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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 989

Memorandum

To: Brian Renaghan, CIV AFCEE/EXA
Mike Dobbs, DES-DDC-EE

From: Tom Holmes

Date: 3 June 2009

Re: **Operating Properly and Successfully Demonstration**
Source Areas Remedial Action
Dunn Field - Defense Depot Memphis, Tennessee
FA8903-04-D-8722-0043

engineering-environmental Management, Inc (e^2M) has prepared this memorandum to demonstrate that the Source Areas Remedial Action (RA) on Dunn Field at Defense Depot Memphis, Tennessee (DDMT) is in place and "operating properly and successfully" (OPS). This memorandum was prepared for the Defense Logistics Agency under Contract FA8903-04-D-8722, Task Order 0043 to the Air Force Center for Engineering and the Environment.

The demonstration is a precondition to the deed transfer of federally-owned property under CERCLA §120(h)(3). This memorandum was prepared in accordance with *Interim Guidance for Evaluation of Federal Agency Demonstrations that Remedial Actions are Operating Properly and Successfully Under CERCLA Section 120(h)(3)*, U.S. Environmental Protection Agency (EPA), 1996. There are two requirements:

- construction and installation of an approved remedial design must be completed; and
- the remedy must be demonstrated to be operating properly and successfully.

INTRODUCTION

The selected remedy for the Source Areas was established in the *Memphis Depot Dunn Field Record of Decision* (ROD) (CH2M HILL, 2004b), which was approved in April 2004. The eastern portion of Dunn Field, including most of the Northeast Open Area and the Stockpile Area with approximately 41 of the total 64 acres, was designated available for unrestricted use (Figure 1). The selected remedy addresses surface soil, material within disposal sites and associated soil, and chlorinated volatile organic compounds (CVOCs) in subsurface soil and groundwater.

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

- Disposal Sites RA to address ET&D;
- Source Areas RA to address SVE in subsurface soils, ZVI injections at Dunn Field, and implementation of LUCs; and

- Off-Depot Groundwater RA to address installation of a PRB, MNA, and LTM.

Based on additional information developed after approval of the Dunn Field ROD, components of the selected remedy were revised as described in the *Dunn Field ROD Amendment* (e^2M, 2009b). The ROD Amendment was finalized in March 2009. The changes to the Source Areas RA components were:

- reduction in the areal extent of SVE treatment in subsurface soils on Dunn Field;
- use of thermal-enhanced SVE in the shallow subsurface soils (loess) on Dunn Field instead of conventional SVE.
- reduction in the areal extent of ZVI injections in groundwater on Dunn Field based on potential source areas with groundwater total CVOC concentrations above 1,000 µg/L;
- use of excavation, transportation and off-site disposal (ET&D) in two areas with shallow impacts; and
- re-ordered sequence of RA components so that ZVI injections in groundwater on Dunn Field will occur after implementation of the subsurface soil remedies.

The Disposal Sites RA was completed in March 2006 following attainment of remedial action objectives in each excavation area. The *Dunn Field Disposal Sites RA Completion Report* (MACTEC, 2006b) was approved by EPA on 25 August 2006. Implementation of the Off Depot Groundwater RA will begin in summer 2009. This memorandum only addresses the Source Areas RA.

SOURCE AREAS RD AND RAWPS

The *Memphis Depot Dunn Field Source Areas Final Remedial Design* (RD) (CH2M HILL, 2007) was approved by EPA on 20 March 2007 and by TDEC on 23 March 2007. The Dunn Field Land Use Controls Implementation Plan (LUCIP) was to be included in the Source Areas RD but it had not been approved at that time and was omitted. The approved LUCIP was included in the *Memphis Depot Dunn Field Off Depot Groundwater Final RD* (CH2M HILL, 2008) which was approved by EPA on 6 October 2008 and by TDEC on 8 October 2008.

The approved Source Areas RD included the following components:

- Use of thermal-enhanced and conventional SVE to remove CVOCs from subsurface soil 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 small areas in the Disposal Area.
- Injection of ZVI to remediate CVOCs in groundwater beneath onsite vadose zone source areas.
- Implementation and enforcement of land and groundwater use controls in accordance with the Dunn Field LUCIP.

The BRAC Cleanup Team (BCT) agreed to expedite implementation of the SVE component in the deeper, coarse-grained fluvial soils while the remedy for the shallow subsurface soil (loess) was reviewed. The *Dunn Field Source Areas Fluvial Soil Vapor Extraction Remedial Action Work Plan, Rev.1* (RAWP) (e^2M, 2007) was approved by EPA on 3 July 2007.

The *Dunn Field Source Areas Loess/Groundwater RAWP, Rev.1*, including the remaining components of the Source Areas remedy (thermal SVE and ET&D in the loess and ZVI injection in groundwater), received partial approval from EPA on 2 October 2007. The RAWP was approved for RA construction and operation, with demonstration of attainment of the clean-up levels for subsurface soils left to be resolved. The final approval for Loess/Groundwater RAWP, Rev. 3 was given by EPA on 5 June 2008 and by TDEC on 7 July 2008.

SOURCE AREAS RA

The implementation of the Source Areas RA components is described below. The information is taken from the *Source Areas Interim Remedial Action Completion Report* (IRACR) (e²M, 2009), which was submitted to the BCT on 26 May 2009.

