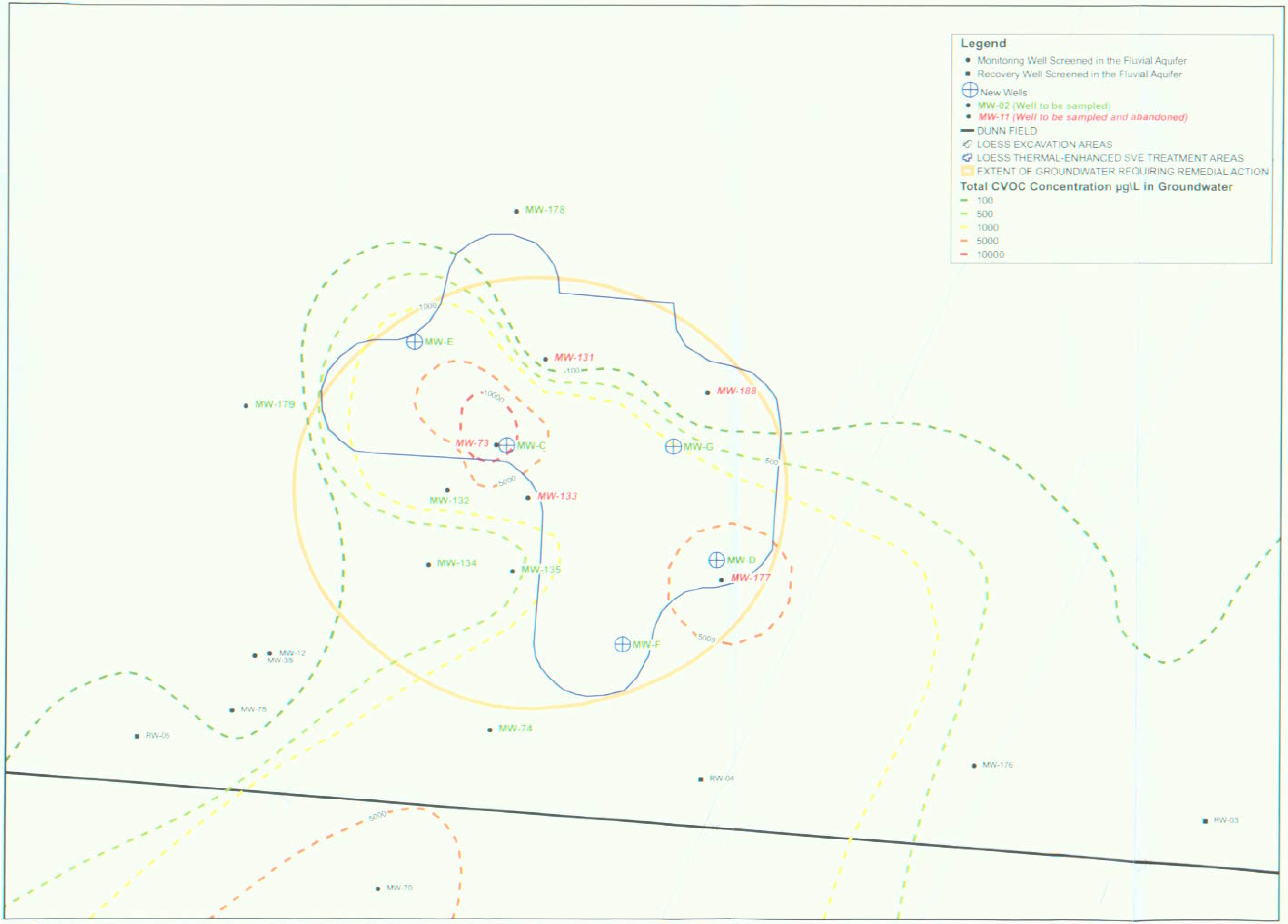
Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:600

0 20 40 60 80 Feet
Meters
0 5 10 15

Installation Location
Memphis, Tennessee

Date: January 2007
Edition: Draft



N
S
E
W

Figure 7

BASELINE GROUNDWATER SAMPLING TREATMENT AREA 2

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:400

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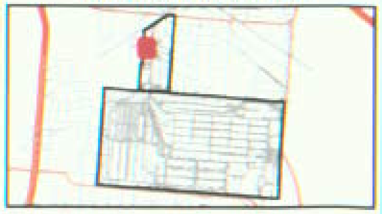
0 5 10 15 Meters

Installation Location
Memphis, Tennessee



Date: January 2007
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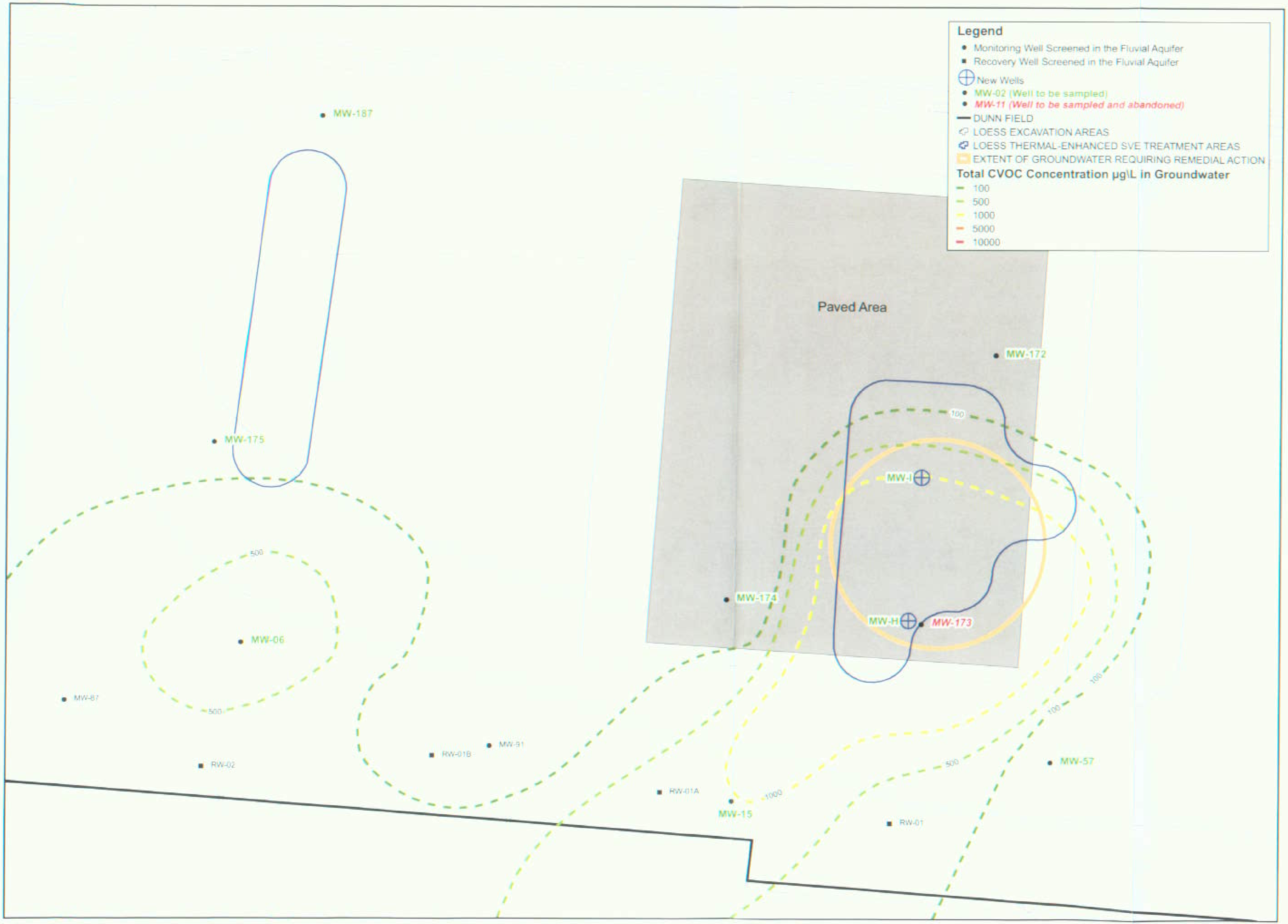


Figure 8

BASELINE GROUNDWATER SAMPLING TREATMENT AREAS 3 and 4

FLUVIAL SVE
REMEDIAL ACTION
WORK PLAN

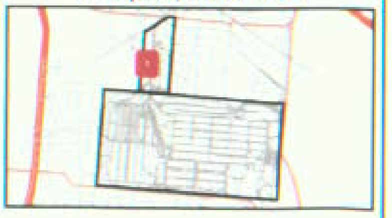
DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Datum : WGS 84
Units: Feet

1:600

0 20 40 60 80 Feet
Meters
0 5 10 15

Installation Location
Memphis, Tennessee



Date: January 2007
Edition: Draft

APPENDIX A

PROJECT MANAGEMENT PLAN

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A-2 Remedial Action Implementation Schedule

LIST OF ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
BCT	BRAC Cleanup Team
BRAC	Base Realignment and Closure
CCE	Certifying Construction Engineer
COR	Contracting Officer Representative
CQAP	Construction Quality Assurance Plan
DLA	Defense Logistics Agency
e^2M	engineering-environmental Management, Inc.
H&S	Health and Safety
IRACR	Interim Remedial Action Completion Report
O&M	Operations and Maintenance
PMP	Project Management Plan
POC	Point of Contact
RA	Remedial Action
RA-C	Remedial Action Construction
RA-O	Remedial Action Operation
RASAP	Remedial Action Sampling and Analysis Plan
RAWP	Remedial Action Work Plan
RD	Remedial Design
SVE	Soil vapor extraction
TDEC	Tennessee Department of Environment and Conservation
USEPA	United States Environmental Protection Agency
VMP	Vapor monitoring point

1.0 PROJECT RESPONSIBILITY AND AUTHORITY

The organization chart for the Source Areas Fluvial SVE Remedial Action (RA) personnel is shown on Figure A-1. The project team consists of management and field personnel to implement Remedial Action Construction (RA-C) and Remedial Action Operations (RA-O).

1.1 BASE REALIGMENT AND CLOSURE CLEANUP

The Base Realignment and Closure (BRAC) Cleanup Team (BCT) includes representatives of the Defense Logistics Agency (DLA), the United States Environmental Protection Agency (USEPA), and the Tennessee Department of Environment and Conservation (TDEC). The BCT will monitor the progress of RA-C and RA-O and will review and approve documents submitted during the RA activities including progress updates, schedules, and status reports. The BCT will determine when the RA-C and RA-O are completed. Mr. Michael Dobbs of the DLA will be responsible for overall project direction, project funding, and implementing the responsibilities identified in the Federal Facilities Agreement (USEPA, 1995).

1.2 AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

The Air Force Center for Environmental Excellence (AFCEE) will be the service agency for e^{2}M's contract during the RA. The AFCEE Contracting Officer Representative (COR), Mr. Jesse Perez, will oversee all contractual matters in consultation with DLA.

1.3 ENGINEERING-ENVIRONMENTAL MANAGEMENT, INC. (E^{2}M)

Mr. Glen Turney is e^{2}M's Program Manager for the AFCEE contract and will be the Construction Certifying Engineer (CCE). As Program Manager, Mr. Turney will conduct routine project reviews of the financial, schedule, and technical performance. As CCE, Mr. Turney will ensure that RA-C is performed in accordance with specifications in the *Source Areas Remedial Design* (RD) (CH2M HILL, 2006) and subsequent specifications provided to subcontractors. The CCE will communicate with field personnel during RA-C to ensure conformance with provisions of the Construction Quality Assurance Plan (CQAP). Changes made during RA-C (if any) will be communicated by the CCE to field personnel and subcontractors through the RA Task Manager. Mr. Turney is a registered Professional Engineer in the State of Tennessee with over 20 years of experience in environmental engineering.

Mr. Tom Holmes will serve as e^{2}M's Project Manager and designated POC for the project. Mr. Holmes will have the primary responsibility for managing the Fluvial SVE RA. He will provide technical coordination with Mr. Perez, the AFCEE COR, and Mr. Dobbs of the DLA. Mr. Holmes will monitor the RA to manage contractual and administrative requirements for the project, provide regular updates to the AFCEE and DLA during the RA, and oversee preparation of the reports including the RA-C report, the Interim Remedial Action Completion report (IRACR), and quarterly reports during RA-O. Mr. Holmes is a registered Professional Geologist with over 25 years of engineering and environmental experience.

Mr. Steven Herrera, P.E. is e^{2}M's Fluvial SVE RA Task Manager and will be responsible for planning and implementing the RA. He will coordinate activities of the field teams and subcontractors during RA-C and RA-O and will work with the CCE to address technical issues that arise during RA. Mr. Herrera is a registered Professional Engineer with over 5 years of experience in environmental engineering.

Mr. Kevin Sedlak is e^{2}M's Field Team Leader for all RA activities at DDMT. RA-C activities will include installation and abandonment of monitoring wells, installation of SVE wells and vapor monitoring points, and baseline groundwater monitoring. Mr. Sedlak will assist the Task Manager in directing field technicians during construction of the SVE system and monitoring during RA-O. Mr. Sedlak is a licensed professional geologist in the State of Tennessee and has over 18 years of field experience.

Mr. David Wineman will oversee construction of the conveyance piping, control building and treatment compound during RA-C. He will assist the Task Manager in oversight of field staff and review of monitoring data during RA-O. Mr. Wineman is a registered Professional Geologist with over 30 years of experience in environmental restoration.

Lance Hines, Ph.D. is the Project Chemist and will support the Field Support team to ensure sampling activities are conducted in accordance with the Remedial Action Sampling and Analysis Plan (RASAP) (MACTEC, 2005). He will be the technical POC with the analytical subcontractor and will supervise evaluation of analytical laboratory data. Dr. Hines has over 20 years of laboratory and environmental consulting experience.

Rob Klawitter is e^{2}M's Health and Safety (H&S) Manager will provide oversight to ensure that field activities are performed in a safe manner and in accordance with the project-specific health and safety plan. Mr. Klawitter will support the RA Task Manager on H&S issues and will provide the field team with H&S information related to RA-C and RA-O.

1.4 FIELD TEAMS

Construction activities during RA-C will include installation of SVE wells, VMPs and groundwater monitoring wells, and SVE conveyance piping and the control building/treatment compound.

A field geologist will oversee the drilling and installation of SVE and monitoring wells and VMPs. Construction of the SVE system will be overseen by on-site personnel who will verify that construction conforms to provisions of the RD and the CQAP. Weekly reports will be submitted to the Project manager listing field activities and schedule status. Post RA-C activities will be managed by the field team leader.

Field personnel conducting SVE operations and maintenance (O&M) will report directly to the RA Task Manager. These field personnel will send completed field measurement records to the RA Task Manager weekly.

