KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Soil-Vapor Extraction Optimization Plan
Bulk Fuels Facility Spill
Solid Waste Management Units ST-106 and SS-111

September 2011

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BULK FUELS FACILITY SPILL
SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-11

September 2011

Prepared for
U.S. Army Corps of Engineers
Albuquerque District
Albuquerque, New Mexico 87109

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This Soil-Vapor Extraction Optimization Plan presents data collection, analysis, and modeling activities that will be used to optimize the soil-vapor extraction (SVE) system at the Bulk Fuels Facility at Kirtland Air Force Base, New Mexico. This system will be optimized within the constraints of the existing SVE and monitoring wells and the capacity of the four internal combustion engine SVE systems. The SVE system comprises 17 extraction wells, 55 monitoring wells, and 3 non-aqueous phase liquid (NAPL) monitoring wells. Currently two SVE extraction wells and the three NAPL wells are connected to SVE engine units.

To quantitatively assess and model SVE vadose-zone remediation and subsequently optimize the existing system, primary data to be collected will include: (1) existing SVE extraction and monitoring wells will be surveyed for coordinates and elevation; (2) individual extraction well performance criteria, including vapor flow/vacuum/concentration relationships, will be developed; (3) vertical radius of influence (ROI) around a given extraction well will be determined; and horizontal ROI around individual extraction wells and the extraction well cluster will be determined.

Collected data will be incorporated into the 3D optimization analysis of remediation prospects for the vadose zone contamination using existing SVE extraction wells and the RSI SVE units. This analysis will involve vapor concentration distribution, lithology, and 3D numerical modeling of vapor flow. Optimization parameters to be evaluated will include vapor concentrations, minimized supplemental propane usage, lithology, and effective 3D treatment volume associated with a given extraction well.

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PREFACE

This Soil-Vapor Extraction (SVE) Optimization Plan was prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) for the U.S. Army Corps of Engineers (USACE) under Contract No. W912DY-10-D-0014, Delivery Order 0002. This work plan presents the data collection, analysis, and modeling activities that will be used to optimize the SVE system at the Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111 at Kirtland Air Force Base, located in Albuquerque, New Mexico. This system will be optimized within the constraints of the existing SVE and monitoring wells and the capacity of the four internal combustion engine SVE systems. To quantitatively assess and model SVE vadose-zone remediation and subsequently optimize the existing system, it is necessary to collect fundamental data on the performance of the wells in terms of operational effectiveness and mass removal. The primary data to be collected are as follows:

- Existing SVE extraction and monitoring wells will be surveyed for coordinates and elevation.
- Individual extraction well performance criteria, including vapor flow/vacuum/concentration relationships, will be developed.
- Vertical radius of influence (ROI) distances around extraction wells will be determined.
- Horizontal ROI distances around extraction wells will be determined.

Once the data are collected, they will be incorporated into the three-dimensional (3D) optimization analysis of remediation prospects of the vadose zone contamination using existing SVE extraction wells and the RSI SVE units. This analysis will involve vapor concentration distribution, lithology, and 3D numerical modeling of vapor flow. The optimization parameters will be evaluated in terms of importance as follows: cost of operation, vapor concentrations, lithology, and effective 3D treatment volume associated with a given extraction well.

This work was performed under the authority of the USACE, Contract No. W912DY-10-D-0014, Delivery Order 0002. All work was conducted from January through March 2011. Mr. Walter Migdal is the Project Manager for the USACE Albuquerque District. Mr. Wayne Bitner, Jr. is the Kirtland AFB Restoration Section Chief, and Mr. Tom Cooper is the Shaw Project Manager. This plan was prepared by Mr. Gary Hecox.

Tom Cooper, PG, PMP
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Project Manager

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ACRONYMS AND ABBREVIATIONS

$\mu g/L_V$	micrograms per liter vapor
3D	three-dimensional
AFB	Air Force Base
AST	aboveground storage tank
AvGas	aviation gasoline
BFF	Bulk Fuels Facility
bgs	below ground surface
BTU	British thermal unit
FFOR	Former Fuel Offloading Rack
ft	feet
ft^3	cubic foot (feet)
JP-4	Jet Propellant-4 fuel
JP-8	Jet Propellant-8 fuel
lbs	pounds
mg/kg	milligrams per kilogram
NAPL	non-aqueous phase liquid
NMED	New Mexico Environment Department
PLC	programmable logic controller
ppm	parts per million
PPM_V	parts per million vapor
ROI	radius of influence
RSI	Remediation Services, International
SCFM	standard cubic feet per minute
SVE	soil-vapor extraction
TPH	total petroleum hydrocarbons
TPH-GRO	total petroleum hydrocarbons as gasoline range organics
USF	Santa Fe Group depositional group
VOC	volatile organic compound

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EXECUTIVE SUMMARY

This work plan presents the data collection, analysis, and modeling activities that will be used to optimize the soil-vapor extraction (SVE) system at the Bulk Fuels Facility (BFF) at Kirtland Air Force Base, New Mexico. This system will be optimized within the constraints of the existing SVE and monitoring wells and the capacity of the four internal combustion engine SVE systems. The current SVE system comprises 17 extraction wells, 55 monitoring wells, and 3 non-aqueous phase liquid (NAPL) monitoring wells. Currently two SVE extraction wells and the three NAPL wells are connected to SVE engine units.

In 2011, 210 new vadose zone monitoring wells in 35 well clusters were installed in the BFF area. Of the 210 wells, 35 wells were constructed with 3-inch screens and casing and 20-foot sand-pack intervals that allow their use as SVE extraction wells. These wells have been incorporated as appropriate into the radius of influence (ROI) in this work plan.

Three-dimensional (3D) modeling allows for the calculation of the volumes and areas of contaminated soil within various concentration ranges. For the volatile organic compound (VOC) plume, approximately 7,000,000 cubic yards (187 million cubic feet) of vadose zone are contaminated at concentrations greater than 1,000 parts per million vapor (ppm_V) and 34,000,000 cubic yards (937 million cubic feet) are contaminated at concentrations greater than 100 ppm_V. The horizontal footprint of the 10,000-ppm_V plume encompasses approximately 29 acres and extends from near the ground surface downward to the top of the water table at an approximate depth of 500 feet below ground surface. The footprint of the 100-ppm_V plume covers approximately 77 acres with the same vertical extent as the 1000 ppm_V plume.

The Remediation Services, International (RSI) Unit 249 is connected by manifold to nine of the ST-106 SVE wells, two of which are currently operational. The current mass recovery rate is approximately 720 pounds (lbs) (120 gallons) of VOCs per day; through the end of June 2011, this unit had removed more than 200,000 gallons of NAPL-equivalent vapors (Shaw, 2011). The two active SVE extraction well clusters influence a maximum of approximately 30% of the vadose zone contamination.

RSI Unit 335, installed on groundwater monitoring well KAFB-1065, has a current mass removal rate of 66 lbs (11 gallons) of VOCs per day. Through the end of June 2011, this unit had removed slightly more than 80,000 gallons of NAPL-equivalent vapors (Shaw, 2011). RSI Unit 344, installed on well KAFB-1068, has a current mass recovery rate of approximately 100 lbs (18 gallons). Through the end of June 2011, this unit had removed slightly more than 55,000 gallons of NAPL-equivalent vapors (Shaw, 2011). RSI Unit 345, installed on well KAFB-1066, has a current mass recovery rate of approximately 350 lbs (58 gallons) of VOCs per day. Through the end of June 2011, this unit had removed slightly more than 59,000 gallons of NAPL-equivalent vapors (Shaw 2011). Through the end of June 2011, all SVE units combined had removed more than 400,000 gallons of NAPL-equivalent vapors (Shaw, 2011). An overall maximum area of NAPL plume remediation is calculated at 4.5 acres for all three systems combined. This compares to a to an overall NAPL plume area of approximately 50 acres.

After up to six years of SVE operations, the majority of the vapor concentration trends in SVE wells exhibit declines, but the magnitude of the decline since 2004 varies quite markedly. In conjunction with a simple remedial volume analysis around the existing extraction wells, it is concluded that while active remediation has reduced concentrations locally, natural attenuation is a major contributor to the overall decreases in concentrations.

To quantitatively assess and model SVE vadose-zone remediation and subsequently optimize the existing system, it is necessary to collect fundamental data on the performance of the wells in terms of operational effectiveness and mass removal. The primary data to be collected are as follows:

- Existing SVE extraction and monitoring wells have been surveyed for coordinates and elevation.
- Selected extraction well performance criteria, including vapor flow/vacuum/concentration relationships, will be developed.
- Vertical radius of influence (ROI) distances around a given extraction well will be determined.
- Horizontal ROI distances around individual extraction wells or extraction well clusters will be determined.

Once the data are collected, they will be incorporated into the 3D optimization analysis of remediation prospects for the vadose zone contamination using existing SVE extraction wells and the RSI SVE units. This analysis will involve vapor concentration distribution, lithology, and 3D numerical modeling of vapor flow. The optimization parameters will be evaluated in terms of importance as follows: vapor concentrations, minimized supplemental propane usage, lithology, and effective 3D treatment volume associated with a given extraction well.

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1. INTRODUCTION

This work plan presents the data collection, analysis, and modeling activities that will be used to optimize the soil-vapor extraction (SVE) system at the Bulk Fuels Facility (BFF) at Kirtland Air Force Base (AFB), located in Albuquerque, New Mexico. This system will be optimized within the constraints of the existing SVE and monitoring wells and the capacity of the four internal combustion engine SVE systems. The results of the optimization will be presented in the ongoing quarterly reports.

Section 2 of this SVE Optimization Plan presents background information for the Kirtland AFB BFF Spill. Section 3 discusses site conditions including regional and site-specific geology and hydrogeology, presents the nature and extent of contamination at the site, and summarizes previous investigations. Section 4 describes the current SVE system operating conditions, and Section 5 presents the proposed SVE remediation optimization program.

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2. BACKGROUND INFORMATION

2.1 Site Description

Kirtland AFB is located in Bernalillo County, in central New Mexico, southeast of and adjacent to the City of Albuquerque and the Albuquerque International Sunport (Figure 2-1). The approximate area of the base is 52,287 acres.

2.2 Operational History

The BFF Spill site (Solid Waste Management Units ST-106 and SS-111) is located in the northwestern portion of Kirtland AFB (Figure 2-1). Historical aerial photography has revealed that the area was used for fuel storage and processing as early as 1951 (CH2M HILL, 2001). At that time, the fueling area was separated into a distinct tank holding area where bulk shipments of fuel were received (near the location of existing well KAFB-1066) and a separate fuel loading area where individual fuels trucks were filled. The truck loading area appears to have been approximately 250 feet (ft) north of the tank area.

Subsequent aerial photographs indicate that construction of the facility and associated infrastructure took place from 1951 until 1953. Once completed, the facility operated until it was removed from service in 1999, as a result of below-grade line leakage along the offloading rack (CH2M HILL, 2001). Bulk storage for Jet Propellant-8 fuel (JP-8), diesel fuel, and aviation gasoline (AvGas) was managed in the eastern portion of the facility. A 250-gallon underground storage tank was located near the Pump House, Building 1033 (CH2M HILL, 2001). The three types of fuel handled by the BFF were AvGas, Jet Propellant-4 fuel (JP-4), and JP-8. The use of AvGas and JP-4 at Kirtland AFB was phased out in 1975 and 1993, respectively. JP-8 was handled through the Former Fuel Offloading Rack (FFOR) until the leak was discovered in 1999.

The exact history of releases is unknown. Conceptually, releases could have occurred when fuel was transferred from railcars, through the FFOR, to the Pump House and then to the bulk fuel storage containers on the south end of the site (aboveground storage tanks [ASTs] Tanks 2420 and 2422). The probable release points were investigated and are summarized in subsequent sections. Fuel transfer from the railcars to the Pump House was done under vacuum transfers. Transfer of fuel from the Pump House to the bulk storage containers was performed under pressurized conditions. Fuel transfer infrastructure for vacuum transfers was exempt from pressure testing, whereas fuel infrastructure for pressurized transfer did undergo regular pressure testing. Only when the vacuum portion of the fuel system underwent pressure testing in 1999 was any problem noted in the fueling system.

At present, jet fuel is stored in two ASTs (2.1- and 4.2-million gallon capacity), diesel fuel is stored in two ASTs (one 5,000-gallon and one 10,000-gallon capacity), and unleaded gasoline is stored in one AST (10,000-gallon capacity). The site currently has one temporary JP-8 offloading rack located in the southwest corner of the facility, west of the fuel loading structure at Building 2404. This rack was placed into service following the piping failure at the FFOR (ST-106). A second small offloading rack (Building 2401) is used for the delivery of diesel and unleaded gasoline motor vehicle fuels.

Fuel delivered to the temporary JP-8 offloading rack is conveyed to the Pump House (Building 1033) via subsurface transfer lines. The fuel is then pumped to the JP-8 ASTs by piping of varying sizes that runs aboveground for approximately 750 ft and runs belowground for approximately 300 ft.

3. SITE CONDITIONS

This section presents a detailed discussion of Kirtland AFB history, geology, and known extent of contamination.

3.1 Geology

3.1.1 Regional Geology

The geology of the Kirtland AFB area varies in accordance with the regional geology. The eastern portion of the base is mountainous, with elevations reaching 7,900 ft above mean sea level. These mountains are composed of Precambrian metamorphic, igneous (primarily granite), and Paleozoic sedimentary rock (primarily marine carbonates). The western portion of the base (which includes the BFF) lies within the Albuquerque Basin. Geologic features in this area of the basin include travertine and unconsolidated and semi-consolidated piedmont deposits, as well as aeolian, lacustrine, and stream channel deposits.

In general, the surficial geology is characterized by recent deposits (i.e., mixtures of sandy silt and silty sand with minor amounts of clay and gravel), Ortiz gravel (i.e., alluvial piedmont sand and gravel deposits), and the Santa Fe Group (i.e., a mixture of sand, silt, clay, gravel, cobbles, and boulders). Generally, the northern and western portions of Kirtland AFB are dominated by unconsolidated geologic units; consolidated units predominate within the eastern half of the base.

Kirtland AFB lies within the eastern portion of the Albuquerque structural basin, which contains the through-flowing Rio Grande. The basin is approximately 90 miles long and 30 miles wide. The deposits within the Albuquerque Basin consist of interbedded gravel, sand, silt, and clay. The presence of clay has significant implications for bulk hydrocarbon migration in the vadose zone. The thickness of basin-fill deposits in most of the basin exceeds 3,000 ft, though the thickness varies considerably because of the significant amount of faulting in the basin (CH2M HILL, 2008).

Geologic materials of primary importance within the basin are the Santa Fe Group and piedmont slope deposits. The Santa Fe Group consists of beds of unconsolidated to loosely consolidated sediments and interbedded volcanic rocks. The materials range from boulders to clay and from well-sorted stream channel deposits to poorly sorted slope wash deposits. Coalescing alluvial fans of eroded materials from the surrounding mountains were deposited unconformably over the Santa Fe Group, extending westward from the base of the Sandia and Manzano mountains to the eastern edge of the Rio Grande floodplain. The fan sediments range from poorly sorted mud flow material to well-sorted stream gravel; the beds consist of channel fill and interchannel deposits. The fan deposits range in thickness from 0 to 200 ft and thicken toward the mountains. The Santa Fe Group (USF) underneath the BFF is further broken down into two depositional facies called the USF-1 and USF-2 (Hawley et al., 1995). USF-1 is present from ground surface to approximately 86 ft below ground surface (bgs), then a transition occurs where USF-1 and USF-2 are interfingered to a depth of 144 ft bgs, under which USF-2 is present to a depth of greater than 500 ft bgs (CH2M HILL, 2008).

3.1.2 Site-Specific Geology

Soil types at the BFF range from lean clays, silts, and sands to minor silty or sandy gravels. These soil types can be correlated into several litho-stratigraphic zones discussed as follows:

- From the surface to approximately 86 ft bgs, the soil primarily consists of thick, discontinuous intervals of silt and silty or sandy clays.
- From approximately 86 to 144 ft bgs, two 13- to 25-ft-thick units of poorly graded, fine-grained sands alternate with two silty, sandy, and lean clay units that are up to 25 ft in thickness.
- From approximately 144 to 270 ft bgs, poorly graded, fine-grained sands combine with well-graded, fine-to- coarse-grained sands.

Soil types at the BFF range from wet to dry. The finer-grained upper soil is generally moist, while the coarser-grained deeper soil could be moist or dry. Several minor perched water-bearing zones are present in the vadose zone above the regional groundwater table at the BFF. None of these water-bearing zones is substantial enough to merit the installation of a groundwater monitoring well. Some of these water-bearing zones below 400 ft bgs are probably remnants of the regional aquifer left behind as the water table has dropped. The regional water table varies with location within Kirtland AFB and ranges from approximately 485 to 500 ft bgs (CH2M HILL, 2001).

3.2 Hydrogeology

The groundwater system at Kirtland AFB and in the Albuquerque area lies within the Albuquerque Basin, also referred to as the Middle Rio Grande Basin. The basin is part of the Rio Grande Rift. As the Rio Grande Rift spread, the Albuquerque Basin filled with sediments several miles in thickness, most of which are referred to as the Santa Fe Group. The unit consists of unconsolidated sediments that thin toward the basin boundary. Edges of the basin are marked by normal faults. Overlying the Santa Fe Group are the Pliocene Ortiz gravel and Rio Grande fluvial deposits.

Generally, the upper unit of the Santa Fe Group contains the most productive portion of the regional aquifer that supplies groundwater to the City of Albuquerque and Kirtland AFB. The unit is characterized by piedmont slope, river, and floodplain deposits. The ancestral Rio Grande formed a large aggradational plain in the central basin, depositing a mix of coarse- to fine-grained sands, silts, and clays with variable bed thickness.

Basin-fill deposits make up the aquifer in the Albuquerque Basin. Hydraulic conductivity values range from 0.25 to 50.0 ft/day because of large variations in the lithology of the basin-fill deposits. Clay layers have relatively low hydraulic conductivity, whereas gravel and cobble deposits have relatively high hydraulic conductivity. Deposits of interbedded gravel, sand, silt, and clay have intermediate hydraulic conductivity (Tetra Tech, 2004).

This principal aquifer underlies Kirtland AFB, with the basin fill in this area consisting of unconsolidated and semi-consolidated sands, gravels, silts, and clays of the Santa Fe Group; alluvial fan deposits associated with erosion of upland areas; and valley alluvium associated with stream development. The alluvium varies in thickness from a few feet near the mountains on the east side of the base to greater than 2,100 ft at a location 5 miles southwest of the airfield (Tetra Tech, 2004).

3.3 Nature and Extent of Contamination

In November 1999, three known discharges occurred as a result of pressure testing of the lines that transfer fuel from the JP-8 offloading rack (Building 2405) to the Pump House at the facility:

- Failure of one of the 14-inch-diameter belowground transfer pipelines (Pipeline #22) during a hydrostatic pressure test,
- Failure of a cam-lock coupling during pressure test of the second belowground transfer pipeline (Pipeline #23), and
- Failure of the second belowground transfer pipeline (Pipeline #23) during a hydrostatic pressure test after the cam-lock coupling problem had been corrected.

Testing revealed that the primary belowground transfer pipeline (Pipeline #22) had been in a state of failure for an unknown duration; therefore, the total amount of fuel released is unknown. The volumes of the second batch of two discharges were estimated to be approximately 200 to 400 and 30 gallons, respectively. For all discharges documented in November 1999, the product released was JP-8. However, because of the presence of multiple types of fuel contamination on the water table and the size of the non-aqueous phase liquid (NAPL) plume, it is likely that the primary pipeline had been in a state of failure for many years. The presence of NAPL fuel hydrocarbons on the water table also indicates that substantial releases have occurred and that a range of fuel types may have been released. Possible fuel types include AvGas, diesel, JP-4, and JP-8 (Tetra Tech, 2004).

Over the past several years, potential sources in addition to the offloading rack were evaluated as possible contributors to NAPL on the water table. These previously investigated potential sources include the Pump House, a fueling island, underground piping, an evaporation pond, and areas where water from the tank bottom water-holding tanks was released. The bulk fuel ASTs will be investigated following demolition of the standing ASTs. Demolition in this area is anticipated to be complete in the second quarter of 2011 (Tetra Tech, 2004).

3.4 Previous Investigations

As previously mentioned, in November 1999, three known discharges occurred as a result of pressure testing of the lines that transfer fuel from the JP-8 offloading rack (Building 2405) to the Pump House at the facility. Subsequent investigations were conducted and the results are provided in the following reports:

- *Stage 1 Abatement Plan Report for the Bulk Fuels Facility (ST-106)* (CH2M HILL, 2001);
- *Stage 2 Abatement Plan Report for the Soil Vapor Extraction and Treatment System, Bulk Fuels Facility (ST-106)* (CH2M HILL, 2006a);
- *Stage 1 Abatement Plan Report, East Side of the Kirtland AFB Bulk Fuels Facility* (CH2M HILL, 2006b);
- *Semi-Annual Summary and Performance Report, October 2007 through March 2008, Bulk Fuels Facility* (CH2M HILL, 2008); and
- *Remediation and Site Investigation Report for the Bulk Fuels Facility* (CH2M HILL, 2009).

The conclusions of these reports are summarized in the following sections. In the reports, soil data collected during the BFF Spill investigations are compared with the *New Mexico Environment Department [NMED] TPH [Total Petroleum Hydrocarbon] Screening Guidelines* to aid in defining the extent of contamination (NMED, 2006).

3.4.1 Stage 1 Abatement Plan Report

In the soil investigations initiated immediately after the 1999 discovery of the fuel line leak, contamination was detected along the JP-8 offloading rack that supplies the 300-ft-long belowground pipeline. The horizontal extent of shallow contamination less than 40 ft bgs was delineated during the June 2000 direct-push investigation portion of the Stage 1 investigation. This contamination appeared to be limited to within 50 ft lateral to the location where the pipelines went belowground.

Site investigations conducted during 2000 also included soil characterization at depth, extending downward to the water table at select locations. Contamination was identified in two deep soil borings (SB-25 and SB 26) installed during July 2000 using hollow-stem auger drilling. These two borings were located on the eastern and western ends of the offloading rack. The maximum concentration detected in soil samples from boring SB-25 was 81,000 parts per million (ppm) of TPH in the sample from 105 ft bgs, which is just below the Transition Zone between USF-1 and USF-2. The maximum concentration detected in boring SB-26 was 114,000 ppm of TPH in the sample from 270 ft bgs, which is just above the clay zone that divides the USF-2 hydrostratigraphic unit.

Additional borings were installed to determine the horizontal extent of the soil that has TPH concentrations greater than 100 milligrams per kilogram (mg/kg). Based on data from the additional borings, soil contaminated in excess of the *NMED TPH Screening Guidelines* (NMED, 2006) is limited to within approximately 310 ft of the surface and within the area 65 ft south (SB-29A), 280 ft north (SB-34), 400 ft east (SB-32), and 175 ft west (SB-33) of the FFOR. The total area of soil affected by the petroleum hydrocarbon contamination is estimated to be 6.5 acres, with depths of contamination extending to 310 ft bgs (CH2M HILL, 2001).

3.4.2 Stage 2 Abatement Plan Report

Four additional soil borings were advanced in 2003 as part of a pilot test for SVE. All four soil-vapor monitoring wells included both soil and vapor sampling capabilities and were completed to a depth of approximately 450 ft bgs. In addition to the anticipated intervals of petroleum-related contamination, two locations were found to have detections at the shallowest sampling depth of 60 ft bgs (CH2M HILL, 2006a).

3.4.3 Stage 1 Abatement Plan Report, East Side of the Kirtland AFB BFF

In 2005, a shallow soil investigation of potential source areas on the east side of the BFF was conducted. Soil samples were collected from the following areas:

- Former Wash Rack Drainfield
- Three fuel-storage ASTs
- Former Fuel/Water Evaporation Pond
- Recovered Liquid Fuel Collector Tank
- Primary fuel-storage ASTs and tank bottom water-holding tanks

The investigation included excavating test pits (TP-07, TP-08, and TP-09) and advancement of a direct-push borehole (SB-04) to 50 ft bgs. Additionally, a temporary soil-vapor monitoring point was installed in the direct-push borehole and was monitored for hydrocarbon concentrations with field monitoring equipment for several quarters. Based on visual observations and analysis of soil samples from the test pit and shallow soil samples at this location, as well as soil-vapor samples, no substantial hydrocarbon impacts were identified in the interval from the ground surface to 50 ft bgs. The only area where the NMED TPH guideline (NMED, 2006) was exceeded was in the vicinity of the primary fuel storage ASTs and tank bottom water-holding tanks. The maximum petroleum hydrocarbon concentration was 2,400 mg/kg detected in the sample from 15 ft bgs. None of the detections suggested the area was a contributor to the soil-vapor profile at the BFF Spill (CH2M HILL, 2006b).

3.4.4 Semi-Annual Summary and Performance Report

In 2007, groundwater monitoring well KAFB-1066 was installed in the general vicinity of the east side of the BFF. This monitoring well was located between the presumed area of the storage tank associated with the 1951 rack operations and the location of the filling rack itself where tanker trucks would have been fueled. Well KAFB-1066 is roughly 75 ft north of the storage tank area associated with 1951 operations. Additionally, 15 groundwater monitoring wells were installed between 2007 and 2008. These monitoring well installations are documented in the Semi-Annual Summary and Performance Report (CH2M HILL, 2008). Soil sampling was conducted at 20-ft intervals during advancement of the KAFB-1066 borehole, from 20 to 480 ft bgs. Soil sampling results did not indicate the presence of a large surface release of fuel in this area. However, detections of limited petroleum hydrocarbon concentrations (less than 100 mg/kg) were reported for samples from throughout much of the borehole length, and isolated, higher concentration detections of other fuel compounds, such as toluene, benzene, xylenes, etc., were reported for samples collected at individual shallower depths of 40 and 140 ft bgs in the borehole. While the individual fuel-related detections in the borehole were not extremely high, the pattern of detections may be indicative of a predominantly stair-step lateral and vertical migration of near-surface releases of fuel through the vadose zone (CH2M HILL, 2008).

3.4.5 Remediation and Site Investigation Report

In 2009, soil boring investigations were conducted, and four additional groundwater monitoring wells were installed at the BFF Spill site to further evaluate other potential source areas.

4. CURRENT SOIL-VAPOR EXTRACTION SYSTEM OPERATING CONDITIONS

In this section, the performance of the existing SVE system is evaluated to establish a baseline for an optimization program. To evaluate the performance of this system, the well construction and vadose zone contamination footprint are first summarized to present the foundation for the remediation analysis.

In the following discussions, two vapor concentration units are used, based on the source of the data—micrograms per liter vapor (µg/L_v) and parts per million vapor (PPM_v). Assuming a petroleum hydrocarbon molecular weight of 120 grams/mole, the following unit conversions are provided:

- 1 µg/L_v = 0.200 PPM_v
- 1 PPM_v = 5.0 µg/L_v

4.1 Soil-Vapor Extraction Well Construction Summary

The SVE well construction details are presented in Table 4-1 with locations shown on Figure 4-1. As presented in the table, the extraction wells all have 15-foot screens and nominally 20-foot sand packs. SVEW-01 through SVEW-09 are located in the immediate vicinity of what was believed to be the original BFF leak location. SVEW-10 through SVEW-13 are located outside this area in other areas of vadose zone contamination.

As presented on Figure 4-1 and in Table 4-1, wells SVEW-01 through SVEW-05 are collocated together with screens at depths of 60, 160, 260, 313, and 460 ft bgs. Wells SVEW-06 through SVEW-09 are located together with screens at depths of 60, 160, 260, and 460 ft bgs. The SVEW-01 well cluster has a cumulative 100 ft of sand pack exposed to the 500-foot-thick vadose zone and the SVEW-06 well cluster has 79 ft of sand pack exposed to the vadose zone. As discussed in Section 4.2, these two SVE extraction well clusters are located on the eastern side of the vadose zone contamination area. While all nine wells in the two clusters are connected to the ST-106 SVE RSI Unit 249 system; currently only SVEW-01 and

SVEW-05 are currently being used for extraction because of declining organic vapor concentrations in the other wells.