Fluvial SVE

Construction of the Fluvial SVE system was completed in July 2007. The system includes seven SVE wells with screen lengths of 25 to 35 feet and extending from approximately 5 feet above the water table to approximately 5 feet below the loess/fluvial contact. Individual conveyance piping was routed to each extraction well from the treatment compound to allow operational flexibility. Vacuum is created by two 13.1 horsepower regenerative blowers. Vapor monitoring points (VMPs) were installed at ten locations, up to 80 feet from the SVE wells, to assess the vacuum ROI and vapor extraction effectiveness. The fluvial SVE system layout is shown on Figure 2.

The vapor treatment system consists of granular activated carbon (GAC) in two epoxy-coated steel vessels. Vapor treatment is implemented as necessary to meet permit discharge limits, but has not been required since the first 6 months of operation. System monitoring include weekly photoionization detector (PID) readings and measurements of flow rates and vacuum at each SVE well and the system effluent; monthly vacuum measurements at VMPs; and laboratory analysis of quarterly vapor samples at SVE wells and system effluent and annual samples at VMPs.

Condensate recovery is discharged to the City of Memphis sewer system. Samples are collected and analyzed as necessary for discharge in accordance with the discharge permit.

Individual SVE well flow rates vary from 20 to 190 actual cubic feet per minute (acfm) and combined flow from all SVE wells is approximately 785 standard cubic feet per minute (scfm) at 5.25 inches of mercury (inches, Hg) with both blowers operating. Field measurements indicate the ROI exceeds 80 feet. The Fluvial SVE system extracted approximately 3,870 pounds of VOCs from startup on 25 July 2007 through 30 January 2009.

Thermal-enhanced SVE

The thermal-enhanced SVE system utilized in situ thermal desorption (ISTD) to remove CVOCs in the loess and underlying sandy clay. Construction of the Loess SVE System was completed in May 2008. The system included 367 ISTD heater-only wells, 68 vapor extraction wells (VEWs), 63 temperature monitoring points and 26 pressure monitoring points. Chain link fencing and security lighting was constructed around each of the treatment areas for enhanced site security. A separate security fence encloses all of Dunn Field. The thermal SVE system layout is shown on Figure 3.

The target treatment zone (TTZ) for the Loess SVE system extended from approximately 5 feet bgs to 30 feet bgs. Each of the heater-only (HO) wells was installed from approximately 2 feet bgs to approximately 5 feet below the bottom of the TTZ to offset potential heat loss through the top and bottom of the TTZ. The HO well spacing was approximately 15 to 20 feet. After startup, the heater-only wells were ramped up to an operating temperature of 1,000 to 1,400°F.

The VEWs were completed with a 2-inch diameter vacuum screen that extended from approximately 5 feet to 20 feet bgs. The spacing between VEWs was approximately 25 to 30 feet. Vacuum at the VEWs was approximately 6 to 20 inches of water with individual well flow rates around 15 standard cubic feet per minute (scfm). The temperature monitoring points have individual temperature sensors at five-foot intervals that start at approximately 5 feet bgs. The pressure monitoring points were constructed with a 1-foot long well screen from 5 to 6 feet bgs.

The AQC system treated extracted vapors from the treatment areas. The AQC system consisted of vacuum blowers, heat exchangers, moisture knockout tanks, a cooling tower, transfer pumps, and liquid and vapor-phase GAC vessels. The AQC was designed to handle a combined flow of 1,500 scfm from the well field (800 scfm of steam and 700 scfm of vapor) at approximately 8 inches, Hg. The vacuum was generated by two rotary lobe positive displacement blower, with one blower operated and the other in reserve. Condensate was separated on the upstream end of the AQC system and is treated using two 250-pound liquid phase GAC vessels. The condensate treatment portion of the AQC system had a flow rate of approximately 7 gallons per minute (gpm). Treated condensate was approved for discharge by the City of Memphis under the existing IRA discharge agreement.

The thermal-enhanced SVE system began operation on 27 May 2008. Daily field measurements included system operating parameters and PID readings for vapor effluent. Additional PID readings from individual treatment areas and samples of vapor and condensate for laboratory analysis were collected periodically during operations to evaluate system performance. Confirmation soil samples were collected in a phased approach based on system performance. The heater wells in individual treatment areas were shutdown as confirmation samples demonstrated that RAOs had been met. The final heater wells were shutdown on 20 November and the vacuum extraction wells and AQC system was shutdown in the final areas on 4 December 2008. Approximately 12,300 pounds of CVOCs were removed during treatment.

ET&D

TA-1F

Excavation at TA-1F was performed to remove waste material (white, dry, fine-grained) buried at a depth of approximately 9 feet and containing carbon tetrachloride and chloroform above the RGs. The initial excavation at TA-1F was completed on 6-7 November 2007 with additional excavation on 5-7 December 2007. A storm water pipe at a depth of approximately 5 feet temporarily prevented further excavation to remove the waste material. Approximately 150 cubic yards of waste material and associated soil was excavated and placed in lined roll-offs. The soil was disposed at a landfill approved for CERCLA off-site disposal. The excavation was backfilled with clean soil. Confirmation samples confirmed only the waste material exceeded RGs.

The final excavation at TA-1F was performed on 16 February 2009. The storm sewer was removed over a length of approximately 30 feet. The waste material and associated soil approximately 1 foot above and below was placed into lined roll-off containers for waste characterization and disposal. No other waste materials were observed during the excavation. All the waste material was excavated; approximately 44 cubic yards (CY) of the soil and white material was placed into four roll-offs. The soil at the limits of the excavation was below RGs and the area was restored in accordance with the RAWP. The final limits of the excavation are shown on Figure 4.