1.5 SUBCONTRACTORS

Subcontractors will be used to perform pre- and post-construction surveys of drilling and construction locations, to install the SVE and monitoring wells and the VMPs, and to construct the SVE system. The drilling subcontractor will also dispose of investigation-derived waste at the completion of RA-C. A subcontract analytical laboratory will analyze vapor and groundwater samples. Subcontractors will be evaluated on technical capabilities and their capacity to perform the required work and will be procured in accordance with procedures outlined in the Federal Acquisition Regulations. Subcontractors will be directed by the technical POCs with oversight by the RA Task Manager.

2.0 REMEDIAL ACTION SCHEDULE

A schedule for Fluvial SVE RA implementation is presented in Figure A-2. The schedule presents timelines and milestones for RA-C and RA-O. The schedule does not include the IRACR, which will address the complete Source Areas RA, including the loess treatment and ZVI injections. The IRACR schedule will be provided in the Source Areas Loess/Groundwater RAWP. The schedule for Fluvial SVE RA implementation is consistent with the DDMT master schedule presented in the *BRAC Cleanup Plan, V.10* (e2M, 2006). The schedule will be updated as needed and updated schedules (if any) will be included in the quarterly reports submitted to the BCT during RA-O.

3.0 ADMINISTRATIVE PROCEDURES

3.1 COMMUNICATION

Clear lines of communication will be maintained to avoid duplication of effort and misunderstandings among project personnel. The primary line of communication will be from the AFCEE COR to, in sequence, the e^{2}M Project Manager, the e^{2}M RA Task Manager, field personnel and subcontractors. Subcontractors will be directed by the technical POCs with oversight by the RA Task Manager. Issues regarding scope of work, schedule, budget, meetings, and reports will initially be discussed internally with the e^{2}M Project Manager and externally with Mr. Dobbs of DLA and Mr. Perez of AFCEE.

3.2 MAINTENANCE OF RECORDS

A central file was established in e^{2}M's San Antonio office during earlier stages of the project and will continue to be maintained so that documents pertaining to the RA work can be referenced as necessary. Separate sections of the central file are maintained for correspondence, memos, confirmation summaries, invoices, subcontracts, technical data, and reports. Personnel working on the project will forward copies of project documents to the central files. Original field log books, data sheets, geologic logs, well construction diagrams, well development logs, field records generated during injection events, and sampling forms will be placed in the central files.

Field data will be recorded in indelible ink and legibly written. Errors will be crossed out, initialed, and dated. No documents will be discarded or destroyed. Information that should be recorded in site logbooks, field logbooks, equipment logbooks, data forms, chain-of-custody forms, materials certificates, and records of variance is described in the RAWP and the RA SAP. Records will be completed by field personnel, originals of the records will be sent to the RA Task Manager or his designee, and copies of records will be maintained on-site.

Following project completion, copies of project records including correspondence, memorandums, trip reports, confirmation notices, sampling plans, test results, submittals, photographs and other records or documents generated as a result of the project will be retained in the central files.

3.3 IMPLEMENTATION OF CONSTRUCTION QUALITY ASSURANCE PLAN

The CQAP will be implemented under the direction of the CCE. The CCE and/or the RA Task Manager will discuss RA-C activities on a weekly basis with the Field Team Leader. The CCE will direct the RA Task Manager to modify RA-C activities if and when the CCE determines that construction is not being performed in accordance with specifications in the RD and RAWP, or that construction is not being done in conformance to provisions in the CQAP.

3.4 REPORTING

The c^{2}M Project Manager will use written reports, telecommunications, and direct personal communication with AFCEE and DLA to ensure that project objectives are met and that the project is kept on schedule and within the budget. An RA-C Report will be submitted after completion of RA-C activities. Weekly field activity reports during RA-C and quarterly reports during RA-O will be prepared to document construction activities and SVE operations, respectively.

4.0 REFERENCES

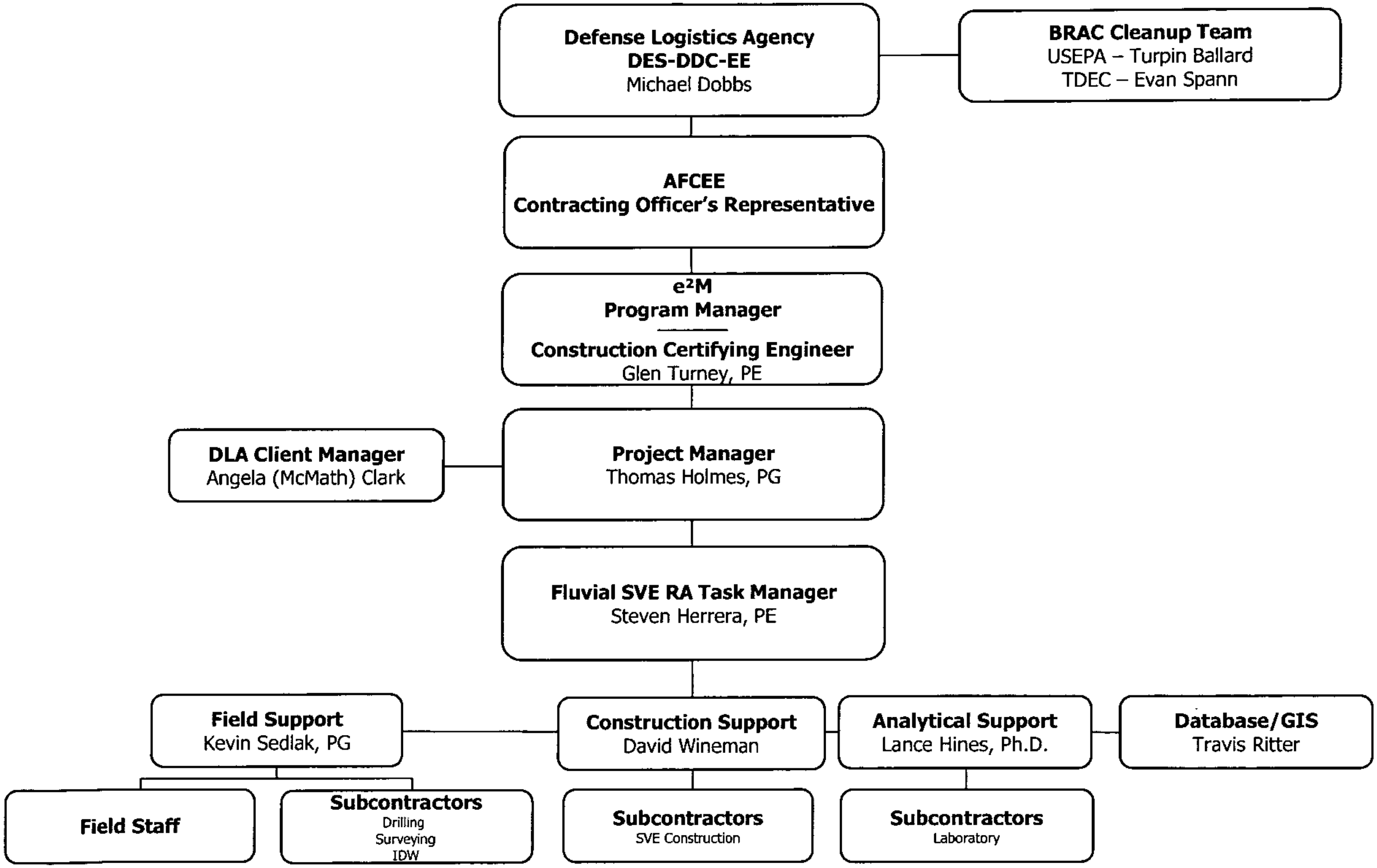
CH2M Hill, 2006. Rev. 0 Memphis Depot, Dunn Field Source Areas Remedial Design. Prepared for the U.S. Army Engineering and Support Center, Huntsville, Alabama. January 2006.

engineering-environmental Management, Inc., 2007. BRAC Cleanup Plan, Version 10, Rev. 1 Defense Distribution Depot, Memphis, Tennessee. January 2007.

engineering-environmental Management, Inc., 2005. Remedial Action Health and Safety Plan, Rev. 0 Defense Distribution Depot, Memphis, Tennessee. April 2006.

MACTEC Engineering and Consulting, Inc, 2005. Remedial Action Sampling and Analysis Plan, Volume I: Field Sampling Plan and Volume II: Quality Assurance Project Plan. Prepared for the Air Force Center for Environmental Excellence. November 2005.

USEPA, 1995b. Federal Facilities Agreement Between USEPA Region IV, TDEC, and Defense Logistics Agency at Defense Distribution Depot Memphis, Tennessee. Effective March 6, 1995.



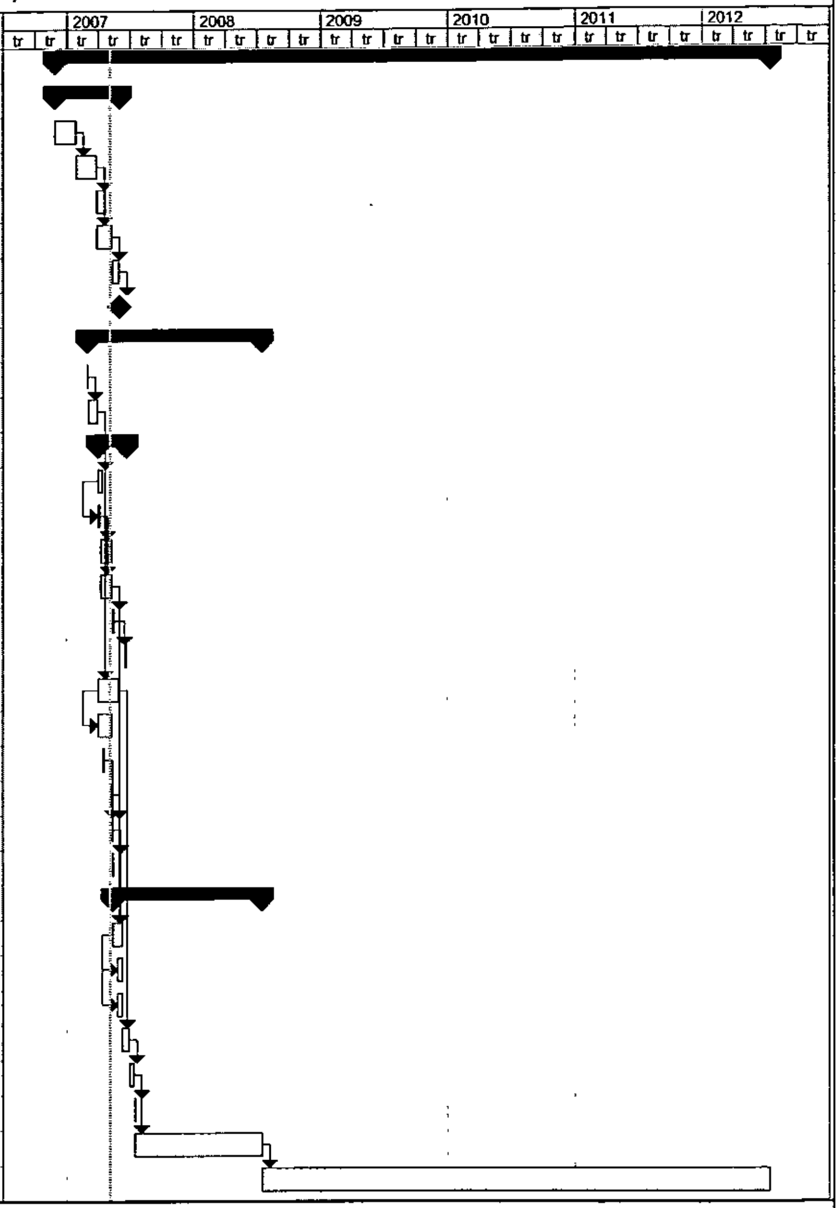
Contract No. FA8903-04-D-8722
Task Order 0019

e2mserverb/marketing/cmo/TO 19 Org Chart 92006

Figure A-1
Source Areas Fluvial SVE Remedial Action Project Organization Chart

Figure A-2
Source Areas Fluvial SVE Remedial Action Project Schedule

ID	Task Name	Duration	Start	Finish
1	**Dunn Field Source Areas Remedial Action**	**1469 days**	**Wed 11/29/06**	**Mon 7/16/12**
2	**Dunn Field Fluvial SVE Remedial Action Work Plan**	**133 days**	**Wed 11/29/06**	**Fri 6/1/07**
3	Prepare & Submit Rev. 0 Fluvial SVE RAWP to BCT	43 days	Wed 11/29/06	Fri 1/26/07
4	BCT Review & Submit Comments on Fluvial SVE Rev. 0 RAWP	43 days	Mon 1/29/07	Wed 3/28/07
5	Respond to BCT Comments on Rev 0 Fluvial SVE RAWP	18 days	Thu 3/29/07	Mon 4/23/07
6	Prepare & Submit Rev. 1 Fluvial SVE RAWP	32 days	Thu 3/29/07	Fri 5/11/07
7	BCT Review of Rev. 1 Fluvial SVE RAWP w/Concurrence	15 days	Mon 5/14/07	Fri 6/1/07
8	Final Fluvial SVE RAWP	0 days	Fri 6/1/07	Fri 6/1/07
9	**Dunn Field Fluvial SVE Remedial Action Implementation**	**359 days**	**Fri 3/2/07**	**Wed 7/16/08**
10	Notice to proceed	1 day	Fri 3/2/07	Fri 3/2/07
11	Complete Subcontracts	20 days	Mon 3/5/07	Fri 3/30/07
12	**Site Clearing and and Baseline Sampling**	**60 days**	**Mon 4/2/07**	**Fri 6/22/07**
13	Site Preparation & Utility Clearance	10 days	Mon 4/2/07	Fri 4/13/07
14	Survey Groundwater and SVE Well Locations	5 days	Mon 4/2/07	Fri 4/6/07
15	Remove Soil/Rubble Pile in Treatment Area 3	25 days	Mon 4/9/07	Fri 5/11/07
16	Install & Develop New Monitoring Wells	25 days	Mon 4/9/07	Fri 5/11/07
17	Collect Baseline GW Samples	5 days	Mon 5/14/07	Fri 5/18/07
18	Abandon PVC Monitoring Wells in Treatment Areas	5 days	Mon 6/18/07	Fri 6/22/07
19	Construct SVE Control Building Off-Site	45 days	Mon 4/2/07	Fri 6/1/07
20	Obtain Air Permit for SVE System	30 days	Mon 4/2/07	Fri 5/11/07
21	Preconstruction Conference	5 days	Mon 4/16/07	Fri 4/20/07
22	Source Areas RD Briefing	5 days	Mon 5/7/07	Fri 5/11/07
23	Mobilization	1 day	Mon 5/14/07	Mon 5/14/07
24	Notice of Fluvial SVE RA Implementation	1 day	Tue 5/15/07	Tue 5/15/07
25	**Fluvial SVE - Install and Year 1**	**307 days**	**Tue 5/15/07**	**Wed 7/16/08**
26	Install Fluvial SVE Wells and Vapor Monitoring Points	20 days	Tue 5/15/07	Mon 6/11/07
27	Install Conveyance Piping	10 days	Tue 5/29/07	Mon 6/11/07
28	Build Concrete Pad for Treatment Compound	10 days	Tue 5/29/07	Mon 6/11/07
29	Install SVE Control Building & Treatment Equipment	15 days	Mon 6/11/07	Fri 6/29/07
30	Test and Calibrate Fluvial SVE System	10 days	Mon 7/2/07	Fri 7/13/07
31	Demobilization for Fluvial SVE Construction	3 days	Mon 7/16/07	Wed 7/18/07
32	Fluvial SVE Year 1 Operation	263 days	Mon 7/16/07	Wed 7/16/08
33	**Dunn Field Fluvial SVE Operation (RA-O) Year 2 - 5**	**1043 days**	**Thu 7/17/08**	**Mon 7/16/12**