The SVEW-11 and SVEW-13 extraction wells, with extraction well screens at 400 to 410 ft bgs, are located in the middle part of the vadose zone contaminated area. SVEW-10 and SVEW-12 extraction wells, with well screens also at 400 to 410 ft bgs, are located on the eastern side of the vadose zone contaminated area in areas of lower concentration. None of these four wells are currently connected to an SVE extraction system.

4.2 Vadose Zone Contaminant Area and Volume

While full characterization of the vadose zone contamination is currently ongoing, it is necessary to assess the extent of hydrocarbon contamination in the vicinity of the BFF using available data. The extent analysis was performed using the following procedure:

1. The most June 2011 laboratory analytical vapor total volatile organic compound (VOC) concentration data were queried from the Kirtland AFB analytical database.
2. The analytical data were joined with the three-dimensional (3D) X, Y, Z coordinate and elevation data for the respective wells. The sand-pack intervals were used to represent the vertical sample intervals for the wells. The vapor data locations used in the analysis are presented in Figure 4-2.
3. Two-dimensional data posting maps were prepared for the BFF area. The maps are presented as Figures 4-3 and 4-4.
4. The coordinates, elevations, and concentration data were imported into the RockWorks system (RockWare, 2010). The vapor VOC data were then gridded in three dimensions using logarithmic inverse distance weighting, horizontal and vertical distance weighting exponents of 2 and 4, respectively, and horizontal and vertical distance cutoff values of 300 and 50 ft, respectively. The grid exponents define how the distances between adjacent data points are handled mathematically. An exponent of 1 is a linear relationship, and exponent of 2 is a distance squared relationship, etc. The distances and exponents are used in an inverse relationship when calculating concentrations at each point in the grid. The higher the exponent, the more influence nearby points will have in calculating the value at a given point. The cutoff distances are the horizontal and vertical distances beyond which, a data point will no longer influence the calculated value at a given point. In other words, any data point more than 300 feet horizontally and 50 feet vertically from a given point will not be used to calculate the value at that point. All points were included in the gridding. This generated the 3D volumetric model of the total VOC vadose zone contamination at the site.

5. The results of the 3D gridding are presented as series of horizontal plan-view maps at five elevations in Figure 4-5. As presented, the vadose zone contaminated area and concentrations increase markedly going from higher to lower elevations with the 5300-foot elevation plot having the smallest footprint and lowest overall concentrations and the elevation 4900-foot plot having the highest concentrations and largest footprint. The 3D plume distribution is used in the following analysis of the remediation system and design of the radius of influence (ROI) testing in Section 5.

6. East-west and north-south cross sections were created through the 3D vadose zone plume to illustrate the vertical concentration variability in the vapor plume in conjunction with the lithology of the vadose zone. The results are presented on Figures 4-6 and 4-7 illustrating the heterogeneous nature of the vadose zone contamination in the BFF area.

The 3D modeling allows for the calculation of the volumes and areas of contaminated soil within various concentration ranges. For the volatile organics plume, approximately 7,000,000 cubic yards (190 million cubic feet) of vadose zone are contaminated at concentrations greater than 1,000 parts per million vapor (ppm_V) and 34,000,000 cubic yards (940 million cubic feet) are contaminated at concentrations greater than 100 ppm_V. The horizontal footprint of the 1,000-ppm_V plume encompasses approximately 29 acres and extends from near the ground surface downward to the top of the water table at an approximate depth of 500 feet below ground surface. The footprint of the 100-ppm_V plume covers approximately 77 acres with the same vertical extent as the 1000 ppm_V plume.

4.3 Soil-Vapor Extraction Remediation Unit Vapor Concentration Calculations

Four SVE units, manufactured by Remediation Service, International (RSI) of Ventura, California, are currently operating at the BFF site. The units are used to extract and treat organic vapors from selected vadose zone SVE extraction wells at the ST-106 BFF location (referred to as the ST-106 SVE unit) and three NAPL wells—KAFB-1065, KAFB-1066, and KAFB-1068. Table 4-2 presents the system summary for the four units. Each unit consists of two trailer-mounted internal combustion engines equipped with catalytic converter off-gas emissions control and a programmable logic controller (PLC) system that monitors and directs system operations. The PLC controls the operation of the units and logs performance parameters at 2- to 4-hour intervals. The three units on the NAPL wells are equipped with cellular telemetry for remote operational changes and data download. Operational changes to the ST-106 SVE unit and data downloads are made locally at the unit.

Each SVE units is operated so that the energy content in the inflow vapor stream is analyzed by the controller and supplemental propane is added to the influent vapor stream through the fuel valve to provide sufficient energy for engine operations. An air control valve is operated by the controller to provide sufficient air for operation of the engines. The vacuum applied to a well or set of wells is controlled by adjusting the well process control valve. Adjustments to the well valve require commensurate adjustments in fuel and air valves, and these operational changes are made automatically by the controller.

The influent vapor concentrations for each unit are calculated by the engine controller data based on the BTU [British thermal unit] energy content of the vapor using an assumption of 20,000 BTUs per pound of volatile organic compounds (VOCs) and the following calculation process (as described in the RSI output files):

RSI's Approach to Estimating BTU/Hr

1. The controller measures alternate fuel usage of engine prior to introduction of process flow.
2. The controller multiplies the standard cubic feet per minute (SCFM) flow rate of the alternate fuel (propane or natural gas) by the BTU value to determine energy demand on the engine at static conditions.
3. The controller records a "snapshot" of the energy demand at a given rate of revolutions per minute and engine manifold vacuum just prior to allowing the process flow to begin.
4. The controller adjusts the initial baseline based on engine load or oxygen deficiency as necessary.
5. Any drop in energy demand is assumed to be caused by the introduction of the process flow and is displayed as "Estimated BTU/Hr" and recorded accordingly.

RSI's Approach to Estimating PPM_V

1. The controller completes the BTU/Hr calculation as explained above.

2. The controller records the well flow rate (estimated or measured in SCFM)

3. The controller then computes the average PPM_V using the mass transfer equation to solve for PPM_V.

4. If the flow rate is estimated, then PPM_V is subject to accuracy of estimated flow and accuracy of the BTU/Hr calculation.

5. If the flow rate is measured, then this PPM_V estimate will be relative to actual laboratory data assuming the flow measurement and the BTU calculations are correct.

4.4 Soil-Vapor Extraction Mass Recovery Rates

These data are plotted by the controller for real-time monitoring and periodically exported to a database for long-term process and cumulative mass recovery analysis. The cumulative mass removal graphs are presented in Figure 4-8.

The ST-106 SVE unit 249 is connected by manifold to nine of the SVE wells—SWEW-01 through SWEW-09. As presented on Figure 4-8, the cumulative mass recovery of the ST-106 SVE unit is a relatively straight line indicating essentially a constant mass recovery rate over time. The current mass recovery rate is approximately 720 pounds (lbs) (120 gallons) of volatile organic compounds (VOC) per day; through the end of June 2011, this unit had removed more than 200,000 gallons of NAPL-equivalent vapors (Shaw, 2011). The two active SVE extraction well clusters influence a maximum of approximately 30% of the vadose zone contamination.

RSI Unit 335 is installed on groundwater monitoring well KAFB-1065. As presented on Figure 4-8, the mass recovery rate for this well has become asymptotic with a low mass recovery rate currently 66 lbs (11 gallons) of VOCs per day. Through the end of June 2011, this unit had removed slightly more than 80,000 gallons of NAPL-equivalent vapors (Shaw, 2011). As explained in Section 5, to achieve this level of recovery, it is necessary to operate one engine in the unit at a well vacuum between 150 and 200 inches of water (vacuum of 12 to 16 ft of water). This means that the fluid level in KAFB-1065 is being drawn up to near the top of the well screen in the well under operating conditions.

RSI Unit 344, installed on well KAFB-1068, has a current mass recovery rate of approximately 100 lbs (18 gallons). Through the end of June 2011, this unit had removed slightly more than 55,000 gallons of NAPL-equivalent vapors (Shaw, 2011). As presented on Figure 4-8, the mass recovery rate for this well became asymptotic in early 2010. The unit currently operates with an average vacuum of 50 inches of water. This means that under operating conditions, approximately 4 ft of screen is open to the formation.

RSI Unit 345, installed on well KAFB-1066, has a current mass recovery rate of approximately 350 lbs (58 gallons) of VOCs per day. Through the end of June 2011, this unit had removed slightly more than 59,000 gallons of NAPL-equivalent vapors (Shaw 2011). As presented on Figure 4-8, the mass recovery rate for this well became asymptotic in early 2010 at the same time as KAFB-1068. The unit currently operates with an average vacuum of up to 30 inches of water. This means that under normal operating conditions, approximately 7 ft of screen is open to the formation.

Through the end of June 2011, all SVE units combined had removed more than 400,000 gallons of NAPL-equivalent vapor (Shaw, 2011). An overall maximum area of NAPL plume remediation is calculated at 4.5 acres for all three systems combined. This compares to a to an overall NAPL plume area of approximately 77 acres.

4.5 Vapor Extraction and Monitoring Well Concentration Trends

The trends in the hydrocarbon concentrations as measured with field instrumentation were evaluated over the period of record from July 2004 through September 2010. The trend plots are presented in Appendix A and summarized in Table 4-3. As presented in the table and as would be expected after six years of SVE operations, the majority of the vapor concentration trends exhibit declines but the magnitude of the decline since 2004 varies quite markedly.

4.6 Assessment of Soil-Vapor Extraction Remediation Systems

4.6.1 Vadose Zone System

While radius of influence (ROI) test results are not currently available (these data will be collected according to this plan as described in Section 5), it is possible to qualitatively assess the area of influence of the active SVE remediation system. If it is assumed that the ROI of each extraction well cluster is 250 ft (an optimistic assumption based on experience with the operation and performance of other SVE systems), the two operational SVE well clusters have a horizontal remediation footprint of 6.65 acres. If it is further assumed that each cluster is capable of remediating the full 500-foot interval from ground surface downward to the water table, the two SVE extraction well clusters are affecting approximately 5.4 million cubic yards. Compared to the 34,000,000 cubic yards (Section 4.2) of vadose zone soil contaminated at greater than 100 ppm_v, the two active SVE extraction well clusters influence approximately 23% of the vadose zone contamination.

The overall effectiveness of the active remediation system can be further assessed by evaluating the concentrations in the SVE monitoring wells located near the two extraction well clusters. The 2011 vapor concentration data are posted on Figures 4-3 and 4-4. The SVEW-01 cluster has several monitoring well clusters within 50 to 100 ft of the five extraction wells in this cluster. The following distances are approximate because the well locations and elevations have not been surveyed but were located using map location estimates. SVE monitoring well clusters SVMW-10 and SVMW-11 are approximately 50 ft from SVEW-01 and monitoring well cluster SVMW-03 is approximately 100 ft from SVEW-01.

After six years of essentially continuous operation, the current monitoring well concentration data can be summarized as follows:

- At the SVMW-10 cluster, the highest total VOC concentration is higher than 40,000 ppm_v and all wells in the cluster have concentrations greater than 22,000 ppm_v. The highest percentage decline (Table 4-3) is 72% at a depth of 250 ft with the other three wells showing less than 20% concentration decrease over six years. Vapor concentrations in three of the four wells in the cluster have remained steady over the period of record as well as during the recent period of data trends. Data below a depth of 250 ft bgs are not available at this cluster.
- At the SVMW-11 cluster, the highest TPH-GRO concentration is 58,000 ppm_v and all wells in the cluster have concentrations greater than 14,000 ppm_v. The highest percentage decline (Table 4-3) is 46% at a depth of 250 ft bgs with the other three wells showing less than 40% concentration decrease over six years. Vapor concentrations in three of the four wells in the cluster have remained steady over the period of record as well as during the recent period of data trends. The 250-foot monitoring well had concentration declines in the first three years or so of the SVE operation but concentrations have recently been increasing. Data below a depth of 250 ft bgs are not available at this cluster.
- At the SVMW-03 cluster, the highest TPH-GRO concentration is 18,000 ppm_v and only the 100-foot well has concentrations greater than 10,000 ppm_v. The highest percentage decline (Table 4-3) is 88% at a depth of 250 ft bgs with the other three wells showing declines between 15% and 72% over six years. Vapor concentrations in the two shallowest wells in the cluster have remained steady over the period of record as well as during the recent period of data trends. The 250- and 300-foot monitoring wells had concentration declines over the past six years.

These data and analyses indicate that while the ST-106 SVE system has removed more than 200,000 gallons of NAPL-equivalent vapors through the end of June 2011, the effective area of active remediation is small compared to the overall vadose zone contaminated volume. Furthermore, even though the SVEW-01 and SVEW-06 SVE extraction well clusters are located in the eastern portion of the vadose zone plume and each have a possible ROI of 250 or less, when assessing the hydrocarbon vapor concentration trends in a spatial context, it is apparent that overall vapor concentrations have been declining across the majority of the vadose zone contaminated volume (Table 4-3).

Further evaluation of the active SVE system efficacy can be illustrated by a simple vapor volume calculation and noting that the ST-106 SVE system is operated at a flow rate of less than 40 SCFM (Table 4-2).

- If it is assumed that the ST-106 system operates 75% of the time, in six years this system has removed approximately 100 million cubic ft of vapor.
- If it is further assumed that the effective soil porosity available for vapor transport is 25% and the total soil volume with vapor concentrations greater than 100 ppm_v is 940 million cubic ft (Section 4.2), one pore volume of contaminated vapor is approximately 230 million cubic ft.
- Thus *if* the SVE system influences the entire vadose zone contaminated volume, it would have removed less than one pore volume of vapor. It is unlikely that removal of one pore volume could account for the observed vapor concentration declines of up to several orders of magnitude.

This means that much of the overall vapor concentration declines potentially can be attributed to natural degradation of organic compounds by both abiotic and microbial degradation processes. Confirmation of vadose zone microbial degradation will require additional data.

4.6.2 Non-Aqueous Phase Liquid Well Systems

The three NAPL well SVE remediation systems have removed a combined total of 194,000 gallons of NAPL-equivalent vapor in the past three years. The following simple remediation analysis provides a relative perspective for this volume. In the following calculations, a number of assumptions are made for which site data are not yet available. As such, these calculations are presented for illustration only and should not be construed as the actual effective NAPL remediation areas. These calculations will be updated once the NAPL data from ongoing site investigations become available.

- Assuming a 1-foot-thick NAPL zone on the water table, a 1-foot-thick NAPL smear zone in the capillary fringe above the water table, an effective porosity of 25%, and a NAPL-filled porosity fraction (portion of pore space filled with NAPL) of 0.25, a NAPL volume of 0.125 cubic feet (ft^3) of NAPL per 1 ft^3 of soil is calculated. This is equivalent to a NAPL volume of 1 gallon per 1 ft^3 of soil.
- Using the cumulative mass recovery data in Table 4-2, it is possible to assess an effective NAPL remediation radius in terms of mass removal.
  - For KAFB-1065 with a total NAPL removal mass of 88,000 gallons, the NAPL remediation radius is 160 ft.
  - KAFB-1066 with a mass removal of 55,000 gallons, the remediation radius is 130 ft.
  - KAFB-1068 with a mass removal of 59,000 gallons the remediation radius is 140 ft.

- Of course if the actual NAPL thickness on the water table and vadose zone capillary fringe smear zone is thicker, these radii will be proportionally smaller, and vice versa. For example, if the vadose zone NAPL contamination interval is 5 ft thick, the above remediation radii will be reduced by a factor of 2.5.

Based on the respective remediation areas calculated from the preceding analysis, an overall NAPL plume remediation area of 4.5 acres is calculated for all three systems combined. This compares to a to an overall NAPL plume area of approximately 50 acres.

It is unclear at this time how much of the NAPL SVE well vapor mass is being extracted from the vadose zone capillary fringe compared to that being removed from the water table. Based on the available thickness data through June 2011, no apparent decrease in thickness has occurred in the three wells that would indicate a substantial volume of NAPL being removed from the water table. Therefore, it is likely that the majority of the vapor mass is being removed from the capillary fringe smear zone above the top of the NAPL plume on the water table.

The three NAPL wells with SVE units installed were designed as monitoring wells and not SVE extractions wells. They have 0.010-inch slots and fine-grained sand packs. This has resulted in the need to gradually increase the operating vacuums to maintain the flow rates. For example, well KAFB-1065 is currently being operated at an average vacuum of 126 inches of water at a flow rate of only 16 SCFM. As more volatile fuel compounds are preferentially being removed from the NAPL in the capillary fringe and on the water table by the SVE operations, the remaining viscous fuel compounds are in turn clogging the thin slots and biofouling may also be clogging the well screens. Field observations supporting the biofouling conclusion are the descriptions of the NAPL as being “foamy or bubbly,” indicating that biofouling is causing operational problems in the wells. It is anticipated that these wells will eventually become clogged with biofouling to the point that they no longer function as SVE extraction wells or viable NAPL monitoring wells.

5. SOIL-VAPOR EXTRACTION REMEDIATION OPTIMIZATION PROGRAM

To quantitatively assess and model SVE vadose-zone remediation and subsequently optimize the existing system, it is necessary to collect fundamental data on the performance of the wells in terms of operational performance and mass removal. The primary data to be collected are as follows:

- Existing SVE extraction and monitoring wells have been surveyed to determine New Mexico State Plane North American Datum of 1983 coordinates and National Geodetic Vertical Datum of 1988 elevations.
- Extraction well performance criteria, including vapor flow/vacuum/concentration relationships, will be developed for the wells used in the ROI testing.
- Vertical ROI around a given extraction well will be determined.
- Horizontal ROI around individual extraction wells and extraction well clusters will be determined.

Once the data are collected, they will be incorporated into the 3D analysis of remediation prospects for the vadose zone contamination using existing SVE extraction wells and RSI SVE units. This analysis will involve vapor concentration distribution, lithology, and 3D numerical modeling of vapor flow. The ongoing quarterly field and analytical vapor concentration monitoring data from existing SVE monitoring and extraction wells will be used as input chemical data for the analysis.

5.1 Individual Well Tests

Each of the five potential SVE extraction wells proposed of ROI testing (KAFB-106121-440, KAFB-106117-450, KAFB-106149, SVEW-01, and SVEW-05, Figure 5-1) will be tested to determine well flow characteristics. The following general procedure will be used for the tests but may be modified based on field test results. All operating SVE units will be shut down for one month prior to start of testing to allow the system to equilibrate.

1. Each extraction well will be configured to accept a test wellhead. The test wellhead will consist of a 4 --inch-diameter, 5-foot-long, hard pipe equipped with a well seal, gauges, sample ports, vacuum ports, and a hot-wire anemometer port.

2. One RSI SVE unit will be configured to function as a mobile unit for use on extraction wells not currently set up for extraction. This configuration will consist of having propane available at the various test locations and using hoses to connect the RSI unit to the specific extraction wells. RSI unit 249 will be used for the SVEW-01/05 tests and the mobile unit will be used for the tests on the other three extraction wells.

3. Each individual well test will consist of monitoring flow, vacuum, and vapor concentrations at the wellhead under step increases in vacuum. Wellhead data are critical to these tests as line leaks can affect the vacuum, flow, and concentrations observed by the engine PLC monitor.

    a. Initially the vacuum steps will be at 10, 20, 30, 50 and 100 inches of water. This may be adjusted in the field depending on well response and RSI unit capacity.

    b. Each step will be run for 2 hours or until the following test parameters stabilize. No step will be less than 1 hour.

    c. During each step at specified times of 10, 20, 30, 40, 50, 60, 90, and 120 minutes, the following parameters will be measured:

        i. Wellhead vacuum will be measured with a vacuum gauge or electronic manometer.

        ii. Well flow rate will be measured with a hot-wire anemometer or pitot tube air flow instrument.

        iii. Vapor concentrations will be measured with the Horiba Mexa 554J or equivalent vapor analyzer. Carbon monoxide, carbon dioxide, oxygen, and hydrocarbon vapor concentration can be measured with the Horiba.

        iv. At each cluster of extraction wells, vacuum will be measured with an electronic manometer or vacuum gauge at inactive wells in the cluster to develop a vertical profile of the vacuum distribution.

4. Once the field data are collected, curves will be prepared relating vacuum, flow, and vapor concentration. These results will be combined with propane requirements for the RSI engines to determine the optimal operating conditions in terms of cost per pound of VOCs removed.

5.2 Radius of Influence Testing

To determine the vertical and horizontal ROI distances, three ROI tests will be performed as presented on Table 5-1 and Figure 5-1. The following procedure will be used for the ROI testing:

1. All operating SVE units will be shut down prior to start of testing to allow the system to equilibrate. Only the one SVE unit will be operated during each test.

2. KAFB-106121-440 will be the initial test well. The vacuum used for testing will be determined from the individual well test results.

    a. The initial test on this well will be conducted for five days or until the field parameters stabilize.

        i. On the first day of the test, the following parameters will be measured on an hourly schedule for the first 8 hours of testing. On subsequent days, the parameters will be measured daily.

        ii. Extraction Well Parameters

            1. Wellhead vacuum will be measured with a vacuum gauge or electronic manometer.

            2. Well flow rate and temperature will be measured with a hot-wire anemometer or pitot tube.

            3. Vapor concentrations will be measured with the Horiba Mexa 554J or equivalent vapor analyzer.

        iii. Vacuum will be measured daily with an electronic manometer or vacuum gauge at all wells in the well clusters presented in Table 5-1 and Figure 5-1 to determine vertical and horizontal vacuum distribution.

3. SVE extraction will be shut down for one week to allow the system to equilibrate.

4. Either well SVEW-01, SVEW-05, or a combination of the two wells will be used as an extraction well for ROI Test 2. The vacuum used in this well will be determined from the individual well test results and will be adjusted using a control valve at the pipe manifold. The same monitoring parameters and schedule presented in Step 2 will be used once this well is brought online. This test will be performed for five days or until field vacuums stabilize, whichever comes first.

5. SVE extraction will be shut down for one week to allow the system to equilibrate.

6. The high concentration area test using KAFB-106117-450 and/or KAFB-106149 as extraction wells will be used for ROI Test 3. Depending on the results of the first two tests and the individual extraction well performance, wells may be added or removed from those presented in Table 5-1 and Figure 5-1. This test will be conducted until either wellhead vacuums stabilize or one month, whichever comes first. The Step 2 parameters will be monitored at the respective wells after the first 4 hours of testing and subsequently on a daily basis excluding weekends.

7. The data from all three tests will be evaluated to determine the horizontal and vertical ROI using 3D data analysis methods and the RockWorks software package (RockWare, 2010).

5.3 Soil-Vapor Extraction Data Analysis and Optimization Numerical Modeling

Analysis of the vapor flow versus well head vacuum and associated permeability calculations will be performed using the steady state radial air flow equations as developed by Johnson and others (Johnson 1990a). The computer model HyperVentilate (Johnson/EPA 1993) or similar software based on these equations can be used to analyze the data from the SVE tests. The HyperVentilate program will calculate the formation permeability that would produce the observed vapor flow rates for a specific effective screen length and the applied well vacuum.

The data from the tests will be used in conjunction with the existing 3D lithologic and vadose contamination models to develop a 3D SVE vapor flow model using the MODFLOW-SURFACT modeling code. The model will be calibrated to the ROI vacuum and well flow test results.

After flow calibration, the model will be used to determine how to optimize the RSI SVE units and the existing extraction wells to access the current high-concentration contaminant areas in the vadose zone. This optimization will be based on observed lithology, vadose zone vapor concentrations, and modeled air flow in conjunction with the operating parameters of the RSI SVE units.

The following parameters will be used in the optimization analysis in order of importance:

1. Cost of operation in terms of dollars per pound of hydrocarbons removed. The main operating cost is the consumption of propane.
2. Vapor concentrations in the immediate vicinity of a given extraction well.
3. Lithology in immediate vicinity of a given extraction well.
4. Effective 3D volume treated as determined from the vapor flow modeling around a given extraction well in conjunction with the vacuum/flow rate/concentration performance curve data for that well.

5.4 Reporting

All of the data, analyses, and modeling results will be reported to the NMED in an optimization report.

This report will be submitted to the NMED six months after approval of this work plan.