TA-3

Excavation at TA-3 was performed to remove crushed, buried drums discovered during construction of the Fluvial SVE system. The limits of excavation were estimated in October 2007 on the basis of a geophysical survey and test pits. Excavation began on 27 October 2007 and was completed on 8 January 2008. Approximately 3,600 cubic yards of drums, other debris and soil were excavated and transported to a landfill approved for CERCLA off-site disposal. The final excavation covered an area of approximately 14,000 square feet (sq. ft.) and averaged approximately 5 feet deep. Although reported concentrations of VOCs, SVOCs and metals in soil confirmation samples exceeded RGs, further excavation was not performed in order to proceed with construction of the thermal-enhanced SVE system in the loess. The excavation was backfilled in January 2008.

Additional soil sampling was performed in TA-3 in February 2009 to determine whether ET&D was required to meet RGs and, if necessary, to establish the limits of additional excavation. Soil borings were located on grids in the areas where initial confirmation samples exceeded the RGs and samples were analyzed for VOCs and SVOCs; the metal concentrations in the initial confirmation samples only slightly exceeded RGs and the average concentrations were well below RGs. Additional excavation is required in three areas in order to achieve the soil RAO in TA-3. ET&D is currently being performed. The initial limits of excavation at TA-3 and the three areas requiring additional excavation are shown on Figure 5.

ZVI

ZVI injections were to be performed after completion of the thermal-enhanced SVE treatment. The highest total CVOC concentrations in groundwater samples collected from the Source Areas on Dunn Field in April 2009 was 107 µg/L in MW-107 (Figure 6). Since the sample analytical results demonstrate that total CVOC concentrations are well below 1000 µg/L throughout Dunn Field, ZVI injection is not required.

OPS DEMONSTRATION

System metrics for each Source Areas RA component were provided in the approved RAWPs. The Fluvial SVE system is planned to operate for approximately 5 years and metrics were developed to determine whether it is operating both properly and successfully. Since there are no continuing operations for the other components (soil ET&D, thermal-enhanced SVE and ZVI), operating properly determinations were not necessary; however, metrics were developed to confirm each RA had operated successfully.

The metrics from the RAWPs are listed below with a summary of the RA status supporting the OPS demonstration. Detailed information on the RA construction, operation and performance monitoring is provided in the Source Areas IRACR.

Fluvial SVE

The metrics for determining that the Fluvial SVE is operating properly are:

- SVE wells and VMPs are installed at locations and to depths and specifications as indicated in the RAWP.
  - SVE wells and VMPs were installed at the locations and depths planned as confirmed by as-built surveys and field installation diagrams.
- 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 the RAWP.
  - All components were installed in accordance with the RD as documented by as-built drawings.
  - A final inspection was performed by the BCT on 8 August 2007 with no corrective actions required.
  - From system start-up in July 2007 through January 2009, the system has operated 93.6 percent of the time. System vacuum and flow rate have averaged approximately 775 scfm at 5.5 inches Hg with both blowers.
- Blowers extract subsurface vapor from individual SVE wells near the design flow rate of 100 acfm.
  - Flow rates at individual wells range from less than 20 acfm at SVE-A and –G to over 170 acfm at SVE-B, -C and -F. The lower flow rates at wells SVE-A and SVE-G are due to more fine-grained soils in the fluvial deposits at those locations.
- GAC adsorption capacity is sufficient to remove CVOCs from extracted vapor stream.
  - Vapor treatment with GAC kept air emissions below permit limits since operations began, as demonstrated by field and laboratory monitoring results. GAC treatment was discontinued when CVOC concentrations declined below permit limits.

The metrics for determining that Fluvial SVE is operating successfully are:

- 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);
  - Vapor pressure measurements at VMPs have demonstrated vacuum influence beyond 80 feet since system operations began. VMPs 4A/B, 8A/B and 10A/B located 60 to 80 feet from the associated SVE wells have consistently had vacuums greater than 1 inch H_2O.
- Total extracted CVOC mass is consistent with estimates as indicated in the RD as updated by RA-C soil sample results.
  - CVOC mass in the fluvial deposits was estimated at 90 to 230 pounds in the RD. The estimate was revised to 979 pounds based on additional soil sampling during installation of the Fluvial SVE system. The fluvial SVE system has removed an estimated 3,870 pounds as of 30 January 2009. The difference is considered due to the limited number of soil samples used to estimate the mass and to CVOC mass being removed from the overlying loess.

The metrics for determining that the other RA components operated successfully are:

ET&D

- CVOC concentrations in confirmation soil samples below RGs.
  - Confirmation soil samples from TA-1F were below RGs and visual observations confirmed the waste material was removed.
  - Excavation is continuing in TA-3.

Thermal-Enhanced SVE

- CVOC concentrations in confirmation soil samples below RGs based on comparison with average CVOC concentrations for each treatment area and no individual samples with CVOC concentrations exceeding an RG by a factor of 10 or more.
  - Confirmation soil samples were collected at various depths from soil borings advanced throughout the four treatment areas and analyzed for VOCs. The average concentration for each of the CVOCs in TA-1, TA-2, TA-3 and TA-4 was below the RG and none of the final samples exceeded an RG by a factor of 10 or more.
  - The thermal SVE system removed an estimated 12,500 pounds of CVOCs from the loess. CVOC mass in the loess was estimated at 9,000 to 14,000 pounds in the RD.

ZVI Injections

- Groundwater concentrations in Source Areas are reduced by 90% without significant rebound in concentrations during post-ZVI monitoring. Reduction in groundwater concentrations to below MCLs throughout the plume will be achieved through the Off Depot Groundwater RA.