Project Fluvial SVE RAWP, Rev 1
Date Thu 5/3/07

Task	☐	Summary	▬	Rolled Up Progress	▬	Project Summary	▨
Progress	▬	Rolled Up Task	☐	Split	┈	Group By Summary	▬
Milestone	◆	Rolled Up Milestone	◇	External Tasks	☐	Deadline	⇩

APPENDIX B

WASTE MANAGEMENT PLAN

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DDMT	Defense Depot Memphis, Tennessee
DLA	Defense Logistics Agency
GAC	granular activated carbon
IDW	Investigation Derived Waste
POTW	publicly owned treatment works
PPE	personal protective equipment
RA	Remedial Action
RA-C	Remedial Action Construction
RA-O	Remedial Action Operation
RCRA	Resource Conservation and Recovery Act
SVE	Soil Vapor Extraction
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
USEPA	United States Environmental Protection Agency
VMP	vapor monitoring point
VOC	volatile organic compound
WMP	Waste Management Plan

1.0 INTRODUCTION

This Waste Management Plan (WMP) describes waste characterization, management, and minimization activities for the Source Areas Fluvial Soil Vapor Extraction (SVE) Remedial Action (RA) on Dunn Field at Defense Depot Memphis, Tennessee (DDMT). The primary objective of this WMP is to properly identify the waste types that are anticipated to be generated during Remedial Action Construction (RA-C) and Remedial Action Operation (RA-O) and present a general strategy for managing waste in compliance with local, state, and federal regulations.

2.0 WASTE IDENTIFICATION

Wastes generated during RA-C will include, but not be limited to:

- Soil cuttings generated during installation of groundwater monitoring wells, SVE wells and vapor monitoring points (VMPs) using rotasonic drilling methods. A total of 26 borings will be installed at Dunn Field to depths of 75 to 90 feet.
- Water generated during development of monitoring wells.
- Purge water generated during sampling of monitoring wells.
- Liquids and solids generated during decontamination of drilling rigs and other construction equipment.
- Liquids generated during decontamination of sampling equipment.
- Spent personal protective equipment (PPE).

Wastes generated during RA-O will include, but not be limited to:

- Condensate from the extracted vapor.
- Spent granular activated carbon (GAC) from the vapor treatment system.

Based on previous investigations conducted at DDMT it is expected that wastes generated during RA-C activities will not be classified as Resource Conservation and Recovery Act (RCRA) hazardous waste. Waste characterization samples will be collected but it is planned to manage and disposed of these wastes as non-hazardous solid waste.

Soil cuttings will be placed into roll-off boxes before disposal at a landfill permitted to receive Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) off-site waste. If characterization samples indicate soil cuttings require classified as RCRA hazardous waste, the cuttings will be transported to a permitted RCRA hazardous waste facility for disposal.

Wastewater generated during equipment decontamination, development of monitoring wells, purging of wells for sampling will be contained in a storage tank at Dunn Field, and sampled for discharge permit parameters. Development and purge water generated during previous investigations has met permit limits and been discharged directly to the publicly owned treatment works (POTW). If water does not meet permit requirements for discharge, treatment and disposal options will be evaluated.

Spent PPE generated during RA-C and RA-O will be placed in collection bins disposed as non-hazardous waste.

Condensate will be collected in a storage tank within the treatment compound and sampled for discharge permit parameters. The condensate is expected to be discharged to publicly owned treatment works (POTW). If water does not meet permit requirements for discharge, treatment and disposal options will be evaluated.

Waste disposal activities will be documents. The Defense Logistics Agency (DLA) will sign hazardous waste manifests as the waste generator if such manifests are needed during RA-C.

3.0 GENERAL REQUIREMENTS

3.1 WASTE CHARACTERIZATION

Drill cuttings placed into roll-off boxes will be sampled for analyses of volatile organic compounds (VOCs) by the Toxicity Characteristic Leaching Procedure (TCLP). Sampling and analysis will be conducted in general accordance with requirements of the waste disposal contractor. Further characterization will be performed if required to meet waste acceptance criteria (WAC) of off-site disposal facilities. Grab samples of water and condensate will be collected from each storage tank and analyzed for VOCs, semi-volatile organic compounds and metals in accordance with discharge agreement.

3.2 WASTE MANAGEMENT

Wastes that are transported off-site along public right-of-ways will meet applicable transportation requirements. These include, but are not limited to, packaging, labeling, marking, manifesting, and placarding requirements. CERCLA Section 121(d)(3) provides that the offsite transfer of hazardous substances, pollutants, or contaminants generated during CERCLA response actions be sent to a treatment, storage, or disposal facility that is in compliance with applicable federal and state laws and has been approved by the United States Environmental Protection Agency (USEPA) for acceptance of CERCLA waste (see also the "Off-Site Rule" at 40 CFR 300.440 et. seq.). Documentation of USEPA approval will be obtained for facilities selected for off-site disposal .

3.2.1 Management of Non-Hazardous Waste

Soil cuttings generated during RA-C are expected to be non-hazardous and will be placed into roll-off boxes. The drilling subcontractor will label the roll-off boxes with a weatherproof label, signifying the dates, site number, and well numbers. The drilling subcontractor will provide a sufficient quantity of roll-off boxes to manage drill cuttings generated during RA-C.

3.2.2 Management of Hazardous Waste

Wastes generated during RA-C and RA-O are not expected to be hazardous. If characterization sampling indicates that waste is hazardous, the waste will be managed and disposed in accordance with local, state, and federal regulations.

3.3 WASTE MINIMIZATION AND SEGREGATION

Wherever possible, generation of waste will be minimized through design and planning to ensure efficient operations that will not generate unnecessary waste. Emphasis will be placed on waste minimization during the preconstruction conference and field personnel will be encouraged to improve methods for minimizing waste generation. Waste minimization practices will include, but not be limited to:

- Use of rotasonic rather than mud-rotary drilling techniques to avoid generation of waste drilling mud.
- Using disposable items when the decontamination process would generate a waste stream that would be more costly to characterize and dispose.
- Reusing items when practical.

APPENDIX C

CONSTRUCTION QUALITY ASSURANCE PLAN

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LIST OF ACRONYMS AND ABBREVIATIONS

CCE	Construction Certifying Engineer
CQAP	Construction Quality Assurance Plan
EBT	Enhanced Bioremediation Technology
e^{2}M	engineering-environmental Management, Inc.
H&S	Health & Safety
gpm	gallons per minute
MI	Main Installation
PM	Project Manager
PMP	Project Management Plan
psi	pounds per square inch
PSVP	Performance Standards Verification Plan
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RA-C	Remedial Action Construction
RACR	Remedial Action Completion Report
RAWP	Remedial Action Work Plan
RD	Remedial Design
TDEC	Tennessee Department of Environment and Conservation
WMP	Waste Management Plan

1.0 INTRODUCTION

This Construction Quality Assurance Plan (CQAP) describes quality assurance/quality control (QA/QC) activities during construction associated with Source Areas Fluvial Soil Vapor Extraction (SVE) Remedial Action (RA) on Dunn Field at Defense Depot, Memphis, Tennessee (DDMT). This CQAP addresses Remedial Action Construction (RA-C) activities related to installation of SVE wells, vapor monitoring points (VMPs) and groundwater monitoring wells, and construction of SVE conveyance piping and the control building/treatment compound. The QA/QC activities will aid in completing the RA-C in accordance with specifications and procedures presented in the *Source Areas Remedial Design* (RD) (CH2M HILL, 2007) and achieving the following objectives:

- Installation of SVE wells and VMPs at the proper locations and depths
- Installation of groundwater monitoring wells and abandonment of selected existing monitoring wells to facilitate later RA (loess thermal-enhanced SVE)
- Construction of conveyance piping and blowers capable of achieving the flow rates and vacuum pressure specified
- Construction of vapor treatment system and condensate storage to achieve discharge limits
- Construction of the control building in accordance with specifications
- Disposal of RA-C wastes in accordance with the Waste Management Plan (WMP) in Appendix B of the RAWP
- Documentation of construction in the RA-C Report

2.0 CQAP IMPLEMENTATION

2.1 RESPONSIBILITY AND AUTHORITY

The RA project organization is divided into management and field teams as described in the Project Management Plan (PMP) in Appendix A of the RAWP. The Construction Certifying Engineer (CCE) is the project team member responsible for construction QA/QC activities during RA-C. The CCE will communicate changes to be made during RA-C (if any) to field personnel and subcontractors through the Project Manager and the Fluvial SVE RA Task Manager.

The CCE, Mr. Glen Turney, is a Tennessee-Registered Professional Engineer who will have the authority to certify that work has been conducted in accordance with the plans and specifications in the RD and the RAWP. Mr. Turney will:

- Provide technical support to the RA Task Manager in directions to field personnel
- Review field inspection teams, including evaluation of field inspection personnel qualifications and monitoring field documentation
- Evaluate construction subcontractor or supplier QA/QC documentation, protocols, or plans before the mobilization
- Ensure that work is performed in accordance with the construction drawings and specifications, and approve modifications, if necessary
- Identify construction completion acceptance criteria or measures of performance
- Ensure compliance with cost and schedule constraints or document reasons for non-compliance

The team leaders for field and construction support will communicate with Mr. Turney, the Project Manager and RA Task Manager through telephone and e-mail communication daily and weekly activity reports during RA-C. Personnel responsibilities are described in the PMP.

2.2 PROJECT MEETINGS

2.2.1 Pre-Construction Meeting

A pre-construction conference will be held before RA-C begins. Conference attendees are listed in Section 4.2 of the RAWP. A portion of the conference will be dedicated to QA/QC issues including:

- The responsibilities of each organization for QA/QC

- The authority of regulatory agency representatives and project and field team members to order work stoppages
- Lines of authority and communication for each organization
- Understanding of the RAWP and CQAP by field staff and of the availability of the RAWP and CQAP to field staff during RA-C
- Procedures or protocols for observations and tests, including sampling strategies
- Procedures or protocols for handling construction deficiencies, repairs, and retesting, including "stop work" conditions
- Methods for documenting and reporting inspection data
- Methods for distributing and storing documents and reports
- Work area security and safety protocols
- Procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events

2.2.2 Problem or Work Deficiency Meetings

Meetings will be convened if needed to address construction or inspection deficiencies or non-conformances with the RD, RAWP, CQAP, or subsequent specifications submitted to or from subcontractors. Deficiencies or non-conformances will be brought to the attention of the CCE and the Project Manager. Deficiencies and non-conformances will be tracked in the field log books maintained by field personnel. Field personnel will prepare brief summary reports of deficiencies or non-conformances and resolution of deficiencies or non-conformances will be documented in a field report sent to the CCE immediately upon resolution of the situation. Originals of these reports will be placed in the project central files and copies of the reports will be maintained on-site.

3.0 IMPLEMENTATION OF REMEDIAL ACTION CONSTRUCTION

3.1 SVE AND MONITORING WELLS

The locations, numbers, and depths of SVE wells, VMPs and groundwater monitoring wells are presented in Sections 4.4 and 4.5 of the RAWP. Specifications for the wells and VMPs are provided in the RD and the RAWP. QA/QC activities will include:

- Obtaining documentation that the drilling subcontractor is licensed and insured to install wells in the State of Tennessee and is familiar with all applicable federal, state, county and local laws and regulations, including but not limited to the Tennessee Department of Environment and Conservation (TDEC) Water Well Licensing Regulations and Well Construction Standards (Chapter 1200-4-9) and the Shelby County Rules and Regulations of Wells.

- Ensuring that all drilling permits required to conduct this work are obtained
- Providing written authorization to begin work and the anticipated work schedule to subcontractors in the format of an email transmission, facsimile transmission, or letter
- Certifying Health and Safety (H&S) training and medical monitoring for the drilling subcontractor's workers
- Listing materials and the material suppliers that will be used during well and VMP construction
- Obtaining lot numbers and manufacturers specification sheets for the well casing and screen materials.
- Obtaining sieve analyses of the well filter pack material to document that the grain-size distributions meet the 4-20 gradation specification
- Certifying that the well filter pack material is contaminant-free
- Verifying that cement grout mixtures conform to manufacturer's specifications by measurement with a pressurized mud balance and conform to specifications in the RD and the RAWP
- Confirming boring and well installation depths provided by the drilling subcontractor.

The e^{2}M field geologist will be a registered Professional Geologist in Tennessee. The geologist will confirm drilling depths and well screen placements.

The drilling subcontractor is required to submit daily logs for the previous day's activities to the field geologist by noon the following day. The daily logs will contain information on drilling depths for each well, sampling, well casing and screen installations, and other information requested by the field geologist.