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FIGURES

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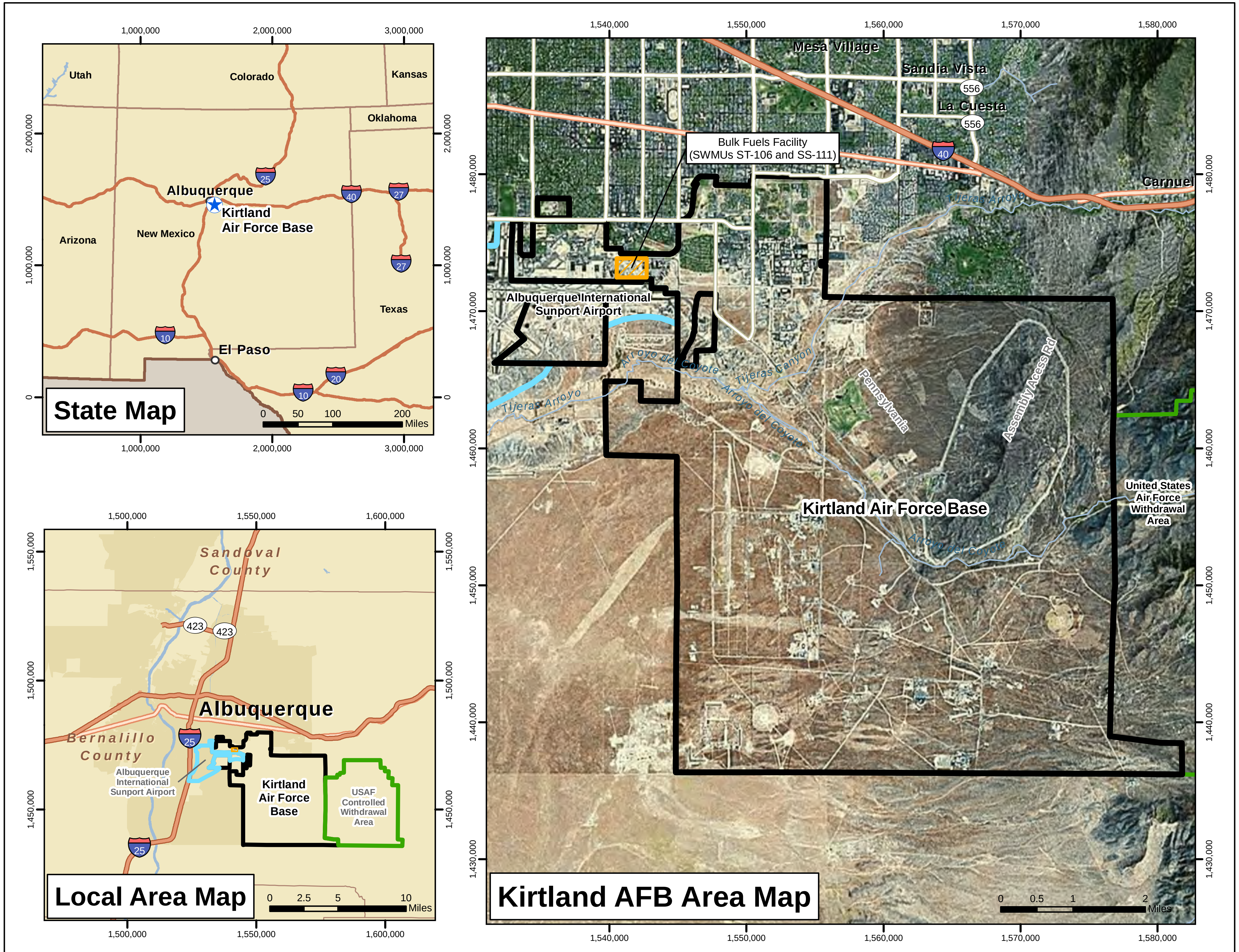

Legend

- Major Highways
- Highways
- Major Roads
- Rivers
- Bulk Fuels Facility (SWMUs ST-106 and SS-111)
- Installation Location
- Kirtland Air Force Base Installation Boundary
- Albuquerque International Sunport Airport
- United States Air Force Withdrawal Area
- Urban Areas
- Counties
- States

N

Revision Date: 03/16/11

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 2-1

SITE LOCATION MAP

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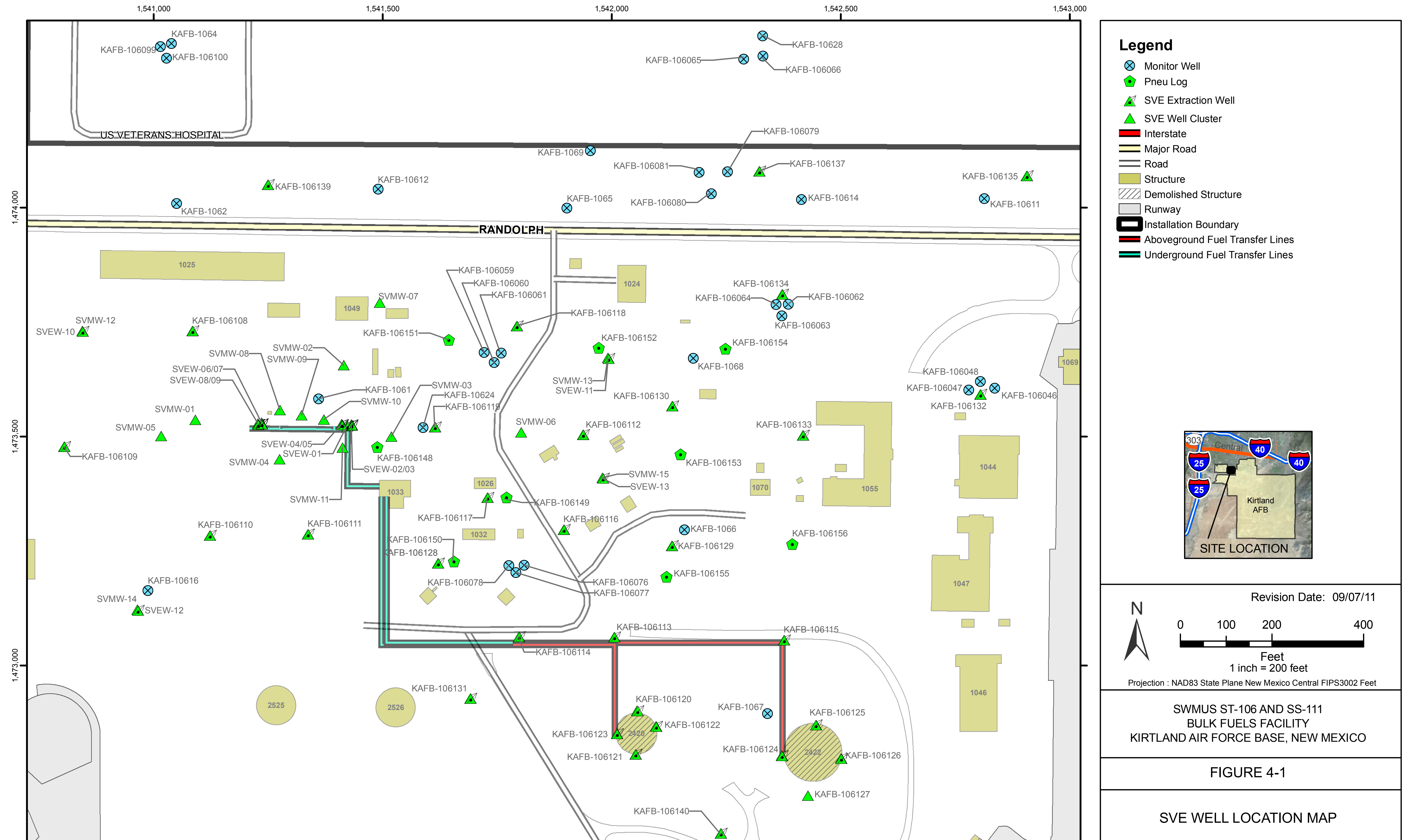

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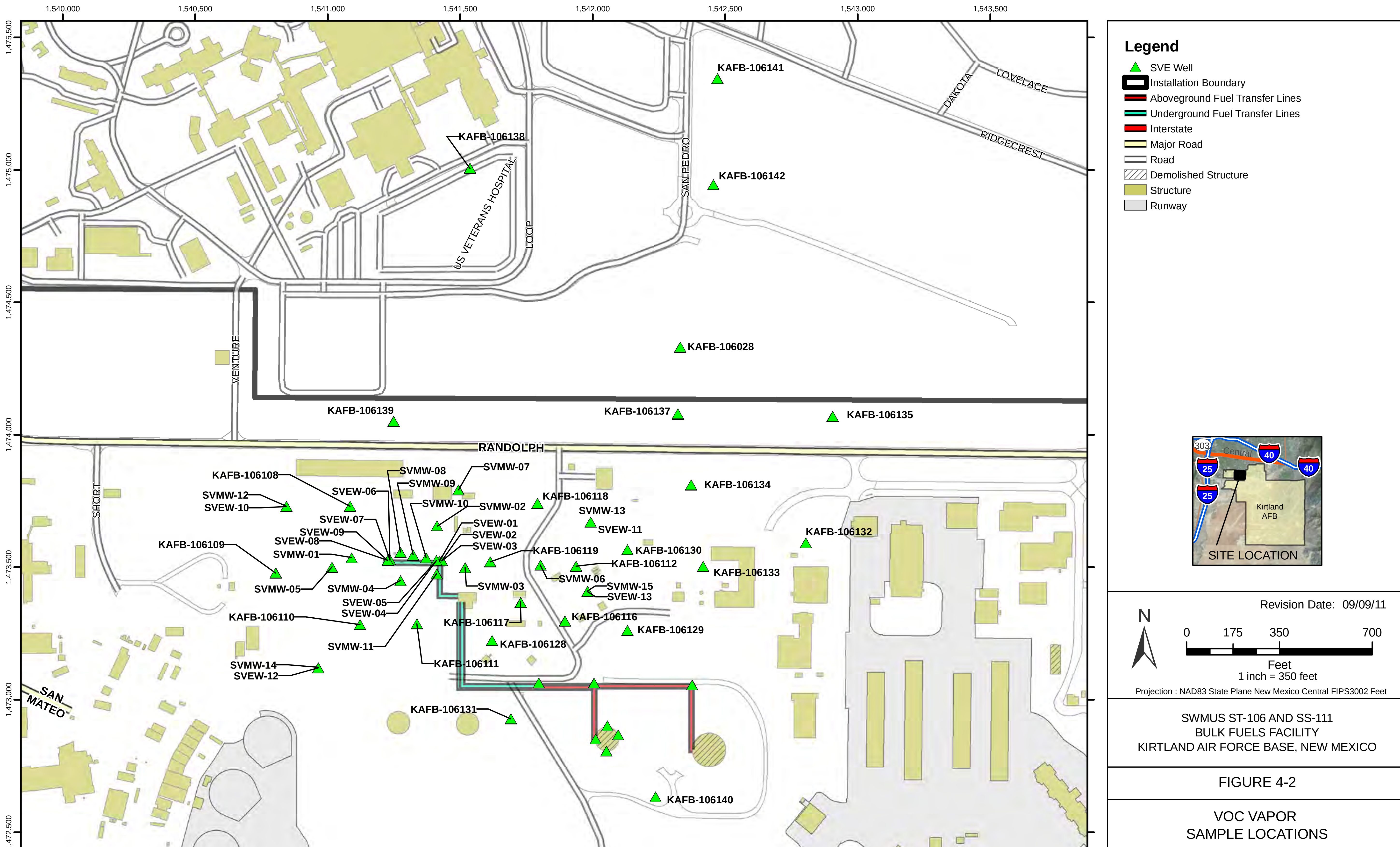

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-2

VOC VAPOR
SAMPLE LOCATIONS

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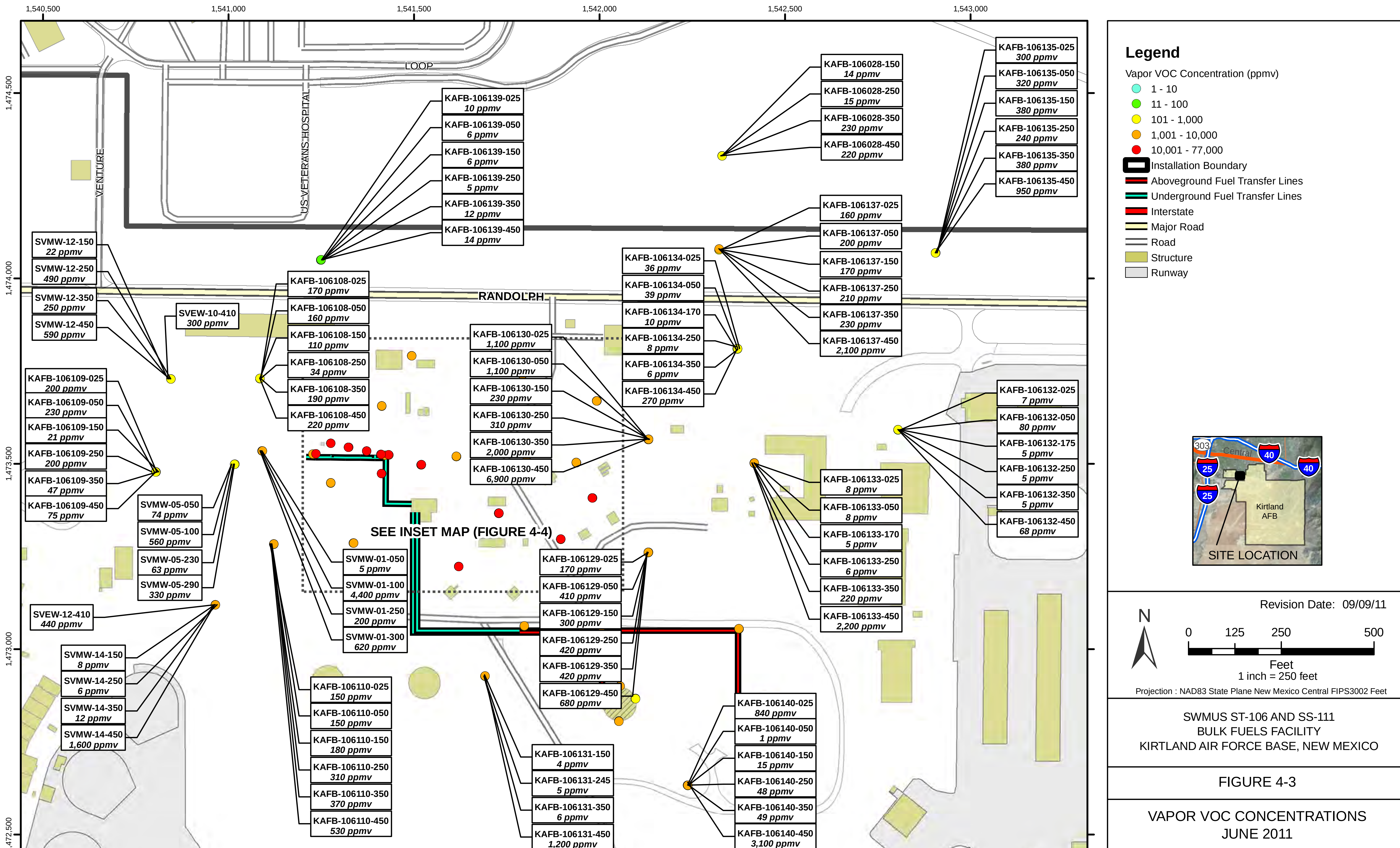

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-3

VAPOR VOC CONCENTRATIONS
JUNE 2011

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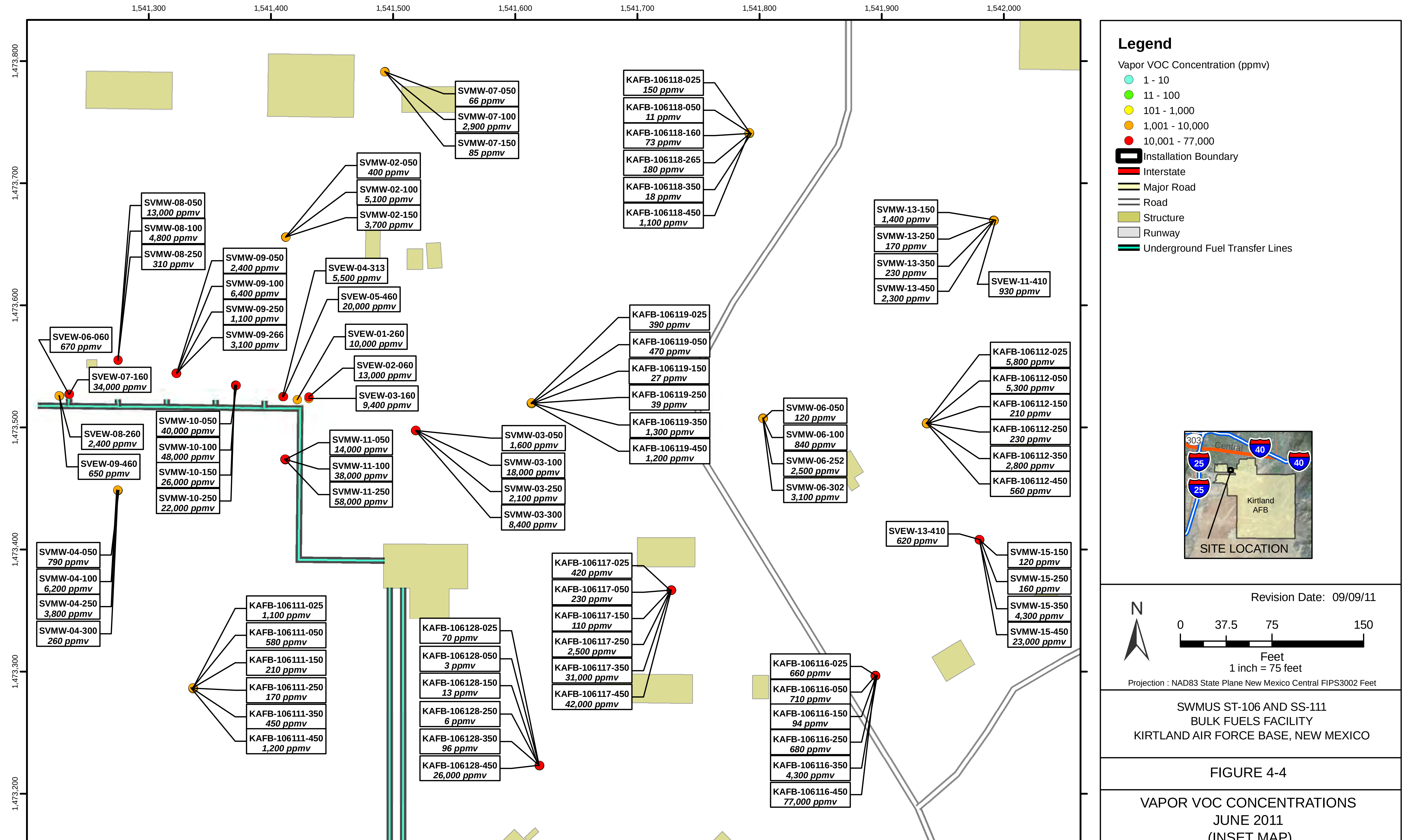

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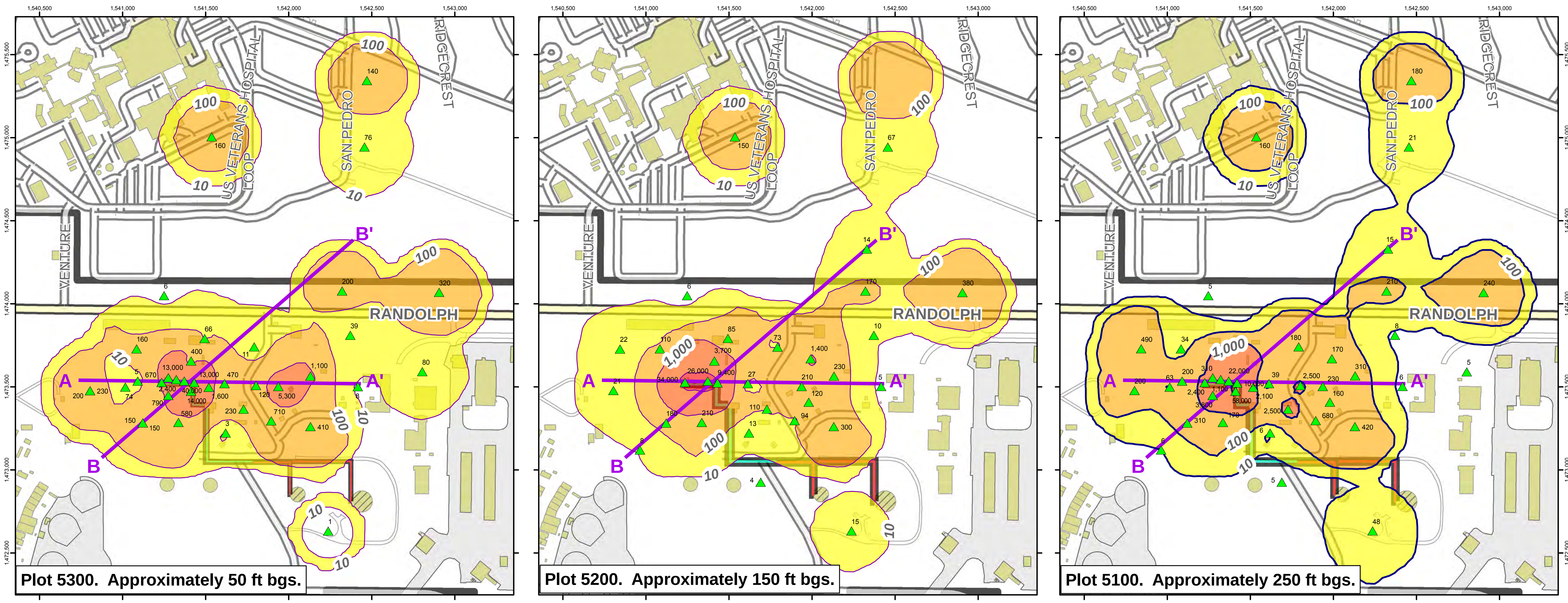
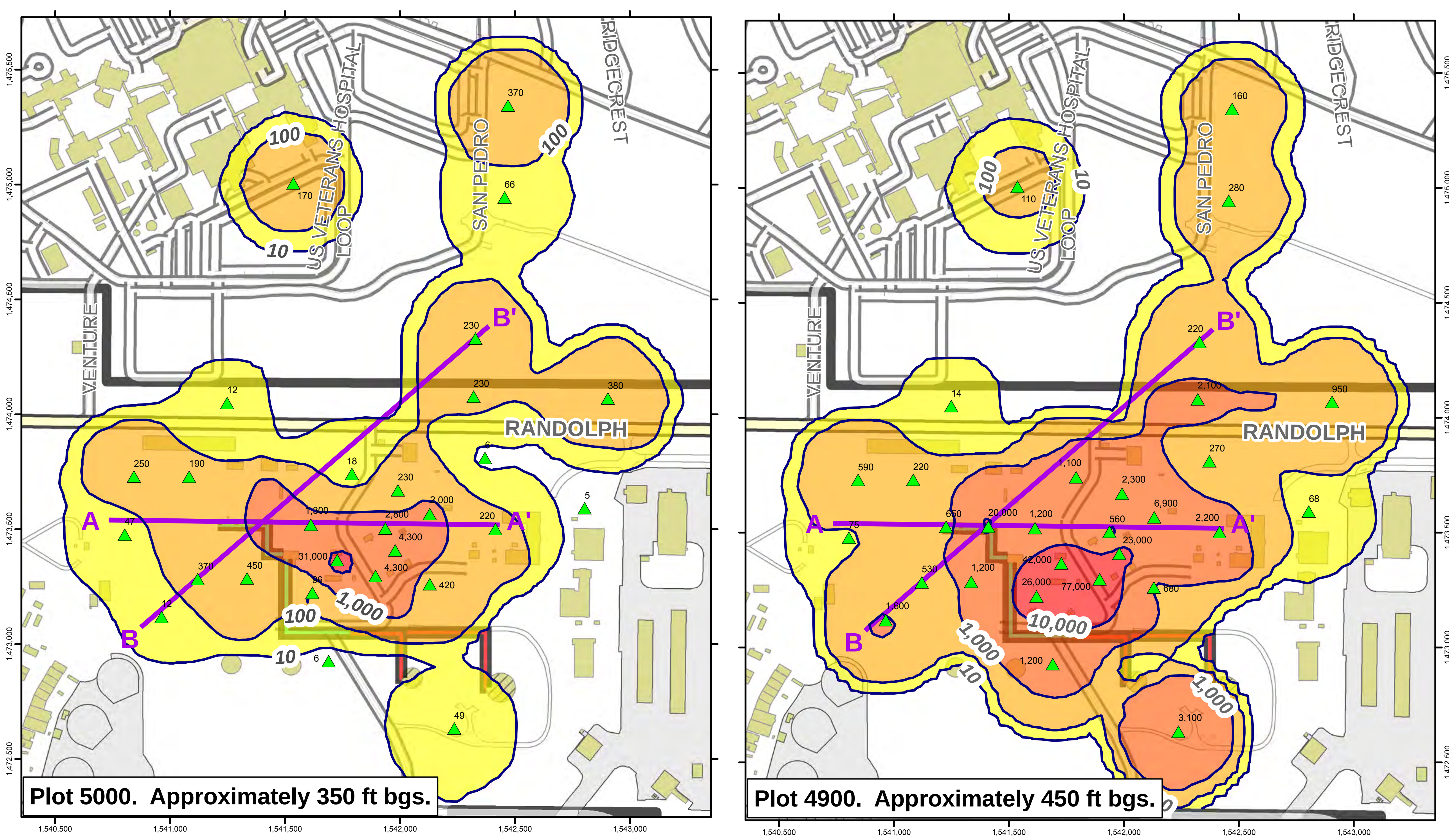




Note:
The vadose zone VOC plume was gridded in three dimensions using inverse distance weighting in RockWorks and then concentration plan-view maps were "cut" at respective elevations. Ground elevations range from 5314 to 5364 ft above mean sea level across the ST-106/SS-111 investigation area.

SVE well locations are presented with the total vapor VOC concentration in ppmv for each elevation. Sample results within 25 ft of the elevation are posted. For example, plot 5000 includes sample results within the 5025 to 4075 ft interval. Locations are not shown at elevations where there is no sample result for the elevation interval.

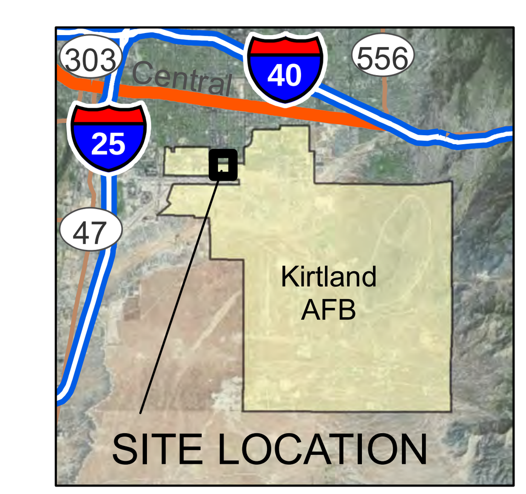
See Figure 4-2 for SVE well locations with ID numbers.

Legend

- SVE Well with Vapor VOC Concentration (ppmv)
- Cross-Section Line
- VOC Concentration Contour (ppmv)

VOC Concentration (ppmv)

- 10 - 99
- 100 - 999
- 1,000 - 9999
- ≥ 10,000
- Installation Boundary
- Aboveground Fuel Transfer Lines
- Underground Fuel Transfer Lines
- Highway
- Major Road
- Road
- Structure
- Demolished Structure
- Runway



Revision Date: 09/09/11

N

0 400 800 1,600

Feet

1 inch = 400 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-5

LAB TOTAL VAPOR VOC PLUME FOOTPRINTS BY ELEVATION
JUNE 2011

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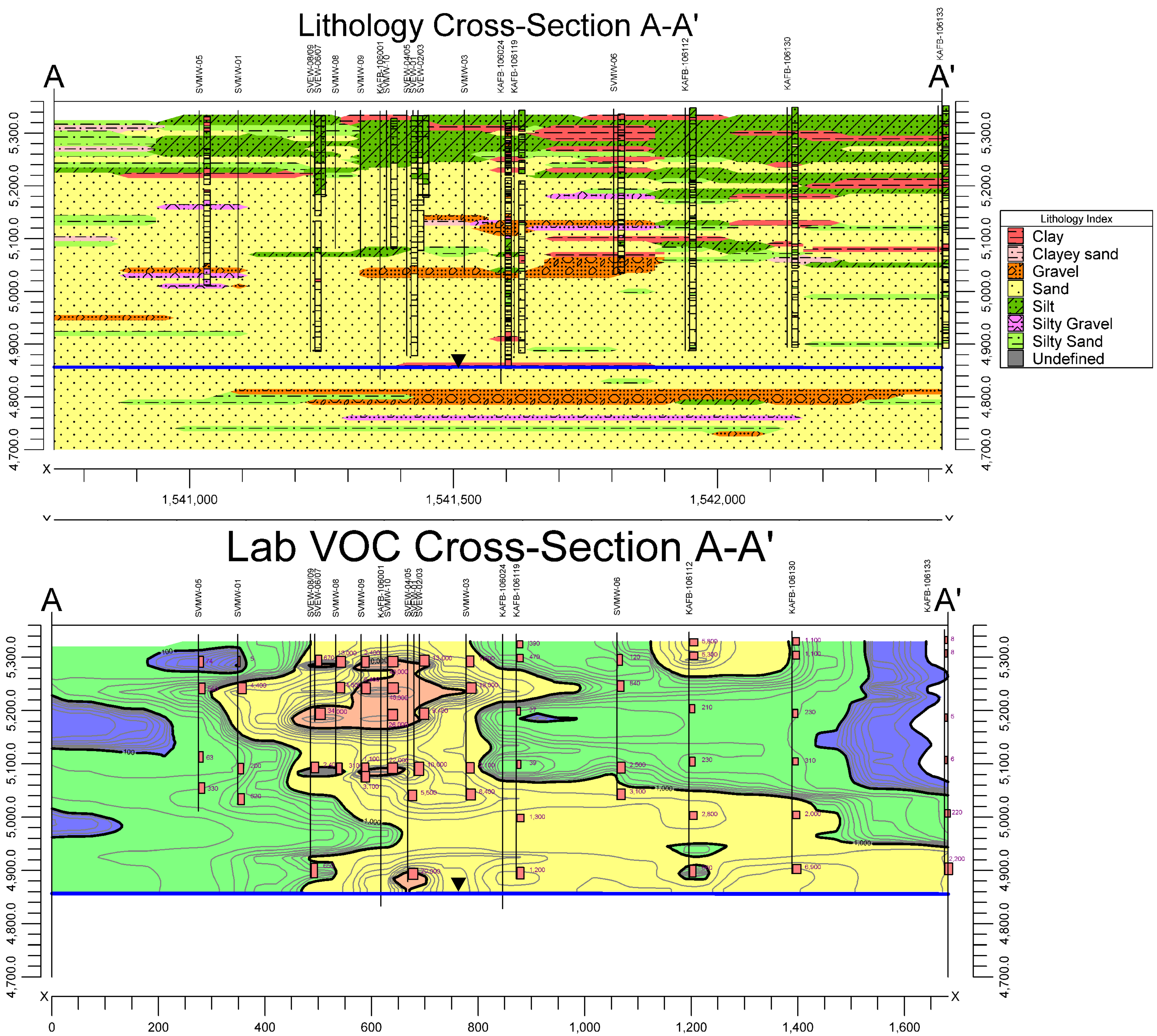

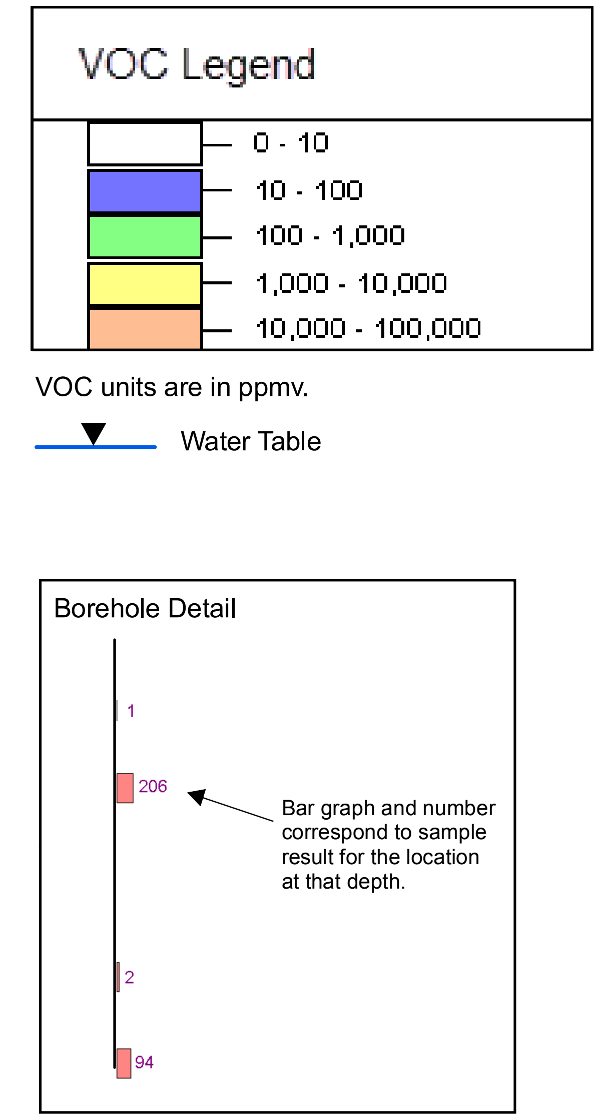

Note: No vertical exaggeration.
See Figure 4-5 for cross-section location map.