- ZVI injections were not required because groundwater objectives for the Source Areas remedy were achieved by the subsurface soil remedies.
- The highest total CVOC concentration reported on Dunn Field in the May 2007 baseline groundwater sampling prior to fluvial SVE operation was 42,560 µg/L in MW-73; the highest total CVOC concentration in April 2009 was 107 µg/L in MW-57, a reduction of 99.7%.

SUMMARY

The metrics established to demonstrate OPS for the Source Areas RA have been met, as discussed above. In addition, the Source Areas RA has met the groundwater cleanup objective for Dunn Field. The goal for the Source Areas groundwater remedy is that concentrations of individual CVOCs not exceed 50 µg/L, with further reduction to MCLs to be achieved by the Off Depot remedy.

CVOC concentrations in groundwater began to decrease after fluvial SVE operations began in July 2007 indicating that contaminant migration from subsurface soils to groundwater was prevented. The decrease is evident in plume maps developed from semiannual groundwater sample analyses in 2007 and 2008 (Figure 7).

The Interim Remedial Action groundwater recovery system includes 11 recovery wells on the north and west boundaries of Dunn Field and when operating discharges approximately 70 gallons per minute to the City of Memphis sewer system. All recovery wells (RWs) are currently offline due to the decrease in concentrations. Five RWs were shutdown on 9 June 2008 and the remaining six RWs were shutdown on 23 January 2009. Following review of the April 2009 groundwater sample results (Figure 6), removal of the IRA system with proper abandonment of all RWs was recommended.

CVOC concentrations for individual constituents are below 50 µg/L in all RWs and Dunn Field monitoring wells, except MW-07 and MW-230. Wells MW-07 and MW-230 are near the northern property line upgradient of the Source Areas and the concentrations are due to the plume migrating on to Dunn Field from an off-site source to the northeast.

Groundwater concentrations have decreased dramatically downgradient of the Source Areas. From October 2008 to April 2009, total CVOC concentrations in MW-77 located 200 feet west of Dunn Field decreased from 2827 µg/L to 52 µg/L (98%) and concentrations in MW-162 located 400 feet west of Dunn Field decreased from 8789 µg/L to 184 µg/L (98%).

Figures

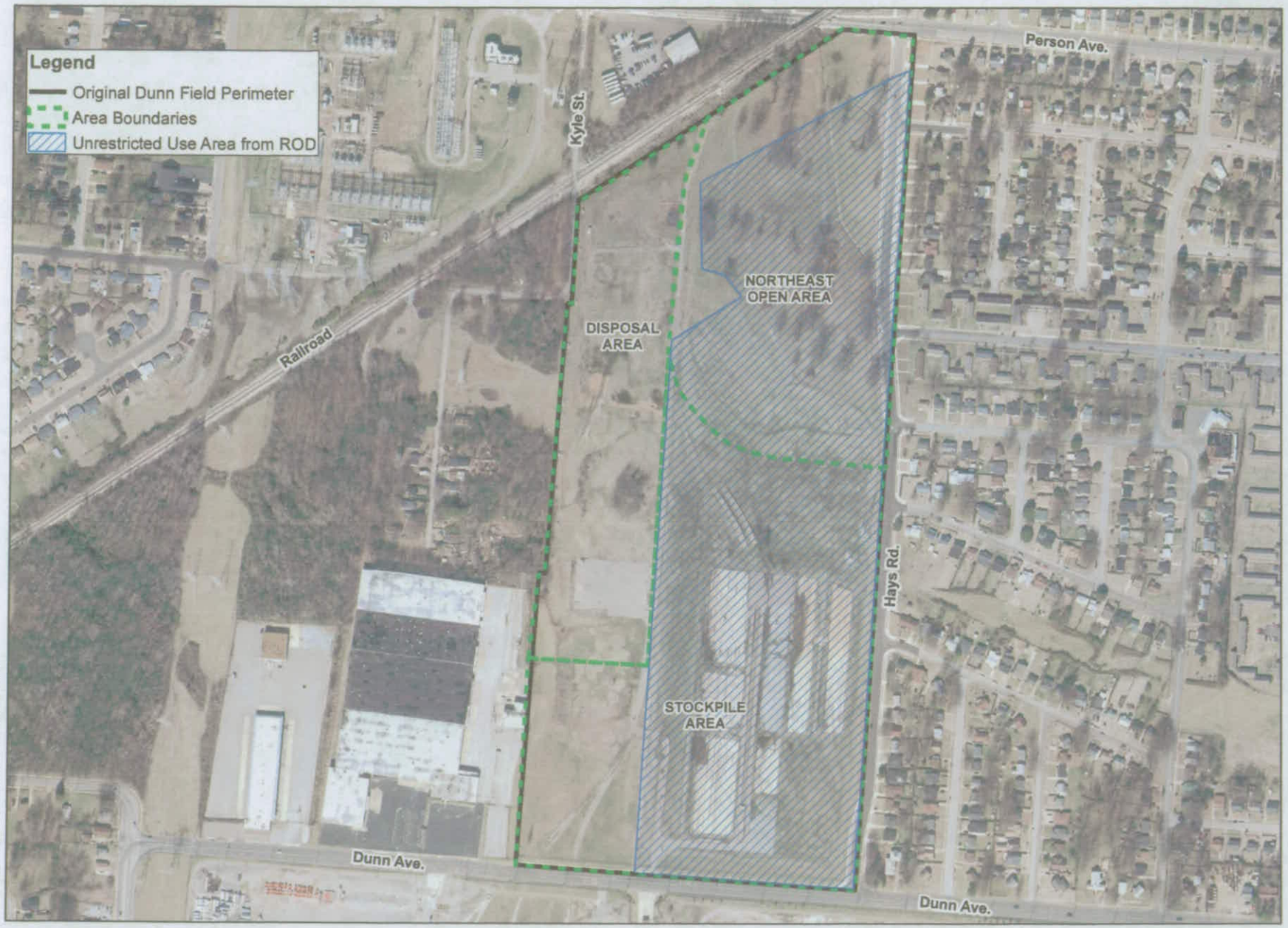

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Figure 1

AREA DESIGNATIONS AT DUNN FIELD

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Projection: NAD 1927 StatePlane Tennessee
Units: Feet