3.2 SVE CONTROL BUILDING AND TREATMENT COMPOUND

The SVE control building and treatment compound to be constructed in the north-central portion of Dunn Field are described in Section 4.5 of the RAWP. The treatment compound will have a concrete base and will be enclosed with a chain link fence. The two-room control building within the compound will contain the individual SVE manifold legs, blowers, aftercoolers and moisture separator in the equipment room and the system control panel in a second room (office). Individual conveyance piping will be routed from each extraction well to provide operational flexibility. A two blower system will permit uninterrupted SVE system operation at lower extraction rates if one of the units is offline for maintenance. The extracted vapor will be treated using granular activated carbon in two epoxy-coated steel vessels. A condensate recovery system will also be installed. Construction drawings are provided in Appendix D of the RAWP. QA/QC activities will include the following:

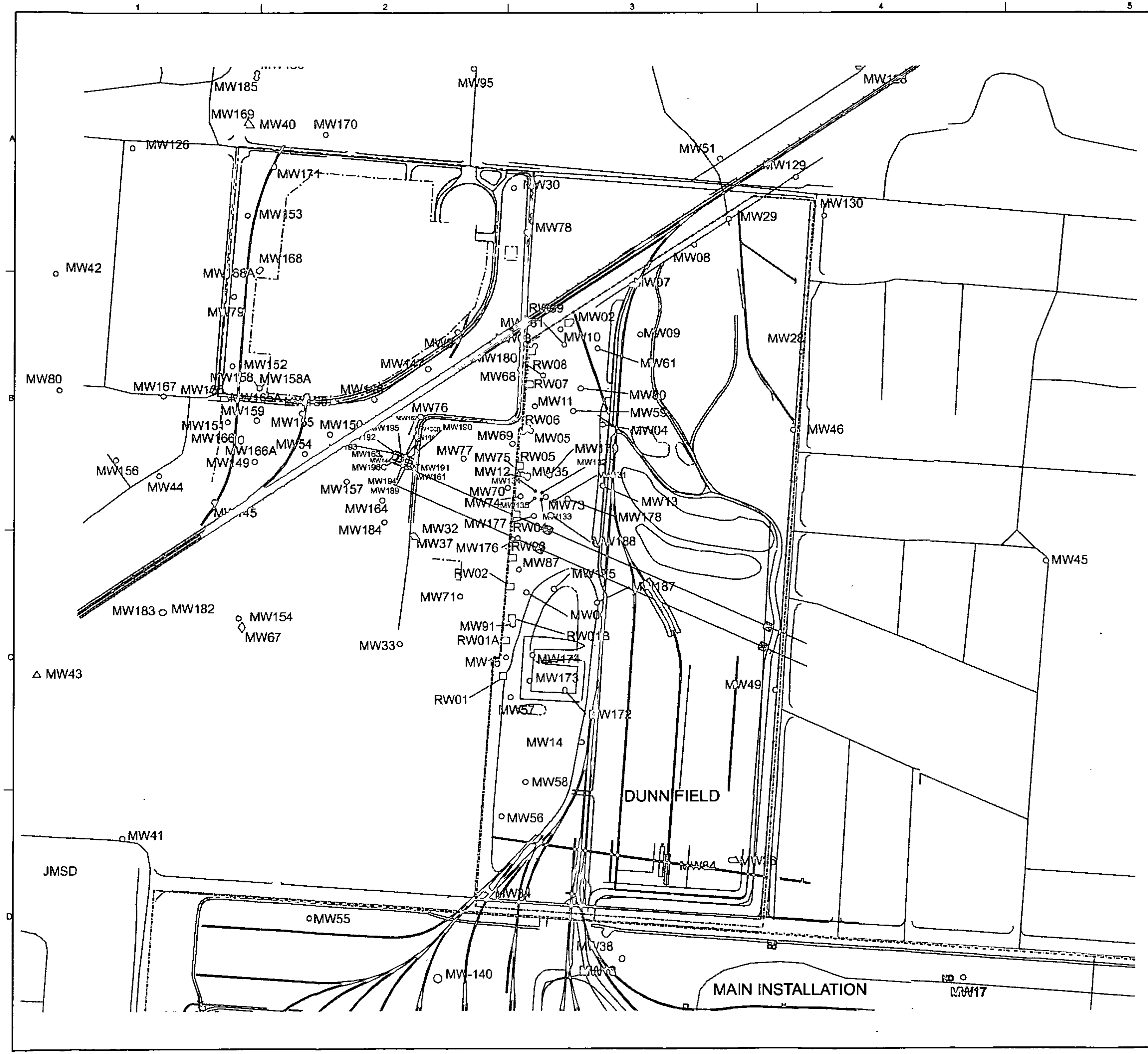
- The Subcontractor will submit documentation that it is licensed to conduct the specified plumbing and electrical work
- The completed facility will meet the National Electrical Code and applicable local codes and documentation of an inspection will be provided
- The Subcontractor will submit the layout, manufacturer's data, and dimensional information for all equipment and supplies provided or constructed for the facility ("as-built" drawings), which will subsequently be verified by the CCE or his designated representative.
- Upon completion of system installation, the SVE system will be tested to identify potential performance issues. Testing will include proper motor rotations, float switch operations, valve operations, gauge operations, and general PLC sequencing. Upon successful completion of system tests, the system will be brought online.
- Initial vacuum monitoring will be conducted at the vapor monitoring points and SVE wells.
- A program of initial startup air discharge sampling will be conducted on effluent air samples collected at the discharge stacks. In addition, initial startup air sampling will be conducted on the system influent with a sample pump capable of drawing a sample against the system vacuum to evaluate initial removal and destruction rates.
- System operations and performance data will be collected to assess removal rates and capture zones and to provide a basis for system modifications and enhancements. The following parameters will be included:
  - Organic vapor for each extraction well;
  - Flow rate for each extraction well;
  - Flow rate, temperature and vacuum for each main manifold;
  - Applied vacuum at the extraction well head and the vacuum influence at the VMP well heads;
  - Vacuums at the individual extraction lines prior to the main manifolds;
  - Vacuums across the condensate tanks and air filters;
  - Condensate water generation rates;
  - Vacuum blower runtime meter and transfer pump cycle counters;
  - Temperature and pressure post-blower.

4.0 REFERENCES

CH2M Hill, 2007. Rev. 0 Memphis Depot, Dunn Field Source Areas Remedial Design. Prepared for the U.S. Army Engineering and Support Center, Huntsville, Alabama. January 2007.

APPENDIX D

REMEDIAL DESIGN CONSTRUCTION DRAWINGS



LEGEND:

------	DEPOT BOUNDARY
○ MW	MONITORING WELL SCREENED IN FLUVIAL AQUIFER
△ MW	MONITORING WELL SCREENED IN INTERMEDIATE AQUIFER
□ RW	GROUNDWATER EXTRACTION WELL
◇ MW	MONITORING WELL SCREENED IN MEMPHIS AQUIFER

N

0 400
SCALE IN FEET

CH2MHILL

GENERAL
SITE MAP

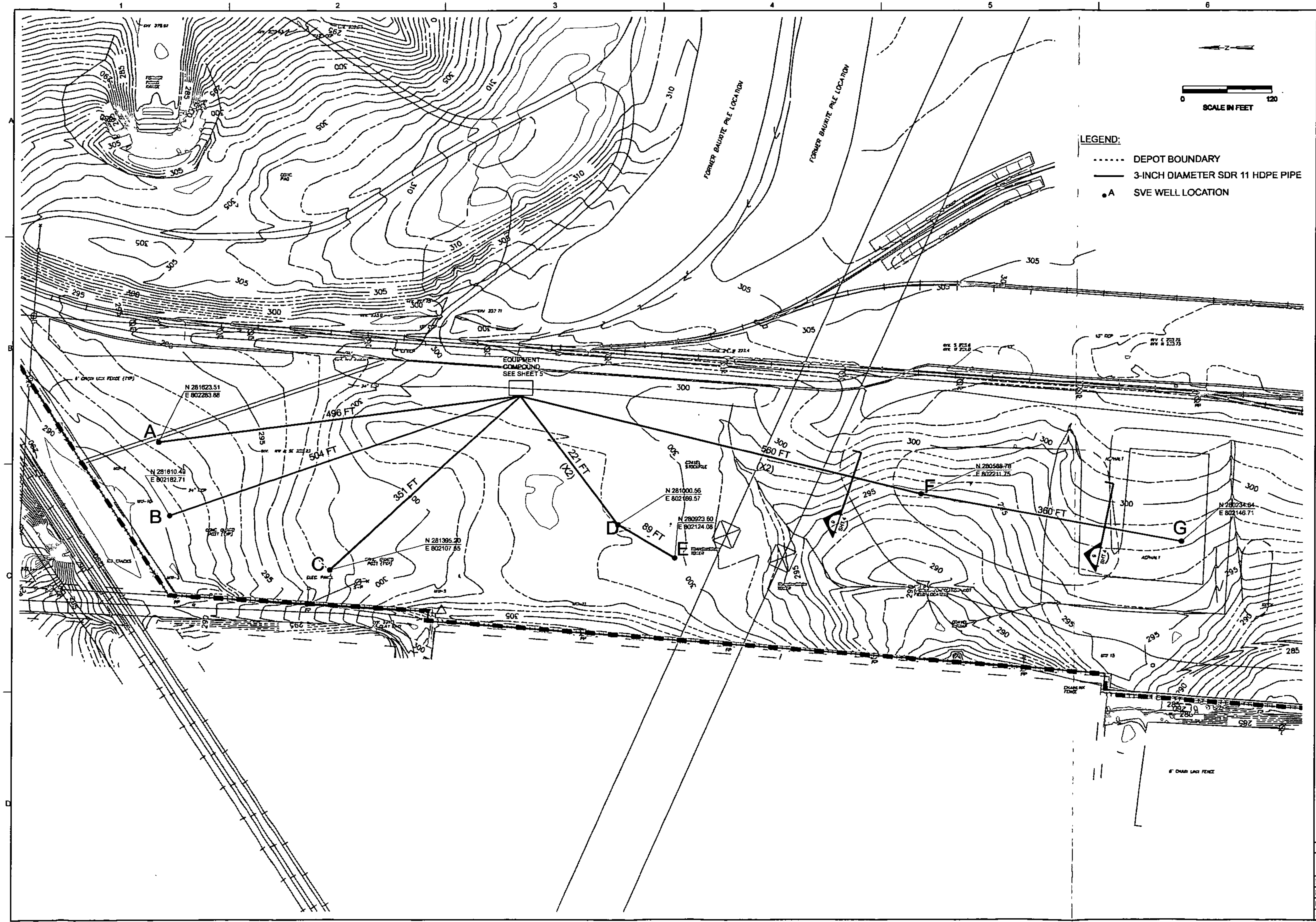
MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

NO.	DATE	REVISION	BY	APVD

DSGN M. PERLMUTTER
DR E. GRIGGS
CHK M. STRONG
APVD D. NELSON

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	SEPTEMBER, 2006
PROJ	177556
DWG	G-2
SHEET	2



CH2MHILL

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL SANDS SVE
SVE SYSTEM LAYOUT

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
M. PERLMUTTER	E. GRIGGS	M. STRONG	D. NELSON

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0 1"

DATE	SEPTEMBER, 2006
PROJ	177556
DWG	F-1
SHEET	3

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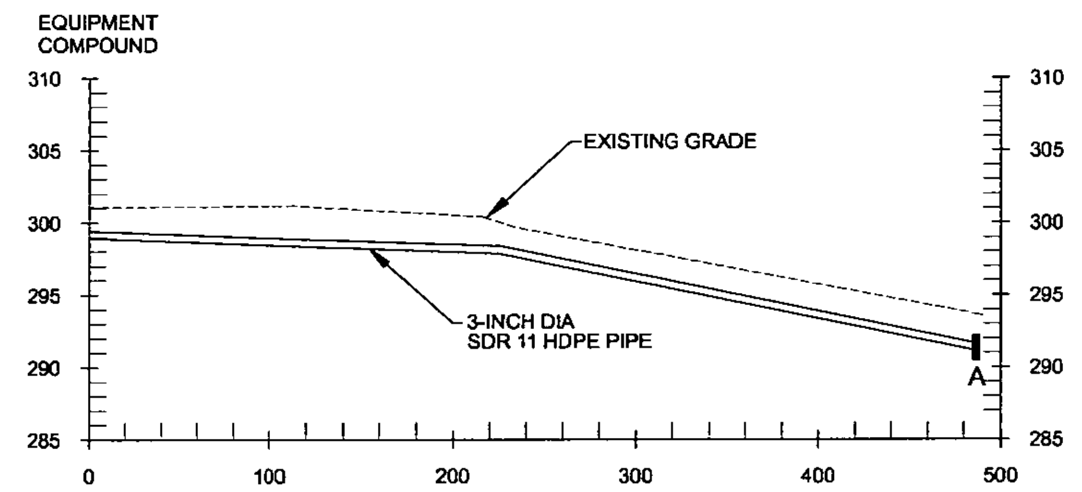
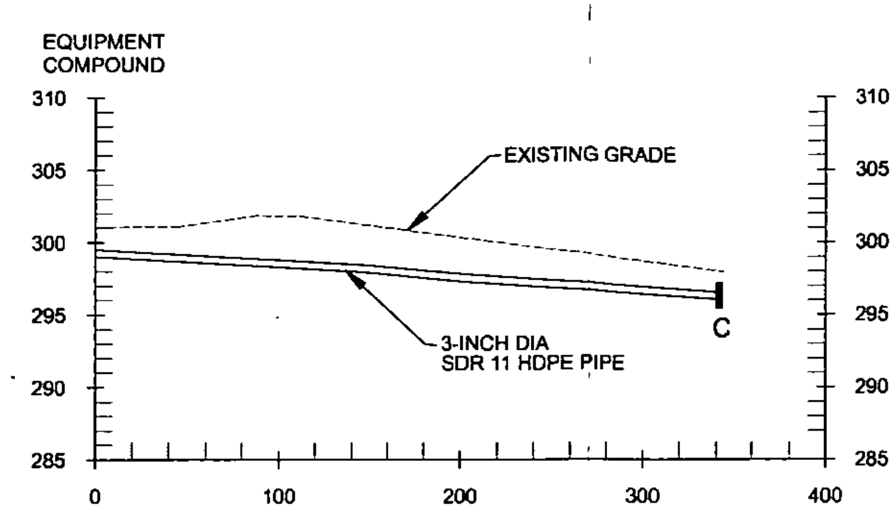
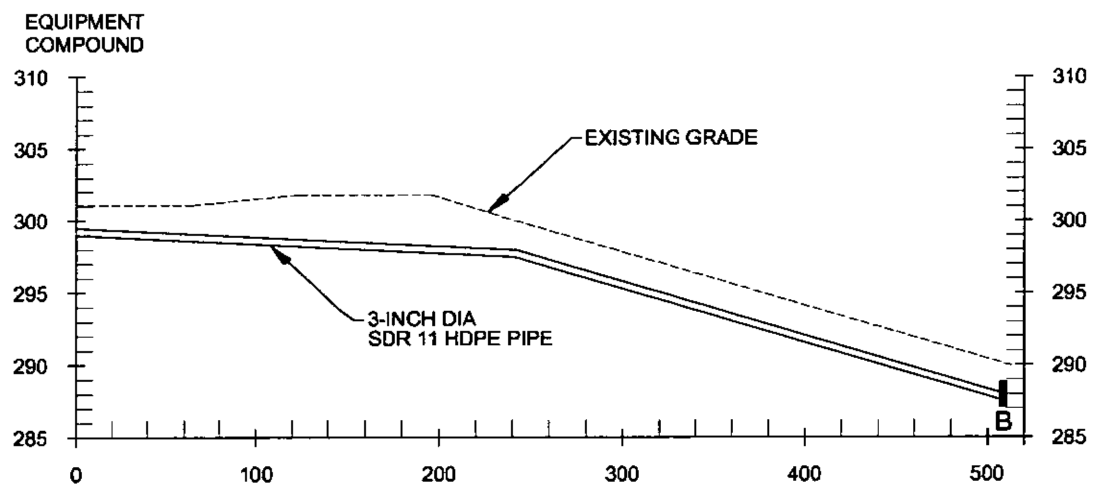