Revision Date: 09/09/11

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-6

LITHOLOGY AND LAB TOTAL VAPOR VOC
EAST-WEST CROSS-SECTIONS

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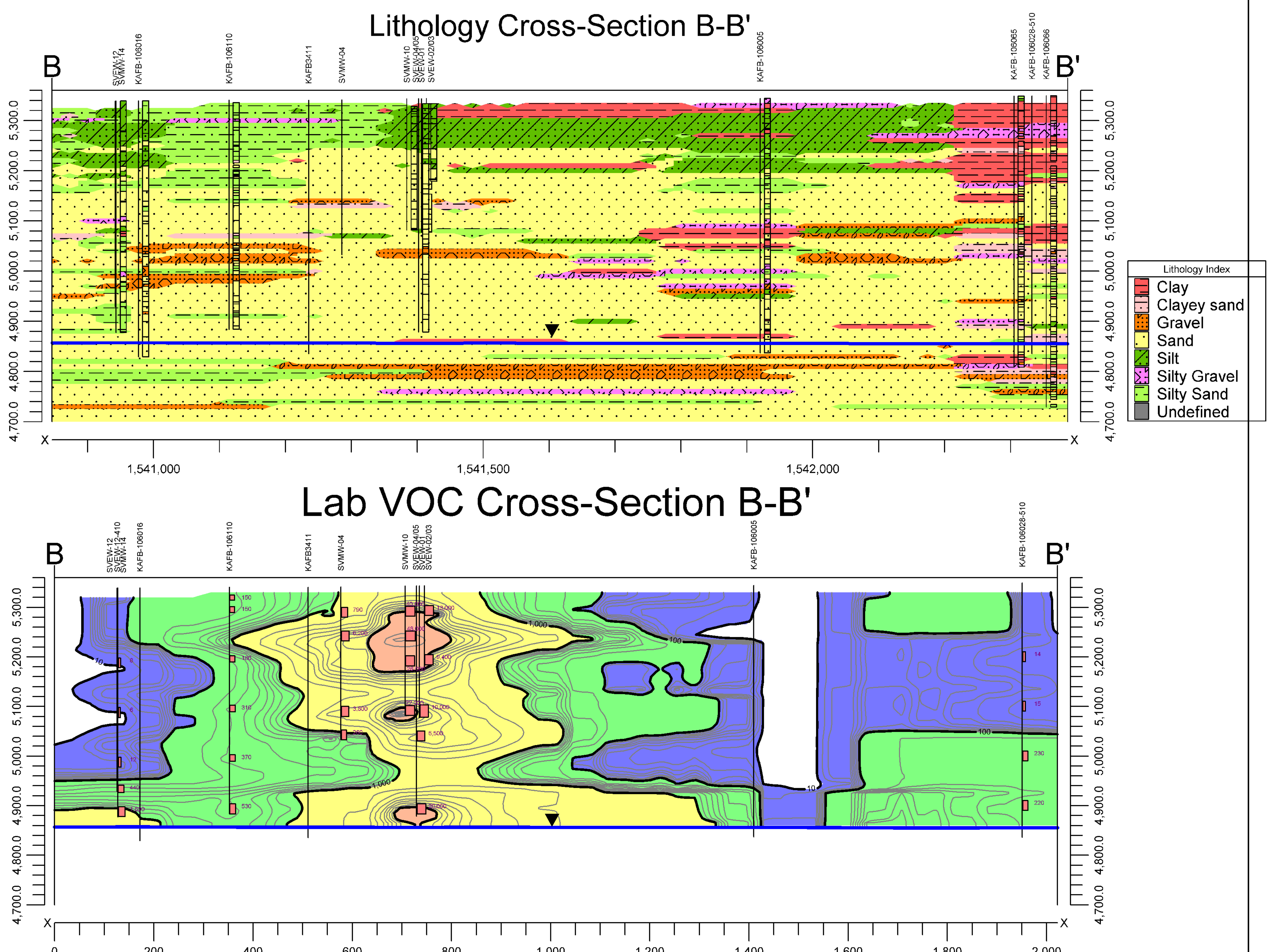
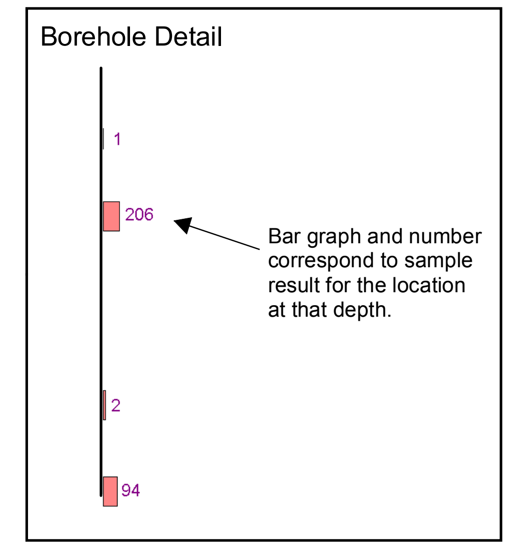


VOC Legend

- 0 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- 10,000 - 100,000

VOC units are in ppmv.

Water Table



Note: No vertical exaggeration.
See Figure 4-5 for cross-section location map.

Revision Date: 09/09/11

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-7

LITHOLOGY AND LAB TOTAL VAPOR VOC NORTH-SOUTH CROSS-SECTIONS

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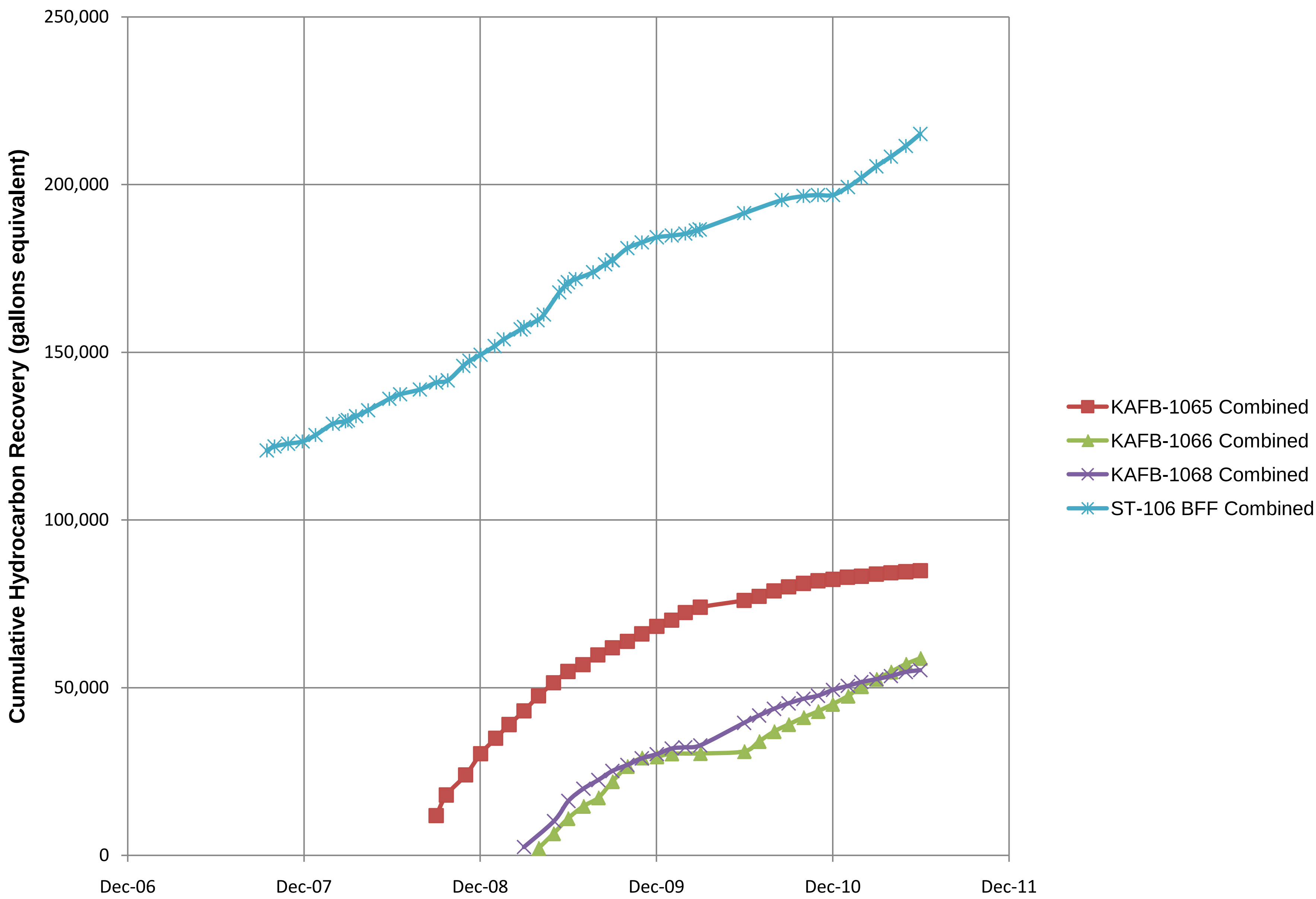
Figure 4-8. SVE Cumulative Mass Recovery Over Time



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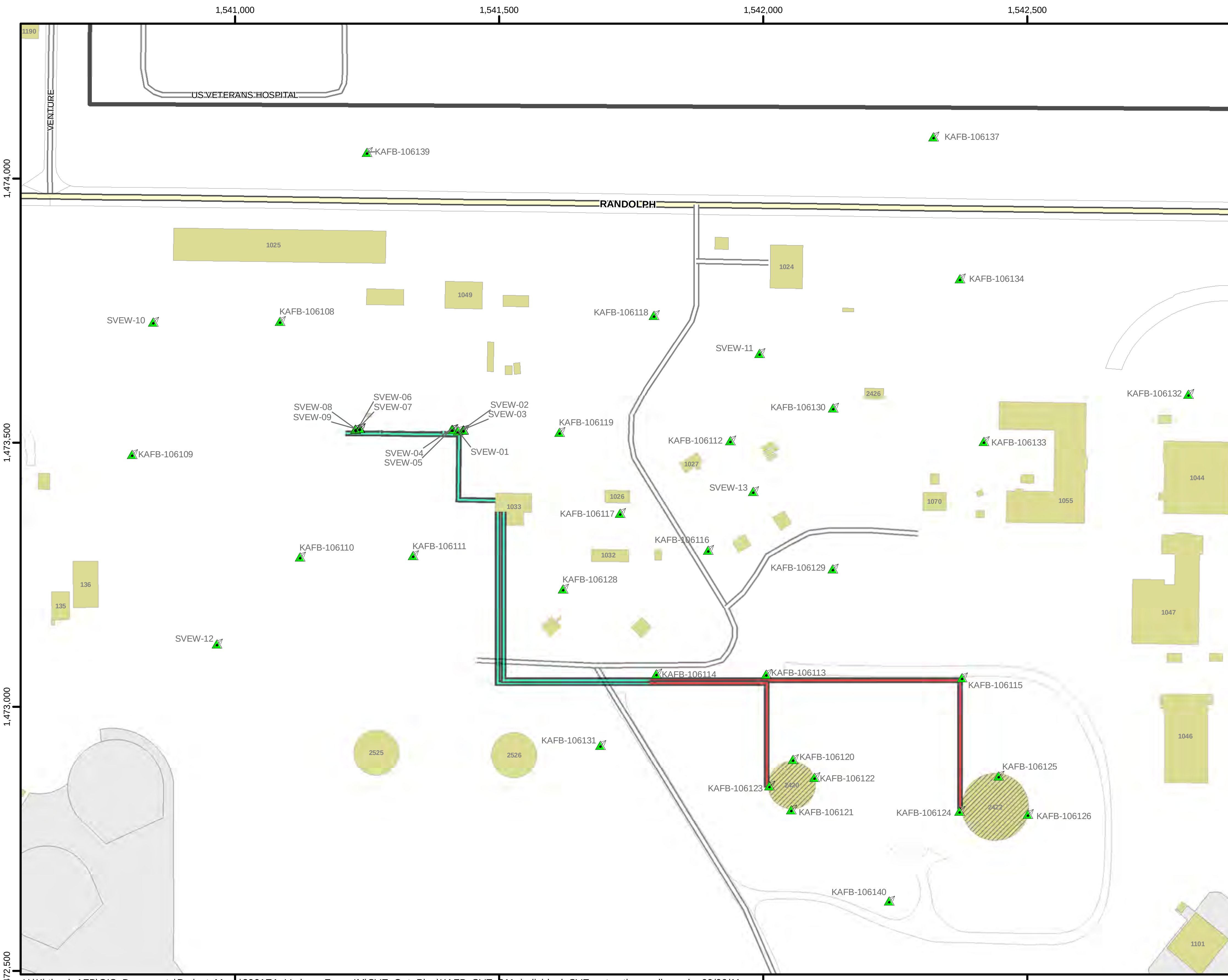

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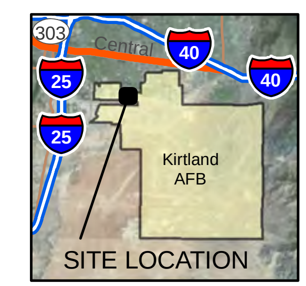
Legend

- SVE Extraction Well
- Aboveground Fuel Transfer Lines
- Underground Fuel Transfer Lines
- Interstate
- Major Road
- Road
- Demolished Structure
- Structure
- Runway
- Installation Boundary



Revision Date: 09/09/11

N

0 75 150 300

Feet

1 inch = 200 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 4-9

INDIVIDUAL SVE EXTRACTION WELLS

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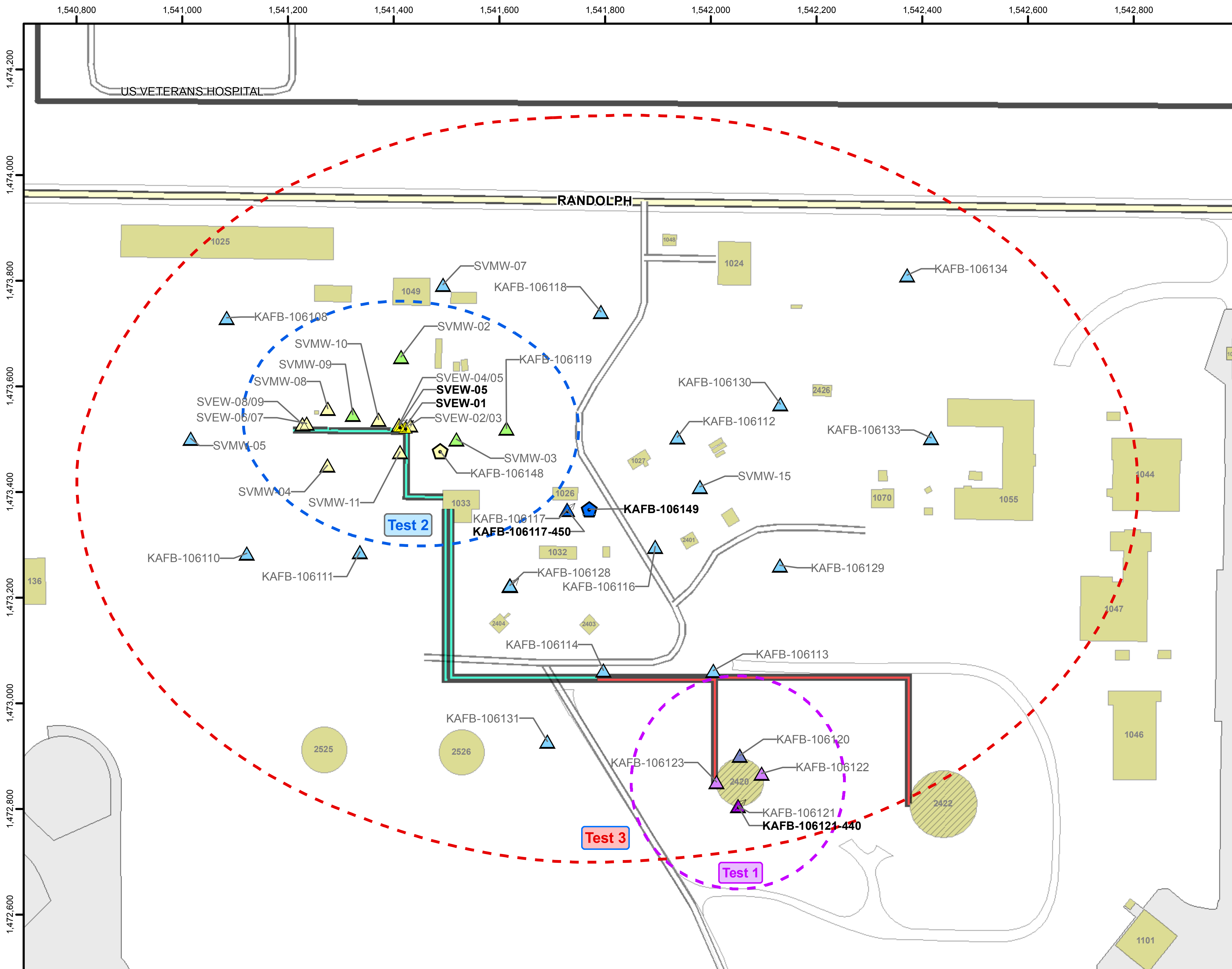

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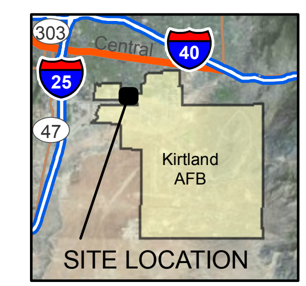
Legend

- Extraction Well For ROI Test 1
- Observation Well Cluster for ROI Test 1
- Observation Well Cluster for ROI Tests 1 and 3
- Observation Well Cluster for ROI Tests 2 and 3
- Extraction Well and Alternative for ROI Test 2
- Observation Pneulog Well for ROI Test 2
- Observation Well for ROI Test 2
- Extraction Well for ROI Test 3
- Alt. Extraction Well for ROI Test 3 (Pneulog well)
- Observation Well Cluster for ROI Test 3
- Aboveground Fuel Transfer Lines
- Underground Fuel Transfer Lines
- Interstate
- Major Road
- Road
- Structure
- Runway
- Installation Boundary

Note:
Extraction wells for tests are labeled in **bold** font.
Observation wells for tests are labeled in regular font.



Revision Date: 03/16/11

N

0 100 200 400
Feet
1 inch = 200 feet

Projection : NAD83 State Plane New Mexico Central FIPS3002 Feet

SWMUS ST-106 AND SS-111
BULK FUELS FACILITY
KIRTLAND AIR FORCE BASE, NEW MEXICO

FIGURE 5-1

RADIUS OF INFLUENCE TEST WELLS

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TABLES

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Table 4-1. SVE Well Construction Summary

LOCATION_ID	EASTING	NORTHING	GRND ELEV	DEPTH	DATE INSTALL	WELL TYPE	CASING DIA (in)	CASING TYPE	SCREEN TOP	SCREEN BOTTOM	Slot SIZE	SCREEN INTERVAL	TOP SAND PACK	BOTTOM SAND PACK	SAND PACK INTERVAL
KAFB-106108-450	1,541,084.0	1,473,730.1	5,341.9	450.0	02/18/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	458	21
KAFB-106109-450	1,540,803.6	1,473,478.0	5,338.7	450.0	02/09/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	436	458	22
KAFB-106110-450	1,541,121.6	1,473,283.8	5,340.5	450.0	02/24/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	457	20
KAFB-106111-450	1,541,336.1	1,473,286.6	5,341.4	450.0	03/04/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	460	23
KAFB-106112-450	1,541,936.8	1,473,503.7	5,347.7	450.0	02/24/2011	SVE Extraction Well	3.00	PVC	439	449	0.050	10	438	460	22
KAFB-106113-450	1,542,004.5	1,473,062.0	5,345.8	450.0	02/08/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	457	19
KAFB-106114-450	1,541,796.5	1,473,062.6	5,344.8	450.0	03/01/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	451	13
KAFB-106115-450	1,542,375.1	1,473,055.2	5,348.0	450.0	02/20/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	455	17
KAFB-106116-450	1,541,894.7	1,473,296.7	5,346.2	450.0	03/10/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	456	19
KAFB-106117-450	1,541,727.8	1,473,366.7	5,345.3	450.0	03/15/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106118-450	1,541,791.6	1,473,741.3	5,345.8	450.0	03/07/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	459	22
KAFB-106119-450	1,541,613.2	1,473,520.2	5,343.6	450.0	03/06/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106120-450	1,542,054.9	1,472,900.6	5,343.4	450.0	06/09/2011	SVE Extraction Well	3.00	PVC	434	444	0.050	10	431	447	16
KAFB-106121-440	1,542,051.5	1,472,805.7	5,343.8	450.0	05/25/2011	SVE Extraction Well	3.00	PVC	430	440	0.050	10	428	448	20
KAFB-106122-450	1,542,096.1	1,472,866.5	5,343.9	450.0	06/18/2011	SVE Extraction Well	3.00	PVC	434	444	0.050	10	431	448	17
KAFB-106123-442	1,542,010.5	1,472,850.6	5,344.1	450.0	05/31/2011	SVE Extraction Well	3.00	PVC	432	442	0.050	10	429	442	13
KAFB-106124-450	1,542,370.2	1,472,802.5	5,345.6	450.0	06/27/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	436	458	22
KAFB-106125-450	1,542,444.8	1,472,869.6	5,345.6	450.0	07/10/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	436	457	21
KAFB-106128-450	1,541,619.7	1,473,223.1	5,343.8	128.0	03/08/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	458	21
KAFB-106129-450	1,542,130.8	1,473,261.4	5,348.5	450.0	03/06/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	460	23
KAFB-106130-450	1,542,131.3	1,473,566.3	5,349.1	450.0	02/21/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	455	17
KAFB-106131-450	1,541,690.6	1,472,927.6	5,344.5	450.0	03/07/2011	SVE Extraction Well	3.00	PVC	430	440	0.050	10	428	450	22
KAFB-106132-450	1,542,804.1	1,473,591.7	5,353.0	450.0	02/17/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	460	23
KAFB-106133-450	1,542,416.3	1,473,502.4	5,352.0	450.0	02/16/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106134-450	1,542,371.2	1,473,810.7	5,347.8	450.0	02/23/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106135-450	1,542,905.0	1,474,068.8	5,351.1	450.0	02/05/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	460	23
KAFB-106136-450	1,543,098.7	1,474,675.9	5,351.7	450.0	07/06/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	457	20
KAFB-106137-450	1,542,321.5	1,474,079.4	5,347.3	450.0	01/25/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106138-450	1,541,536.6	1,475,005.5	5,347.4	450.0	04/07/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106139-450	1,541,248.5	1,474,050.1	5,341.3	450.0	01/08/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	438	460	22
KAFB-106140-450	1,542,236.9	1,472,632.8	5,345.3	450.0	01/12/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	458	21
KAFB-106141-450	1,542,470.8	1,475,343.8	5,334.4	450.0	04/15/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	458	21
KAFB-106142-450	1,542,455.5	1,474,944.0	5,349.2	450.0	04/21/2011	SVE Extraction Well	3.00	PVC	440	450	0.050	10	437	460	23
SVEW-01-260	1,541,421.4	1,473,522.6	5,343.3	260.0	02/25/2003	SVE Extraction Well	2.00	PVC	245	260	0.050	15	240	265	20
SVEW-02-060	1,541,431.0	1,473,524.9	5,343.4	60.0	09/09/2003	SVE Extraction Well	2.00	PVC	45	60	0.050	15	40	60	20
SVEW-03-160	1,541,431.1	1,473,523.8	5,343.4	160.0	09/09/2003	SVE Extraction Well	2.00	PVC	145	160	0.050	15	139	160	20
SVEW-04-313	1,541,409.4	1,473,525.0	5,343.4	313.0	09/17/2003	SVE Extraction Well	2.00	PVC	298	313	0.050	15	293	313	20
SVEW-05-460	1,541,410.3	1,473,525.1	5,343.4	460.0	09/17/2003	SVE Extraction Well	2.00	PVC	445	460	0.050	15	440	460	20
SVEW-06-060	1,541,234.4	1,473,527.2	5,343.4	60.0	08/25/2003	SVE Extraction Well	2.00	PVC	45	60	0.050	15	40	60	20
SVEW-07-160	1,541,235.1	1,473,527.2	5,343.4	160.0	08/25/2003	SVE Extraction Well	2.00	PVC	145	160	0.050	15	139	160	20
SVEW-08-260	1,541,226.5	1,473,525.9	5,343.4	260.0	08/27/2003	SVE Extraction Well	2.00	PVC	245	260	0.050	15	240	260	20
SVEW-09-460	1,541,226.9	1,473,525.5	5,343.4	457.0	08/27/2003	SVE Extraction Well	2.00	PVC	443	457	0.050	14	430	457	19