Aerial Photo Date: 2006

0 100 200 400
Feet

Installation Location
Memphis, Tennessee

Date: June 2009
Edition: Rev. 0

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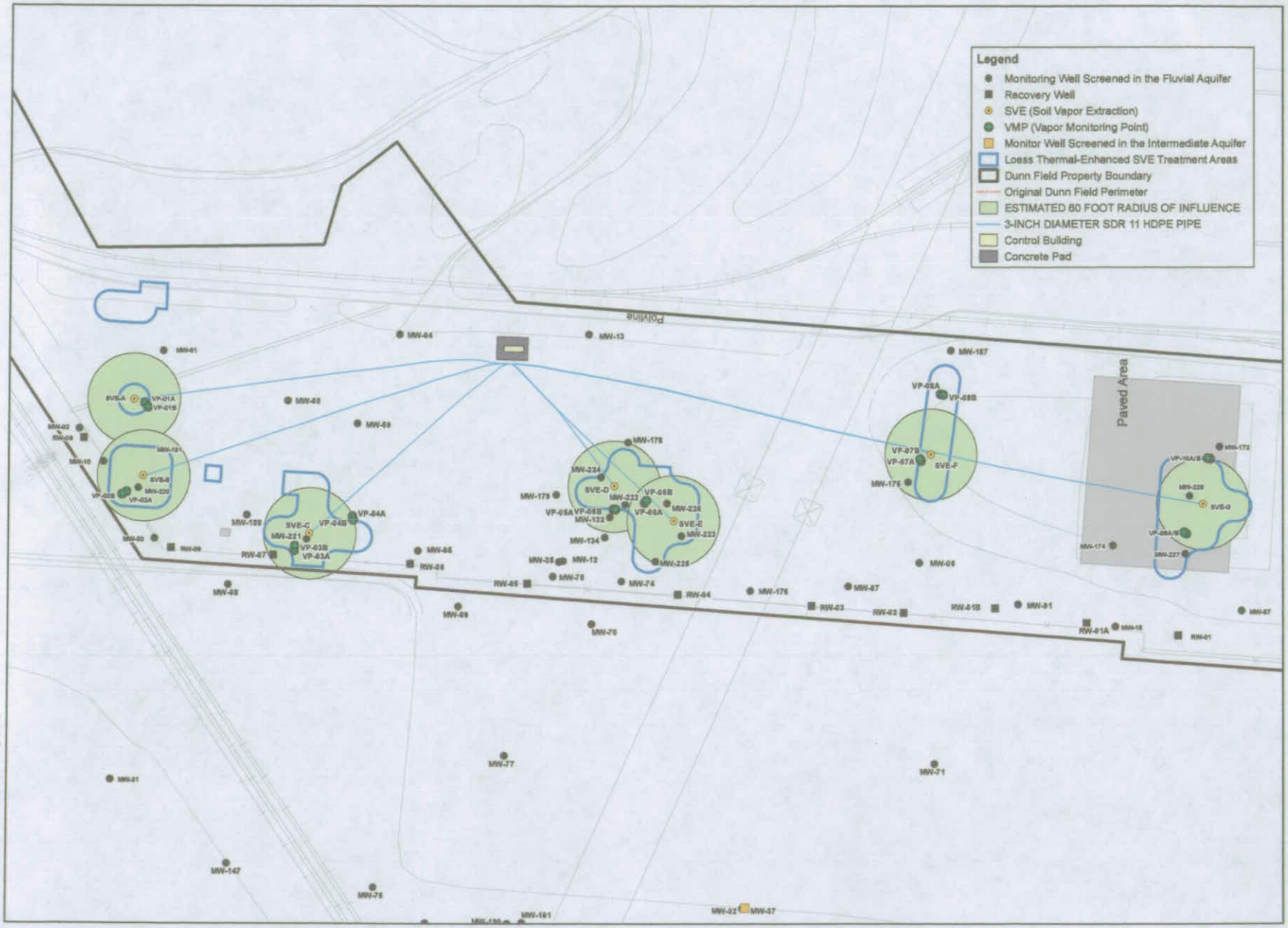