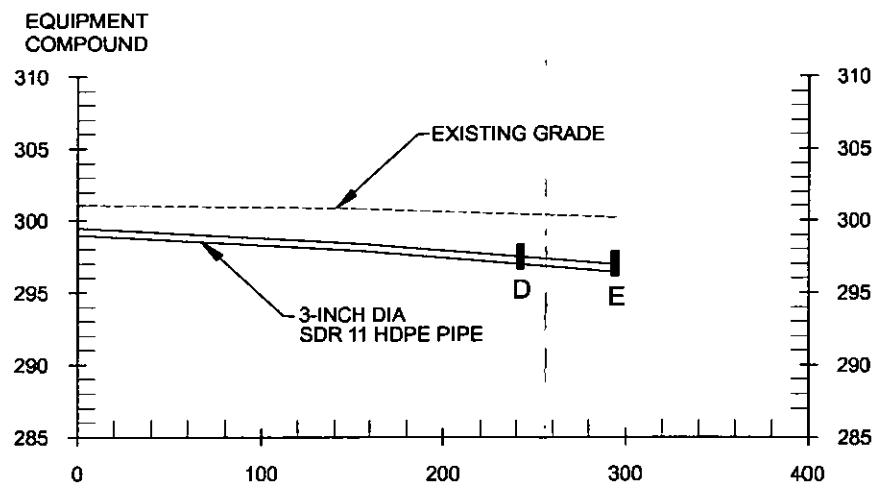
EQUIPMENT COMPOUND TO SVE WELL A



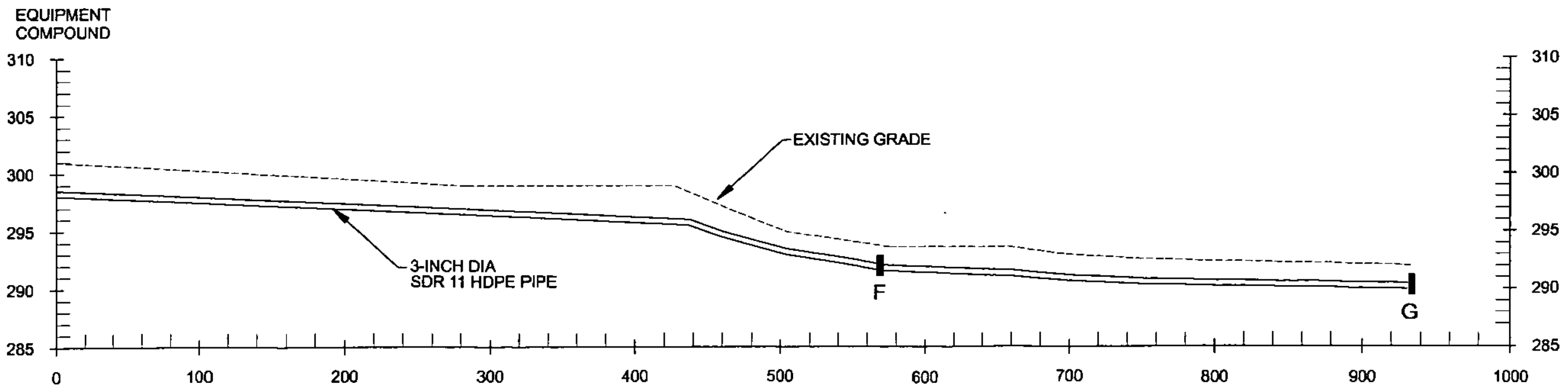
EQUIPMENT COMPOUND TO SVE WELL C



EQUIPMENT COMPOUND TO SVE WELL B



EQUIPMENT COMPOUND TO SVE WELL D AND E



EQUIPMENT COMPOUND TO SVE WELL F AND G

NOTES:

1. CROSS-SECTIONS REPRESENT FINAL PIPING LOCATION. CONVEYANCE PIPING TO BE PLACED ABOVE GRADE DURING OPERATION OF LOESS DEPOSITS THERMAL-ENHANCED SVE.
2. HDPE PIPE TO BE MINIMUM 2 - FEET BELOW EXISTING GRADE FOLLOWING DECOMMISIONING OF LOESS DEPOSITS THERMAL-ENHANCED SVE SYSTEM.
3. MAINTAIN 0.5% SLOPE TO SVE WELLS TO PROMOTE CONDENSATE RETURN.

NO.	DATE	REVISION	BY	APVD

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APVD D. NELSON

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

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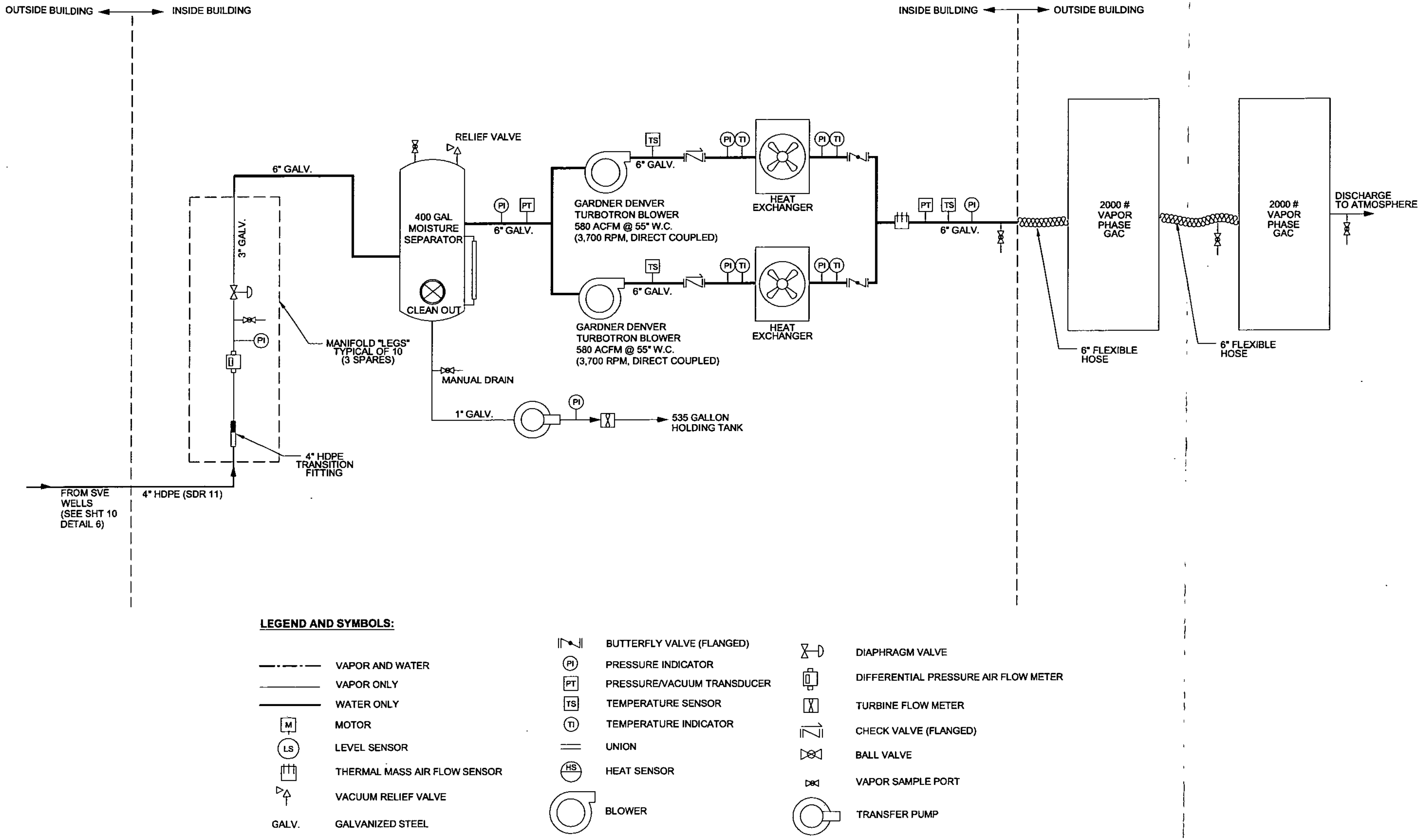
FLUVIAL SANDS SVE
CONVEYANCE PIPING CROSS
SECTIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"

DATE	SEPTEMBER, 2006
PROJ	177556
DWG	F-2
SHEET	4



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FLUVIAL SANDS SVE
PROCESS FLOW DIAGRAM

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

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VERIFY SCALE
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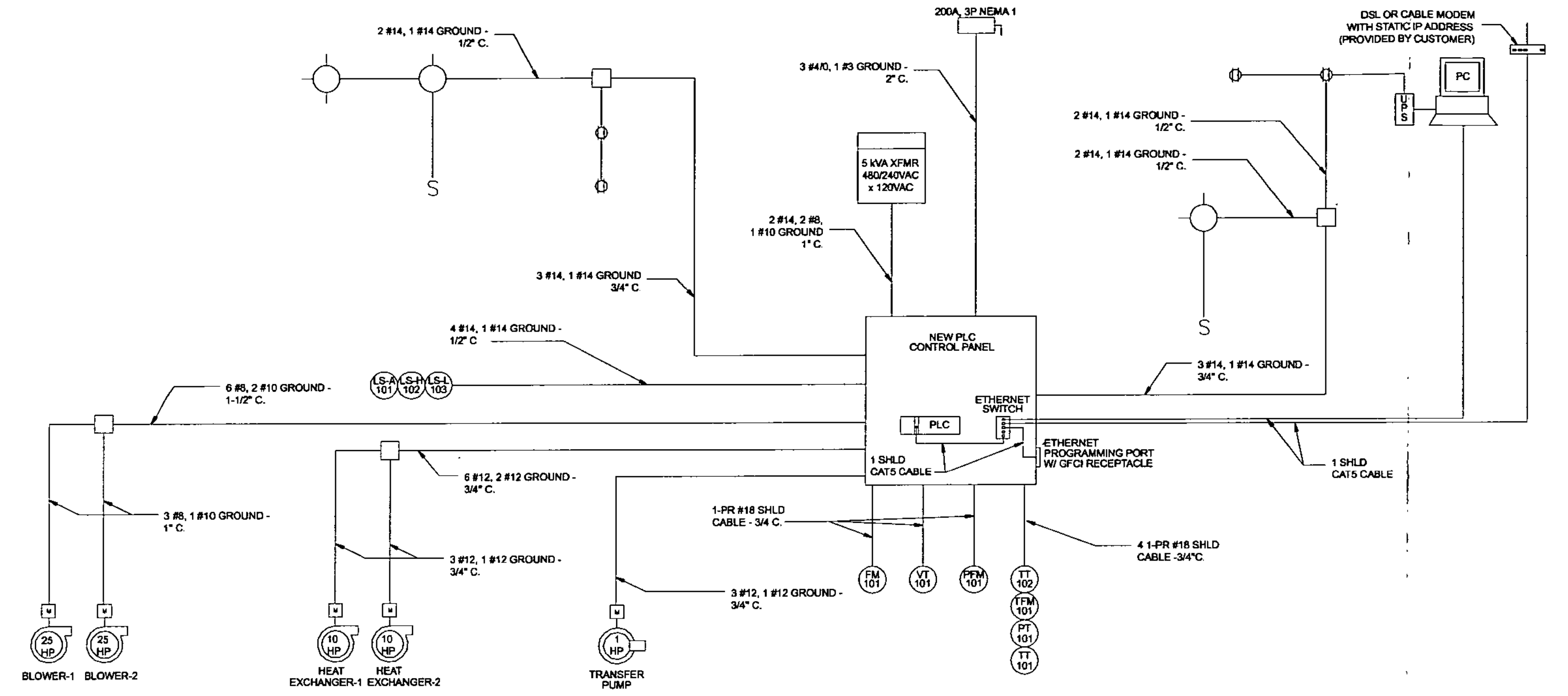
0 1"

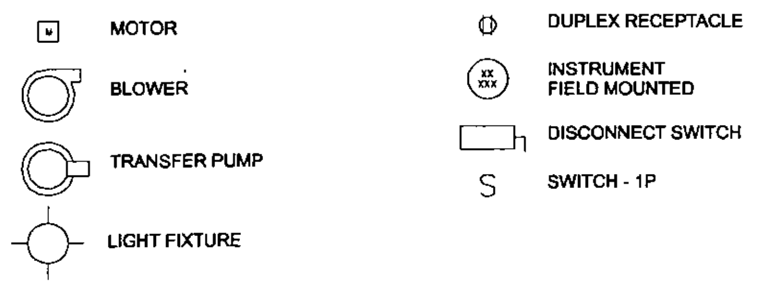
DATE MARCH 2007
PROJ 177556
DWG F-3
SHEET 5

FILENAME: SHEET_5_(P_ROCESS_FLOW_DIA).DWG
PLOT DATE: 19-Feb-07
PLOT TIME: 4:58:00 PM

48071 DDMT/SARD 2006



PROCESS EQUIPMENT LEGEND



PROCESS ABBREVIATIONS

FM —— FLOW METER
LS-H —— LEVEL SWITCH - HIGH LEVEL
LS-H —— LEVEL SWITCH - HIGH LEVEL
LS-L —— LEVEL SWITCH - LOW LEVEL
PT —— PRESSURE TRANSDUCER
TFM —— THERMAL FLOW METER
TT —— TEMPERATURE TRANSDUCER
VT —— VACUUM TRANSDUCER