Table 4-1. SVE Well Construction Summary

LOCATION_ID	EASTING	NORTHING	GRND ELEV	DEPTH	DATE INSTALL	WELL TYPE	CASING DIA (in)	CASING TYPE	SCREEN TOP	SCREEN BOTTOM	Slot SIZE	SCREEN INTERVAL	TOP SAND PACK	BOTTOM SAND PACK	SAND PACK INTERVAL
SVEW-10-410	1,540,843.9	1,473,728.9	5,340.2	410.0		SVE Extraction Well	2.00	PVC	400	410	0.050	10	395	410	15
SVEW-11-410	1,541,992.0	1,473,669.5	5,347.6	410.0		SVE Extraction Well	2.00	PVC	400	410	0.050	10	395	410	15
SVEW-12-410	1,540,964.2	1,473,119.6	5,338.9	410.0		SVE Extraction Well	2.00	PVC	400	410	0.050	10	395	410	15
SVEW-13-410	1,541,979.9	1,473,408.1	5,347.0	410.0		SVE Extraction Well	2.00	PVC	400	410	0.050	10	395	410	15
KAFB-106108-025	1,541,083.9	1,473,729.7	5,341.9	25.0	02/18/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	14	26	12
KAFB-106108-050	1,541,083.7	1,473,729.5	5,341.9	50.0	02/18/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14
KAFB-106108-150	1,541,084.0	1,473,729.3	5,341.9	150.0	02/18/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	139	152	13
KAFB-106108-250	1,541,084.2	1,473,729.4	5,341.9	250.0	02/18/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	239	252	13
KAFB-106108-350	1,541,084.1	1,473,729.7	5,341.9	350.0	02/18/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	352	15
KAFB-106109-025	1,540,803.7	1,473,477.6	5,338.7	25.0	02/09/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	14	26	12
KAFB-106109-050	1,540,803.9	1,473,477.8	5,338.7	50.0	02/09/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106109-150	1,540,803.7	1,473,478.1	5,338.7	150.0	02/09/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	152	14
KAFB-106109-250	1,540,803.4	1,473,478.0	5,338.7	250.0	02/09/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106109-350	1,540,803.4	1,473,477.7	5,338.7	350.0	02/09/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106110-025	1,541,121.6	1,473,283.5	5,340.5	25.0	02/24/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	16	26	10
KAFB-106110-050	1,541,121.3	1,473,283.3	5,340.5	50.0	02/24/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	39	51	12
KAFB-106110-150	1,541,121.5	1,473,283.0	5,340.5	150.0	02/24/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	151	13
KAFB-106110-250	1,541,121.7	1,473,283.1	5,340.5	250.0	02/24/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106110-350	1,541,121.8	1,473,283.3	5,340.5	350.0	02/24/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106111-025	1,541,336.0	1,473,286.2	5,341.4	25.0	03/04/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106111-050	1,541,336.1	1,473,286.0	5,341.4	50.0	03/04/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	39	51	12
KAFB-106111-150	1,541,336.4	1,473,286.1	5,341.4	150.0	03/04/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	152	15
KAFB-106111-250	1,541,336.4	1,473,286.3	5,341.4	250.0	03/04/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	252	14
KAFB-106111-350	1,541,336.1	1,473,286.4	5,341.4	350.0	03/04/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	352	15
KAFB-106112-025	1,541,936.5	1,473,503.1	5,347.7	25.0	02/24/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106112-050	1,541,936.7	1,473,502.8	5,347.7	50.0	02/24/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14
KAFB-106112-150	1,541,937.0	1,473,502.9	5,347.7	150.0	02/24/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	152	15
KAFB-106112-250	1,541,937.0	1,473,503.2	5,347.7	250.0	02/24/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	235	252	17
KAFB-106112-350	1,541,936.7	1,473,503.3	5,347.7	350.0	02/24/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	352	15
KAFB-106113-020	1,542,004.4	1,473,062.2	5,345.8	20.0	02/08/2011	SVE Monitor Well	0.75	PVC	10	20	0.050	10	8	21	13
KAFB-106113-050	1,542,004.2	1,473,061.8	5,345.8	50.0	02/08/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106113-150	1,542,004.5	1,473,061.6	5,345.8	150.0	02/08/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	151	13
KAFB-106113-250	1,542,004.8	1,473,061.8	5,345.8	250.0	02/08/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106113-350	1,542,004.7	1,473,062.1	5,345.8	350.0	02/08/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	351	14
KAFB-106114-025	1,541,796.5	1,473,062.4	5,344.8	25.0	03/01/2011	SVE Monitor Well	0.75	PVC	10	20	0.050	10	13	26	13
KAFB-106114-050	1,541,796.2	1,473,062.1	5,344.8	50.0	03/01/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106114-150	1,541,796.4	1,473,061.8	5,344.8	150.0	03/01/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	151	13
KAFB-106114-250	1,541,796.7	1,473,061.9	5,344.8	250.0	03/01/2011	SVE Monitor Well	0.75	PVC	235	245	0.050	10	233	246	13
KAFB-106114-350	1,541,796.7	1,473,062.2	5,344.8	350.0	03/01/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106115-025	1,542,375.3	1,473,054.9	5,348.0	25.0	02/20/2011	SVE Monitor Well	0.75	PVC	10	20	0.050	10	13	26	13
KAFB-106115-050	1,542,375.1	1,473,054.6	5,348.0	50.0	02/20/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106115-150	1,542,374.9	1,473,054.7	5,348.0	150.0	02/20/2011	SVE Monitor Well	0.75	PVC	145	155	0.050	10	143	156	13
KAFB-106115-250	1,542,374.8	1,473,054.9	5,348.0	250.0	02/20/2011	SVE Monitor Well	0.75	PVC	235	245	0.050	10	238	251	13
KAFB-106115-350	1,542,375.1	1,473,055.0	5,348.0	350.0	02/20/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106116-025	1,541,894.6	1,473,296.4	5,346.2	25.0	03/10/2011	SVE Monitor Well	0.75	PVC	10	20	0.050	10	8	22	14
KAFB-106116-050	1,541,894.9	1,473,296.4	5,346.2	50.0	03/10/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106116-150	1,541,894.5	1,473,296.7	5,346.2	150.0	03/10/2011	SVE Monitor Well	0.75	PVC	145	155	0.050	10	137	156	19

Table 4-1. SVE Well Construction Summary

LOCATION_ID	EASTING	NORTHING	GRND ELEV	DEPTH	DATE INSTALL	WELL TYPE	CASING DIA (in)	CASING TYPE	SCREEN TOP	SCREEN BOTTOM	Slot SIZE	SCREEN INTERVAL	TOP SAND PACK	BOTTOM SAND PACK	SAND PACK INTERVAL
KAFB-106116-250	1,541,894.7	1,473,296.9	5,346.2	250.0	03/10/2011	SVE Monitor Well	0.75	PVC	235	245	0.050	10	238	252	14
KAFB-106116-350	1,541,895.0	1,473,296.7	5,346.2	350.0	03/10/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	353	15
KAFB-106117-025	1,541,727.8	1,473,366.3	5,345.3	25.0	03/15/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106117-050	1,541,728.0	1,473,366.6	5,345.3	50.0	03/15/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106117-150	1,541,727.8	1,473,366.8	5,345.3	150.0	03/15/2011	SVE Monitor Well	0.75	PVC	145	155	0.050	10	137	151	14
KAFB-106117-250	1,541,727.5	1,473,366.7	5,345.3	250.0	03/15/2011	SVE Monitor Well	0.75	PVC	235	245	0.050	10	238	251	13
KAFB-106117-350	1,541,727.5	1,473,366.4	5,345.3	350.0	03/15/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106118-025	1,541,791.3	1,473,740.7	5,345.8	25.0	03/07/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106118-050	1,541,791.4	1,473,741.0	5,345.8	50.0	03/07/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106118-160	1,541,791.5	1,473,740.6	5,345.8	160.0	03/07/2011	SVE Monitor Well	0.75	PVC	150	160	0.050	10	147	162	15
KAFB-106118-265	1,541,791.8	1,473,741.0	5,345.8	265.0	03/07/2011	SVE Monitor Well	0.75	PVC	255	265	0.050	10	250	265	15
KAFB-106118-350	1,541,791.8	1,473,740.7	5,345.8	350.0	03/07/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	336	351	15
KAFB-106119-025	1,541,613.1	1,473,519.6	5,343.6	25.0	03/06/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106119-050	1,541,613.2	1,473,519.3	5,343.6	50.0	03/06/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14
KAFB-106119-150	1,541,613.5	1,473,519.4	5,343.6	150.0	03/06/2011	SVE Monitor Well	0.75	PVC	150	160	0.050	10	138	152	14
KAFB-106119-250	1,541,613.5	1,473,519.7	5,343.6	250.0	03/06/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106119-350	1,541,613.3	1,473,519.8	5,343.6	350.0	03/06/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	352	14
KAFB-106120-025	1,542,055.0	1,472,900.3	5,343.4	25.0	06/09/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	27	15
KAFB-106120-050	1,542,055.1	1,472,900.5	5,343.4	50.0	06/09/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	36	53	17
KAFB-106120-150	1,542,055.0	1,472,900.7	5,343.4	150.0	06/09/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	153	16
KAFB-106120-250	1,542,054.6	1,472,900.5	5,343.4	250.0	06/09/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106120-350	1,542,054.8	1,472,900.3	5,343.4	350.0	06/09/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	336	352	16
KAFB-106121-025	1,542,051.5	1,472,805.8	5,343.8	25.0	05/25/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	11	27	16
KAFB-106121-050	1,542,051.8	1,472,805.7	5,343.8	50.0	05/25/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106121-145	1,542,051.3	1,472,805.6	5,343.8	145.0	05/25/2011	SVE Monitor Well	0.75	PVC	135	145	0.050	10	131	149	18
KAFB-106121-250	1,542,051.4	1,472,805.4	5,343.8	250.0	05/25/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106121-350	1,542,051.7	1,472,805.4	5,343.8	350.0	05/25/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	335	356	21
KAFB-106122-025	1,542,096.3	1,472,866.3	5,343.9	25.0	06/18/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	27	15
KAFB-106122-050	1,542,096.3	1,472,866.6	5,343.9	50.0	06/18/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106122-150	1,542,096.0	1,472,866.7	5,343.9	150.0	06/18/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	151	14
KAFB-106122-250	1,542,095.9	1,472,866.4	5,343.9	250.0	06/18/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106122-350	1,542,096.1	1,472,866.2	5,343.9	350.0	06/18/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	336	352	16
KAFB-106123-025	1,542,010.8	1,472,850.4	5,344.1	25.0	05/31/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	27	15
KAFB-106123-050	1,542,010.7	1,472,850.7	5,344.1	50.0	05/31/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106123-150	1,542,010.3	1,472,850.7	5,344.1	150.0	05/31/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	152	15
KAFB-106123-250	1,542,010.3	1,472,850.3	5,344.1	250.0	05/31/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106123-350	1,542,010.6	1,472,850.2	5,344.1	350.0	05/31/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	353	16
KAFB-106124-025	1,542,370.4	1,472,802.6	5,345.6	25.0	06/27/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	27	15
KAFB-106124-050	1,542,370.1	1,472,802.6	5,345.6	50.0	06/27/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106124-150	1,542,370.0	1,472,802.3	5,345.6	150.0	06/27/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	152	15
KAFB-106124-250	1,542,370.2	1,472,802.1	5,345.6	250.0	06/27/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106124-350	1,542,370.5	1,472,802.3	5,345.6	350.0	06/27/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	335	352	17
KAFB-106125-025	1,542,445.0	1,472,869.7	5,345.6	25.0	07/10/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	2	27	25
KAFB-106125-050	1,542,444.7	1,472,869.7	5,345.6	50.0	07/10/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	53	16
KAFB-106125-150	1,542,444.6	1,472,869.5	5,345.6	150.0	07/10/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	136	152	16
KAFB-106125-250	1,542,444.8	1,472,869.3	5,345.6	250.0	07/10/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	236	252	16
KAFB-106125-350	1,542,445.0	1,472,869.3	5,345.6	350.0	07/10/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	351	14

Table 4-1. SVE Well Construction Summary

LOCATION_ID	EASTING	NORTHING	GRND ELEV	DEPTH	DATE INSTALL	WELL TYPE	CASING DIA (in)	CASING TYPE	SCREEN TOP	SCREEN BOTTOM	Slot SIZE	SCREEN INTERVAL	TOP SAND PACK	BOTTOM SAND PACK	SAND PACK INTERVAL
KAFB-106128-025	1,541,619.6	1,473,223.2	5,343.8	128.0	03/08/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	15	26	11
KAFB-106128-050	1,541,619.5	1,473,223.0	5,343.8	128.0	03/08/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	39	51	12
KAFB-106128-150	1,541,619.7	1,473,222.8	5,343.8	128.0	03/08/2011	SVE Monitor Well	0.75	PVC	150	160	0.050	10	139	152	13
KAFB-106128-250	1,541,620.0	1,473,222.9	5,343.8	128.0	03/08/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	236	251	15
KAFB-106128-350	1,541,619.9	1,473,223.3	5,343.8	128.0	03/08/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106129-025	1,542,130.5	1,473,260.8	5,348.5	25.0	03/06/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106129-050	1,542,130.8	1,473,260.6	5,348.5	50.0	03/06/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106129-150	1,542,131.0	1,473,260.9	5,348.5	150.0	03/06/2011	SVE Monitor Well	0.75	PVC	150	160	0.050	10	137	151	14
KAFB-106129-250	1,542,130.9	1,473,261.1	5,348.5	250.0	03/06/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106129-350	1,542,130.6	1,473,261.1	5,348.5	350.0	03/06/2011	SVE Monitor Well	0.75	PVC	337	347	0.050	10	335	348	13
KAFB-106130-025	1,542,130.9	1,473,565.7	5,349.1	25.0	02/21/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	26	14
KAFB-106130-050	1,542,131.1	1,473,565.5	5,349.1	50.0	02/21/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	53	15
KAFB-106130-150	1,542,131.4	1,473,565.6	5,349.1	150.0	02/21/2011	SVE Monitor Well	0.75	PVC	150	160	0.050	10	147	162	15
KAFB-106130-250	1,542,131.3	1,473,565.9	5,349.1	250.0	02/21/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106130-350	1,542,131.1	1,473,566.0	5,349.1	350.0	02/21/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	352	14
KAFB-106131-025	1,541,690.4	1,472,926.9	5,344.5	25.0	03/07/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106131-055	1,541,690.6	1,472,926.7	5,344.5	55.0	03/07/2011	SVE Monitor Well	0.75	PVC	45	55	0.050	10	43	56	13
KAFB-106131-150	1,541,690.5	1,472,927.2	5,344.5	150.0	03/07/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	151	13
KAFB-106131-245	1,541,690.9	1,472,926.9	5,344.5	245.0	03/07/2011	SVE Monitor Well	0.75	PVC	235	245	0.050	10	233	246	13
KAFB-106131-350	1,541,690.8	1,472,927.2	5,344.5	350.0	03/07/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106132-025	1,542,804.3	1,473,591.3	5,353.0	25.0	02/17/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	27	14
KAFB-106132-050	1,542,803.8	1,473,591.4	5,353.0	50.0	02/17/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106132-175	1,542,804.1	1,473,591.1	5,353.0	175.0	02/17/2011	SVE Monitor Well	0.75	PVC	165	175	0.050	10	163	182	19
KAFB-106132-250	1,542,803.8	1,473,591.1	5,353.0	250.0	02/17/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	252	14
KAFB-106132-350	1,542,804.1	1,473,591.5	5,353.0	350.0	02/17/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	352	14
KAFB-106133-025	1,542,416.1	1,473,501.6	5,352.0	25.0	02/16/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106133-050	1,542,416.0	1,473,501.9	5,352.0	50.0	02/16/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14
KAFB-106133-170	1,542,416.3	1,473,502.1	5,352.0	170.0	02/16/2011	SVE Monitor Well	0.75	PVC	160	170	0.050	10	158	172	14
KAFB-106133-250	1,542,416.5	1,473,501.9	5,352.0	250.0	02/16/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	252	14
KAFB-106133-350	1,542,416.5	1,473,501.6	5,352.0	350.0	02/16/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	352	14
KAFB-106134-025	1,542,371.3	1,473,809.9	5,347.8	25.0	02/23/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106134-050	1,542,371.0	1,473,809.9	5,347.8	50.0	02/23/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14
KAFB-106134-170	1,542,371.4	1,473,810.2	5,347.8	170.0	02/23/2011	SVE Monitor Well	0.75	PVC	160	170	0.050	10	158	171	13
KAFB-106134-250	1,542,371.2	1,473,810.4	5,347.8	250.0	02/23/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106134-350	1,542,370.9	1,473,810.2	5,347.8	350.0	02/23/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106135-025	1,542,905.1	1,474,068.9	5,351.1	25.0	02/05/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	27	14
KAFB-106135-050	1,542,905.3	1,474,068.7	5,351.1	50.0	02/05/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106135-150	1,542,905.1	1,474,068.4	5,351.1	150.0	02/05/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	152	14
KAFB-106135-250	1,542,904.8	1,474,068.5	5,351.1	250.0	02/05/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	252	14
KAFB-106135-350	1,542,904.8	1,474,068.8	5,351.1	350.0	02/05/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	352	14
KAFB-106136-025	1,543,098.9	1,474,675.7	5,351.7	25.0	07/06/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	27	14
KAFB-106136-050	1,543,098.9	1,474,676.0	5,351.7	50.0	07/06/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14
KAFB-106136-150	1,543,098.6	1,474,676.0	5,351.7	150.0	07/06/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	152	15
KAFB-106136-250	1,543,098.4	1,474,675.8	5,351.7	250.0	07/06/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	236	253	17
KAFB-106136-350	1,543,098.7	1,474,675.5	5,351.7	350.0	07/06/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	337	352	15
KAFB-106137-025	1,542,321.6	1,474,077.4	5,347.3	25.0	01/25/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106137-050	1,542,321.4	1,474,077.5	5,347.3	50.0	01/25/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	52	14

Table 4-1. SVE Well Construction Summary

LOCATION_ID	EASTING	NORTHING	GRND ELEV	DEPTH	DATE INSTALL	WELL TYPE	CASING DIA (in)	CASING TYPE	SCREEN TOP	SCREEN BOTTOM	Slot SIZE	SCREEN INTERVAL	TOP SAND PACK	BOTTOM SAND PACK	SAND PACK INTERVAL
KAFB-106137-150	1,542,321.1	1,474,077.4	5,347.3	150.0	01/25/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	152	14
KAFB-106137-250	1,542,321.3	1,474,077.1	5,347.3	250.0	01/25/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106137-350	1,542,321.6	1,474,077.1	5,347.3	350.0	01/25/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106138-025	1,541,536.7	1,475,005.7	5,347.4	25.0	04/07/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	26	14
KAFB-106138-050	1,541,536.4	1,475,005.6	5,347.4	50.0	04/07/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106138-150	1,541,536.4	1,475,005.3	5,347.4	150.0	04/07/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	138	152	14
KAFB-106138-250	1,541,536.7	1,475,005.2	5,347.4	250.0	04/07/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	238	251	13
KAFB-106138-350	1,541,536.9	1,475,005.4	5,347.4	350.0	04/07/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	351	13
KAFB-106139-025	1,541,248.3	1,474,049.9	5,341.3	25.0	01/08/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106139-050	1,541,248.5	1,474,049.4	5,341.3	50.0	01/08/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106139-150	1,541,248.3	1,474,049.3	5,341.3	150.0	01/08/2011	SVE Monitor Well	0.75	PVC	140	150	0.050	10	137	152	15
KAFB-106139-250	1,541,248.1	1,474,049.6	5,341.3	250.0	01/08/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	236	252	16
KAFB-106139-350	1,541,248.6	1,474,049.7	5,341.3	350.0	01/08/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	353	15
KAFB-106140-025	1,542,236.6	1,472,632.5	5,345.3	25.0	01/12/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	13	26	13
KAFB-106140-050	1,542,237.0	1,472,632.4	5,345.3	50.0	01/12/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	38	51	13
KAFB-106140-150	1,542,236.7	1,472,632.9	5,345.3	150.0	01/12/2011	SVE Monitor Well	0.75	PVC	142	152	0.050	10	138	153	15
KAFB-106140-250	1,542,237.0	1,472,632.9	5,345.3	250.0	01/12/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	256	19
KAFB-106140-350	1,542,237.2	1,472,632.7	5,345.3	350.0	01/12/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	352	14
KAFB-106141-025	1,542,470.9	1,475,343.4	5,334.4	25.0	04/15/2011	SVE Monitor Well	0.75	PVC	15	25	0.050	10	12	27	15
KAFB-106141-050	1,542,471.0	1,475,343.7	5,334.4	50.0	04/15/2011	SVE Monitor Well	0.75	PVC	50	60	0.050	10	47	60	13
KAFB-106141-170	1,542,470.8	1,475,343.9	5,334.4	170.0	04/15/2011	SVE Monitor Well	0.75	PVC	160	170	0.050	10	158	173	15
KAFB-106141-250	1,542,470.6	1,475,343.8	5,334.4	250.0	04/15/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	253	16
KAFB-106141-350	1,542,470.6	1,475,343.5	5,334.4	350.0	04/15/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	336	353	17
KAFB-106142-030	1,542,455.7	1,474,944.0	5,349.2	25.0	04/21/2011	SVE Monitor Well	0.75	PVC	20	30	0.050	10	17	31	14
KAFB-106142-050	1,542,455.4	1,474,944.2	5,349.2	50.0	04/21/2011	SVE Monitor Well	0.75	PVC	40	50	0.050	10	37	52	15
KAFB-106142-170	1,542,455.2	1,474,943.9	5,349.2	170.0	04/21/2011	SVE Monitor Well	0.75	PVC	160	170	0.050	10	157	173	16
KAFB-106142-250	1,542,455.4	1,474,943.7	5,349.2	250.0	04/21/2011	SVE Monitor Well	0.75	PVC	240	250	0.050	10	237	252	15
KAFB-106142-350	1,542,455.7	1,474,943.7	5,349.2	350.0	04/21/2011	SVE Monitor Well	0.75	PVC	340	350	0.050	10	338	357	19
KAFB-10628-150	1,542,329.4	1,474,330.3	5,348.9	150.0	05/16/2010	SVE Monitor Well	0.75	PVC	147	150	0.010	3	139	159	20
KAFB-10628-250	1,542,329.4	1,474,330.5	5,348.9	250.0	05/16/2010	SVE Monitor Well	0.75	PVC	247	250	0.010	3	239	259	20
KAFB-10628-350	1,542,329.7	1,474,330.5	5,348.9	350.0	05/16/2010	SVE Monitor Well	0.75	PVC	347	350	0.010	3	339	359	20
KAFB-10628-450	1,542,329.8	1,474,330.7	5,348.9	450.0	05/16/2010	SVE Monitor Well	0.75	PVC	447	450	0.010	3	439	459	20
SVMW-01-050	1,541,090.1	1,473,534.4	5,343.1	52.5		SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-01-100	1,541,090.4	1,473,534.8	5,343.1	102.5		SVE Monitor Well	0.50	PVC	100	103	0.050	3	91	111	20
SVMW-01-250	1,541,090.4	1,473,534.4	5,343.1	253.2		SVE Monitor Well	0.50	PVC	251	253	0.050	3	242	262	20
SVMW-01-300	1,541,090.1	1,473,534.9	5,343.1	310.0		SVE Monitor Well	0.50	PVC	309	310	0.050	2	299	319	20
SVMW-02-050	1,541,412.0	1,473,655.9	5,341.5	52.5		SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-02-100	1,541,412.1	1,473,655.7	5,341.5	99.5		SVE Monitor Well	0.50	PVC	97	100	0.050	3	88	108	20
SVMW-02-150	1,541,412.2	1,473,656.0	5,341.5	152.5		SVE Monitor Well	0.50	PVC	150	153	0.050	3	141	161	20
SVMW-03-050	1,541,518.4	1,473,497.4	5,343.6	52.5		SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-03-100	1,541,518.5	1,473,497.7	5,343.6	102.5		SVE Monitor Well	0.50	PVC	100	103	0.050	3	91	111	20
SVMW-03-250	1,541,518.7	1,473,497.5	5,343.6	252.5		SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-03-300	1,541,518.6	1,473,497.2	5,343.6	302.5		SVE Monitor Well	0.50	PVC	300	303	0.050	3	291	311	20
SVMW-04-050	1,541,274.9	1,473,448.5	5,341.3	52.5		SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-04-100	1,541,274.5	1,473,448.6	5,341.3	100.5		SVE Monitor Well	0.50	PVC	98	101	0.050	3	89	109	20
SVMW-04-250	1,541,274.5	1,473,448.4	5,341.3	252.5		SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-04-300	1,541,274.7	1,473,448.1	5,341.3	300.0		SVE Monitor Well	0.50	PVC	298	300	0.050	3	289	309	20

Table 4-1. SVE Well Construction Summary

LOCATION_ID	EASTING	NORTHING	GRND ELEV	DEPTH	DATE INSTALL	WELL TYPE	CASING DIA (in)	CASING TYPE	SCREEN TOP	SCREEN BOTTOM	Slot SIZE	SCREEN INTERVAL	TOP SAND PACK	BOTTOM SAND PACK	SAND PACK INTERVAL
SVMW-05-050	1,541,016.0	1,473,498.3	5,342.9	52.5	03/02/2001	SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-05-100	1,541,015.7	1,473,498.6	5,342.9	102.5	03/02/2001	SVE Monitor Well	0.50	PVC	100	103	0.050	3	91	111	20
SVMW-05-230	1,541,016.2	1,473,498.7	5,342.9	231.0	03/02/2001	SVE Monitor Well	0.50	PVC	229	231	0.050	2	220	240	20
SVMW-05-290	1,541,015.9	1,473,498.8	5,342.9	290.0	03/02/2001	SVE Monitor Well	0.50	PVC	287	290	0.050	3	279	299	20
SVMW-06-050	1,541,802.5	1,473,507.4	5,346.2	52.5	03/12/2001	SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-06-100	1,541,803.0	1,473,507.3	5,346.2	102.0	03/12/2001	SVE Monitor Well	0.50	PVC	99	102	0.050	3	91	111	20
SVMW-06-252	1,541,802.7	1,473,507.7	5,346.2	254.5	03/12/2001	SVE Monitor Well	0.50	PVC	252	255	0.050	3	243	263	20
SVMW-06-302	1,541,802.6	1,473,507.1	5,346.2	305.0	03/12/2001	SVE Monitor Well	0.50	PVC	302	305	0.050	3	294	314	20
SVMW-07-050	1,541,493.3	1,473,791.1	5,342.4	52.0	03/27/2001	SVE Monitor Well	0.50	PVC	50	52	0.050	3	41	61	20
SVMW-07-100	1,541,493.0	1,473,791.2	5,342.4	98.0	03/27/2001	SVE Monitor Well	0.50	PVC	96	98	0.050	3	87	107	20
SVMW-07-150	1,541,493.2	1,473,791.4	5,342.4	149.5	03/27/2001	SVE Monitor Well	0.50	PVC	147	150	0.050	3	138	158	20
SVMW-08-050	1,541,274.7	1,473,555.1	5,342.8	52.5		SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-08-250	1,541,274.8	1,473,555.0	5,342.8	252.5		SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-09-050	1,541,322.7	1,473,544.3	5,343.0	52.5		SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-09-100	1,541,322.6	1,473,544.2	5,343.0	102.5		SVE Monitor Well	0.50	PVC	100	103	0.050	3	91	111	20
SVMW-09-250	1,541,322.4	1,473,544.5	5,343.0	252.5		SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-09-266	1,541,322.2	1,473,544.4	5,343.0	268.5		SVE Monitor Well	0.50	PVC	266	269	0.050	3	257	277	20
SVMW-10-050	1,541,371.1	1,473,534.1	5,343.1	52.5	02/12/2003	SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-10-100	1,541,371.1	1,473,534.6	5,343.1	102.5	02/12/2003	SVE Monitor Well	0.50	PVC	100	103	0.050	3	91	111	20
SVMW-10-150	1,541,371.4	1,473,534.3	5,343.1	152.5	02/12/2003	SVE Monitor Well	0.50	PVC	150	153	0.050	3	141	161	20
SVMW-10-250	1,541,371.0	1,473,534.2	5,343.1	252.5	02/12/2003	SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-11-050	1,541,411.7	1,473,473.5	5,343.1	52.5	02/22/2003	SVE Monitor Well	0.50	PVC	50	53	0.050	3	41	61	20
SVMW-11-100	1,541,411.9	1,473,473.8	5,343.1	102.5	02/22/2003	SVE Monitor Well	0.50	PVC	100	103	0.050	3	91	111	20
SVMW-11-250	1,541,411.4	1,473,473.9	5,343.1	252.5	02/22/2003	SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-11-260	1,541,411.5	1,473,474.1	5,343.1	262.5	02/22/2003	SVE Monitor Well	0.50	PVC	260	263	0.050	3	251	271	20
SVMW-12-150	1,540,843.9	1,473,728.5	5,340.2	152.5	02/02/2004	SVE Monitor Well	0.50	PVC	150	153	0.050	3	141	161	20
SVMW-12-250	1,540,844.2	1,473,728.6	5,340.2	252.5	02/02/2004	SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-12-350	1,540,843.9	1,473,729.0	5,340.2	352.5	02/02/2004	SVE Monitor Well	0.50	PVC	350	353	0.050	3	341	361	20
SVMW-12-450	1,540,843.6	1,473,728.8	5,340.2	452.5	02/02/2004	SVE Monitor Well	0.50	PVC	450	453	0.050	3	441	461	20
SVMW-13-150	1,541,991.8	1,473,669.7	5,347.6	152.5	01/27/2004	SVE Monitor Well	0.50	PVC	150	153	0.050	3	141	161	20
SVMW-13-250	1,541,991.5	1,473,669.7	5,347.6	252.5	01/27/2004	SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-13-350	1,541,991.6	1,473,669.5	5,347.6	352.5	01/27/2004	SVE Monitor Well	0.50	PVC	350	353	0.050	3	341	361	20
SVMW-13-450	1,541,991.7	1,473,669.2	5,347.6	452.5	01/27/2004	SVE Monitor Well	0.50	PVC	450	453	0.050	3	441	461	20
SVMW-14-150	1,540,964.0	1,473,119.4	5,338.9	152.5	01/07/2004	SVE Monitor Well	0.50	PVC	150	153	0.050	3	141	161	20
SVMW-14-250	1,540,963.7	1,473,119.5	5,338.9	252.5	01/07/2004	SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-14-350	1,540,963.7	1,473,119.2	5,338.9	352.5	01/07/2004	SVE Monitor Well	0.50	PVC	350	353	0.050	3	341	361	20
SVMW-14-450	1,540,964.2	1,473,119.2	5,338.9	452.5	01/07/2004	SVE Monitor Well	0.50	PVC	450	453	0.050	3	441	461	20
SVMW-15-150	1,541,979.8	1,473,407.9	5,347.0	152.5	01/20/2004	SVE Monitor Well	0.50	PVC	150	153	0.050	3	141	161	20
SVMW-15-250	1,541,980.3	1,473,408.0	5,347.0	252.5	01/20/2004	SVE Monitor Well	0.50	PVC	250	253	0.050	3	241	261	20
SVMW-15-350	1,541,980.0	1,473,407.7	5,347.0	352.5	01/20/2004	SVE Monitor Well	0.50	PVC	350	353	0.050	3	341	361	20
SVMW-15-450	1,541,980.0	1,473,408.2	5,347.0	452.5	01/20/2004	SVE Monitor Well	0.50	PVC	450	453	0.050	3	441	461	20