Figure 2

FLUVIAL SVE SYSTEM LAYOUT

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

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

0 50 100 150 200 Feet

Installation Location
Memphis, Tennessee

Date: June 2009
Battlbox: Rev. 0

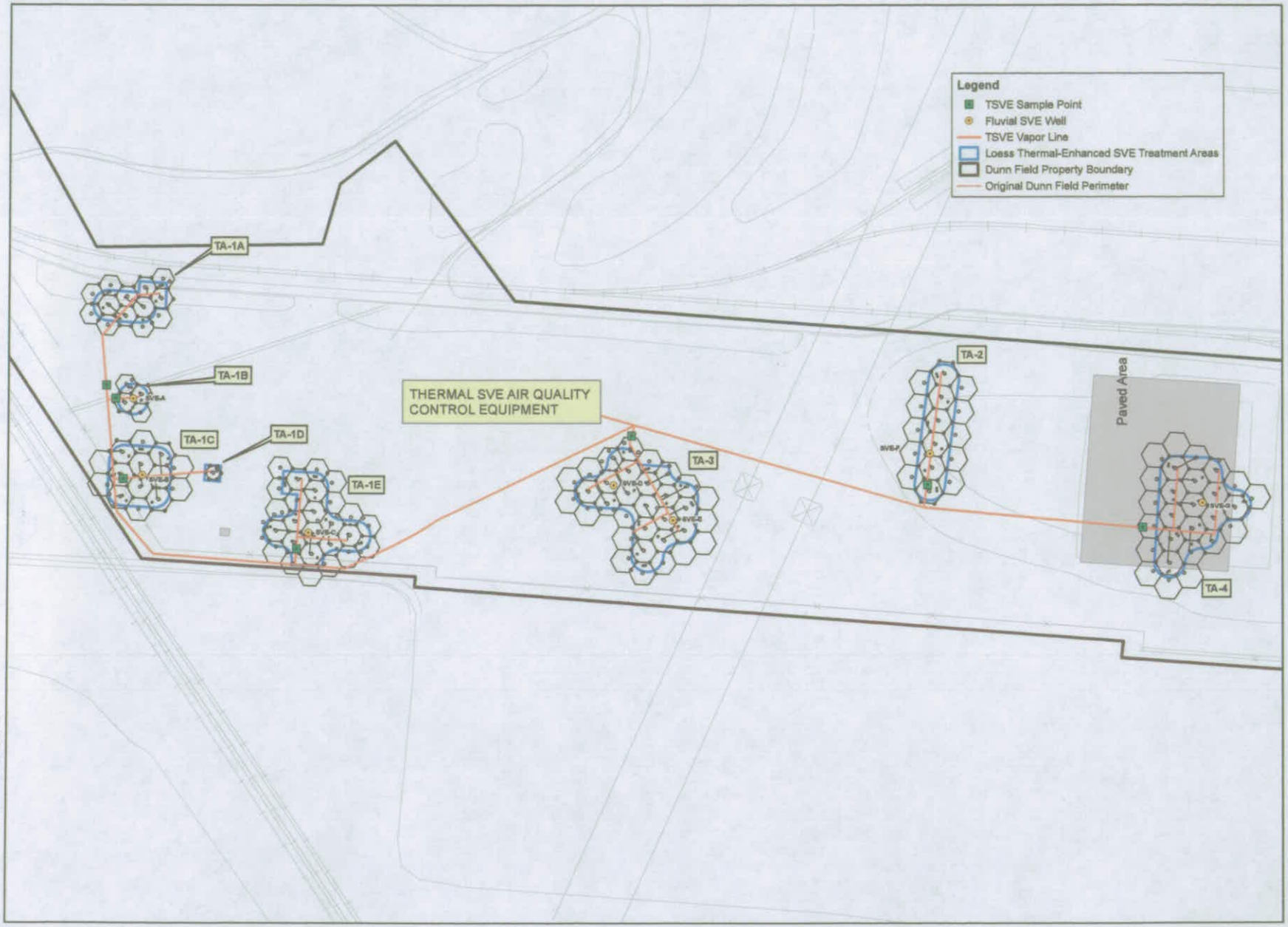

Figure 3

THERMAL SVE SYSTEM LAYOUT

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