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FLUVIAL SANDS SVE
PROCESS AND
INSTRUMENTATION DIAGRAM

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

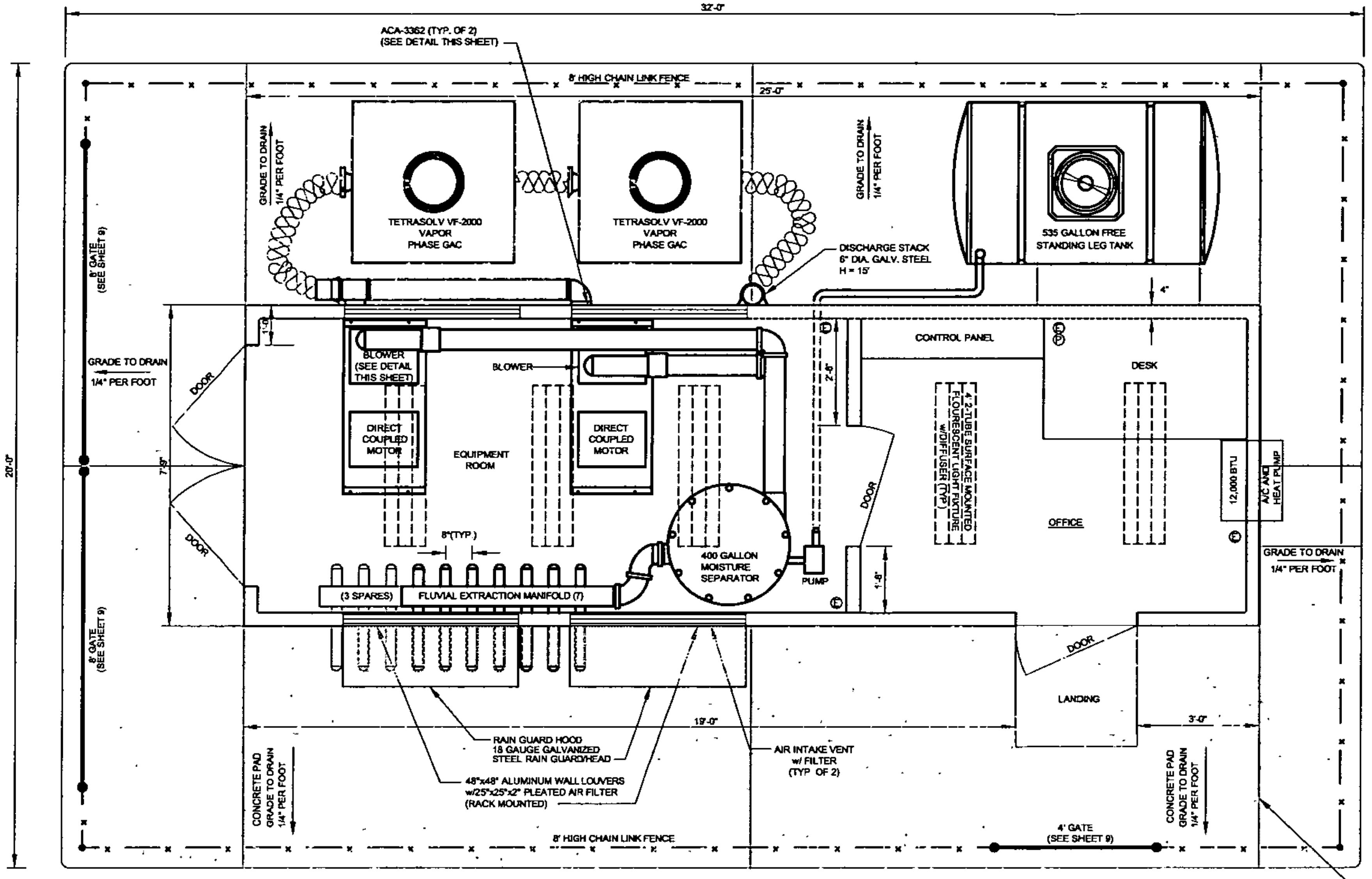
NO.	DATE	REVISION	BY	APVD

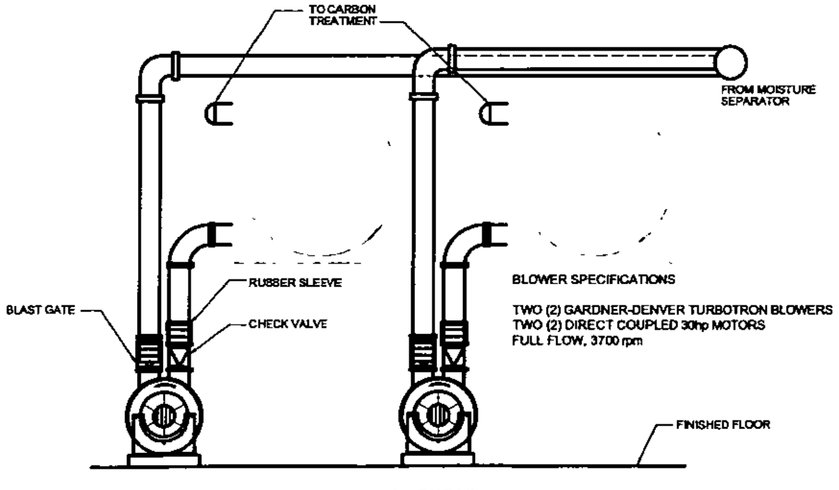
DSGN	DR	CHK	APVD
M. PERLMUTTER	E. GRIGGS	M. STRONG	D. NELSON

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 ▬ 1"

DATE	SEPTEMBER, 2006
PROJ	177556
DWG	F-4
SHEET	6

891 117

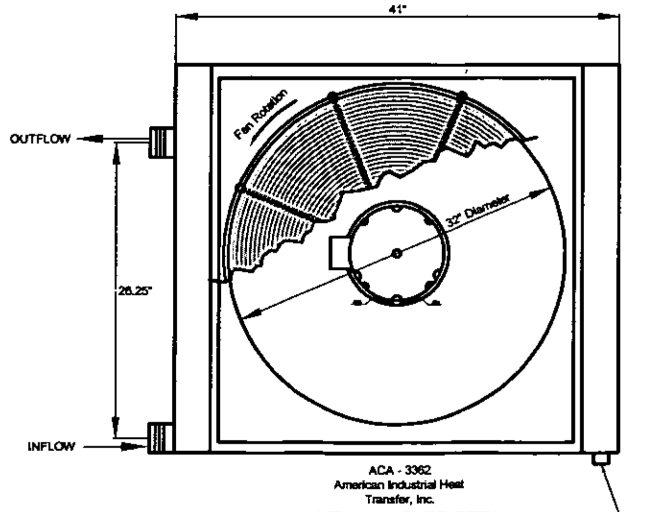




BLOWER SPECIFICATIONS

TWO (2) GARDNER-DENVER TURBOTRON BLOWERS
TWO (2) DIRECT COUPLED 30hp MOTORS
FULL FLOW, 3700 rpm

BLOWER DETAIL
N.T.S.



ACA - 3362
American Industrial Heat
Transfer, Inc.

AFTERCOOLER DETAIL
N.T.S.

BUILDING SPECIFICATIONS

1 PERIMETER FRAME. Perimeter tubular 2" x 6" frame members (13 ga.) with structural steel "C" channel 2" x 6" set perpendicular to and inletted into side tubular members. Channel is utilized as forklift slots for handling. All frame parts are coated with a corrosive resistant (black in color) paint. Anchor bldg. to concrete foundation per manufacturer's recommendation.

2. METAL WEATHER SHIELD: Galvanized steel construction. The shield covers the entire floor assembly and is located between frame and underside of floor joists.

3. FLOOR JOISTS joists are nominal 2 x 4 steel joists spaced in a lateral configuration, 12" O.C.

4 FLOOR INSULATION Fiberglass batt-type insulation between floor joists is R-11 and entirely fills any and all voids.

5. FLOOR COVERING. 3/16" smooth steel floor (painted black).

6. WALL STUDS: Studs are 3 ½" 20 ga Galvanized steel studs spaced 16" O.C. Top and bottom runners are 3 ½" x 18 ga.

7. WALL INSULATION· Fiberglass batt-type insulation between studs is R-11 and entirely fills any and all voids.

8 INTERIOR WALL COVERING: 5/16" thick gypsum board with laminated vinyl covering is fastened to the inside of the studs with screws and gypsum adhesive; material has a class "A" flame spread rating. 4" vinyl base cove is applied at the base. Sound loss for this unit will be approximately 20 decibels from outside to inside.

9. EXTERIOR WALL SHEATHING Under steel siding structural sheathing is secured to entire exterior, per manufacturer's recommendations. Sheathing is 1/8" foil laminated on both sides.

10. ROOF FRAMING: Rafters are nominal 4" 16 ga. galvanized steel spaced in lateral configuration 12" O.C.

11 INTERIOR CEILING Ceiling material is 1/2" gypsum with a white stucco pre-finish, fastened securely to roof rafters with screws Material has a class "A" flame spread rating

12. ROOF INSULATION Fiberglass batt-type insulation between roof rafters is R-11 and entirely fills any and all voids.

13. EXTERIOR ROOF SHEATHING· The top side of the rafter has 16 ga. Smooth steel sheathing fastened securely to roof rafters. Covered completely with a minimum 4 mil. polyvinyl vapor barrier.

14 ROOF COVERING 30 ga. galvanized steel construction. Roof metal covers entire roof assembly

15. EXTERIOR SIDING· Galvanized steel siding is 29 ga pre-finished (on both sides) commercial type with appropriate top and bottom trim fastened securely to studs Seven standard colors are available. 20-year guarantee.

16 EXTERIOR DOORS. Doors are a steel door with steel jamb Jambs will have ball bearing hinges. Door will have a tempered ½ lite and a heavy duty closer

17. FULL DEPTH FORK POCKETS All sizes 2 1/2" x8" structural "C" channel (3 1/2" x 7" opening).

18. INTERIOR LIGHT FIXTURES: All light fixtures are 4' - 0" (four foot) twin tube with an acrylic wrap-around type diffuser cover.

19 INTERIOR CEILING HEIGHT· The dimension from the finished floor surface to the finished ceiling surface is 8'-0"

20. ELECTRIC SERVICE PANEL. Prewire service entrance panel is equipped with a 100-amp main breaker, a 15-amp breaker (for lights), a 20-amp breaker (for receptacles), and any additional breakers necessary Entrance conduit is through the exterior wall for ease of hook-up. All electric components U.L. listed and wired to National Electrical Code. Standard service is 240/120v, single phase, 60 cycle.

21 HVAC. One thru the wall G.E. 12,000 BTU air conditioner

LEGEND

Ⓔ ELECTRICAL OUTLET
Ⓟ PHONE JACK

NO.	DATE	REVISION	BY	APVD
DSGN	M. PERLMUTTER	DR G. HARTLEY	CHK M. STRONG	APVD D. NELSON

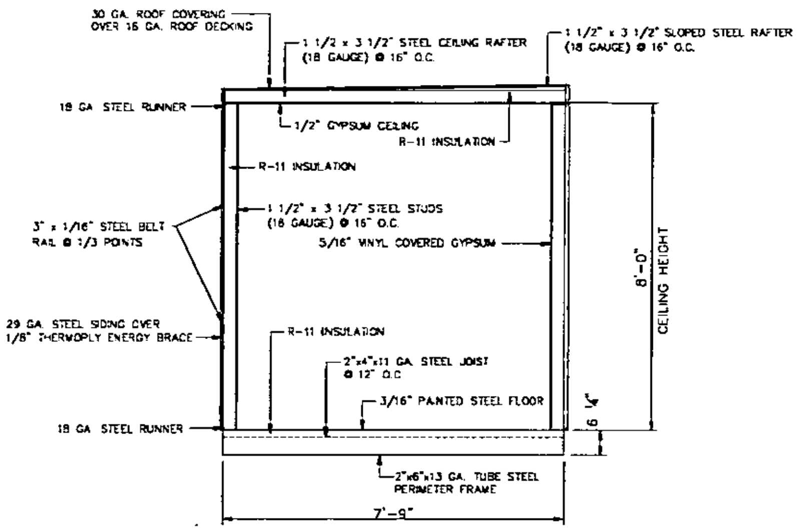
MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

CH2MHILL

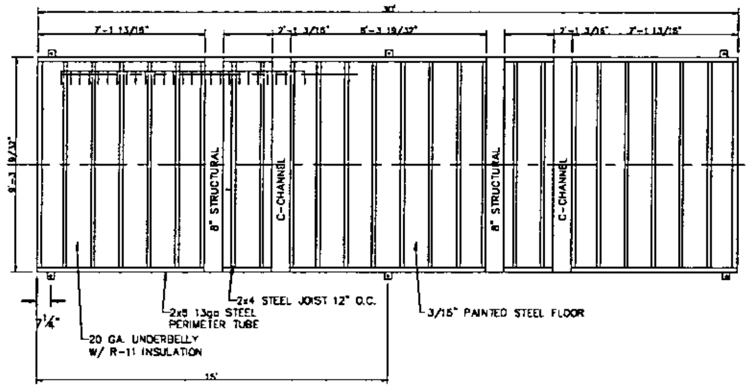
FLUVIAL SANDS SVE
EQUIPMENT COMPOUND

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2007
PROJ	177556
DWG	F-5
SHEET	7



CROSS SECTION



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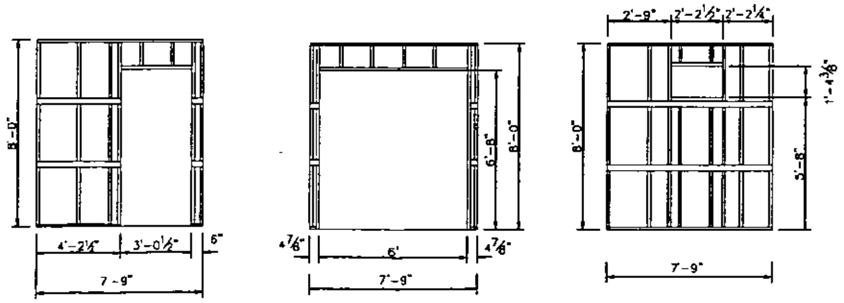


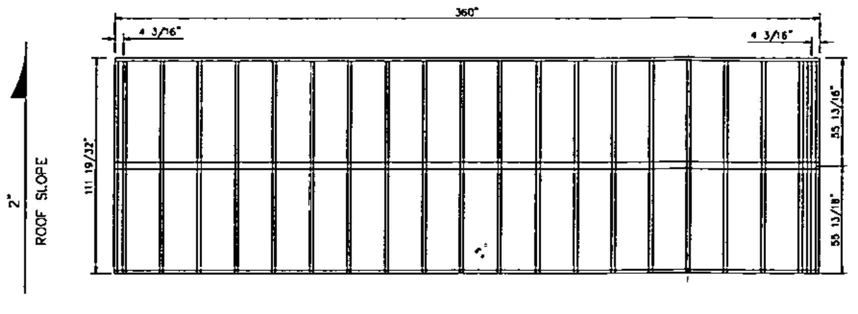
INTERIOR WALLS

NORTH WALL

SOUTH WALL

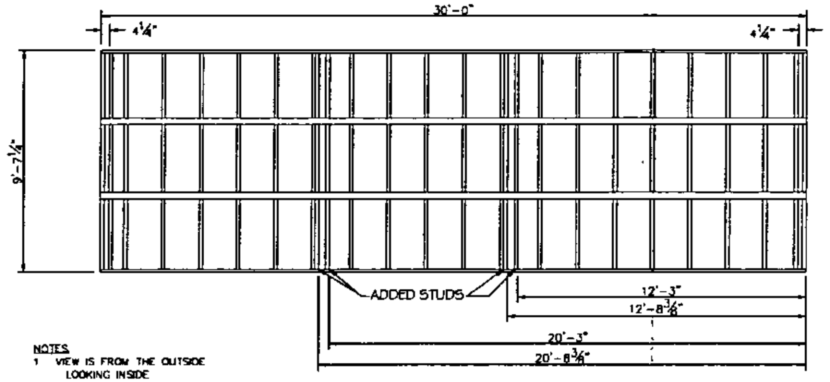
NOTES
1 VIEW IS FROM THE OUTSIDE LOOKING INSIDE
2. 3 1/2" STUDS TO BE ON 16" CENTERS
3 3" BELT RAILS TO BE ON 32" CENTERS
4 WIRE KNOCK OUTS TO BE APPROX. SAME HEIGHT