Table 4-2. SVE System Summary

RSI Unit	Well Location	Average Flow Rate (scfm)[1]	Average Vacuum (in Water)[1]	Maximum Vacuum (in Water)[1]	Average Mass Recovery Rate (lbs/d)[1]	Average Mass Recovery Rate (gal/d)[2]	Average Vapor Conc. (PPMv)[3]	Cumulative Total Mass Recovery (gal)[4]
249	SVEX-01, SVEX-05	37	29	122	720	120	14,700	215,000
335	KAFB-1065	16	126	225	66	11	6,700	85,000
344	KAFB-1068	50	51	221	100	18	5,000	55,000
345	KAFB-1066	40	28	179	350	58	16,200	59,000
							Total	414,000

1 Jan.-March 2011 Average
2 Jan.-March 2011 Average using 6 lbs/gallon conversion
3 Jan.-March 2011 Average as computed from engine operational parameters assuming 20,000 PPMv/BTU
4 July 2004 through Feb 2011

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Table 4-3. SVE Well VOC Concentration Trends (2004-2010)

Location	Initial Concentration PPMv)	2010 Concentration PPMv)	Overall Concentration Trend	Current 2009-2010 Trend	Approximate Change Since Installation	Year Installed
SVEW-01-260	50,000	25,000	Decline	Steady	50%	2004
SVEW-02-060	20,000	4,500	Decline	Steady	78%	2004
SVEW-03-160	11,600	50	Decline	Decline	100%	2004
SVEW-04-313	20,000	500	Decline	Decline	98%	2004
SVEW-05-460	21,000	6,100	Decline	Decline	71%	2004
SVEW-06-060	5,200	1,100	Decline	Steady	79%	2004
SVEW-07-160	26,500	440	Decline	Steady	98%	2004
SVEW-08-260	18,600	90	Decline	Decline	100%	2004
SVEW-09-460	21,000	3,200	Decline	Decline	85%	2004
SVEW-10-410	9,400	11	Decline	Decline	100%	2007
SVEW-11-410	33,000	4,200	Decline	Decline	87%	2007
SVEW-12-410	6,400	360	Decline	Decline	94%	2007
SVEW-13-410	38,000	18,500	Steady	Steady	51%	2007
SVMW-01-050	260	9	Decline	Steady	97%	2004
SVMW-01-100	10400	7000	Decline	Steady	33%	2004
SVMW-01-250	14700	80	Decline	Steady	99%	2004
SVMW-01-310	16800	900	Decline	Decline	95%	2004
SVMW-02-050	2300	600	Decline	Steady	74%	2004
SVMW-02-100	22400	8600	Decline	Decline	62%	2004
SVMW-02-150	11000	2000	Decline	Steady	82%	2004
SVMW-03-050	40	20	Steady	Steady	50%	2004
SVMW-03-100	33,000	28000	Steady	Steady	15%	2004
SVMW-03-250	25,000	3100	Decline	Decline	88%	2004
SVMW-03-300	29,000	8200	Decline	Decline	72%	2004
SVMW-04-050	4300	1400	Steady	Steady	67%	2004
SVMW-04-100	20000	17000	Steady	Steady	15%	2004
SVMW-04-250	28000	1400	Decline	Decline	95%	2004
SVMW-04-300	13000	250	Decline	Decline	98%	2004
SVMW-05-050	100	10	Steady	Steady	90%	2004
SVMW-05-100	1200	240	Steady	Steady	80%	2004
SVMW-05-230	4700	10	Decline	Steady	100%	2004
SVMW-05-290	13000	350	Decline	Steady	97%	2004
SVMW-06-050	300	40	Steady	Steady	87%	2004
SVMW-06-100	1100	30	Steady	Steady	97%	2004
SVMW-06-252	17000	6700	Decline	Steady	61%	2004
SVMW-06-302	25000	15000	Decline	Steady	40%	2004
SVMW-07-050	4500	300	Decline	Decline	93%	2004
SVMW-07-096	8000	1300	Decline	Decline	84%	2004
SVMW-07-150	200	200	Steady	Steady	0%	2004
SVMW-08-050	8000	13000	Steady	Increase	-63%	2004
SVMW-08-250	23000	180	Decline	Steady	99%	2004
SVMW-09-050	10953	3580	Decline	Steady	67%	2004
SVMW-09-100	33660	32670	Steady	Steady	3%	2004
SVMW-09-250	23040	2240	Decline	Steady	90%	2004
SVMW-09-265	31770	14355	Decline	Increase	55%	2004
SVMW-10-050	42000	34000	Steady	Steady	19%	2004
SVMW-10-100	51000	45000	Steady	Steady	12%	2004
SVMW-10-150	31000	27000	Steady	Steady	13%	2004
SVMW-10-250	46000	13000	Steady	Decline	72%	2004
SVMW-11-050	20000	21000	Steady	Steady	-5%	2004
SVMW-11-100	53000	41000	Steady	Steady	23%	2004
SVMW-11-250	57000	31000	Decline	Increase	46%	2004

Table 4-3. SVE Well VOC Concentration Trends (2004-2010) (concluded)

Location	Initial Concentration PPMv)	2010 Concentration PPMv)	Overall Concentration Trend	Current 2009-2010 Trend	Approximate Change Since Installation	Year Installed
SVMW-11-260	56000	35000	Steady	Steady	38%	2004
SVMW-12-150	1300	10	Steady	Steady	99%	2004
SVMW-12-250	5000	500	Decline	Decline	90%	2004
SVMW-12-350	9000	300	Decline	Decline	97%	2004
SVMW-12-450	21000	600	Decline	Decline	97%	2004
SVMW-13-150	42000	7200	Decline	Decline	83%	2004
SVMW-13-250	14000	4000	Decline	Steady	71%	2004
SVMW-13-350	7000	40	Decline	Steady	99%	2004
SVMW-13-450	200	10	Steady	Steady	95%	2004
SVMW-14-150	1000	2	Decline	Decline	100%	2004
SVMW-14-250	3000	5	Decline	Decline	100%	2004
SVMW-14-350	4000	65	Decline	Decline	98%	2004
SVMW-14-450	30000	1900	Decline	Decline	94%	2004
SVMW-15-150	3300	100	Decline	Decline	97%	2004
SVMW-15-250	7700	250	Decline	Decline	97%	2004
SVMW-15-350	27000	12000	Decline	Decline	56%	2004
SVMW-15-450	39000	32000	Decline	Steady	18%	2004

Table 5-1. Radius of Influence Extraction and Observation Wells

Test No.	Extraction Well	Observation Well Clusters[1]	Duration (Days)[2]
1	KAFB-106121-450	KAFB-106121 KAFB-106120 KAFB-106122 KAFB-106123	5
2	SVEW-01 or SVEW-05	SVEW-02/03 SVEW-04/05 SWMW-02 SVMW-03 SVMW-04 SVMW-08 SVMW-09 SVMW-10 SWVM-11 KAFB-106148 KAFB-106119 SWEW-06/07 SVEW-08/09	5
3	KAFB-106117-450 or KAFB-106149-450	KAFB-106108 KAFB-106110 KAFB-106111 KAFB-106112 KAFB-106113 KAFB-106114 KAFB-106116 KAFB-106117 KAFB-106118 KAFB-106119 KAFB-106120 KAFB-106128 KAFB-106129 KAFB-106130 KAFB-106131 KAFB-106133 KAFB-106134 SVMW-02 SVMW-03 SVMW-05 SVMW-07 SVMW-09 SVMW-15	30

Note:

1. All usable wells in each cluster will be monitored for vacuum.
2. ROI tests will be performed for the following durations or until vacuum readings stabilize, whichever is shorter

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APPENDIX A

Vapor Concentration Trend Plots

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LIST OF FIGURES

Figure **Title**

LIST OF FIGURES (concluded)

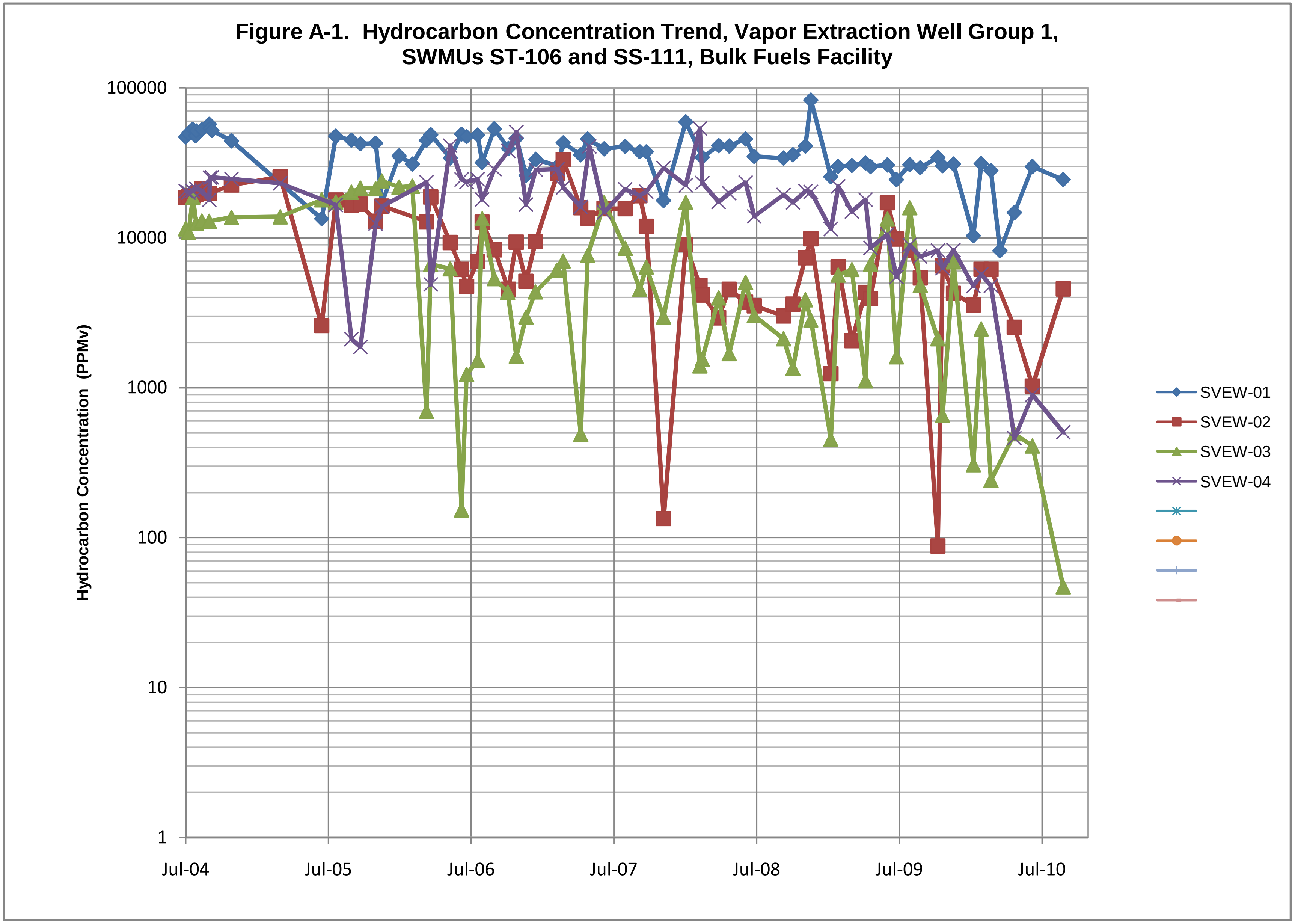


Figure A-1. Hydrocarbon Concentration Trend, Vapor Extraction Well Group 1,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVEW-01
SVEW-02
SVEW-03
SVEW-04

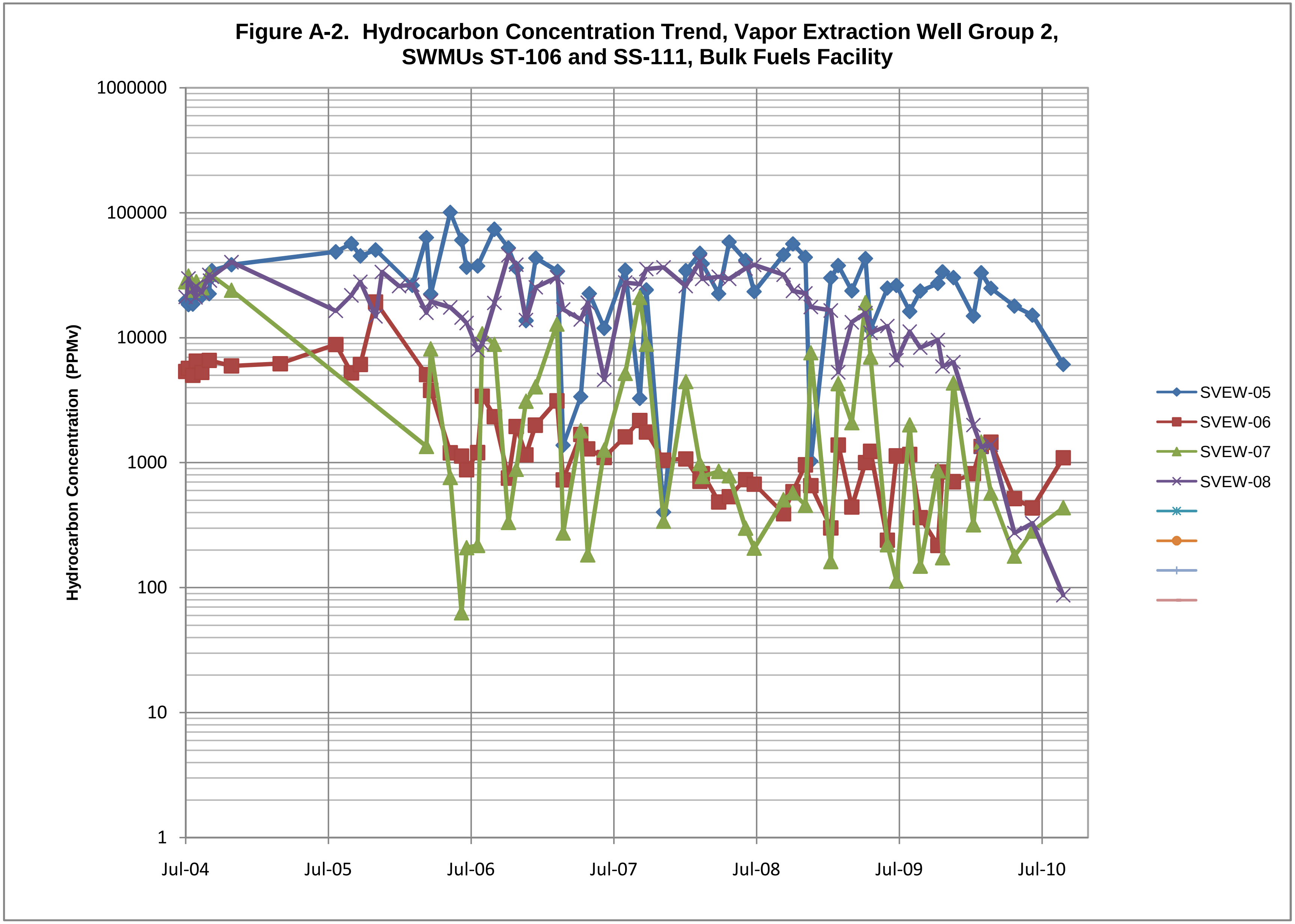


Figure A-2. Hydrocarbon Concentration Trend, Vapor Extraction Well Group 2,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
1000000
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVEW-05
SVEW-06
SVEW-07
SVEW-08

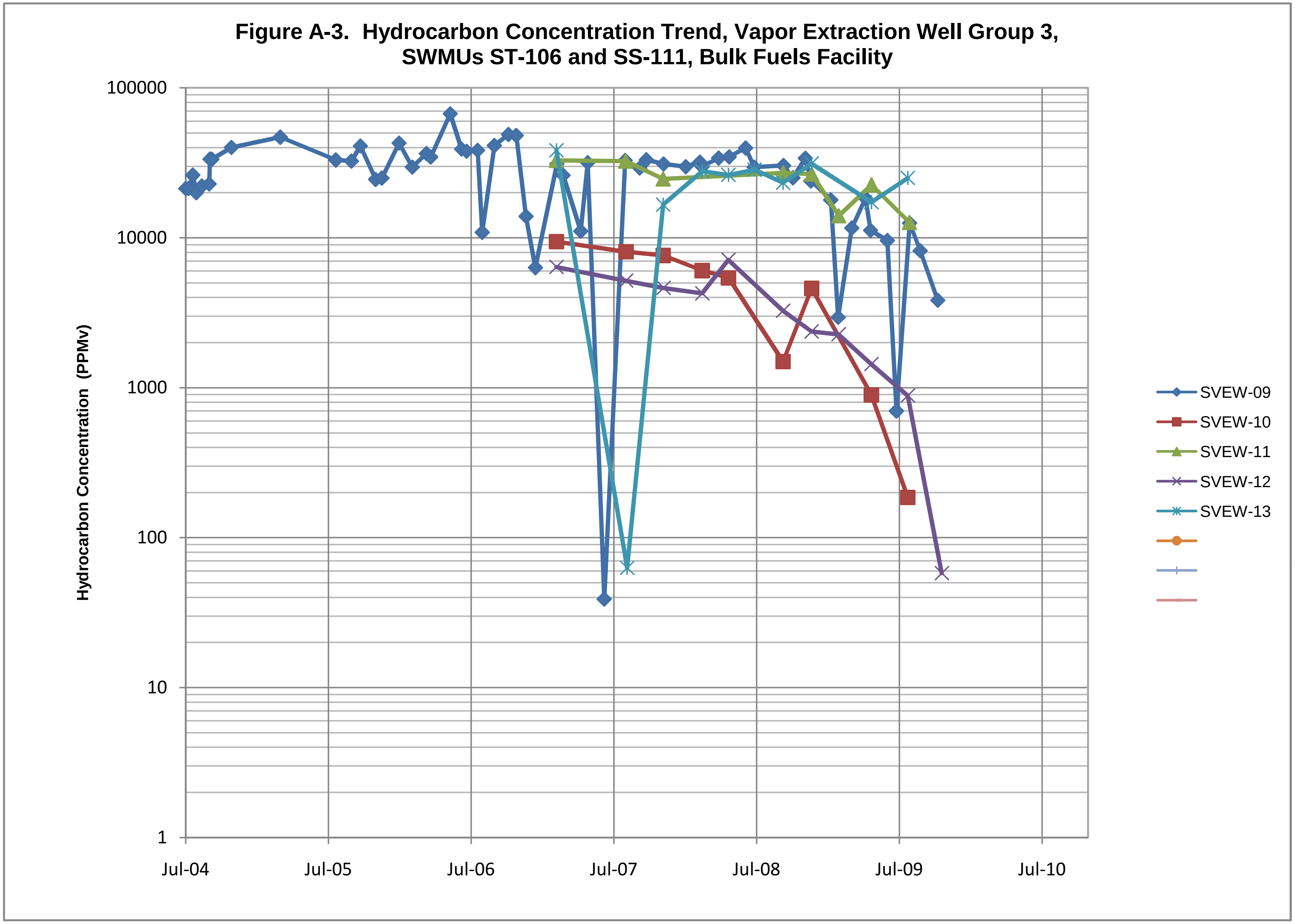


Figure A-3. Hydrocarbon Concentration Trend, Vapor Extraction Well Group 3,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVEW-09
SVEW-10
SVEW-11
SVEW-12
SVEW-13

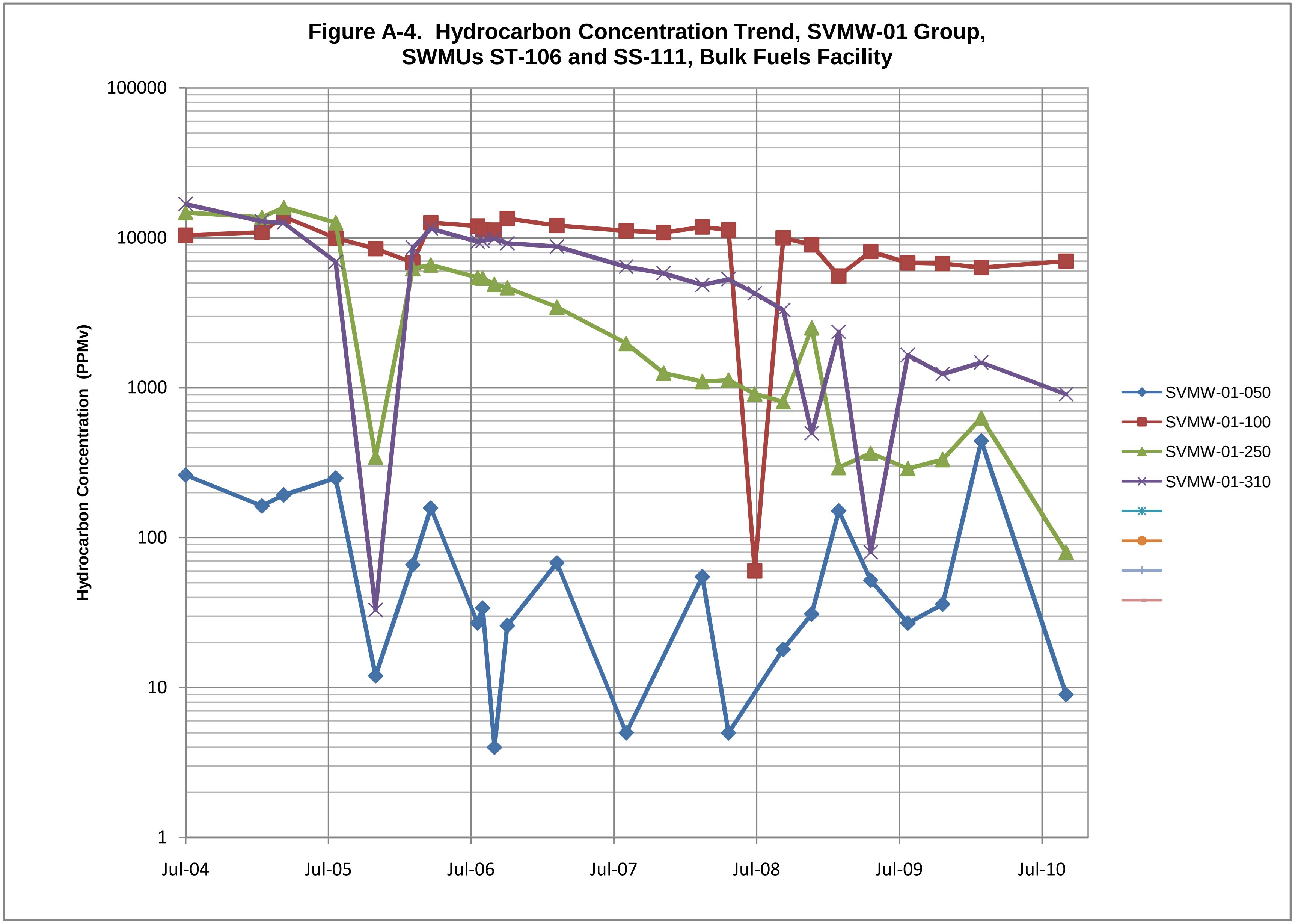
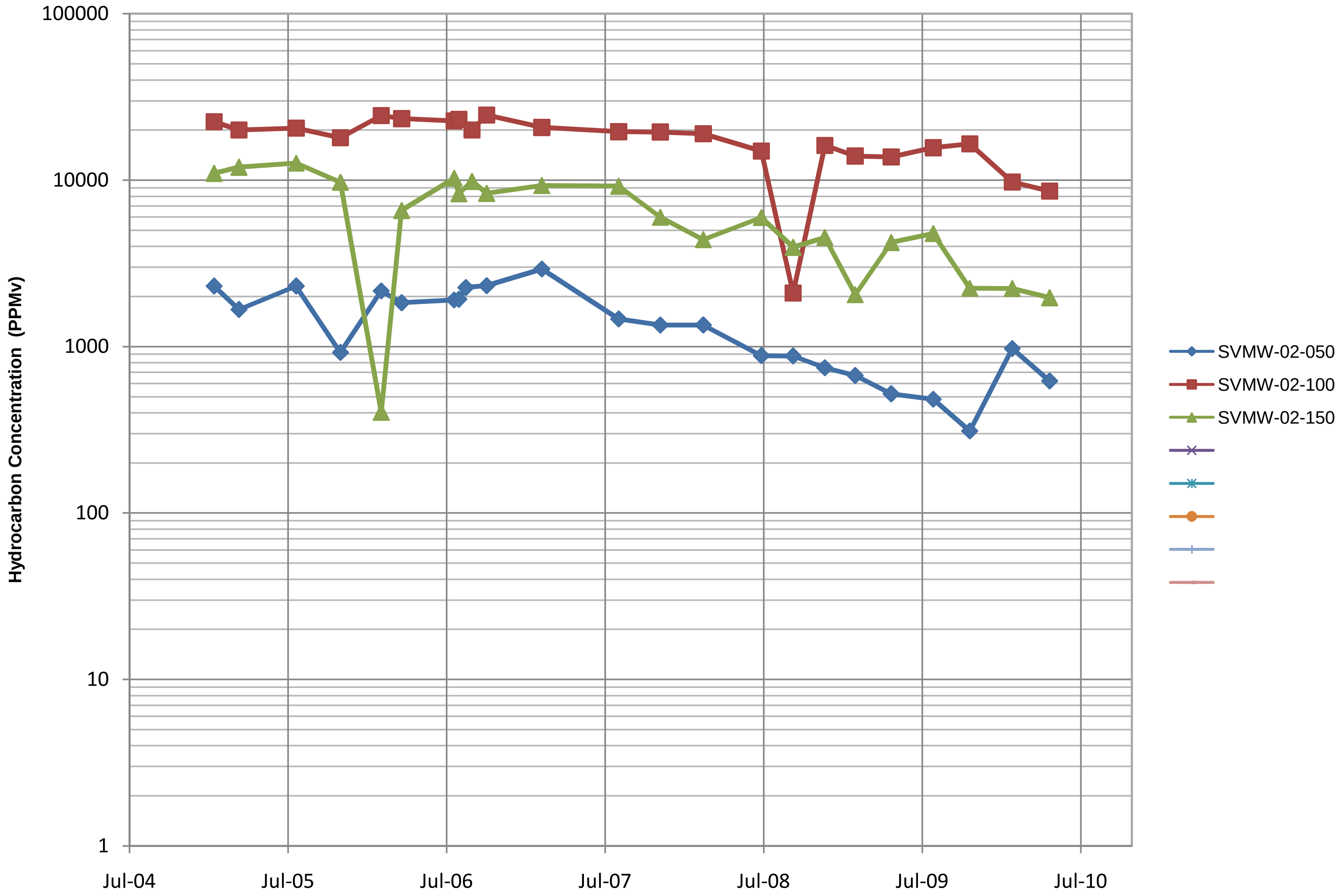