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

0 50 100 150 200 Feet

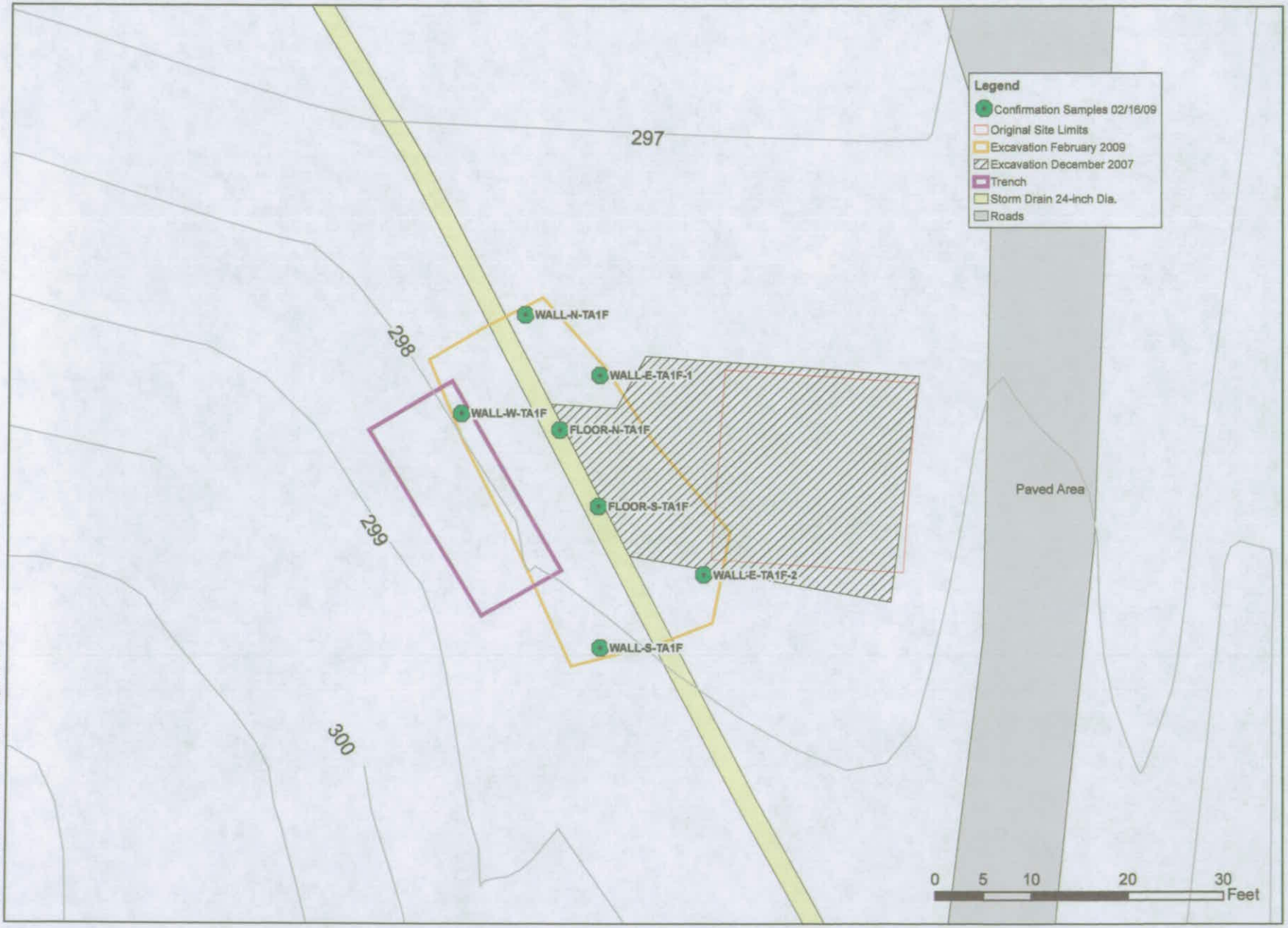

Figure 4

TA-1F EXCAVATION AREA

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

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

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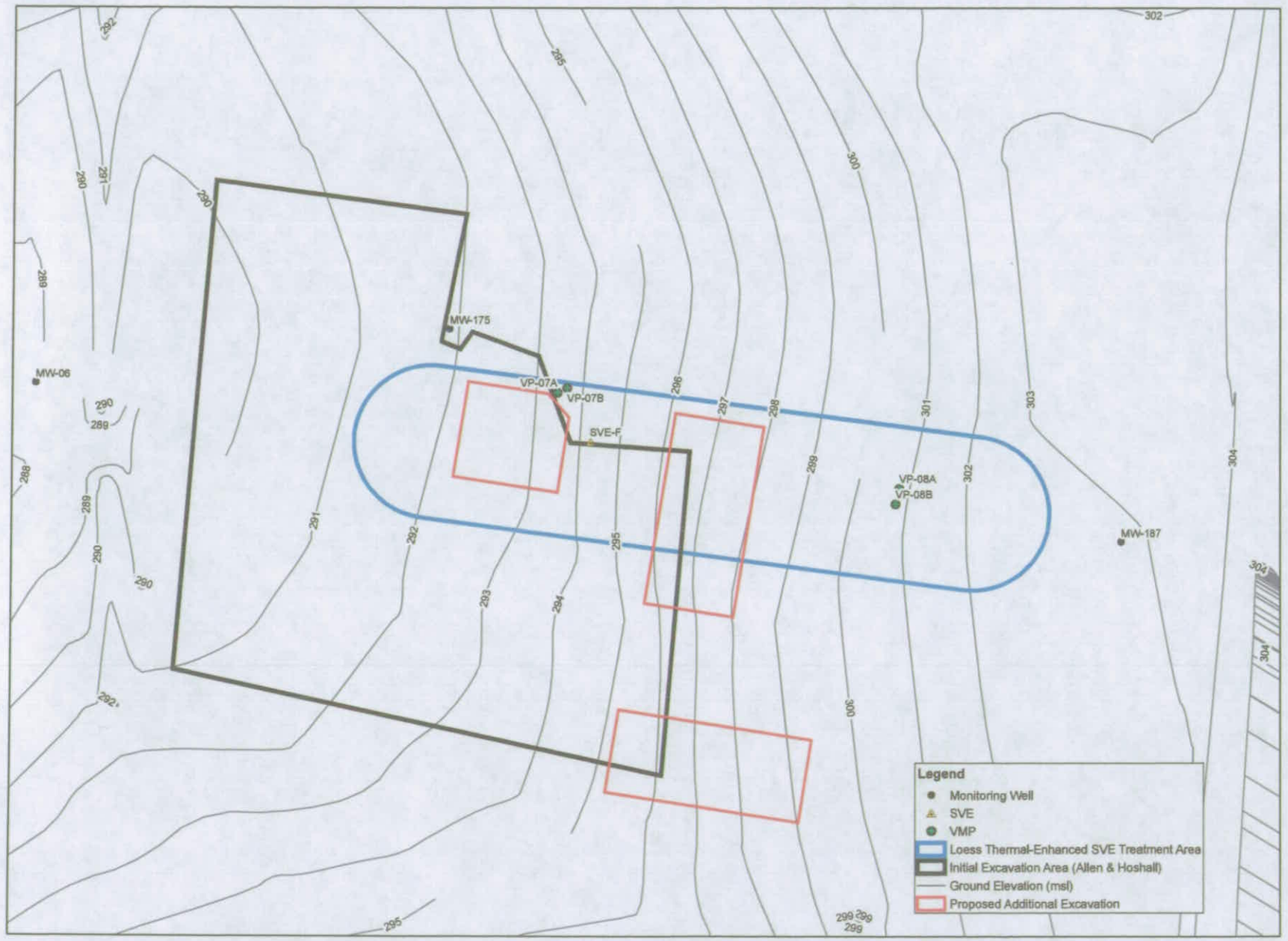

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Figure 5

TA-3 EXCAVATION AREA

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

0 25 50

Feet

Installation Location
Memphis, Tennessee

Date: June 2009
Edition: Rev. 0

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Figure 6

TOTAL CVOC CONCENTRATIONS, APRIL 2009

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

CVOCs Fluvial Wells
ug/L
- 0 - 50
- 51 - 100
- 101 - 500
- 501 - 1000

CVOCs Non-Fluvial Wells
ug/L
- 0 - 50

SVE -Soil Vapor Extraction Point

Original Dunn Field Property Boundary

0 200 400 600
Feet

Installation Location
Memphis, Tennessee

Date: June 2009
Edition: Rev 0

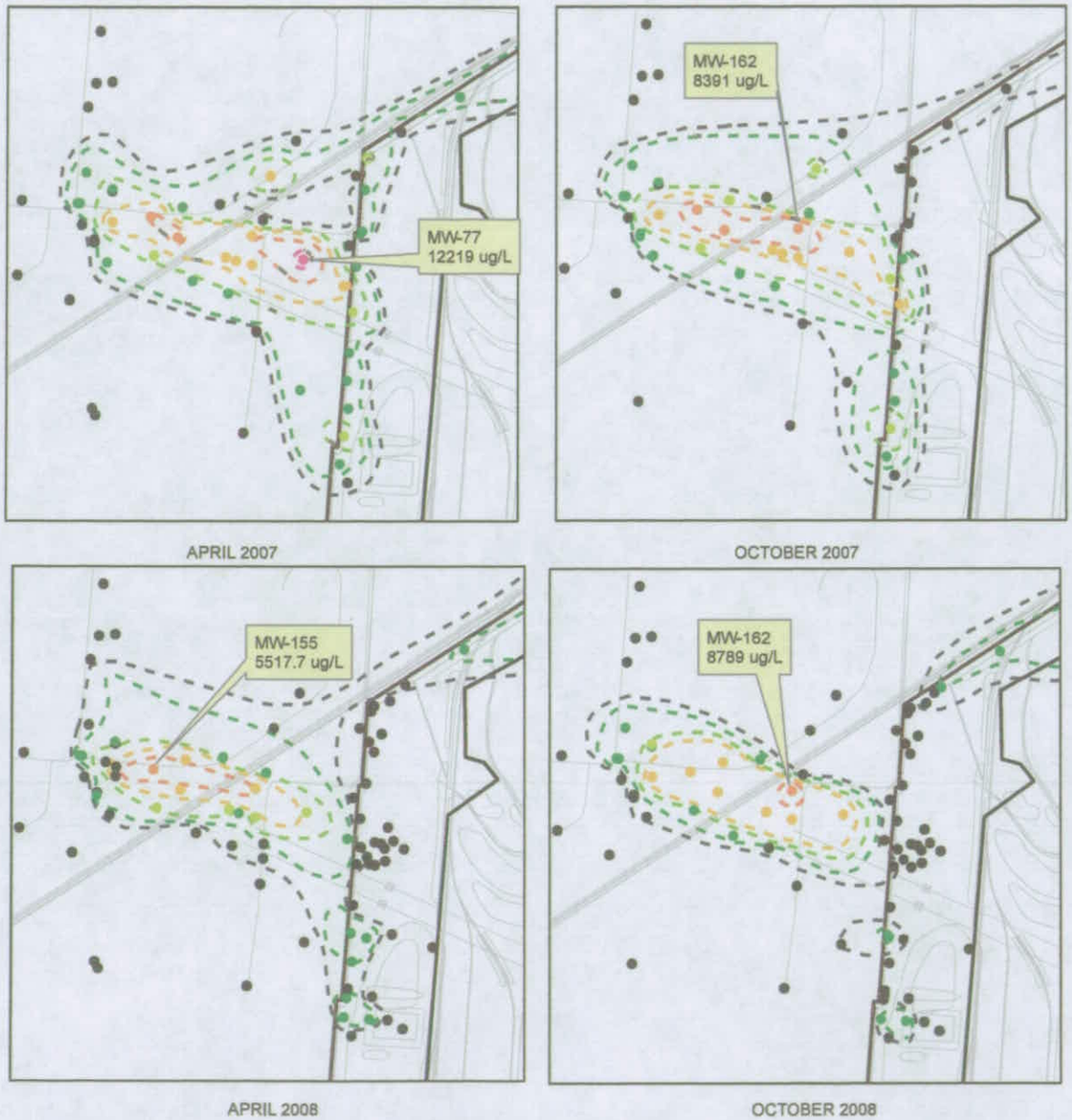

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Figure 7

TOTAL CVOC
PLUME TIME TREND

SOURCE AREAS
OPS DEMONSTRATION

DUNN FIELD
DEFENSE DEPOT
MEMPHIS, TENNESSEE

Legend

Total CVOC Isopleth (ug/L)
- 50
- 100
- 500
- 1000
- 5000
- 10000

Total CVOC Ranges (ug/L)
- 0 - 100
- 101 - 500
- 501 - 1000
- 1001 - 5000
- 5001 - 10000
- 10001 - 50000

Dunn Field Property Line
Original Dunn Field Perimeter

Notes:
1. Highest concentration at well pairs used for contour.
2. Total CVOCs include: CT, CF, DCA, DCE, cDCE, tDCE, TCA, TCE, PCE, PCA and VC.
3. Highest Total CVOC labeled for each event.

0 200 400 600 800 1,000
Feet

Installation Location
Memphis, Tennessee

Date: June 2009
Edition: Rev. 0

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FINAL PAGE

ADMINISTRATIVE RECORD

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