NORTH/SOUTH WALL FRAMING



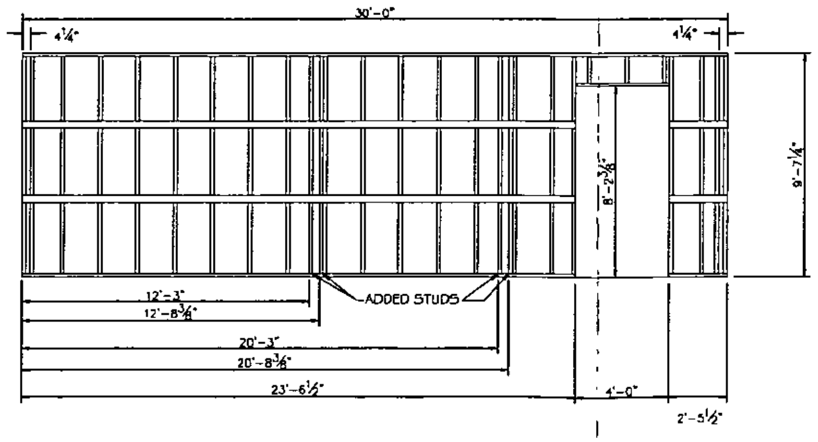
ROOF FRAMING

NOTES:
1 VIEW IS FROM THE TOP LOOKING DOWN
2. 4" RAFTERS TO BE ON 16" CENTERS
3. 3" BELT RAILS TO BE 46 1/2" CENTER TO CENTER
4. WIRE KNOCK OUTS TO BE APPROX. SAME HEIGHT



NOTES
1 VIEW IS FROM THE OUTSIDE LOOKING INSIDE
2. 3 1/2" STUDS TO BE ON 16" CENTERS
3. 3" BELT RAILS TO BE ON 32" CENTERS
4 WIRE KNOCK OUTS TO BE APPROX. SAME HEIGHT

EAST WALL FRAMING



NOTES
1 VIEW IS FROM THE OUTSIDE LOOKING INSIDE
2 3 1/2" STUDS TO BE ON 16" CENTERS
3. 3" BELT RAILS TO BE ON 32" CENTERS
4 WIRE KNOCK OUTS TO BE APPROX. SAME HEIGHT

WEST WALL FRAMING

CH2MHILL

FLUVIAL SANDS SVE
BUILDING DETAILS

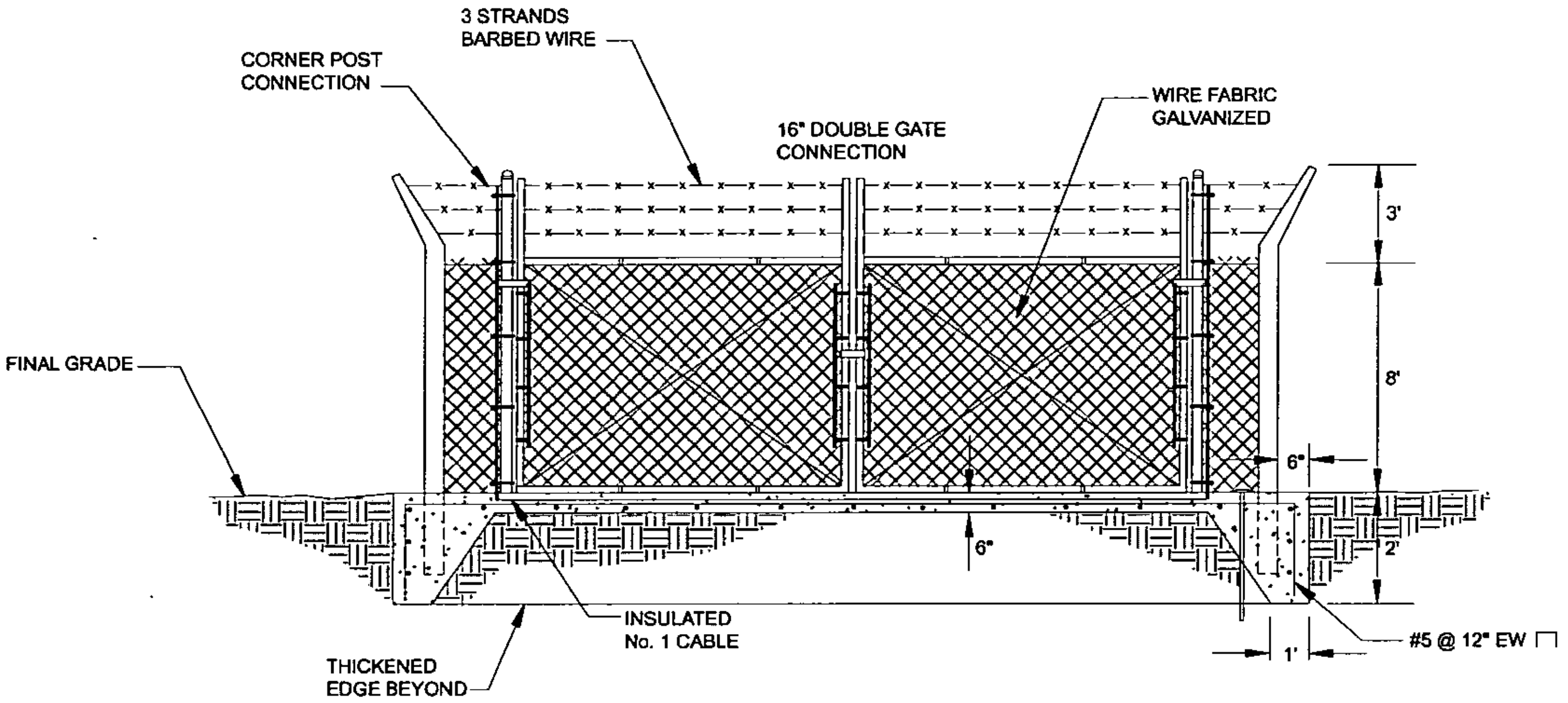
MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

NO.	DATE	REVISION	BY	APVD

DSGN M. PERLMUTTER
DR G. HARTLEY
CHK M. STRONG
APVD D. NELSON

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

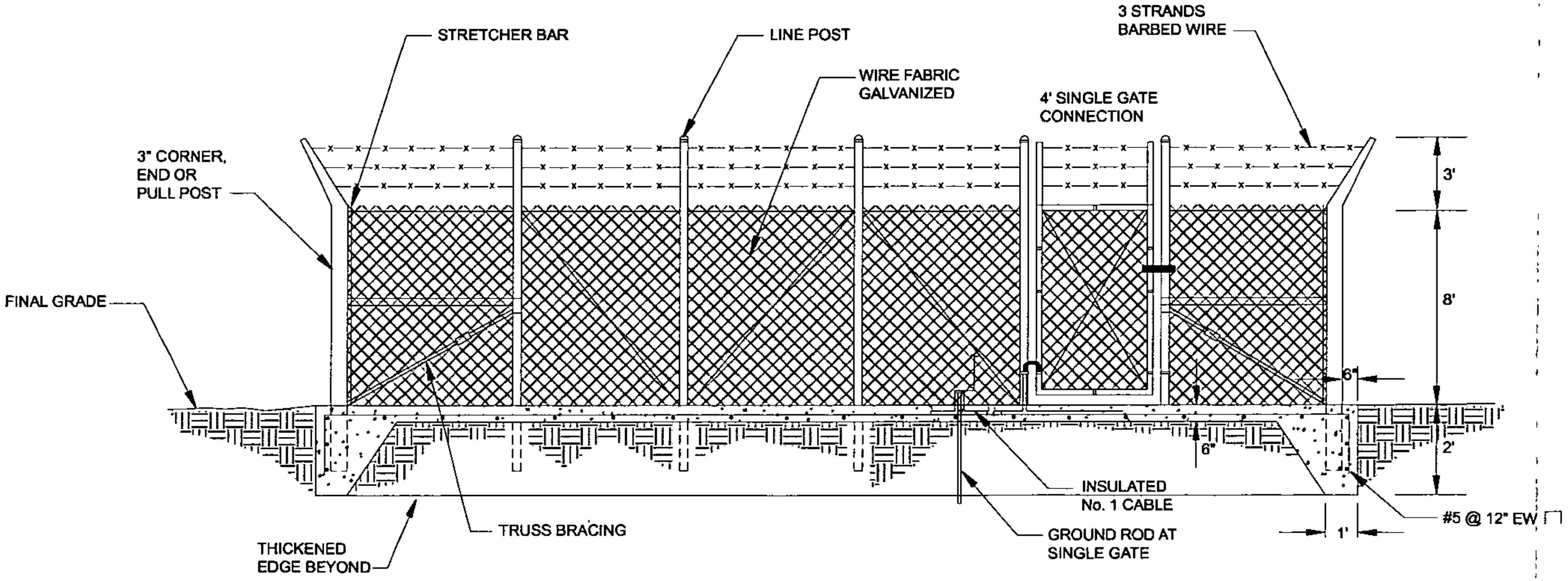
DATE	SEPTEMBER, 2006
PROJ	177556
DWG	F-6
SHEET	8



DOUBLE GATE DETAIL

NO SCALE

NOTES:
WHEN ANCHORAGE OF EQUIPMENT TO
PAD IS REQUIRED, USE CONCRETE ANCHORS
SPECIFIED



CHAIN LINK FENCE & CONCRETE PAD DETAIL

NO SCALE

CH2MHILL

FLUVIAL SANDS SVE
FENCE DETAIL

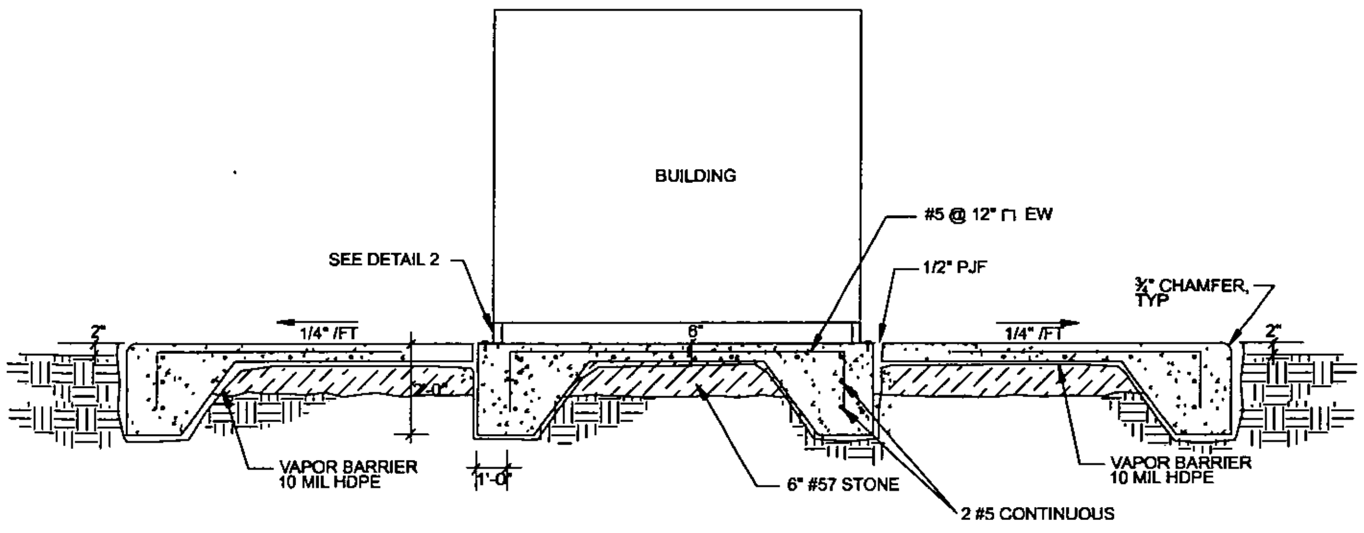
MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

NO.	DATE	REVISION	BY	APVD

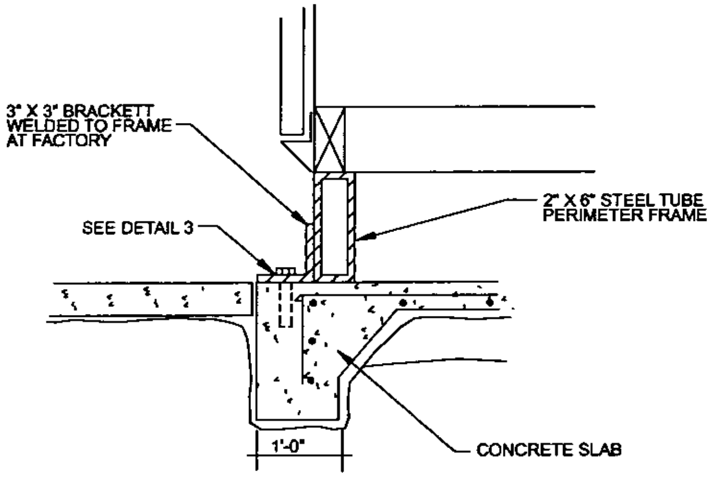
DSGN M. PERLMUTTER | DR G. HARTLEY | CHK M. STRONG | APVD D. NELSON

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	SEPTEMBER, 2006
PROJ	177556
DWG	F-7
SHEET	9



① BUILDING FOUNDATION DETAIL
NTS



② ATTACHMENT DETAIL
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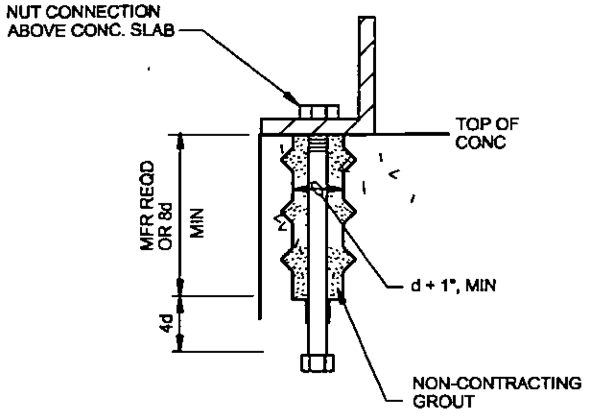