Figure A-4. Hydrocarbon Concentration Trend, SVMW-01 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-01-050
SVMW-01-100
SVMW-01-250
SVMW-01-310

Figure A-5. Hydrocarbon Concentration Trend, SVMW-02 Group, SWMUs ST-106 and SS-111, Bulk Fuels Facility



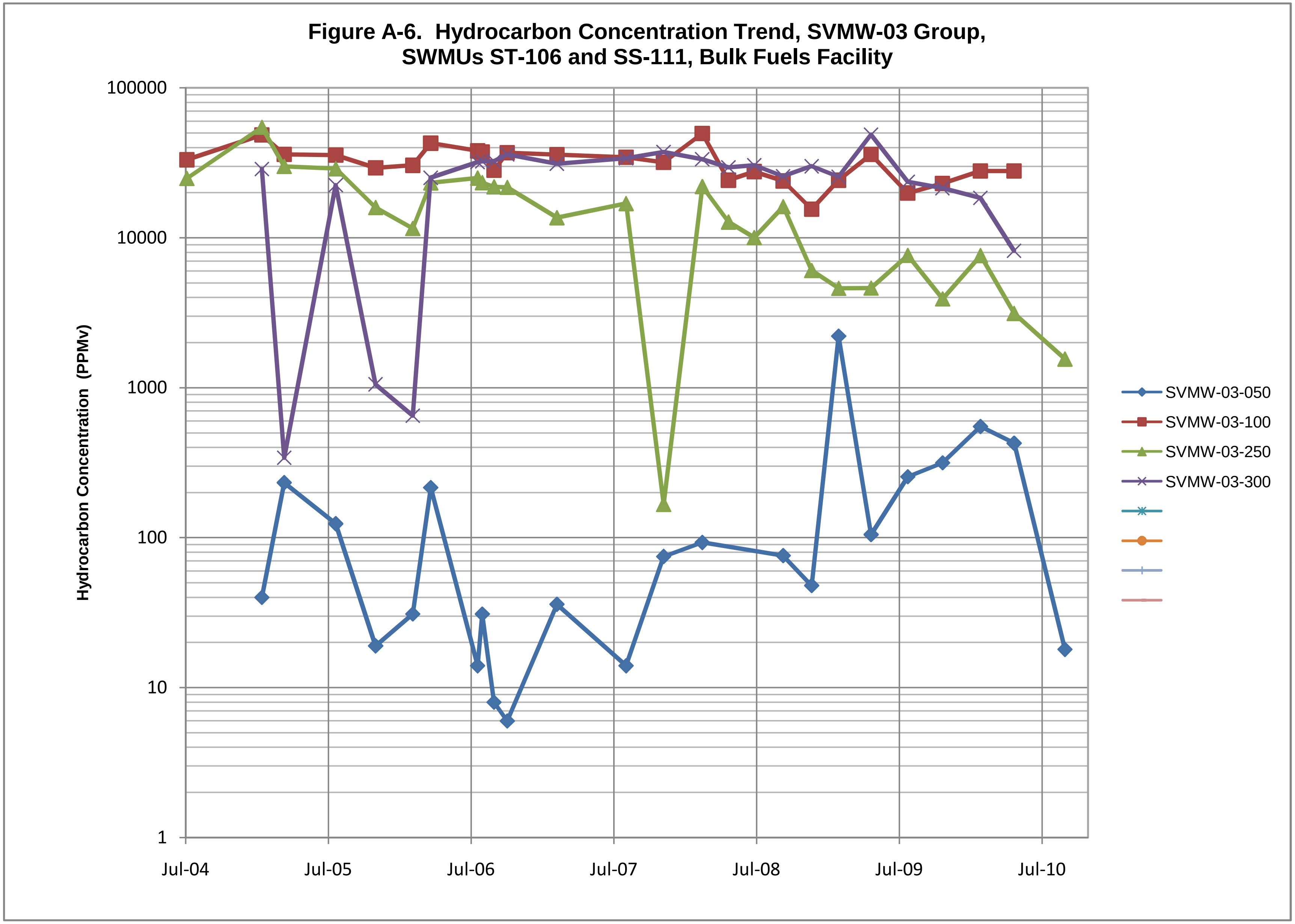


Figure A-6. Hydrocarbon Concentration Trend, SVMW-03 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-03-050
SVMW-03-100
SVMW-03-250
SVMW-03-300

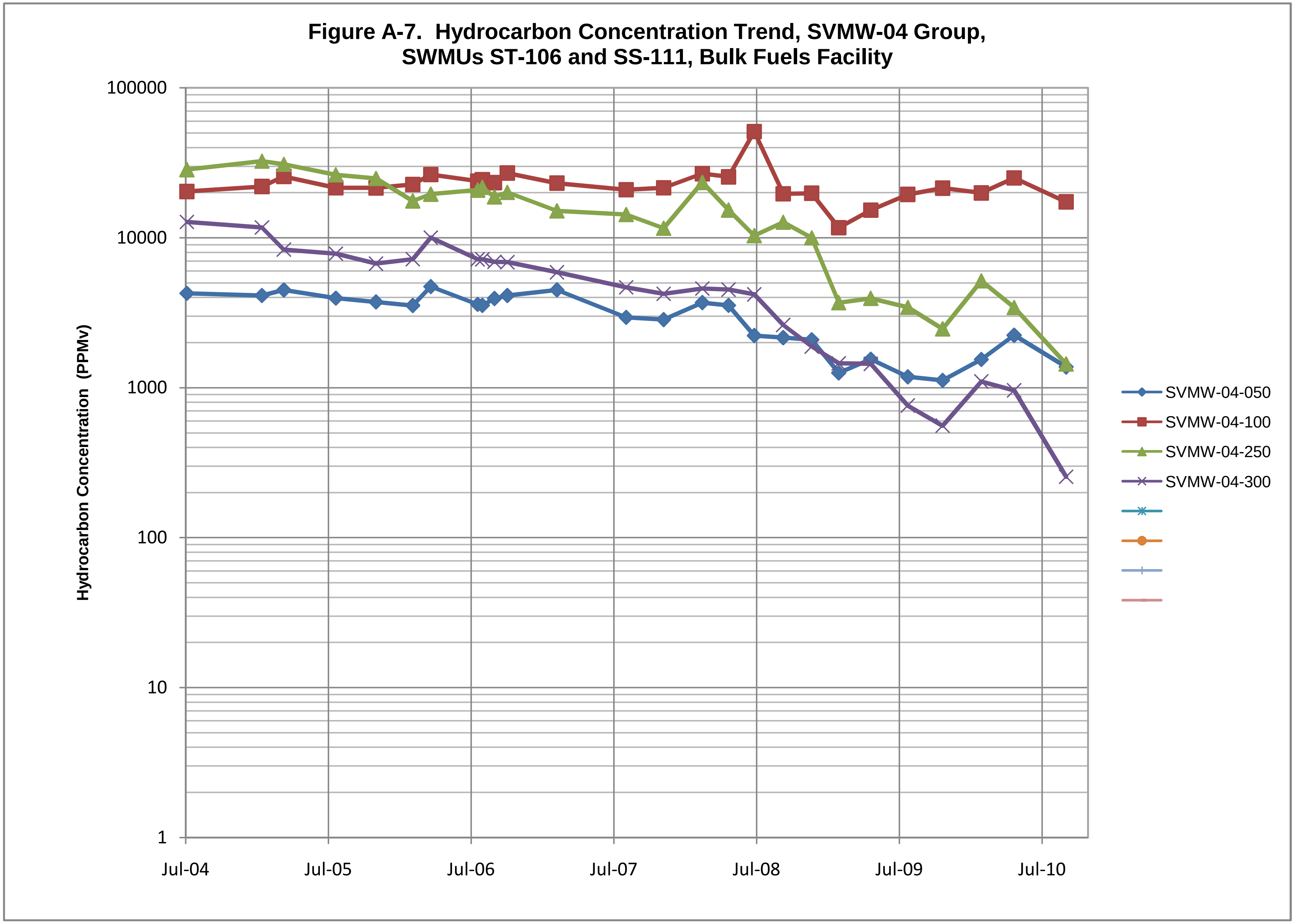


Figure A-7. Hydrocarbon Concentration Trend, SVMW-04 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-04-050
SVMW-04-100
SVMW-04-250
SVMW-04-300

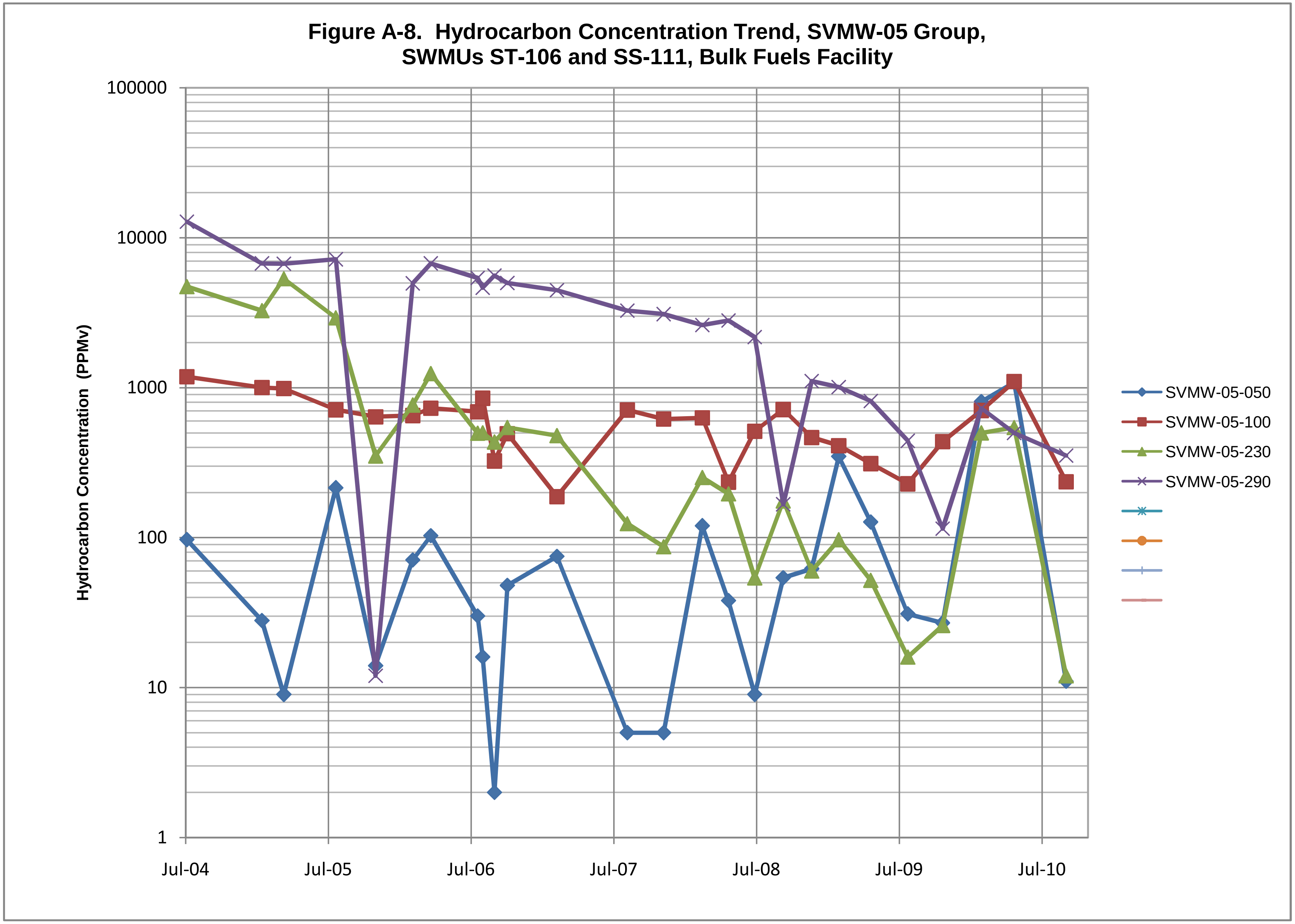


Figure A-8. Hydrocarbon Concentration Trend, SVMW-05 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-05-050
SVMW-05-100
SVMW-05-230
SVMW-05-290

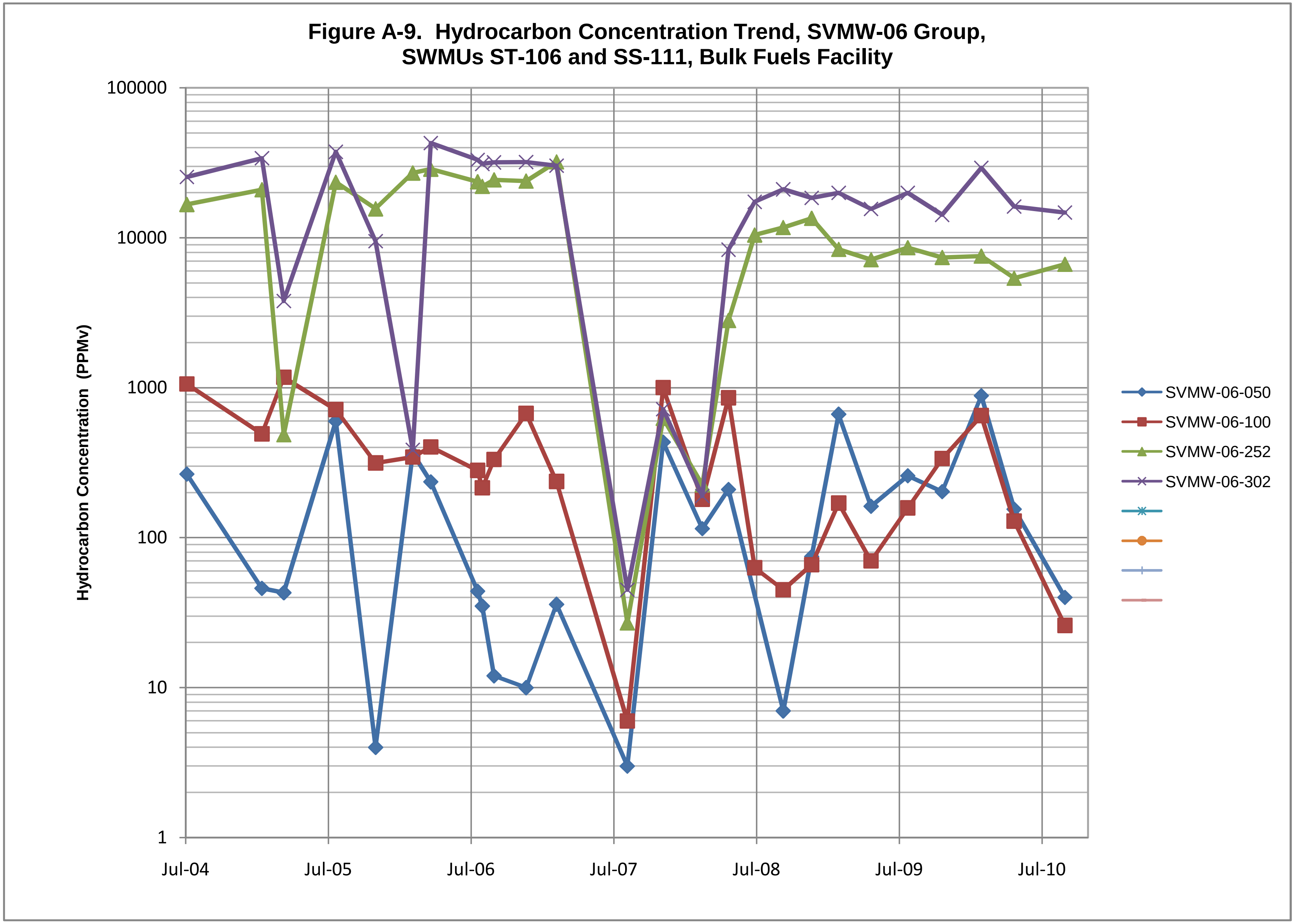


Figure A-9. Hydrocarbon Concentration Trend, SVMW-06 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-06-050
SVMW-06-100
SVMW-06-252
SVMW-06-302

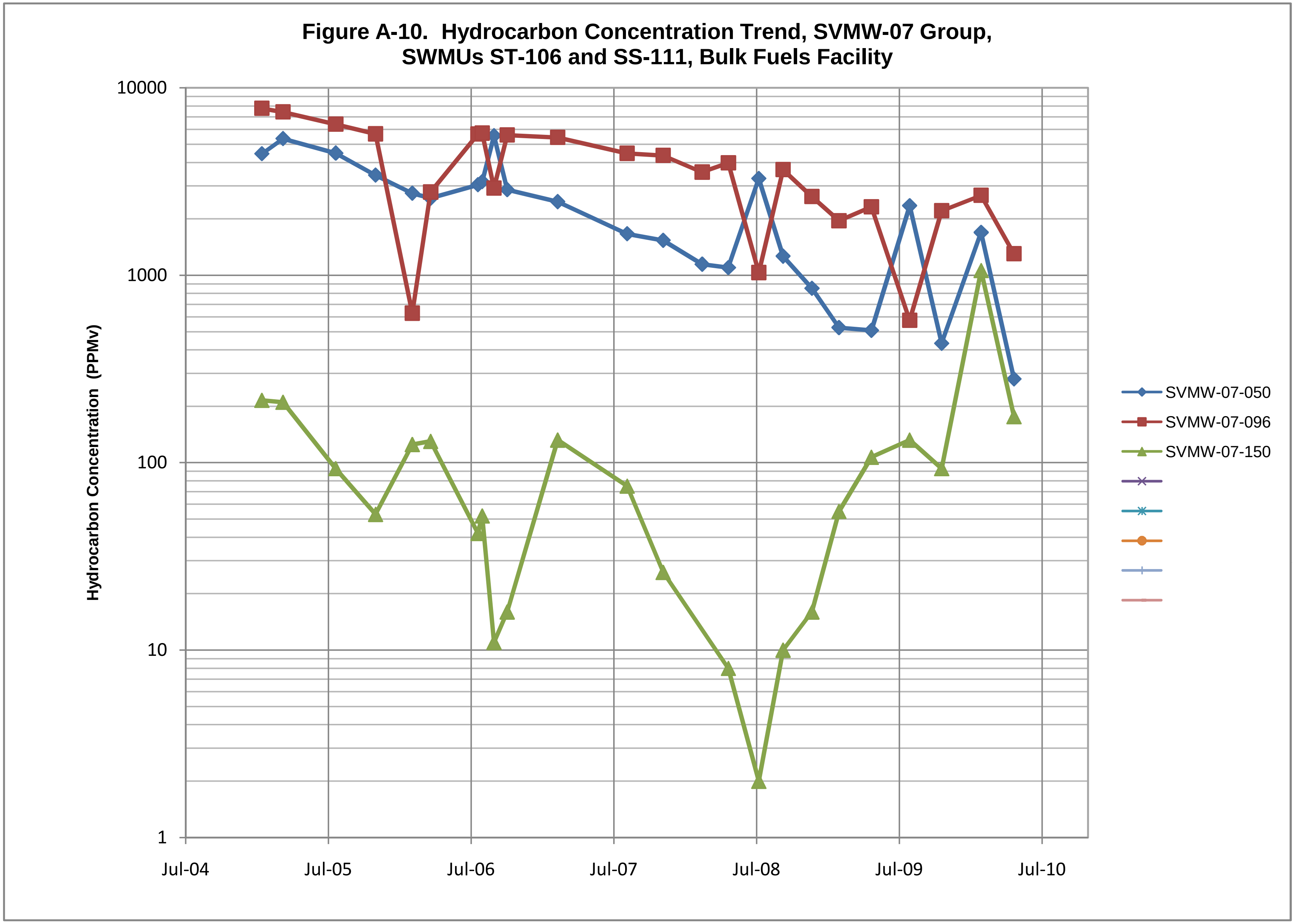


Figure A-10. Hydrocarbon Concentration Trend, SVMW-07 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-07-050
SVMW-07-096
SVMW-07-150

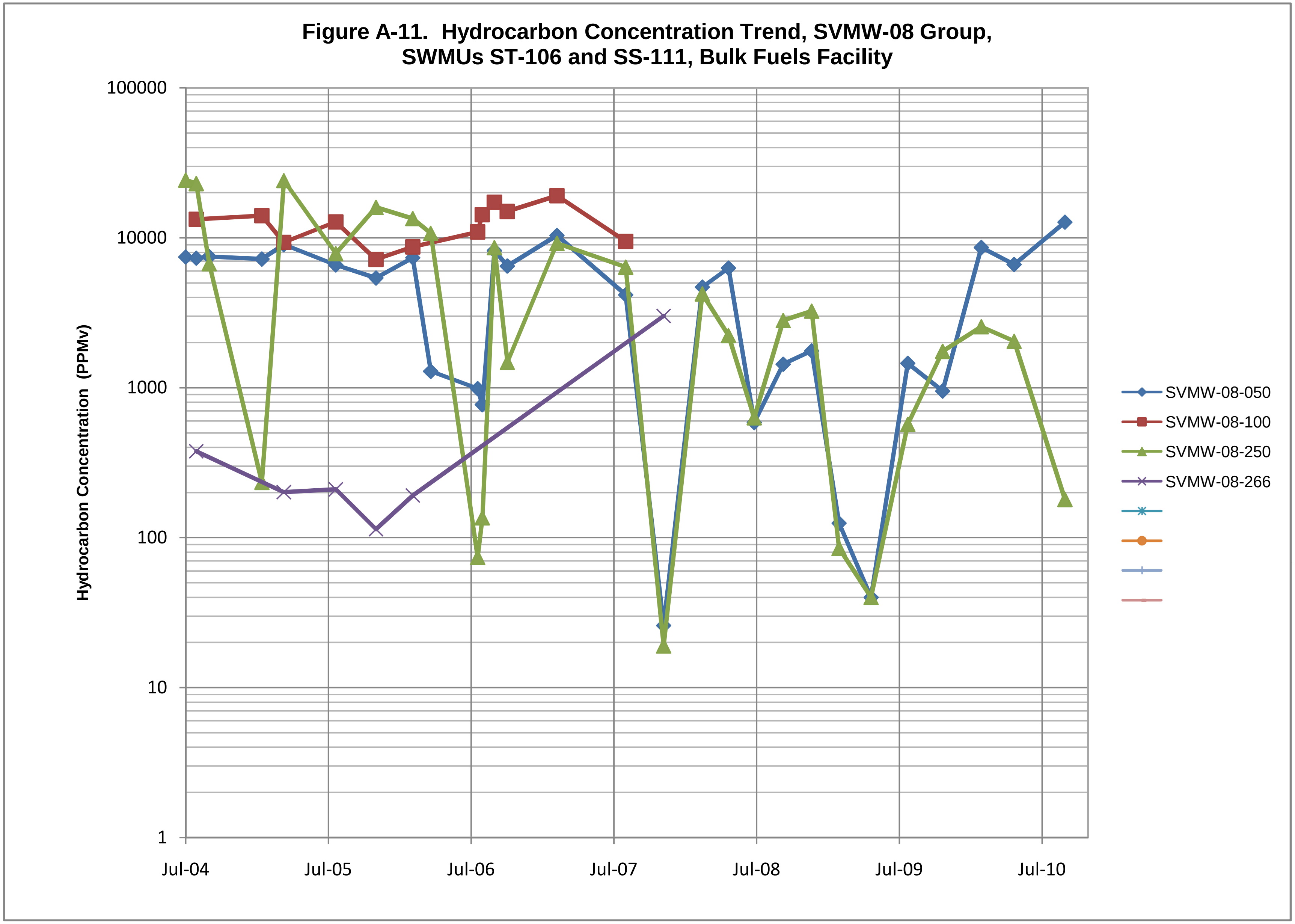


Figure A-11. Hydrocarbon Concentration Trend, SVMW-08 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-08-050
SVMW-08-100
SVMW-08-250
SVMW-08-266

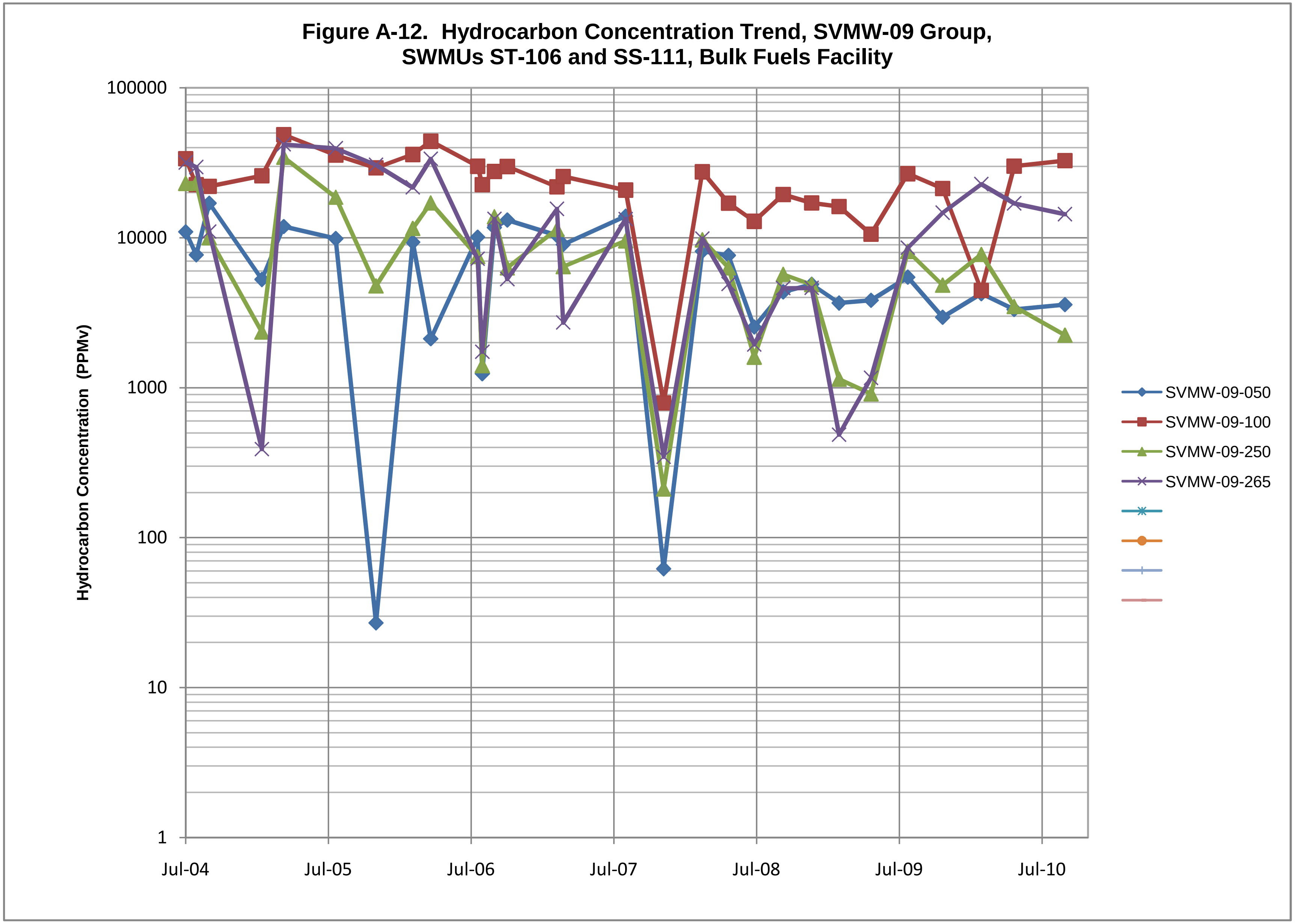


Figure A-12. Hydrocarbon Concentration Trend, SVMW-09 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-09-050
SVMW-09-100
SVMW-09-250
SVMW-09-265

Figure A-13. Hydrocarbon Concentration Trend, SVMW-10 Group, SWMUs ST-106 and SS-111, Bulk Fuels Facility

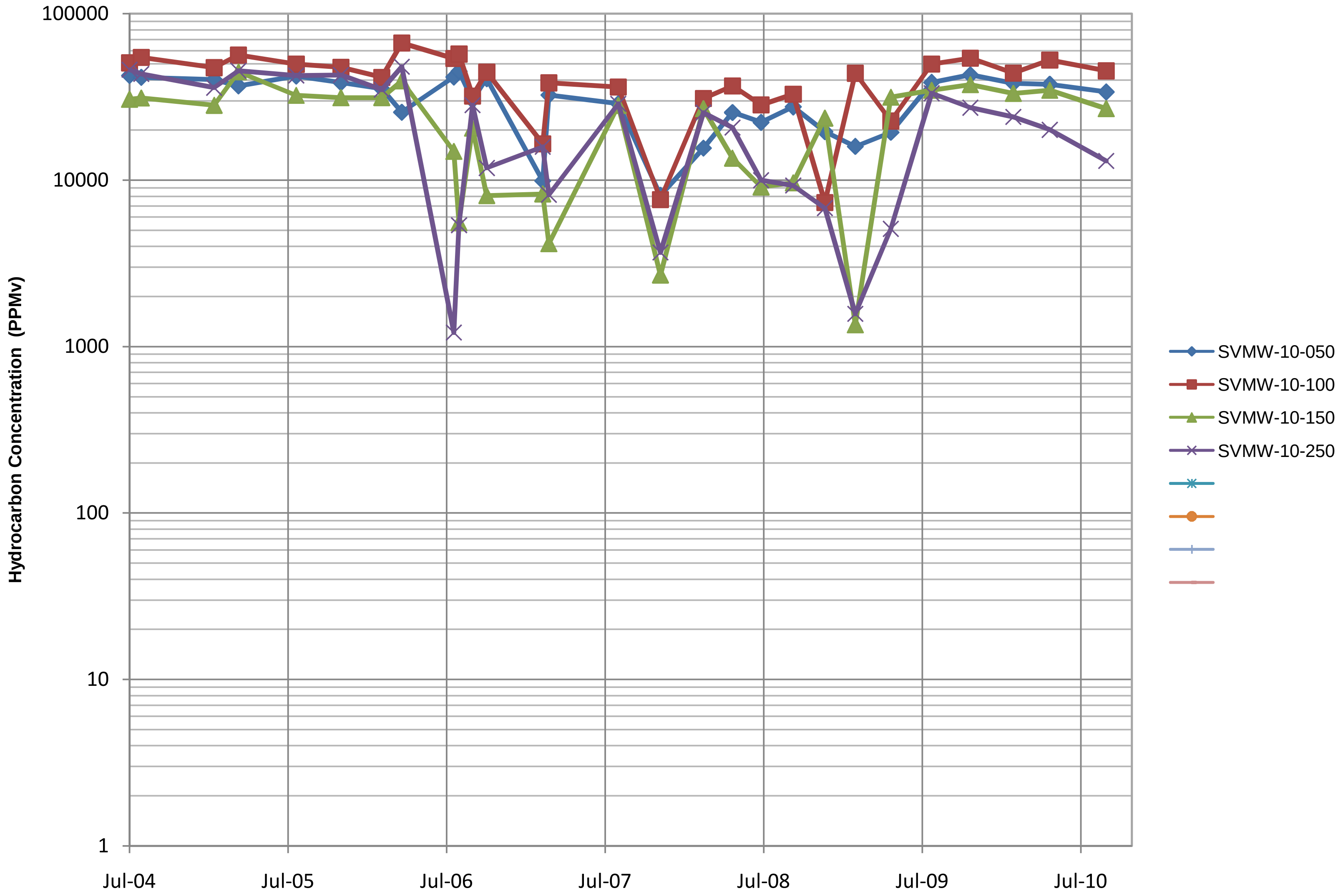
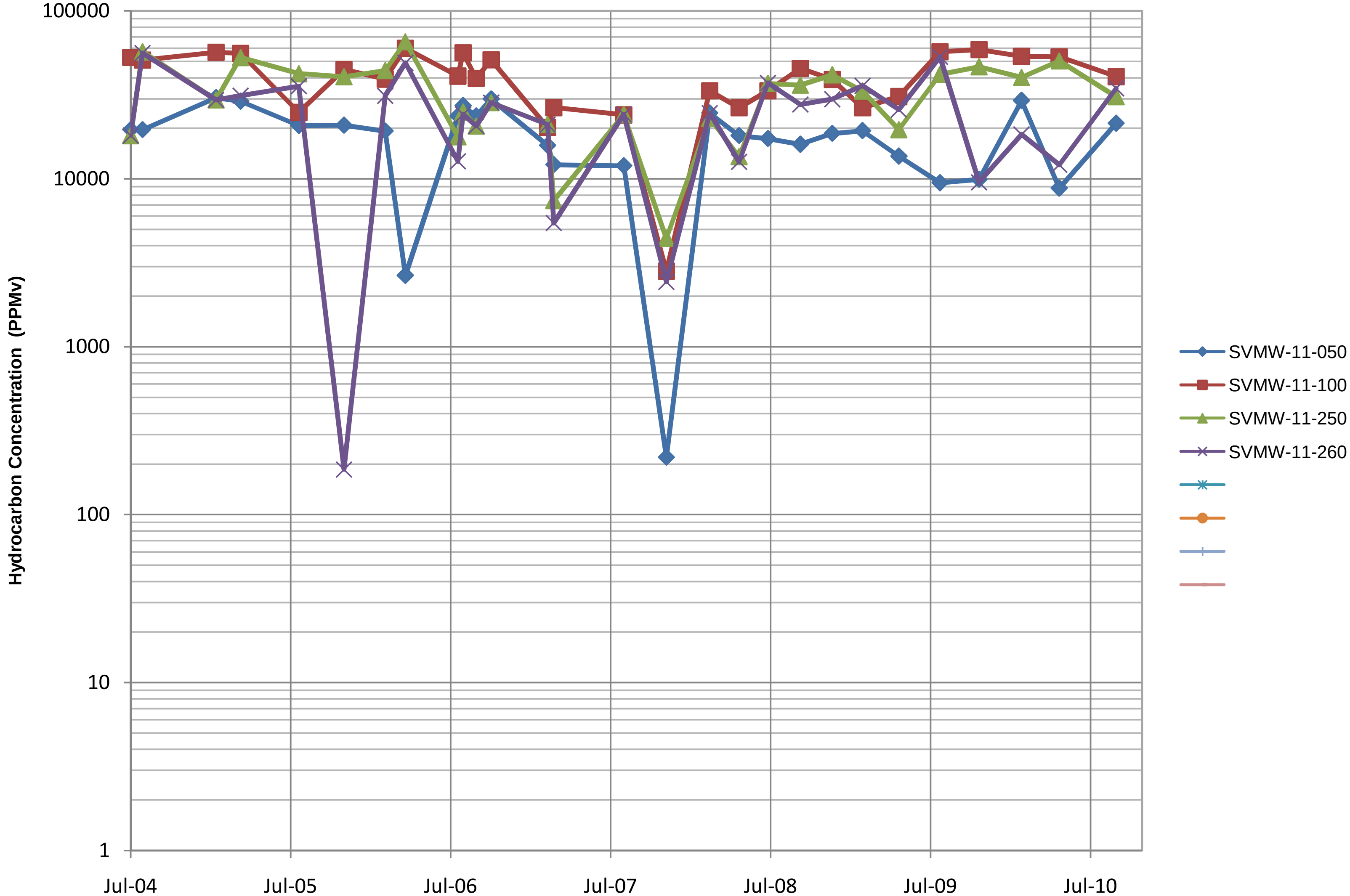


Figure A-14. Hydrocarbon Concentration Trend, SVMW-11 Group, SWMUs ST-106 and SS-111, Bulk Fuels Facility



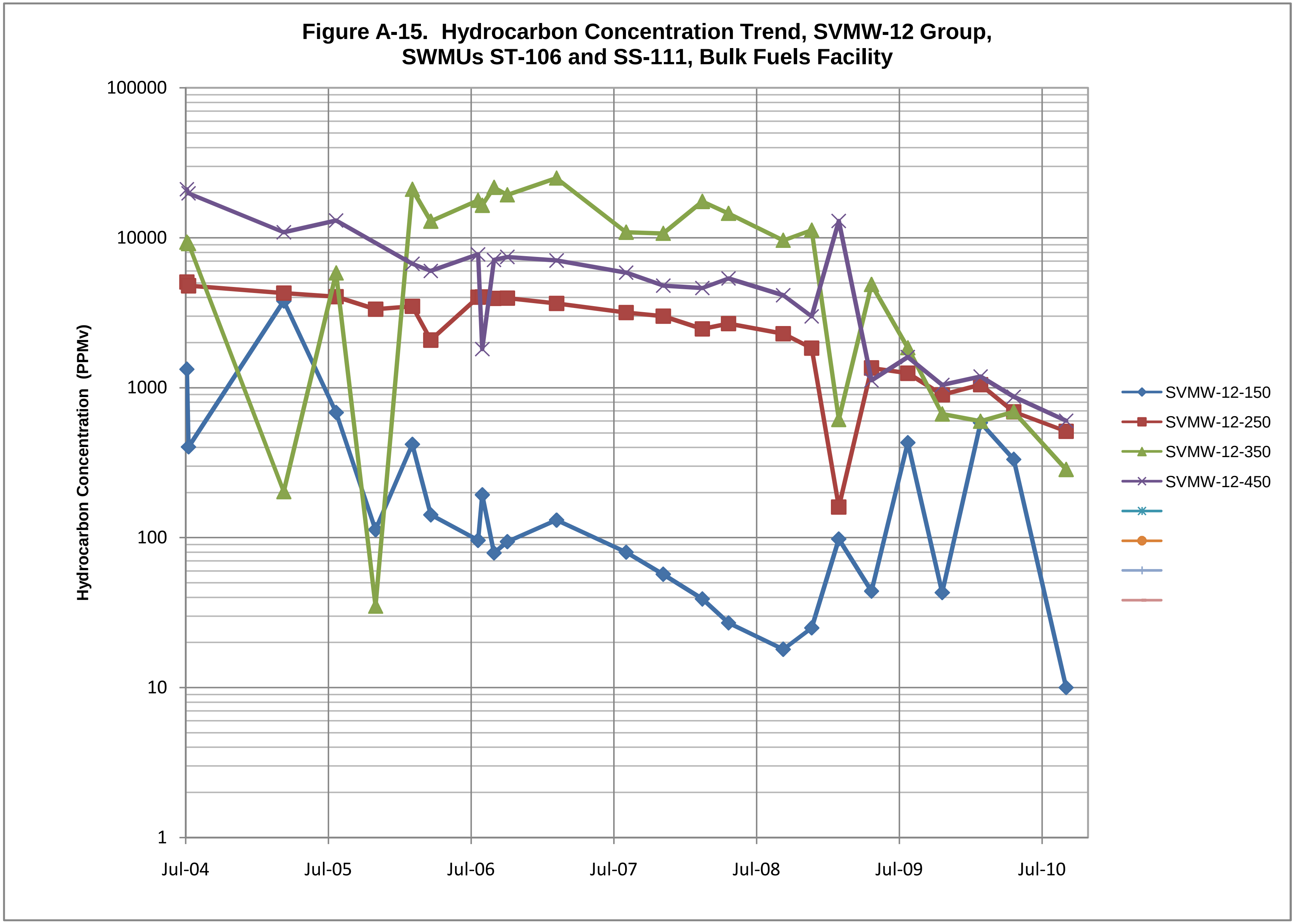


Figure A-15. Hydrocarbon Concentration Trend, SVMW-12 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-12-150
SVMW-12-250
SVMW-12-350
SVMW-12-450

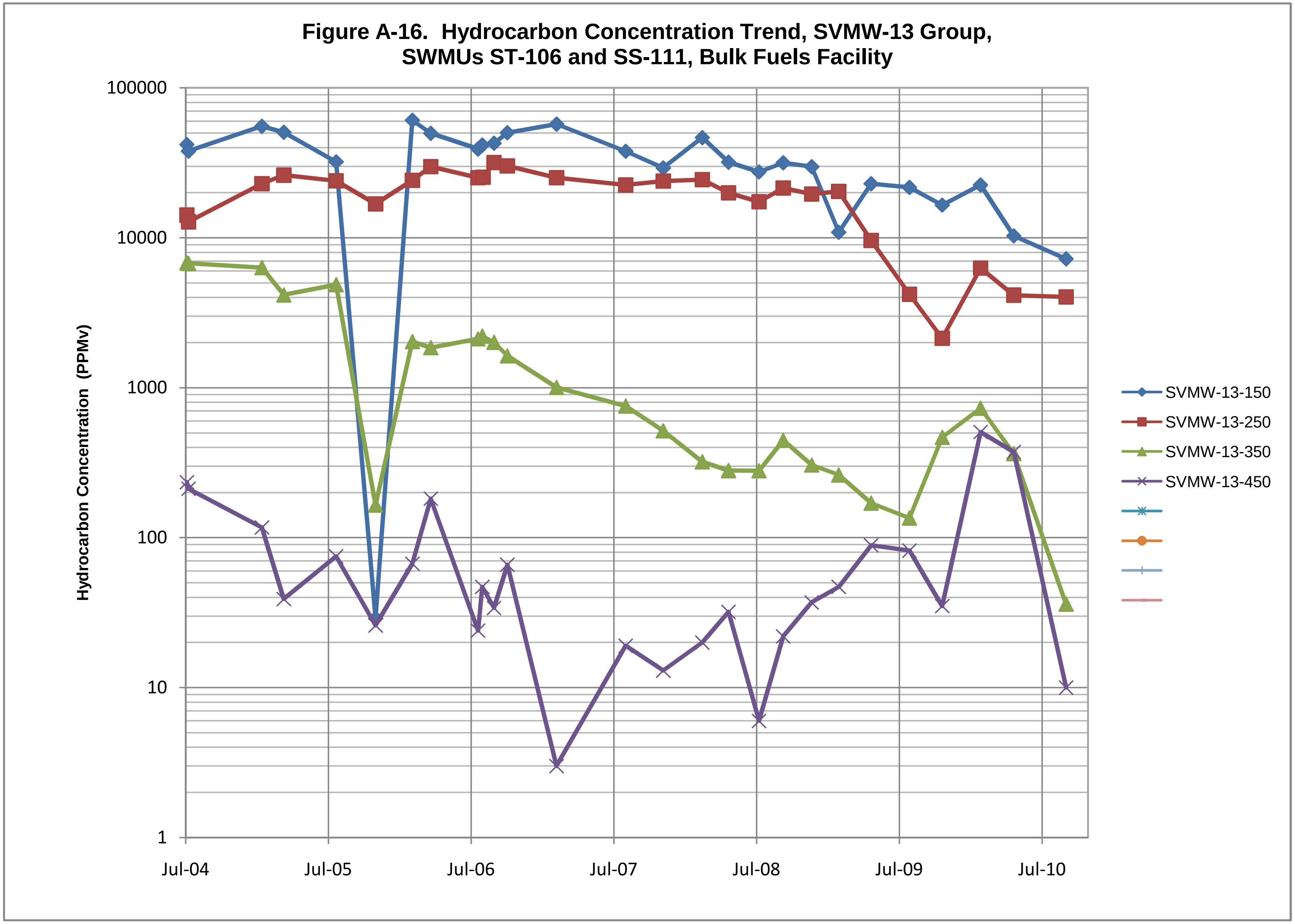


Figure A-16. Hydrocarbon Concentration Trend, SVMW-13 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-13-150
SVMW-13-250
SVMW-13-350
SVMW-13-450

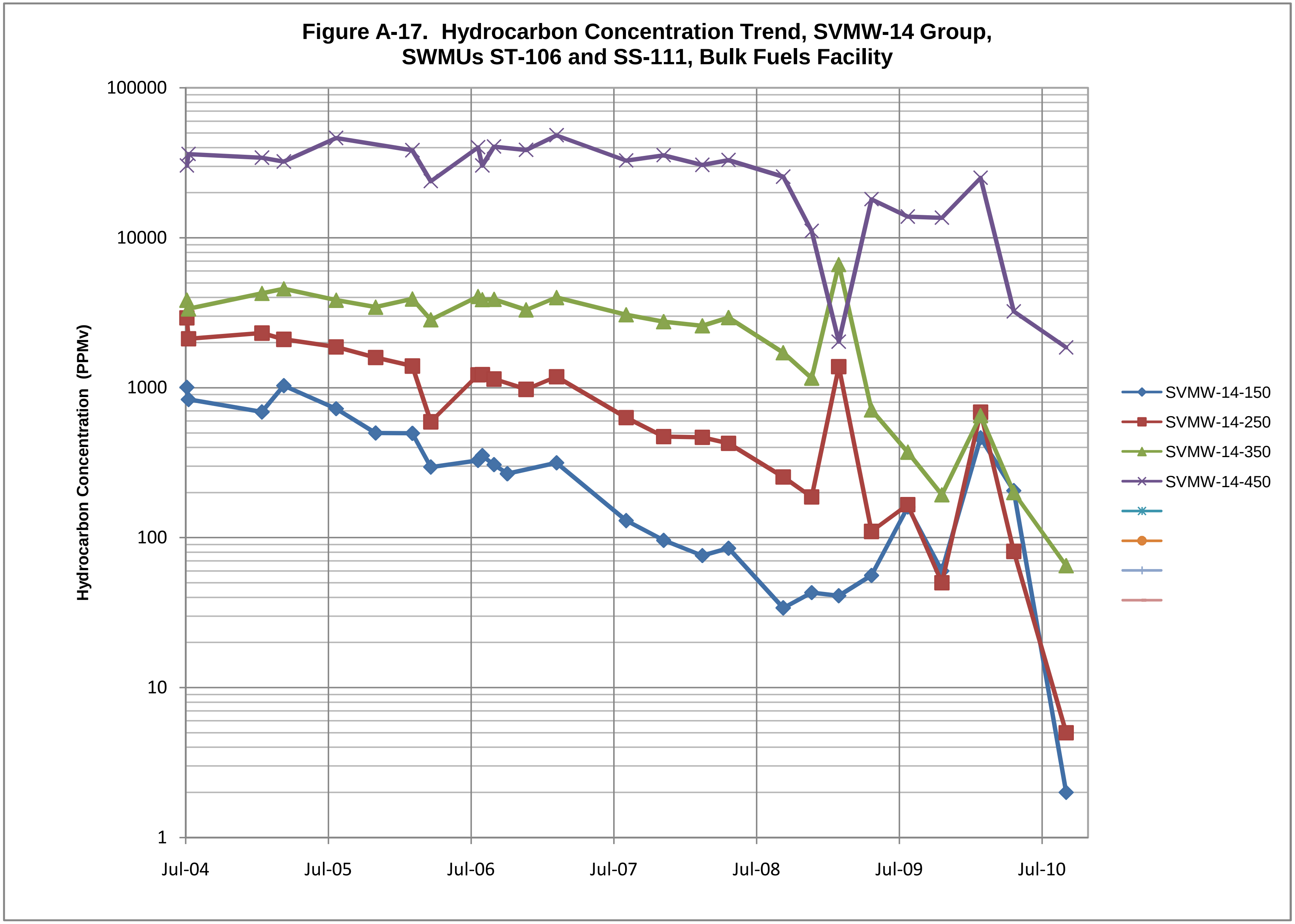


Figure A-17. Hydrocarbon Concentration Trend, SVMW-14 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-14-150
SVMW-14-250
SVMW-14-350
SVMW-14-450

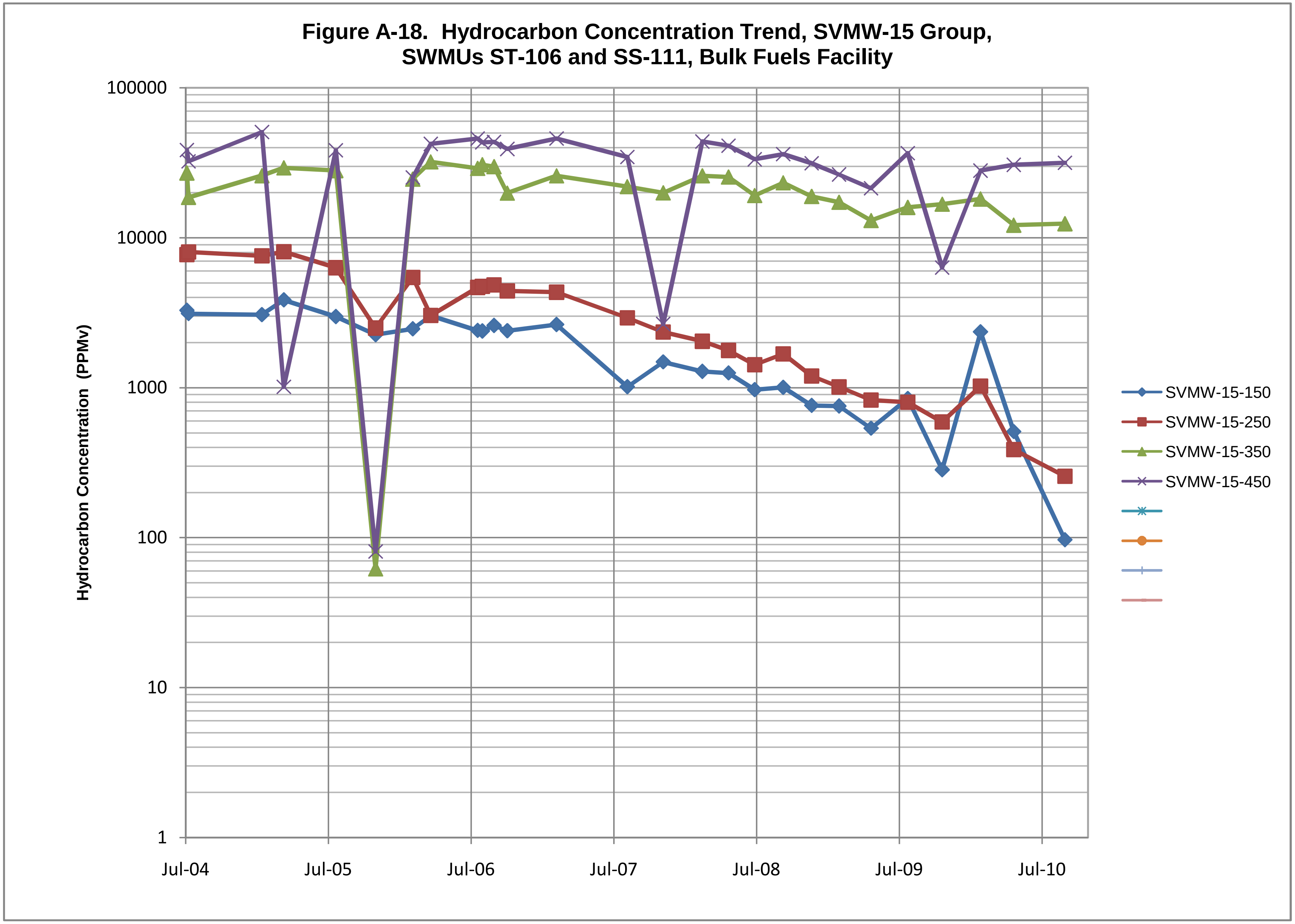


Figure A-18. Hydrocarbon Concentration Trend, SVMW-15 Group,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
SVMW-15-150
SVMW-15-250
SVMW-15-350
SVMW-15-450

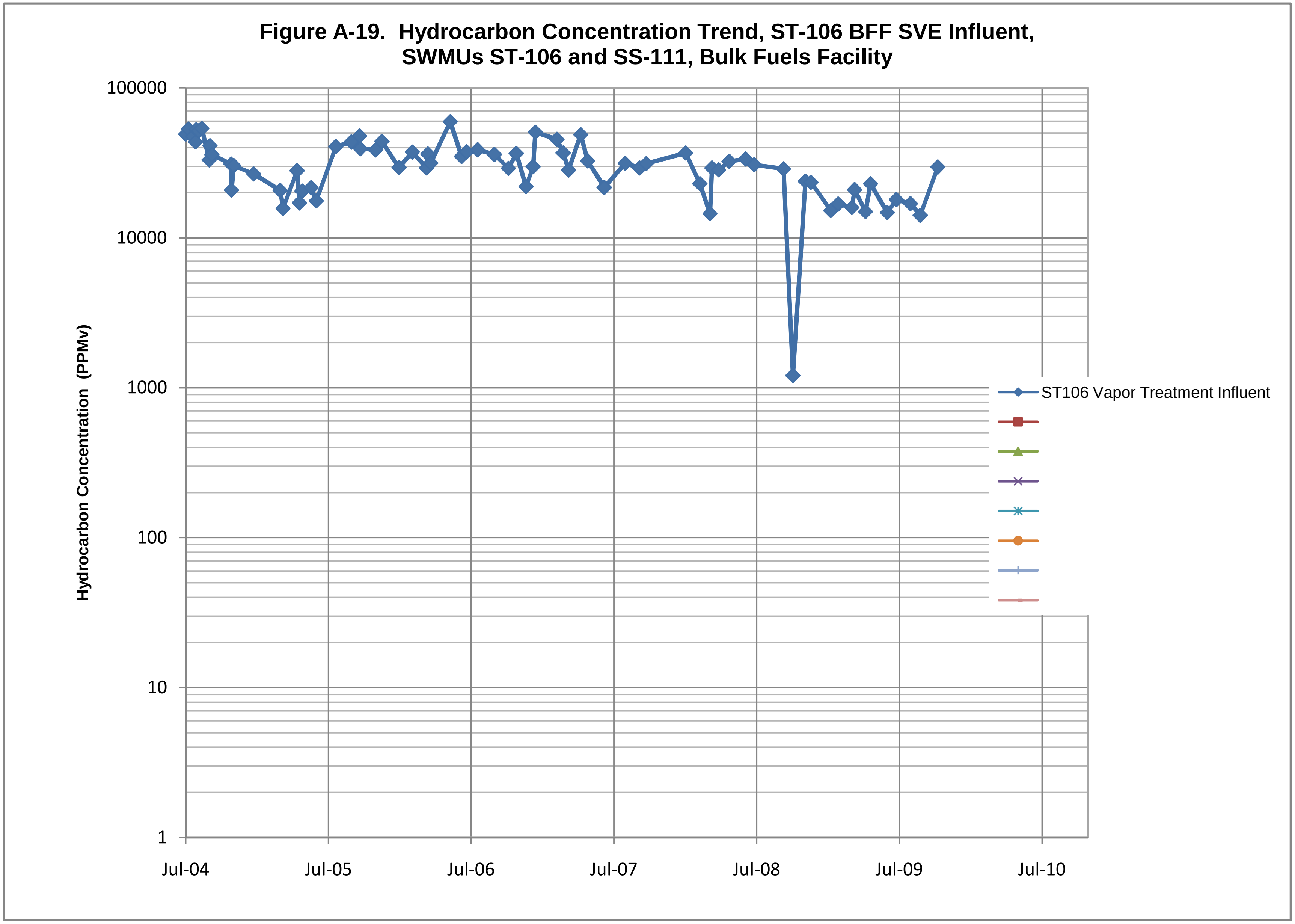


Figure A-19. Hydrocarbon Concentration Trend, ST-106 BFF SVE Influent,
SWMUs ST-106 and SS-111, Bulk Fuels Facility
Hydrocarbon Concentration (PPMv)
100000
10000
1000
100
10
1
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
ST106 Vapor Treatment Influent

Figure A-20. Hydrocarbon Concentration Trend, NAPL Well Influent, SWMUs ST-106 and SS-111, Bulk Fuels Facility