③ ANCHOR BOLT DETAIL
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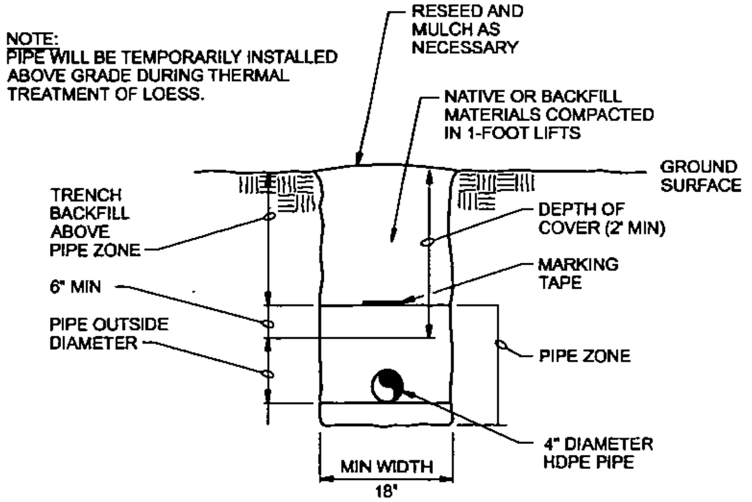
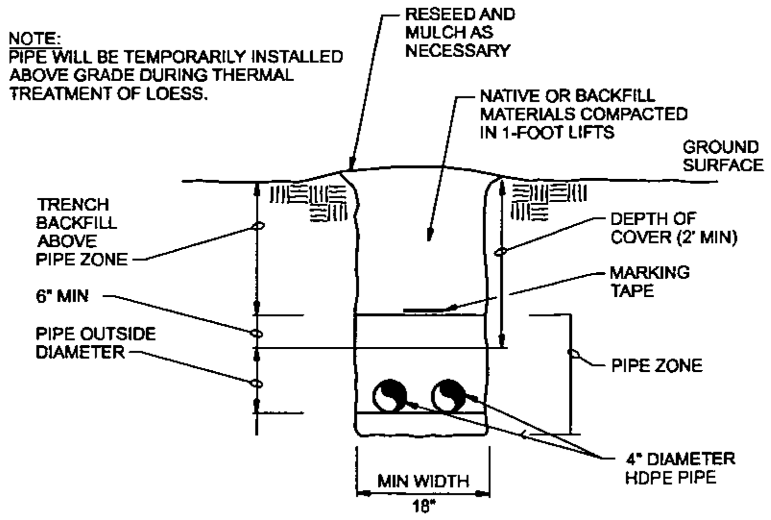
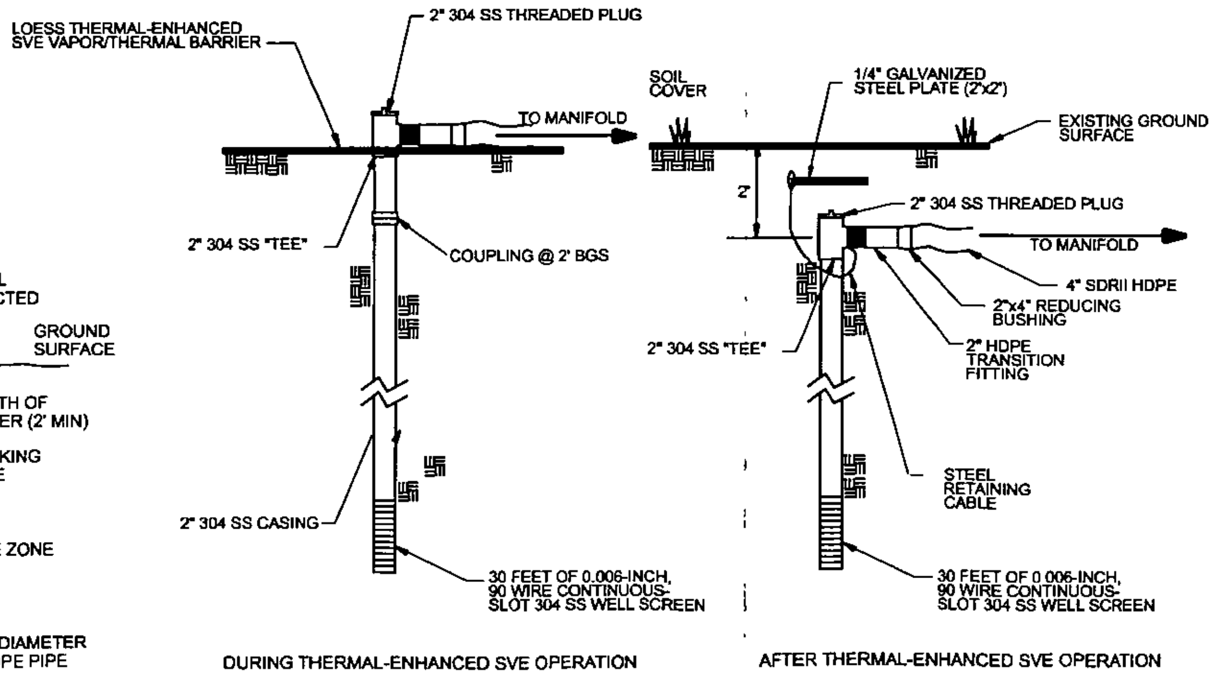


④ SINGLE PIPE SECTION
NTS



⑤ DOUBLE PIPE SECTION
NTS



DURING THERMAL-ENHANCED SVE OPERATION

AFTER THERMAL-ENHANCED SVE OPERATION

⑥ SVE WELL HEAD DETAIL
NTS

NO.	DATE	REVISION	BY	APVD

DSGN M. PERLMUTTER
DR E. GRIGGS
CHK M. STRONG
APVD D. NELSON

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

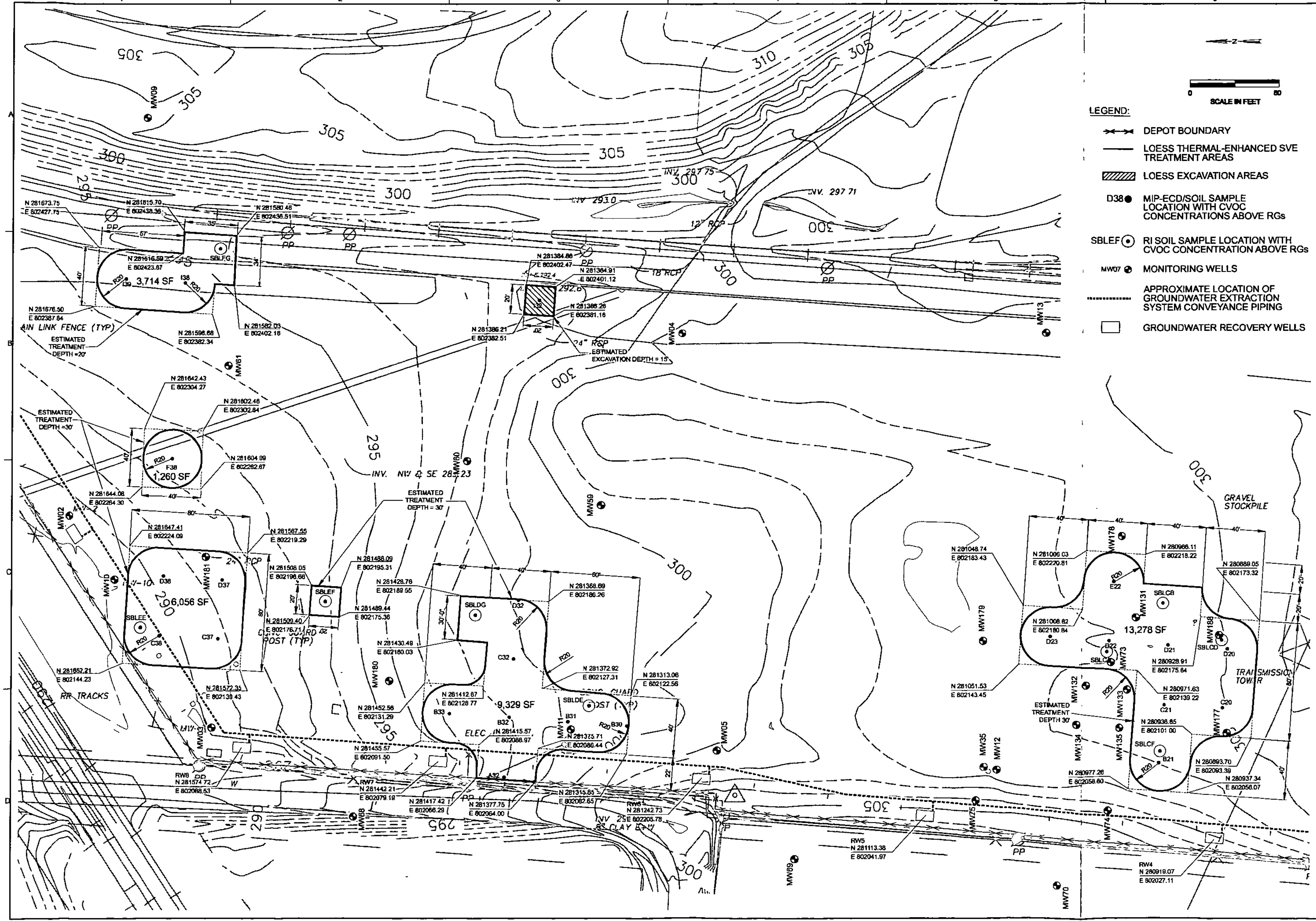
CH2MHILL

FLUVIAL SANDS SVE
DETAILS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE MARCH, 2007
PROJ 177556
DWG F-8
SHEET 10

891 121



NORTH LOESS TREATMENT AREAS

CH2MHILL

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
M. PERLMUTTER	E. GRIGGS	M. STRONG	D. NELSON

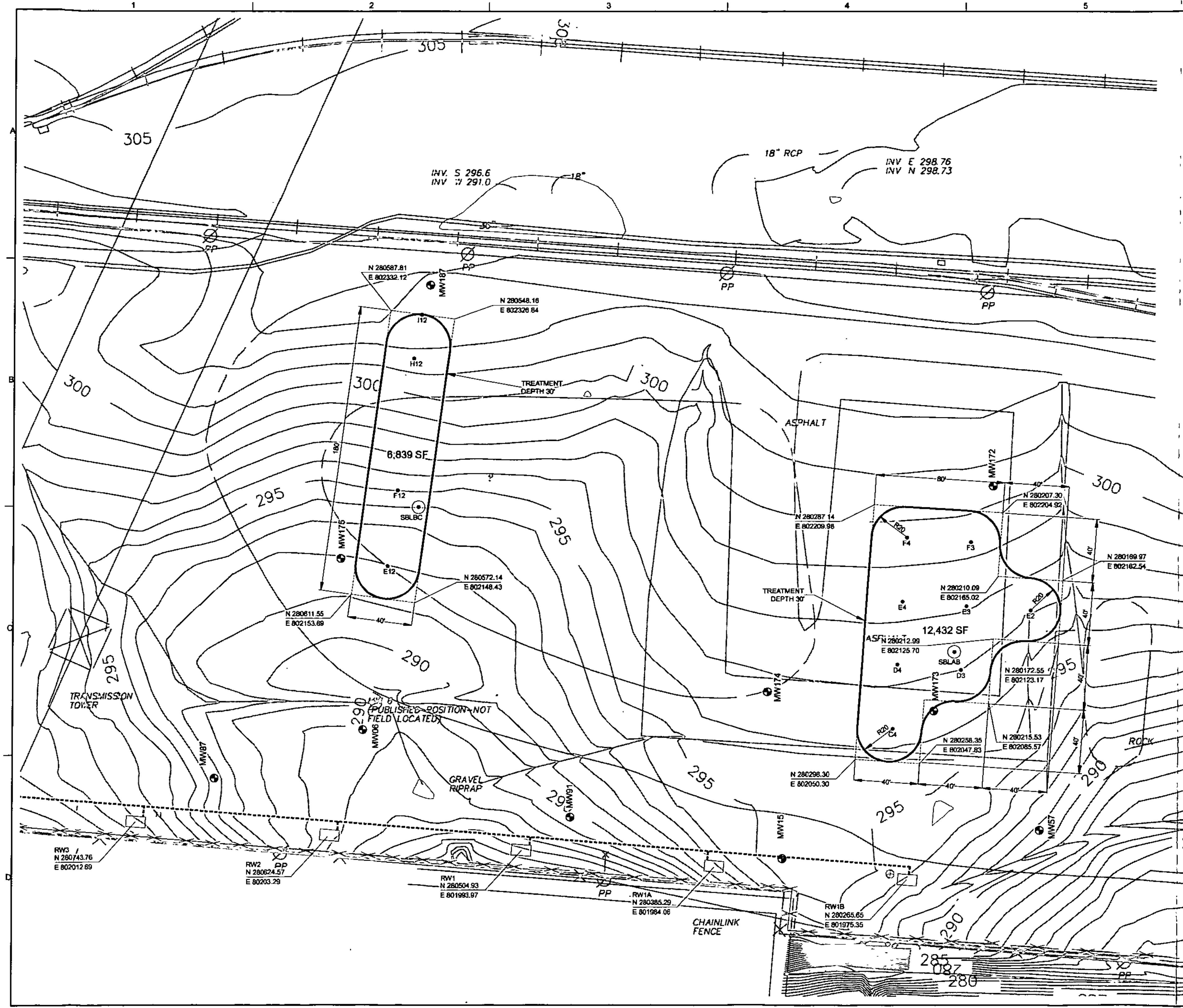
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH, 2007
PROJ	177556
DWG	L-1
SHEET	11

USER: EGRIGGS TAB: DLAYOUT

ATL/PROJ/148071 DDMT/SARD 2006/SARD/NEW FOLDER/SHEET 11 LOESS 1.DWG FILENAME SVE SYSTEM LAYOUT.DWG PLOT DATE: 6-Mar-07 PLOT TIME 5:06:19 PM

891 122



N

0 60
SCALE IN FEET

LEGEND:

⟶✕⟵	DEPOT BOUNDARY
——	LOESS THERMAL-ENHANCED SVE TREATMENT AREAS
▨	LOESS EXCAVATION AREAS
F12 ●	MIP-ECD/SOIL SAMPLE LOCATION WITH CVOC CONCENTRATIONS ABOVE RGs
SBLCB ⊙	RI SOIL SAMPLE LOCATION WITH CVOC CONCENTRATION ABOVE RGs
MW07 ⊕	MONITORING WELLS
....	APPROXIMATE LOCATION OF GROUNDWATER EXTRACTION SYSTEM CONVEYANCE PIPING
☐	GROUNDWATER RECOVERY WELLS

NO.	DATE	REVISION	BY	APVD

DSGN M. PERLMUTTER
DR E. GRIGGS
CHK M. STRONG
APVD D. NELSON

MEMPHIS DEPOT DUNN FIELD
SOURCE AREAS
REMEDIAL DESIGN
MEMPHIS, TN

SOUTH LOESS TREATMENT AREAS

CH2MHILL

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 ▬ 1"

DATE	MARCH, 2007
PROJ	177556
DWG	L-2
SHEET	12

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ATL/PROJ/148071 DDMT/SARD 2006/SARD/NEW FOLDER.SHEET 12 LOESS 2DWG

FILENAME: SVE SYSTEM LAYOUT DWG PLOT DATE 6-Mar-07 PLOT TIME 5:07:36 PM

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE