4300 B Street, Suite 600
Anchorage, AK 99503-5922 USA
907.563.3322 Fax 907.563.3320

Technical Memorandum

Date	7 November 2012
To	David Jadhon, USACE, Alaska District
CC	Donald Aide, USAF 673 CES/CEANR
From	Jill Ladegard, Jacobs
Subject	**F-22 Weapons Release Shop SVE Systems Report – Third and Fourth Quarters (21 February to 16 August 2012)**

Introduction

This Technical Memorandum documents third- and fourth-quarter operations (20 February to 18 May 2012 and 18 May to 16 August 2012, respectively) of the Weapons Release Shop (WRS) Soil Vapor Extraction (SVE) system and the Ventilated Stockpile (VSP) SVE system. These systems are operated as part of the non-time-critical removal action at the F-22 Weapons Release Shop (Building 17720) by Jacobs Engineering Group Inc. (Jacobs) under contract W911KB-06-D-0006-0019 with the U.S. Army Corps of Engineers (USACE) for the U.S. Air Force (USAF).

The WRS and VSP SVE systems are a component of the selected remedial action Alternative 6 (Minimal Excavation and In Situ Treatment) in the *F-22 Weapons Release Shop Engineering Evaluation and Cost Analysis* (USAF 2011b). Figure 1 depicts the locations of the two SVE systems. These systems were installed in accordance with the *Soil Vapor Extraction System Design and Construction Work Plan Addendum* (USAF 2011a), as documented in the *F-22 Weapons Release Shop SVE Installation and Stockpile Construction Technical Memorandum* (USAF 2012c), and operations have been conducted in accordance with the Work Plan Addendum and the *Soil Vapor Extraction System Operations and Maintenance* (O&M) *Manual* (USAF 2012d). First- and second-quarter operations (11 August to 18 November 2011 and 18 November 2011 to 20 February 2012, respectively) were described in previous technical memoranda (USAF 2012c, USAF 2012a).

Contaminants of concern for the two SVE systems are tetrachloroethylene (PCE) and trichloroethylene (TCE). Table 1 lists the updated screening levels used as cleanup goals for these compounds. These have been revised based on the finalized *Vapor Intrusion Guidance for Contaminated Sites* (ADEC [Alaska Department of Environmental

Conservation] 2012) and differ from those given in the work plan addendum (USAF 2011a) or proposed in the first quarterly report for the SVE systems (USAF 2012c), also listed in Table 1. The updated screening levels are conservatively based on one-tenth of the ADEC (2012) target levels for each compound and soil depth. Completion of system operation is judged by comparing extracted soil gas concentrations below screening levels at each monitoring point and by evaluating whether the mass removal rate remains significant.

WRS SVE System

As depicted in Figure 2, the WRS SVE system is removing in situ contamination from the area to the west of Building 17720, within and around the footprint of a programmed military construction project to construct a new building (the F-22 Weapons Release Shop) adjacent to Building 17720. As described in detail in the O&M manual (USAF 2012d), the as-built system consisted of a network of nine vacuum wells connected to a 20-horsepower regenerative blower, with three tri-level vacuum monitoring points and two single-level vacuum monitoring points supporting assessment of subsurface effects. One well (VW2) has since been capped in order to accommodate foundation construction for the new building.

<u>Operational Chronology</u>

Table 2 provides a chronological list of activities relating to the WRS SVE system throughout the third and fourth quarters. System cycling continued to follow the winter pattern established at the beginning of the second quarter (Table 3) until 21 March 2012, when the system was reconfigured (Table 4) to focus on the four wells (VW4, VW6, VW7, VW8, and VW9) producing air near or above the deep soil screening levels. VW3 was operated as a source of bleed air to prevent high vacuum faults while maintaining the minimum recommended variable-frequency drive (VFD) setting of 45 hertz for the blower. Toward the end of April, the soil column thawed sufficiently to permit infiltration of meltwater. The vacuum wells captured a substantial quantity of this water, which overfilled the knockout tank to the 90-gallon level and resulted in system shutdown on 25 April. Wiring issues undetected during acceptance testing prevented draining of the knockout tank until they were rectified on 4 May, and a high-vacuum fault traced to improperly configured valves delayed restart of the system until 11 May. Discussions with the system vendor revealed that the VFD could be set to 30 hertz or even lower without risk of the blower overheating, permitting operation to resume without bleed air from VW3 (Table 5). The system continued to run in this mode for the remainder of the reporting period, with brief interruptions on 28 June and 3 July due to power outages. After each outage, system operation resumed automatically at the point where it had been interrupted.

Construction of the foundation for the new F-22 Weapons Release Shop required re-excavation of the header lines from the blower building to near VW5 to the south and to the 90-degree turn west of VW2 (Figure 2) during the latter half of June (see Photo 11 in the Photo Log [Attachment 1]). No wells were damaged, and system operation continued without interruption, but VW2 was capped (without backfilling) to avoid interference with the vapor barrier at the base of the slab. Loss of this well had no effect on system performance; this well was the least contaminated during the four sampling rounds of the first quarter, with contaminant concentrations less than 1 percent of screening levels. It was functional only sporadically during the second quarter, and was turned off in early in the third quarter as part of system reconfiguration on 21 March. Tubing for the vacuum monitoring points did not fare as well, with damage to lines for VMP2. These were repaired by the foundation contractor and re-buried. The contractor had installed the in-ground piping for the WRS SVE system in July 2011, and was therefore familiar with its features, which enabled them work around the system with only minor damage. Vacuum monitoring points VMP4 and VMP5, bundled with the header lines, were unearthed during foundation work and then re-buried without damage during backfilling.

Energy usage as of the monthly system check on 12 June totaled 51,964 kilowatt-hours, and on 8 August totaled 60,834 kilowatt-hours, extrapolating to 62,079 kilowatt-hours on 16 August. Based on usage at the end of the second quarter of 34,856 kilowatt-hours, the system used 27,223 kilowatt-hours during the third and fourth quarters. This represents a 45 percent reduction from first-quarter operations and a 34 percent increase over second quarter operations, consistent with the evolution of building heating requirements and more efficient operational parameters. During the first quarter, the system was active 100 percent of the time with the VFD set to 60 hertz, and little building heating was needed. During the second quarter (winter), the system was active only 50 percent of the time at a VFD setting of 47.5 hertz, but heating needs were significant. During most of the third and fourth quarters, the system was again 100 percent active but at a VFD setting of only 40 hertz, and heating needs were minimal.

The system was operational for 91 percent of the reporting period, with 16 days of downtime due to knockout-tank issues and minor power outages, and individual wells were active for 7 to 76 percent of system operations (Table 6). Out of 178 days in the reporting period, wells VW1, VW2, and VW5 were discontinued after 29 days (on 21 March), and VW3 was discontinued after 64 days (on 25 April).

Duty fractions for all wells are less than 100 percent because the system cycling schemes (Tables 3, 4, and 5) incorporated downtime for active wells to allow periodic re-orienting of subsurface air flow to enhance contaminant removal.

Observed Air Flow and System Vacuum

With the end of winter and concomitant concerns about freezing large portions of the subsurface as cold air was drawn to extraction wells, the system was reconfigured on 21 April to focus on the five remaining wells with significant PCE and TCE concentrations (VW4, VW6, VW7, VW8, and VW9 [Table 10]). After dealing with knockout-tank issues during breakup, the configuration was finalized on 11 May for the remainder of the reporting period. Because the subsurface distribution of vacuum was shown in Quarter 1 to be less extensive laterally than anticipated (USAF 2012c), the goal of reconfiguration was to extract soil gas as rapidly as possible from the five wells of interest in order to maximize their radii of influence. The other four wells were turned off, and the system was set for a 10-day cycle in which the four of the five wells of interest were always active; each was turned off in sequence for 2 days at a time, periodically re-orienting the flow field to maximize contaminant capture. The blower frequency was reduced to the point that there was no danger of tripping the high-vacuum alarm. Table 5 lists the final system configuration instituted on 11 May.

Air-flow measurements were made for each operational combination of active wells on 9 March under the winter configuration and on 12 June and 8 August under the final focused configuration. Table 7 lists air flow measurements made during the reporting period. Measured air flows on 9 March were essentially identical to those measured at the beginning of the second quarter when the winter configuration was instituted, indicating that the frost or ice that had obstructed VW2 in mid winter (USAF 2012a) had entirely disappeared. Air flows in individual wells ranged from 108 to 137 percent of design flows, with the biggest difference occurring in VW2 (the shallowest), probably reflecting an increase in short-circuit flow from the surface through frost-expanded soil. For the focused configuration instituted on 21 March and revised on 11 May, air flow measurements on 12 June and 8 August showed that flow rates in the wells of interest were stable at 144 to 150 percent of their design rates. Because only five wells were active instead of all nine, total flow was 81 to 82 percent of the design flow, achieved by running the blower at 40 hertz instead of 47.5 hertz. This configuration minimizes energy consumption while maximizing air flow from the remaining wells with significant contamination.

For the winter configuration, manifold vacuums ranged from 38.6 to 44.5 inches of water (" H_2O) at 38 degrees Fahrenheit (°F) on 9 March. For the final focused configuration, manifold vacuums ranged from 53.3 to 62.8" H_2O at 52°F on 12 June, and from 52.5 to 61.6" H_2O at 61°F on 8 August (Periodic Monitoring Logs in Attachment 3). With the high-vacuum alarm set point at 75" H_2O, there was a comfortable margin between the highest operational vacuums and the alarm level. A higher set point for the alarm would allow higher operational vacuums and greater flow from the vacuum wells, but at some point would result in blower overheating. These operational limits have not been explored.

<u>Observed Soil Vacuum and Comparison to Design Predictions</u>

The subsurface vacuum induced by the WRS SVE system in its winter configuration was monitored on 9 March at each of the eleven vacuum monitoring points. The vacuum monitoring points are arranged in three tri-level clusters (VMP1 through VMP3) and two individual points (VMP4 and VMP5), located as shown in Figure 2. Each tri-level cluster contains monitoring points A, B, and C installed in a single boring at 6.5, 26, and 49.5 feet below ground surface (bgs), whereas the individual monitoring points accompany the vacuum piping at 3 to 4 feet bgs (USAF 2012c). At the time of measurement, VMP4 and VMP5 had not yet been disturbed by construction activities for the new F-22 Weapons Release Shop.

Table 8 lists the observed vacuum at each monitoring point. All wells were open and had been running for approximately 15 minutes, and the VFD was kept at its winter configuration of 47.5 hertz. Significant vacuum was present at all points, but higher vacuums were present at the shallow points for VMP1, VMP2, and VMP3 rather than at the deep points as predicted by modeling (USAF 2011a). This could be explained by stronger vertical flow than expected, limiting the propagation of vacuum laterally.

For each monitoring point location, Table 8 also lists the nearby vacuum wells with their distances and design vacuums. As was observed during the first two quarters, the observed vacuums were roughly an order of magnitude smaller than the design vacuums. As previously concluded (USAF 2012a,b), the vastly lower-than-expected vacuum readings at a distance imply extensive vertical flow near each vacuum well and greatly reduced radial flow at a distance, suggesting that vertical pneumatic conductivity is as large as horizontal conductivity rather than a factor of 3 smaller as assumed in the design (USAF 2011a). This indicates that the effective radius of influence of each well and the overall system effectiveness is less than anticipated. The maximal flows (approximately 150 percent of design) of the final focused system configuration offer partial compensation, but the system exchanges soil gas in the distal portions of the treatment volume much more slowly than anticipated in the design. Thus, contaminant concentrations at the design radius of influence are probably declining much more slowly than anticipated, but this is not expected to extend the treatment period because concentrations beneath the new building are already mostly below the proposed screening levels.

Soil Gas Sampling and Results

Samples for laboratory analysis were collected from the manifold (the composite location) during three events (9 March, 12 June, and 8 August), and also from the two wells with the highest TCE concentrations (VW6 and VW9) during the final event. Samples from all events were analyzed for PCE and TCE only. Table 9 presents cumulative laboratory results for vacuum-well samples from startup through the end of the fourth quarter. During collection of the composite sample on 8 August, VW9 was inadvertently left in its operational configuration, which was closed at the time. Thus, only VW4, VW6, VW7, and VW8 were sampled, which biases the results because VW9 contained lower PCE and much higher TCE concentrations than the composite sample. Attachment 4 contains calculations that estimate the actual composite (all wells of interest open) PCE and TCE concentrations, which are reported in Table 9.

The composite TCE concentration, representing the average TCE concentration removed by the system, remained steady through the third and fourth quarters despite the change in system configuration from winter operations (Table 3) to the focused configuration (Tables 4 and 5), with concentrations ranging from 160 to 170 $\mu g/m^3$. The continuity of these concentrations is coincidental. Both total air flow and individual well concentrations were substantially lower in the 8 August sampling event (five wells active) than in the 10 February (all wells active) sampling event, but the 8 August composite concentration was not diluted by contributions from the four wells that had been turned off. The two individual wells sampled at the end of the fourth quarter, VW6 and VW9, recorded declines of 60 and 42 percent, respectively, to concentrations of 100 and 580 µg/m^3 (down from 250 and 1,000 µg/m^3, respectively). This decline is attributable to long-term contaminant reduction and to increased individual air flow under the focused configuration (a greater fraction of the extracted air is clean air from the surface).

The remaining active wells were not sampled during the reporting period, but if they followed the same declining trend for TCE, VW7 would have been close to the revised proposed screening level of 88 µg/m^3 (Table 1), while VW4 and VW8 would have been significantly under it. VW4 is the only remaining active well within the footprint of the new building (Figure 2) and will be sampled near the end of the fifth quarter (early November 2012) to determine whether the WRS SVE system has met the objective of eliminating the vapor intrusion risk to the new building.

For PCE, composite concentrations increased slightly during the reporting period while the two sampled individual wells (VW6 and VW9) showed slight declines. All values remained far below the revised proposed screening level of 1,800 µg/m^3 (Table 1), where they have been since the first round of operational sampling on 2 September 2011 (Table 9). Nevertheless, PCE will continue to be analyzed in future analytical samples.

Figure 3 presents composite PCE and TCE concentrations plotted on a logarithmic axis from startup through Quarter 4. PCE concentrations have always been below the revised proposed screening level of 1,800 µg/m^3, while TCE concentrations have remained at approximately twice the revised proposed screening level of 88 µg/m^3 since late in the first quarter.

Soil-gas field parameters (VOCs, carbon dioxide, and oxygen) were measured in the vacuum monitoring points early in the third quarter, on 9 March (Table 10). VOCs were 0.0 ppm in all vacuum monitoring points, whereas low levels had been measured at startup (17 August 2011) and at the end of first quarter (18 November 2011); the lack of response on 9 March suggests instrumentation difficulties rather than actual subsurface conditions. Carbon dioxide ranged from 650 to 15,900 ppm, with the same pattern as seen at the end of the first quarter.

Oxygen, ranging from 17.6 to 20.9 percent, also showed the same pattern as seen at the end of the first quarter. Thus, the subsurface circulation patterns established in the first quarter continued without significant changes through the winter and into the third quarter.

PCE and TCE were measured in vacuum monitoring points VMP3B and VMP3C at the end of the fourth quarter, on 8 August (Table 11). These were the only vacuum monitoring points that exceeded the TCE screening level at the end of the first quarter (on 18 November 2011). Compared to the first quarter, TCE in VMP3B at 26 feet below ground surface (bgs) was significantly lower at 490 versus 720 µg/m^3, while TCE in VMP3C at 49.5 feet bgs had increased to 700 from 530 µg/m^3. These results show that the WRS SVE system is slowly flushing TCE from mid-depth soil but may be redistributing TCE in deep soil. As discussed above, vacuum measurements (Table 8) for the VMP3 cluster are consistent with less effective flushing with depth.

Mass Removal and Projected Performance

Figure 4 integrates the mass flux (the product of concentration and flow rate) over time to yield cumulative mass removal. Building on mass removal during the first and second quarters (USAF 2012c, 2012a), the effects of operations during the third and fourth quarters were calculated using the actual periods of blower operation and by interpolating the composite PCE and TCE concentrations from one sample to the next. By the end of the fourth quarter (16 August), the WRS SVE system is estimated to have removed 61 grams of PCE and 960 grams of TCE. In comparison, the upper limits of annual emissions are 2,455 grams of PCE and 15,567 grams of TCE; these values were calculated according to the conservative approach and used in Appendix A of the Work Plan Addendum (USAF 2011a). Future operations assume continuous extraction and concentrations declining with a half-life of 1,000 days (2.74 years). Extrapolating to the end of system operations in August 2013, cumulative removal after 2 years of operation is estimated to be 93 grams of PCE and 1,585 grams of TCE. Under these conditions, the first year of operation removed 60 percent of the TCE that will be removed over the 2-year operating period of the system.

VSP SVE System

As depicted in Figure 5 and described in the O&M manual (USAF 2012d), the VSP SVE system is removing PCE and TCE contamination from stockpiled soil via a network of 10 slotted vacuum pipes that span the base of the pile. The system utilizes a 1.5 horsepower regenerative blower to pull air through the pile at an estimated rate of 103 scfm, while makeup air enters through nine perforated ventilation pipes arranged across the top of the pile. Vacuum at the blower is typically 16.5 " H_2O. Unlike the WRS SVE system, this system is not programmable; it runs continuously in a single configuration, applying the same vacuum to all 10 slotted vacuum pipes. Stockpile construction details have been provided in the installation and stockpile construction technical memorandum (USAF 2012b). The stockpile contains approximately 2,200 cubic yards of soil excavated from the footprint of the under-construction F-22 Weapons Release Shop (shown in Figure 2).

Operational Chronology

Table 12 lists the activities relating to the VSP SVE system throughout the third and fourth quarters. After the winter shutdown, the SVE blower was restarted on 26 April. Residual snow around the base of the stockpile and ice in the stockpile sump melted by 30 April. At that time, the header pipe contained water but was not audibly impeding air flow. On 12 June, soil gas from the exhaust stack of the blower was sampled, and the water pump was returned to the sump, automated to discharge to a 500 gallon polyethylene holding tank twice a day. Approximately 250 gallons accumulated by 3 July. On 1 August, soil gas was sampled again and 2 gallons of water was drained from the header pipe after gurgling was heard. By 8 August, the holding tank contained 400 gallons and seemed to be filling at a rapid rate, so pumping was halted until the tank could be emptied early in the fifth quarter. Another 2 gallons was drained from the header. The VSP SVE system was presumably affected by the same power outages that interrupted the WRS SVE system, but the system does not log or report interruptions.

Stockpile Dewatering

The stockpile was constructed during wet weather. Between 20 July and 8 August 2001, precipitation totaled 1.58 inches (wunderground.com historical data for Elmendorf AFB [PAED], accessed 13 March 2012). With a footprint of 7,590 square feet, the stockpile area received approximately 7,500 gallons of precipitation. Much of this was deflected by tarps and temporary covers, but unavoidable exposure of the soil during excavation, transport, and placement probably resulted in the entrapment of at least a thousand gallons during construction. The bottom of the stockpile slopes toward a sump in the southwest corner

(Figure 5), allowing removal of free water from the stockpile. A drain in the SVE header pipe allows removal of water accumulating in the piping.

During the first quarter, 560 gallons was collected during repeated visits to the site. During the second quarter, the stockpile was shutdown for winter. Although SVE operations resumed in the third quarter, stockpile pumping did not resume until the fourth quarter when the 500-gallon holding tank and timer were obtained to automate water collection. During the fourth quarter, an estimated 400 gallons was collected, for total dewatering to date of 960 gallons. Inspections of the stockpile cover have identified some minor ponding adjacent to the berm on the northern edge but no apparent leaks, suggesting that collected water may continue to represent water entrapped during construction.

Soil Gas Sampling and Results

Analytical sampling for PCE and TCE during the third and fourth quarters consisted of one sample collected from the exhaust stack port of the blower system on 8 August (Table 13), near the end of the fourth quarter. PCE was measured at 5.1 $\mu g/m^3$, similar to levels seen at the end of the first quarter (October 2011) and far less than its screening level of 180 $\mu g/m^3$ (Table 1). In contrast, TCE was measured at 11 $\mu g/m^3$, somewhat higher than at the end of the first quarter and slightly higher than its screening level of 8.8 $\mu g/m^3$ (Table 1). Figure 6 depicts these relationships graphically on a plot of concentration versus time. The comparatively elevated concentrations observed near the end of the fourth quarter may reflect elevated soil temperature due to solar warming beneath the black plastic cover during the long summer days of May, June, and July.

Mass Removal and Projected Performance

Mass removal is the product of air flow and concentration integrated over time. Based on the blower performance curve and the observed vacuum in the knockout tank, air flow was essentially constant at 103 scfm during first-quarter operations and after the blower was restarted on 26 April. Figure 6 displays concentrations over time for Quarters 1 through 4. PCE and TCE concentrations were not measured on 26 April but were assumed to have rebounded over the winter to 41.0 $\mu g/m^3$ for both, increasing by a factor of approximately 10. Connecting this value with the PCE and TCE concentrations measured on 8 August corresponds to half lives of 32 and 50 days, respectively, which are assumed to apply to future operations as well. The system is expected to be shut down for winter from approximately 31 October 2012 to 1 May 2013. Afterward, concentrations are projected to rebound by a factor of 5 rather than 10, reflecting presumed progress toward cleanup.

Figure 7 portrays the cumulative mass removal over time. At the end of the fourth quarter (16 August), the VSP SVE system is estimated to have removed 12.4 grams of PCE and 14.7 grams of TCE. In comparison, the upper limits of annual emissions are 611 grams of PCE and 3,872 grams of TCE; these values were calculated according to the conservative approach and are used in Appendix A of the Work Plan Addendum (USAF 2011a). At the end of 2 years, removal is projected to increase to 13.6 grams of PCE and 20.2 grams of TCE, increases of 10 and 37 percent, respectively. PCE concentrations in soil gas samples have never exceeded the soil re-use screening level, but TCE concentrations have done so at startup and during the third and fourth quarters. TCE concentrations are projected to decline below the screening level early in the fifth quarter but rebound over the winter. The extent of rebound is uncertain, with estimates ranging from negligible, such that TCE might remain below the screening level through the coming winter, to high, such that it could increase again by a factor of 10 and fail to reach the screening level by the scheduled end of operations in August 2013.

Based on the rebound estimated to have occurred during the winter shutdown in the second and third quarters, it is unlikely that hypothetical static soil gas samples from within the pile at the end of operations would meet the TCE screening level even if the operational samples were below that level. Nevertheless, confirmation soil samples to be taken from the stockpile as described in the first-quarter report (USAF 2012c) are expected to meet the migration-to-groundwater soil standards for PCE and TCE based on the early waste water characterization sample (USAF 2012b), which was non-detect for those constituents. The migration-to-groundwater soil standards for PCE and TCE (Table B1, 18 AAC 75.341 [ADEC 2011a]) are the most conservative in ADEC regulations.

Combined Air Emissions

Over the first year of operation, combined emissions from the WRS and VSP SVE systems are estimated to have totaled 73 grams PCE and 975 grams TCE, with 97 percent of the mass emitted by the WRS SVE system. These emissions total 1,048 grams (0.0011 tons), far below the permitting threshold of 2 tons per year (18 AAC 50.236 [ADEC 2011b]), indicating that the systems remain exempt from permitting. The total mass emitted over the first year of operation closely matches projections in the second-quarter report (USAF 2012a). Emissions over the second year are projected to total 664 grams, a decline of 37 percent, reflecting the fact that a significant fraction of the accessible contamination has already been removed.

Summary and Recommendations

This report encompasses the third and fourth quarters (21 February to 16 August 2012) of operations of the WRS and VSP SVE systems located on Joint Base Elmendorf Richardson, Alaska (Figure 1).

Screening Levels

ADEC issued its finalized its *Vapor Intrusion Guidance for Contaminated Sites* (ADEC 2012) as this report was being written, and the proposed screening levels for shallow and deep soil were revised to reflect the new target levels contained therein. The revised screening levels proposed in this report are more relaxed for PCE but more stringent for TCE than those proposed in the first-quarter report (USAF 2012c). The revised proposed screening levels presented in Table 1 have been used throughout this report. TCE levels become the focus of system operations because they have commonly exceeded their screening level, whereas even the startup PCE levels did not exceed their screening level.

WRS SVE System

The WRS SVE system continued operation in its winter configuration from 21 February until 21 March, when it was reconfigured to focus extraction on those five wells (VW4, VW6, VW7, VW8, and VW9) with TCE exceeding the screening level. Three of the remaining wells were inactivated, and the fourth (VW3) supplied bleed air to prevent excessive vacuum. As the ground thawed during breakup, water rapidly accumulated in the knockout tank, overfilling it on 25 April. The system was shut down manually when the tank level switches failed to operate, and the next two weeks were spent troubleshooting and repairing the wiring related to the knockout tank. Operation resumed on 11 May at reduced blower output, enabling operation of only the five wells of interest, and VW3 joined the inactive group. Operations continued with only minor interruptions for power outages through the end of the reporting period (16 August). Important developments were as follows:

- TCE concentrations in composite samples have remained steady at approximately twice the revised proposed screening level since late in the first quarter. However, TCE concentrations fell by approximately 50 percent in the two individual wells sampled during the reporting period, with the change occurring between the 10 February and 8 August sampling events. Only the three most southwesterly wells (VW6, VW7 and VW9) are thought to have exceeded the TCE screening level at the end of the fourth quarter. These three wells lie outside the footprint of the new F-22 Weapons Release Shop, and contamination there has little likelihood of affecting indoor air quality in the new building.
- Cumulative mass removal is estimated to have been 61 grams PCE and 960 grams TCE at the end of the fourth quarter, 65 percent of the total PCE and 60 percent of the total TCE that is projected to be removed over the 2-year operating period of the system.
- Measurements in the vacuum monitoring points continue to indicate less flushing than expected at the design radius of influence, which reduces the effectiveness of the system. Some compensation is achieved by operating the wells at 150 percent of their design flows (the maximum achievable while maintaining a reasonable manifold vacuum). Because the only wells thought to exceed the TCE screening level at the end of the fourth quarter lie outside the footprint of the new building, the treatment period will not need to be extended.

Contaminant concentrations have always met the revised proposed screening level of 1,800 µg/m^3 for PCE, and the revised proposed screening level of 88 µg/m^3 for TCE has been met since late in the first quarter for VW1, VW2, and VW3 beneath the footprint of the new building. Outside the footprint of the new building, TCE in VW9 fell by 42 percent between the end of the second quarter and the end of the fourth quarter from 1,000 µg/m^3 to 580 µg/m^3, but remains the most highly contaminated well. VW6 and VW7 also exceed or are near the TCE screening level, while VW4 (beneath the new building) and VW8 are probably below the screening level as of the end of the fourth quarter.

Extraction will continue to focus on the five wells with the highest remaining contaminant concentrations (VW4, VW6, VW7, VW8, and VW9) in order to maximize mass removal. The next report will cover the six-month period ending in February 2013. Because 2011-2012 winter conditions had little effect on subsurface vacuum distribution and well performance, no major changes in operations are planned for the upcoming winter. System operations are planned to continue into August 2013. At that time, VW9 will probably still be producing air above the TCE screening level, but the other four active wells may have cleaned up. The WRS SVE system will have mitigated the threat of vapor intrusion into the new F-22 Weapons Release Shop, and further operation would produce only very slow improvement at VW9.

VSP SVE System

The VSP SVE system operated continuously with only minor interruptions for power outages after restarting on 26 April 2012 following winter shutdown. Important developments were as follows:

- Water continued to drain from the stockpiled soil. Water collection was automated via a sump pump on a timer pumping into a 500-gallon holding tank, eliminating the need for frequent site visits. The header pipe must still be drained manually. An estimated 400 gallons were collected by the end of the fourth quarter. Since startup, approximately 960 gallons has been collected.
- PCE and TCE in extracted soil gas were measured only at the end of the fourth quarter. Unexpectedly, TCE at 11 µg/m^3 was as high as it had been in late September 2011, while PCE at 5.1 µg/m^3 was slightly higher than it had been at winter shutdown on 31 October 2011. These elevated values may reflect solar warming of the stockpile beneath its black plastic cover during the long summer days of May, June, and July.
- Cumulative mass removal is estimated to have been 12.4 grams of PCE and 14.7 grams of TCE at the end of the fourth quarter, 73 percent of the total that is projected to be removed over the 2-year operating period of the system.

Future system operation and evaluation will aim for stockpile decommissioning in the summer of 2013:

- Continue blower operations and dewatering until mid to late October 2012, and then winterize the site. Resume operations in the spring when the sump is free of ice.
- Monitor PCE and TCE concentrations in extracted soil gas quarterly when operating.
- Collect 14 soil samples in June 2013 or later to confirm cleanup. A decommissioning plan was proposed in the first quarterly report (USAF 2012c), but the specific soil standards and sampling plan will need to be approved by ADEC. Decommission the stockpile if results are acceptable. Although TCE might not decline to less than its screening level in extracted soil gas, the absence of PCE and TCE in drainage water suggests that the soil meets the most stringent soil standards (18 AAC 75.341, migration-to-groundwater scenario).

Air Emissions

Air emissions from the two SVE systems totaled 0.0011 tons over the first year of operation, far below the permitting threshold of 2 tons per year, and thus continue to show that the systems are exempt from permitting.

References

ADEC (Alaska Department of Environmental Conservation). 2011a (October). 18 AAC 75 *Oil and Other Hazardous Substances Pollution Control*.

ADEC. 2011b (April). 18 AAC 50 *Air Quality Control*.

ADEC. 2012 (October). *Vapor Intrusion Guidance for Contaminated Sites*. Division of Spill Prevention and Response. Contaminated Sites Program.

ADEC. 2009 (July). *Draft Vapor Intrusion Guidance for Contaminated Sites*. Division of Spill Prevention and Response. Contaminated Sites Program.

EPA (U.S. Environmental Protection Agency). 2012 (March). *Regional Screening Table*. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm, accessed 20 March 2012.

EPA. 2002 (November). *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*. EPA530-D-02-004.

USAF (U.S. Air Force). 2012a (April). *F-22 Weapons Release Shop SVE Systems Quarterly Report — Second Quarter (18 November 2011 to 20 February 2012)*. Technical memorandum from J. Ladegard (Jacobs) to D. Jadhon (U.S. Army Corps of Engineers) dated 25 April 2012.

USAF. 2012b (February). *Final F-22 Weapons Release Shop SVE Installation and Stockpile Construction*. Technical memorandum from J. Ladegard (Jacobs) to D. Aide (U.S. Air Force) dated 16 April 2012.

USAF. 2012c (March). *F-22 Weapons Release Shop SVE Systems Quarterly Report — First Quarter, 11 August to 18 November 2011*. Technical memorandum from J. Ladegard (Jacobs) to D. Jadhon (U.S. Army Corps of Engineers) dated 26 March 2012.

USAF. 2012d (February) *Soil Vapor Extraction System Operations and Maintenance Manual*, JBER-Elmendorf, Alaska. Prepared by Jacobs Engineering Group Inc. on behalf of the U.S. Army Corps of Engineers.

USAF. 2011a (June) *Soil Vapor Extraction System Design and Construction Work Plan Addendum*, JBER-Elmendorf, Alaska. Prepared by Jacobs Engineering Group Inc. on behalf of the U.S. Army Corps of Engineers.

USAF. 2011b (May*) F-22 Weapons Release Shop Engineering Evaluation and Cost Analysis*, JBER-Elmendorf, Alaska. Prepared by Jacobs Engineering Group Inc. on behalf of the U.S. Army Corps of Engineers.

Tables

Table 1 Contaminants of Concern and their Proposed Soil Gas Screening Levels for the F-22 WRS SVE Systems

Table 2 Activities at the Weapons Release Shop SVE System (Quarters 3 and 4)

Table 3 Weapons Release Shop SVE System Cycling for 21 February to 21 March 2012 (Winter Configuration)

Table 4 Weapons Release Shop SVE System Cycling for 21 March to 25 April 2012 (Initial Focused Configuration)

Table 5 Weapons Release Shop SVE System Cycling for 11 May to 16 August 2012 (Final Focused Configuration)

Table 6 Weapons Release Shop SVE Operational Hours Summary (Quarters 3 and 4)

Table 7 Air Flow Measurements at the Weapons Release Shop SVE System (Quarters 3 and 4)

Table 8 Vacuum Measurements at the Weapons Release Shop SVE System (Quarters 3 and 4)

Table 9 Soil Gas Results for Vacuum Wells at the Weapons Release Shop SVE System (Startup through Quarter 4)

Table 10 Soil Gas Field Parameters at the Weapons Release Shop SVE System (Startup through Quarter 4)

Table 11 Soil Gas Results for Vacuum Monitoring Points at the Weapons Release Shop SVE System (Startup through Quarter 4)

Table 12 Activities at the Ventilated Stockpile SVE System (Quarters 3 and 4)

Table 13 Soil Gas Results at the Ventilated Stockpile SVE System (Startup through Quarter 4)

Figures

Figure 1 F-22 Weapons Release Shop Site Locations

Figure 2 Weapons Release Shop SVE System Layout

Figure 3 Measured Composite Contaminant Concentrations in the Weapons Release Shop SVE System

Figure 4 Projected Mass Removal over 2 Years by the Weapons Release Shop SVE System

Figure 5 Ventilated Stockpile SVE System Layout

Figure 6 Measured Contaminant Concentrations in the Ventilated Stockpile SVE System

Figure 7 Predicted Mass Removal over 2 Years by the Ventilated Stockpile SVE System

Attachments

Attachment 1 Photograph Log

Attachment 2 Field Logbooks

Attachment 3 Systems Monitoring Logs

Attachment 4 Estimated PCE and TCE in the 8 August Composite Sample

TABLES

Table 1
Contaminants of Concern and their Proposed Soil Gas Screening Levels for the F-22 WRS SVE Systems

Contaminant	Soil Gas Concentration (µg/m³)	
	Soil Re-Use (VSP SVE System)	Deep Soil (WRS SVE System)
Work Plan Screening Levels (from draft ADEC guidance) [1]		
PCE	21	2,100
TCE	1.1	110
Previously Proposed Screening Levels (from EPA tables) [2]		
PCE	2.1	210
TCE	3.0	300
Revised Proposed Screening Levels (from latest ADEC guidance) [3]		
PCE	180	1,800
TCE	8.8	88

Notes:

[1] Values are from *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC 2009) cited in the Work Plan Addendum (USAF 2011a). Soil re-use values are for commercial indoor air, and deep soil values are for commercial soil more than 5 feet below the surface.

[2] Values are from the U.S. Environmental Protection Agency (EPA) Regional Screening Tables Calculator at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm on 7 March 2012 for an indoor worker. Cancer risk is the limiting factor. Deep soil values are derived from the indoor worker screening levels divided by the default attenuation factor of 0.01 for soils more than 5 feet below the foundation (i.e., the base of the floor slab) recommended in Appendix F of *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (EPA 2002) and utilized by the ADEC (ADEC 2009, 2012).

[3] Values are one tenth of the target levels from *Vapor Intrusion Guidance for Contaminated Sites* (ADEC 2012) for commercial soil up to 5 feet below the surface (for soil re-use), and for commercial soil more than 5 feet below the surface (for deep soil).

= screening levels used in this report

Table 2
Activities at the Weapons Release Shop SVE System (Quarters 3 and 4)

Date	Activity	Comments
2/20/12	**End of Quarter 2, beginning of Quarter 3**	
3/5/12	System re-start	System re-started manually. No flow in VW2.
3/9/12	Air sampling and periodic system check	Conducted the periodic system check, collected a composite sample, and measured vacuum and field parameters (VOCs, carbon dioxide, and oxygen) in all vacuum monitoring points. VW2 operating normally.
3/13/12	Power outage	Power was off from 11:41 to 16:31. No effect on system operation because it was waiting for a manual restart.
3/14/12	System re-start	System re-started manually. No flow in VW2.
3/21/12	Spring reconfiguration	Variable-frequency drive set to 45.00 hertz; cycling wells = VW4, VW6, VW7, VW8, and VW9; bleed well (to prevent excessive vacuum) = VW3. The new configuration omitted a recovery period, enabling a return to fully automated operation.
4/25/12	Knockout tank overfilled	Rapid infiltration as soil thawed resulted in significant water capture. The knockout tank filled with water to the level of air inlet, and the continuing influx of water remained entrained in the air stream, passing through the blower to be discharged as part of the exhaust. The blower system did not shut off because the level sensors in the knockout tank were inoperative. The system was turned off manually until the tank could be drained.
4/26/12	Knockout Tank Transfer Pump Inoperative	Ready to drain the knockout tank, but the transfer pump did not operate when switched on.
4/30/12 to 5/4/12	Transfer Pump Troubleshooting	Transfer pump and level sensors were discovered to be miswired. After rewiring, the knockout tank was drained to an overpack drum (stored on site until disposal could be arranged). The blower could not be restarted due to excessive vacuum.
5/11/12	System re-start; bleed well eliminated	High vacuum traced to improperly configured valves. Proper valve configuration resulted in normal vacuum. Variable-frequency drive set to 40.00 hertz, eliminating the need for a bleed well. Cycling wells = VW4, VW6, VW7, VW8, and VW9. The level sensors in the knockout tank could not be accessed without special tools and were not tested.
5/18/12	**End of Quarter 3, beginning of Quarter 4**	
6/12/12	Air sampling and periodic system check	Conducted the periodic system check and collected a composite sample.
6/19/12 to 6/20/12	Tubing damaged during foundation excavation	The foundation contractor damaged and repaired tubing for the VMP2 vacuum monitoring points during excavation for the footers for the new F-22 Weapons Release Shop.
6/21/12	VW2 decommissioned during foundation excavation	As the foundation contractor excavated for footers for the new F-22 Weapons Release Shop, it was discovered that VW2 was in the way. Jacobs verified that VW2 was no longer needed, and the foundation contractor cut and capped the riser and header pipes as needed. The well was not backfilled with bentonite.
6/28/12	Power outage	Power was off from 10:44 to 11:45. System operation resumed automatically at the point where it had been interrupted.
7/3/12	Power outage	Power was off from 14:22 to 15:00. System operation resumed automatically at the point where it had been interrupted.
8/8/12	Air sampling and periodic system check	Conducted the periodic system check and collected a suite of air samples (composite, VW6, VW9, VMP3B, and VMP3C).
8/16/12	**End of Quarter 4**	

Table 3
Weapons Release Shop SVE System Cycling for 21 February to 21 March 2012 (Winter Configuration)

Period Settings				
			Active Period (days)	4.5
			Recovery period (days)	4.5
			Total Cycle Length (days)	9.0
			Variable-Frequency Drive (hertz)	47.5
Individual Well Operation				
Well	**Valve Operation during the Active Period**		**Description**	**Total Active Time (days)**
	Close	**Open**		
VW1	0%	11%	Closed from 0 to 11% (open from 11 to 100%).	8.0
VW2	11%	22%	Closed from 11 to 22% (open from 0 to 11 and 22 to 100%).	8.0
VW3	22%	33%	Closed from 22 to 33% (open from 0 to 22 and 33 to 100%).	8.0
VW4	33%	44%	Closed from 33 to 44% (open from 0 to 33 and 44 to 100%).	8.0
VW5	44%	56%	Closed from 44 to 56% (open from 0 to 44 and 56 to 100%).	7.9
VW6	56%	67%	Closed from 56 to 67% (open from 0 to 56 and 67 to 100%).	8.0
VW7	67%	78%	Closed from 67 to 78% (open from 0 to 67 and 78 to 100%).	8.0
VW8	78%	89%	Closed from 78 to 89% (open from 0 to 78 and 89 to 100%).	8.0
VW9	89%	100%	Closed from 89 to 100% (open from 0 to 89%).	8.0
Recovery (all closed)	n/a	n/a		19

Notes:

1. Each well was turned off sequentially for approximately 0.5 days over the course of the 4.5 day active period, then all wells were off for 4.5 days (the recovery period). In practice, an error in the PLC program meant that the wells were off until the system was restarted manually.
2. During the 28 days of this configuration, the system was in recovery mode for the first 12 days with manual restarts on 5 March 2012 and 14 March 2012. Thus, the system completed two active periods and had 19 days of recovery time.

n/a = not applicable.

Table 4
Weapons Release Shop SVE System Cycling for 21 March to 25 April 2012 (Initial Focused Configuration)

Period Settings				
			Active Period (days)	10
			Recovery period (days)	0
			Total Cycle Length (days)	10
			Variable-Frequency Drive (hertz)	45

Individual Well Operation				
Well	**Valve Operation during the Active Period**		**Description**	**Total Active Time (days)**
	Close	**Open**		
VW1	n/a	n/a	Inactive (always closed).	0
VW2	n/a	n/a	Inactive (always closed).	0
VW3	100%	0%	Always open, bleeding air into the manifold to prevent overly high vacuum.	35
VW4	0%	20%	Closed from 0 to 20% (open from 20 to 100%).	27
VW5	n/a	n/a	Inactive (always closed).	0
VW6	20%	40%	Closed from 20 to 40% (open from 0 to 20 and 40 to 100%).	27
VW7	40%	60%	Closed from 40 to 60% (open from 0 to 40 and 60 to 100%).	28
VW8	60%	80%	Closed from 60 to 80% (open from 0 to 60 and 80 to 100%).	29
VW9	80%	100%	Closed from 80 to 100% (open from 0 to 80%).	29
Recovery (all closed)	n/a	n/a	The blower is always on; there is no recovery period.	n/a

Notes:
1. Wells VW4, VW6, VW7, VW8, and VW9 were turned off sequentially for 2 days each over the course of the 10 day active period. VW3 served to bleed additional air into the system, preventing the high-vacuum alarm from tripping while maintaining the supplier-recommended minimum VFD setting of 45 hertz. There was no recovery period, sidestepping the error in the PLC program and allowing the system to restart automatically.
2. During the 35 days of this period, the system completed approximately 3.5 cycles.

n/a = not applicable.

Table 5
Weapons Release Shop SVE System Cycling for 11 May to 16 August 2012 (Final Focused Configuration)

Period Settings	
Active Period (days)	10
Recovery period (days)	0
Total Cycle Length (days)	10
Variable-Frequency Drive (hertz)	40

Individual Well Operation

Well	Valve Operation during the Active Period		Description	Total Active Time (days)
	Close	Open		
VW1	n/a	n/a	Inactive (always closed).	0
VW2	n/a	n/a	Inactive (always closed).	0
VW3	n/a	n/a	Inactive (always closed).	0
VW4	0%	20%	Closed from 0 to 20% (open from 20 to 100%).	77
VW5	n/a	n/a	Inactive (always closed).	0
VW6	20%	40%	Closed from 20 to 40% (open from 0 to 20 and 40 to 100%).	77
VW7	40%	60%	Closed from 40 to 60% (open from 0 to 40 and 60 to 100%).	77
VW8	60%	80%	Closed from 60 to 80% (open from 0 to 60 and 80 to 100%).	78
VW9	80%	100%	Closed from 80 to 100% (open from 0 to 80%).	79
Recovery (all closed)	n/a	n/a	The blower is always on; there is no recovery period.	n/a

Notes:

1. The system was shut down for knockout-tank issues from 25 April to 11 May 2012.
2. Wells VW4, VW6, VW7, VW8, and VW9 were turned off sequentially for 2 days over the course of the 10 day active period. No bleed air was needed; upon further discussion, the supplier indicated that the VFD could probably be set as low as 30 hertz. There was no recovery period, sidestepping the error in the PLC program and allowing the system to restart automatically.
3. During the 97 days of this period, the system completed approximately 9.7 cycles.

n/a = not applicable.

Table 6
Weapons Release Shop SVE Operational Hours Summary (Quarters 3 and 4)

Well	Estimated Hours[1] for Quarters 3 and 4			
	Start of Quarter 3	End of Quarter 4	Operational hours	Duty Fraction[2]
System	4,464	8,357	3,891[3]	91%
VW1	2,938	3,228	290	7%
VW2	2,989	3,278	289	7%
VW3	2,990	4,144	1,154	30%
VW4	2,989	5,808	2,819	72%
VW5	2,957	3,243	286	7%
VW6	2,989	5,808	2,819	72%
VW7	2,988	5,807	2,819	72%
VW8	2,986	5,868	2,882	74%
VW9	2,994	5,935	2,941	76%

Notes:

[1] System hours are the difference between total elapsed time and recorded down time. Well hours are estimated from the nearest hour meter readings recorded during periodic monitoring adjusted according to system cycling.

[2] Duty fraction for the system is relative to the total duration of the reporting period, whereas duty fraction of each well is relative to the duration of system operations.

[3] The system was down for 379 hours (15.8 days) from 25 April to 11 May due to knockout-tank issues and 1.6 hours due to power outages.

Table 7
Air Flow Measurements at the Weapons Release Shop SVE System (Quarters 3 and 4)

Date	Flow Rates (scfm)									
	Total	VW1	VW2	VW3	VW4	VW5	VW6	VW7	VW8	VW9
VW1 Off										
3/9/12	422	0	34	55	55	53	48	77	61	40
6/12/12	0	—	—	—	—	—	—	—	—	—
8/8/12	0	—	—	—	—	—	—	—	—	—
VW2 Off										
3/9/12	421	40	0	54	53	52	47	76	60	39
6/12/12	0	—	—	—	—	—	—	—	—	—
8/8/12	0	—	—	—	—	—	—	—	—	—
VW3 Off										
3/9/12	412	41	31	0	56	54	49	78	62	41
6/12/12	0	—	—	—	—	—	—	—	—	—
8/8/12	0	—	—	—	—	—	—	—	—	—
VW4 Off										
3/9/12	412	41	31	55	0	54	49	79	62	41
6/12/12	294	—	—	—	0	—	61	99	82	52
8/8/12	292	—	—	—	0	—	61	98	82	51
VW5 Off										
3/9/12	413	41	31	55	55	0	49	78	62	41
6/12/12	0	—	—	—	—	—	—	—	—	—
8/8/12	0	—	—	—	—	—	—	—	—	—
VW6 Off										
3/9/12	415	41	31	55	55	53	0	78	62	41
6/12/12	298	—	—	—	67	—	0	98	81	52
8/8/12	298	—	—	—	69	—	0	97	81	51
VW7 Off										
3/9/12	404	43	32	57	57	56	51	0	65	43
6/12/12	277	—	—	—	72	—	64	0	86	55
8/8/12	277	—	—	—	73	—	64	0	86	54
VW8 Off										
3/9/12	412	42	32	57	56	54	50	79	0	42
6/12/12	288	—	—	—	70	—	63	101	0	54
8/8/12	286	—	—	—	72	—	62	99	0	53
VW9 Off										
3/9/12	417	40	31	55	54	53	48	76	61	0
6/12/12	301	—	—	—	67	—	59	96	79	0
8/8/12	300	—	—	—	68	—	59	94	79	0

Table 7
Air Flow Measurements at the Weapons Release Shop SVE System (Quarters 3 and 4) (Continued)

Date	Flow Rates (scfm)									
	Total	**VW1**	**VW2**	**VW3**	**VW4**	**VW5**	**VW6**	**VW7**	**VW8**	**VW9**
Average Flow*										
Design†	**357**	**36**	**23**	**48**	**47**	**47**	**42**	**66**	**57**	**36**
3/9/12	414 (116%)	41 (114%)	32 (137%)	55 (115%)	55 (117%)	53 (114%)	49 (116%)	78 (118%)	62 (108%)	41 (114%)
6/12/12	292 (82%)	—	—	—	69 (146%)	—	62 (147%)	99 (149%)	82 (144%)	53 (148%)
8/8/12	290 (81%)	—	—	—	70 (150%)	—	61 (146%)	97 (147%)	82 (144%)	52 (145%)

Notes:

* Average flow for each well excludes the zero flow when the well was off and thus reflects the average operational flow in each well, whereas the average total flow is constructed by averaging the total flow of each configuration. Thus, the average total flow is less than the sum of the average flows by the ratio of active wells to total wells (i.e., 8/9 for Design and 9 Mar or 4/5 for 12 June and 8 August).

† Design flow rates from the work plan (USAF 2011).

scfm = standard cubic feet per minute

— = well not part of active configuration

Table 8
Vacuum Measurements at the Weapons Release Shop SVE System (Quarters 3 and 4)

Location	Nearby Vacuum Wells Name (radius in feet)			Design Vacuum (" H_2O)	Screen	Depth (feet)	Observed Vacuum* (" H_2O)
							3/9/12
VMP1	VW1 (22)	VW3 (16)	VW4 (19)	6.24	A	6.5	0.47
					B	26	0.238
					C	49.5	0.188
VMP2	VW4 (24)	VW7 (32)	VW8 (15)	6.69	A	6.5	0.232
					B	26	0.225
					C	49.5	0.189
VMP3	VW6 (26)	VW7 (18)	VW9 (24)	6.31	A	6.5	0.238
					B	26	0.227
					C	49.5	0.183
VMP4	VW2 (16)	VW5 (34)	—	0.51	—	In Trench	0.092
VMP5	VW4 (34)	VW5 (24)	VW8 (21)	0.91	—	In Trench	0.100

Notes:

* Vacuums measured with all wells operating simultaneously.

In Trench = 3 to 4 feet deep, below the concrete cap in the gravel bedding around the system piping.

Table 9
Soil Gas Results for Vacuum Wells at the Weapons Release Shop SVE System (Startup through Quarter 4)

Location:		Composite		VW1		VW2		VW3		VW4		VW5		VW6		VW7		VW8		VW9	
Date	**Day**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**
8/19/11	0	290	***1,300***	6.9	***210***	29	ND [4.0]	9.1	***800***	690	***960***	1,300	***99***	75	***800***	28	***1,600***	360	***1,500***	44	***3,600***
8/20/11	1	130	***830***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/22/11	3	73	***570***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/25/11	6	51	***490***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8/29/11	10	34	***450***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/2/11	14	35	***390***	4.3	32	ND [0.40]	6.7	5	***98***	120	***300***	8.5	***120***	9	***310***	7	***370***	28	***170***	7.5	***1,700***
9/9/11	21	22	***270***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/19/11	31	22	***280***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9/26/11	38	13	***210***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/5/11	47	11	***210***	1.2	11	2.4	0.045	1.1	34	39	***140***	30	3.6	3.8	***270***	2.3	***200***	12	84	6.3	***920***
10/14/11	56	8.8	***200***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10/24/11	66	9.1	***170***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/4/11	77	9.5	***160***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11/17/11	90	6.5	***180***	0.74	8.1	1.4	0.055	0.76	32	22	***120***	19	2.8	3.1	***310***	1.7	***180***	6.2	64	7.6	***900***
12/8/11	111	9.1	***200***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12/26/11	129	7.6	***190***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1/17/12	151	9.1	***210***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2/10/12	175	7.6	***170***	0.68 J	7.4	—	—	0.85 J	31	27	***120***	18	2.4	2.7	***250***	2.4	***230***	7.5	63	6.7	***1,000***
3/9/12	203	6	***170***	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6/12/12	298	6.5	***160***	Inactive						—	—	Inactive		—	—	—	—	—	—	—	—
8/8/12	355	8.5*	***164****							—	—			1.6	***100***	—	—	—	—	3.3	***580***

Notes:

All results in µg/m³

Bold results exceed the revised proposed screening levels of 1,800 µg/m³ for PCE and 88 µg/m³ for TCE (see Table 1).

[shaded] = third- and fourth-quarter results

ND = nondetect

[ ] = limit of detection

J = analyte detected below the method reporting limit; the result is an estimate.

— = not sampled.

*red = estimated concentrations as described in Attachment 4. VW9 was inadvertently left closed during sampling. PCE and TCE analytical results were 9.3 and 97 µg/m³, respectively.

Table 10
Soil Gas Field Parameters for Vacuum Monitoring Points at the Weapons Release Shop SVE System
(Startup through Quarter 4)

Location	Screen	Depth (ft)	VOCs (ppm)			Carbon Dioxide (ppm)			Oxygen (%)		
			8/17/11	11/18/11	3/9/12	8/17/11	11/18/11	3/9/12	8/17/11	11/18/11	3/9/12
VMP1	A	6.5	10.2	6.3	0.0	2,130	600	950	20.3	21.8	20.9
	B	26	5.6	8.3	0.0	6,530	8,950	7,660	19.7	20.9	19.7
	C	49.5	4.2	4.6	0.0	7,860	12,200	10,100	19.6	18.8	19.7
VMP2	A	6.5	6.0	5.6	0.0	3,310	780	730	20.5	21.8	20.9
	B	26	3.4	4.2	0.0	5,480	2,780	2,550	20.3	21.5	20.9
	C	49.5	3.4	2.7	0.0	6,390	19,100	15,900	20.2	16.8	19.6
VMP3	A	6.5	4.7	3.0	0.0	3,000	670	650	20.5	21.8	20.9
	B	26	3.0	3.1	0.0	5,100	5,850	6,000	20.4	20.9	20.0
	C	49.5	2.7	2.7	0.0	7,720	14,900	15,900	20.2	17.3	17.6
VMP4	—	In Trench	19.0	5.0	0.0	4,500	610	670	20.3	21.7	20.9
VMP5	—	In Trench	6.1	4.5	0.0	1,550	520	600	20.9	21.8	20.9
Ambient	—	—	2.3*	0.0	0.0	440*	760	970	20.9*	21.7	20.9

Notes:
In Trench = 3 to 4 feet deep, below the concrete cap in the gravel bedding around the system piping.
* Ambient field parameters for 8/17/11 measured on 8/18/11.

Table 11
Soil Gas Results for Vacuum Monitoring Points at the Weapons Release Shop SVE System
(Startup through Quarter 4)

Location		VMP1A		VMP1B		VMP1C		VMP3A		VMP3B		VMP3C		VMP4		VMP5	
Date	**Day**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**	**PCE**	**TCE**
8/17/11	-2	ND [3.9]	***270***	8.9	31	ND [8.2]	9.5 J	23	***440***	14	***680***	140	***88***	ND [160]	ND [170]	56	***170***
11/18/11	91	0.94	30	1.1	64	0.92	37	13	32	15	***720***	14	***530***	0.25	ND [0.13]	6.3	1.7 J
8/8/12	355	—	—	—	—	—	—	—	—	6.3	***490***	4.7	***700***	—	—	—	—

Notes:
All results in µg/m^3
Bold results exceed screening levels of 1,800 µg/m^3 for PCE and 88 µg/m^3 for TCE (see Table 1).
= third- and fourth-quarter results
ND = nondetect.
[ ] = limit of detection.
J = analyte detected below the method reporting limit.
— = not sampled.

Table 12
Activities at the Ventilated Stockpile SVE System (Quarters 3 and 4)

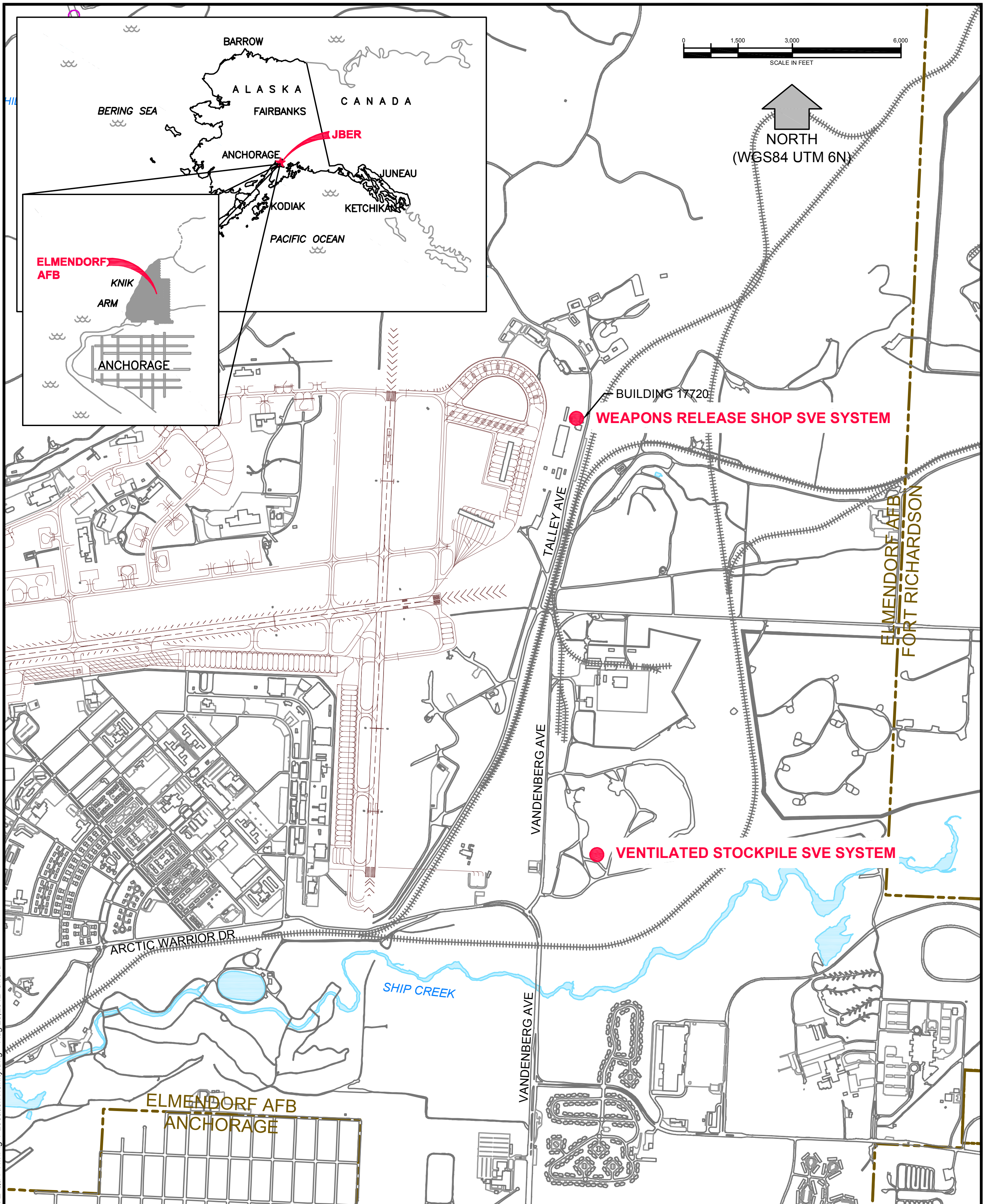
Date	Activity	Comments
2/21/12	Beginning of Quarter 3	
4/26/12	Started blower after winter shutdown	A little snow remained around the base of the stockpile and the sump contained some ice.
4/30/12	Site visit	All snow inside the fence had melted, as had the ice in the sump. Header pipe contained water but did not seem to be impeding air flow.
5/11/12	Site visit	Water depth in the sump was approximately 7 inches.
5/19/12	Beginning of Quarter 4	
6/12/12	Periodic system check Tank setup and timer installation	See checklist for this date. Configured the sump pump to discharge to a 500-gallon holding tank. A standard 24-hour timer automated operation of the sump pump, running it twice a day for 15 minutes.
7/3/12	Tank check	The holding tank contained approximately 250 gallons.
8/1/12	Sampling Water in header	Collected a soil gas sample from the exhaust port of the blower. Approximately 2 gallons was drained from the header pipe.
8/8/12	Periodic system check Tank check Water in header	See checklist for this date. 500-gallon holding tank contained approximately 400 gallons, an estimated increase of 100 gallons during the past week. To prevent overfilling, the sump pump was unplugged. Pumping to resume early in Quarter 5 after the holding tank is emptied. Approximately 2 gallons was drained from the header pipe.
8/16/12	End of Quarter 4	

Table 13
Soil Gas Results at the Ventilated Stockpile SVE System (Startup through Quarter 4)

Date	Day	PCE	TCE
8/17/11	0	78	***53***
8/20/11	3	47	***30***
8/2911	12	29	***30***
9/9/11	23	18	***19***
9/26/11	40	11	***13***
10/14/11	58	6.3	4.6
10/31/11	75	3.5	4.7
8/1/12	172*	5.1	***11***

Notes:
* Winter shutdown (178 days) not included.
All results in µg/m^3.
Bold results exceed screening levels of 180 µg/m^3 for PCE and 8.8 µg/m^3 for TCE (see Table 1).
= third- and fourth-quarter results

FIGURES

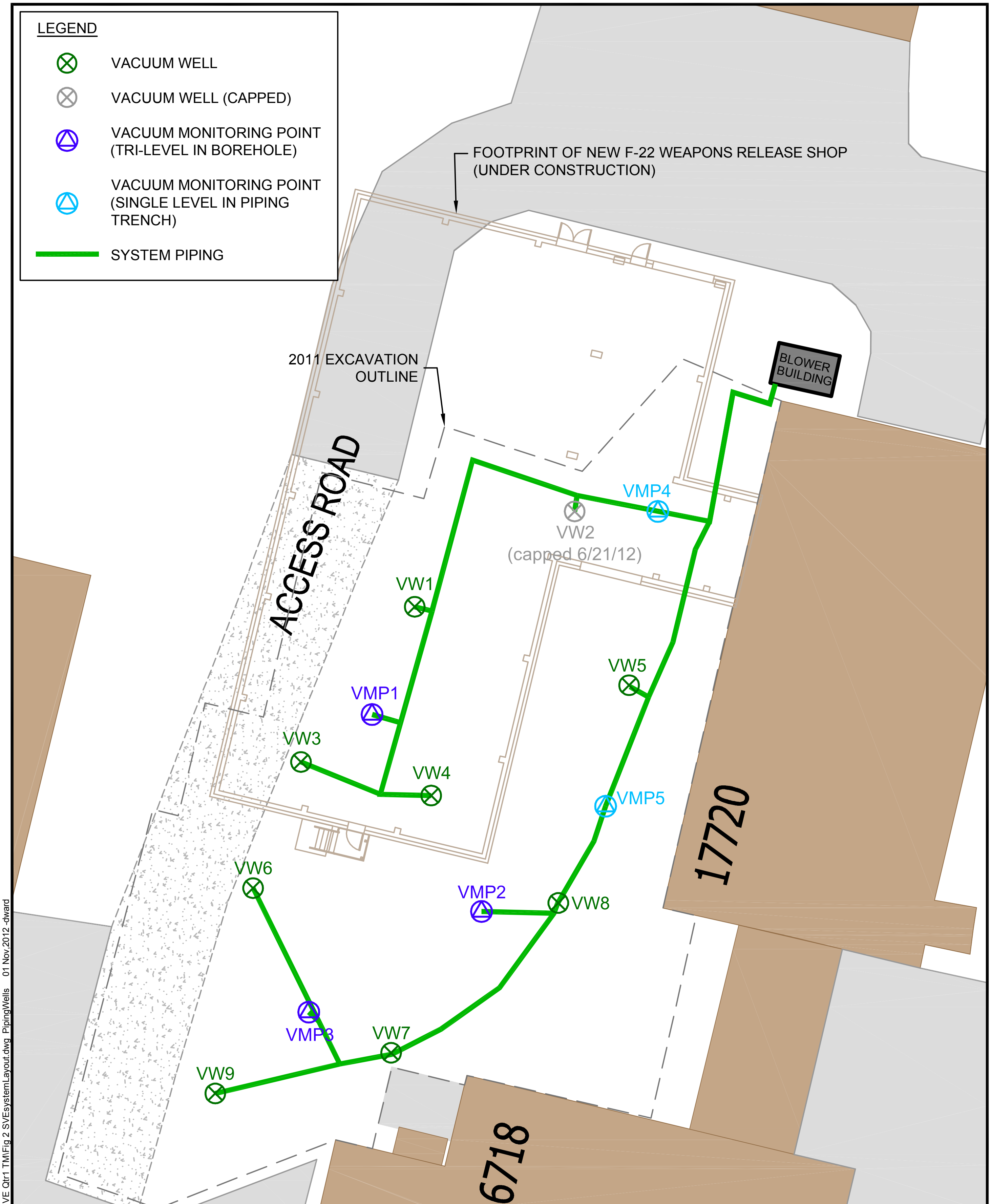


F-22 WEAPONS RELEASE SHOP SITE LOCATIONS

F-22 WEAPONS RELEASE SHOP
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

JACOBS	DATE: 29-Aug-2012	PROJECT MANAGER: J. Ladegard	FIGURE NO. : 1

G:\Autocad\ERS-UR\05F51904\SVE Qtr1 TM\Fig 1 LocationVicinity.dwg Aug 29,2012 -dward



WEAPONS RELEASE SHOP SVE SYSTEM LAYOUT

F-22 WEAPONS RELEASE SHOP
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

JACOBS	DATE: 01-Nov-2012	PROJECT MANAGER: J. Ladegard	FIGURE NO.: 2

G:\Autocad\ERS-UR\05F51904\SVE Qtr1 TM\Fig 2 SVEsystemLayout.dwg PipingWells 01 Nov,2012 -dward

Figure 3 Measured Composite Contaminant Concentrations in the Weapons Release Shop SVE System

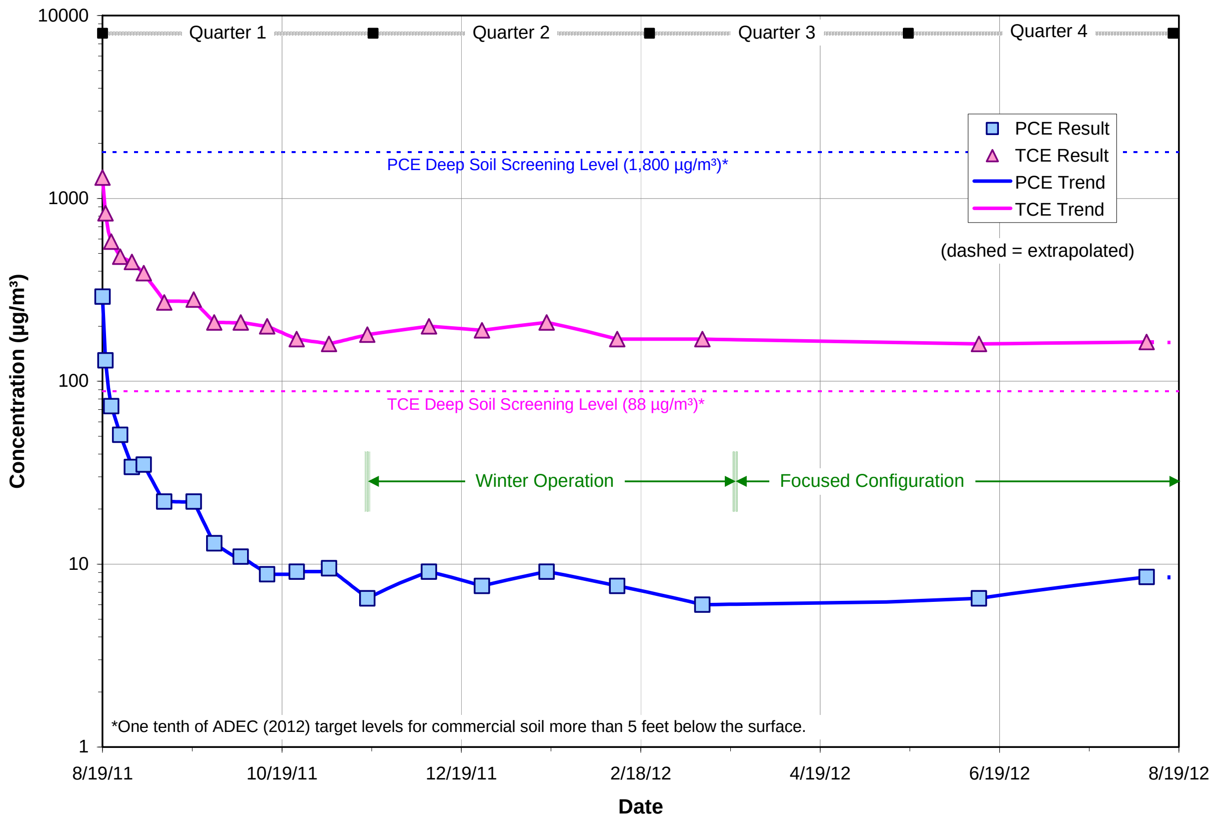
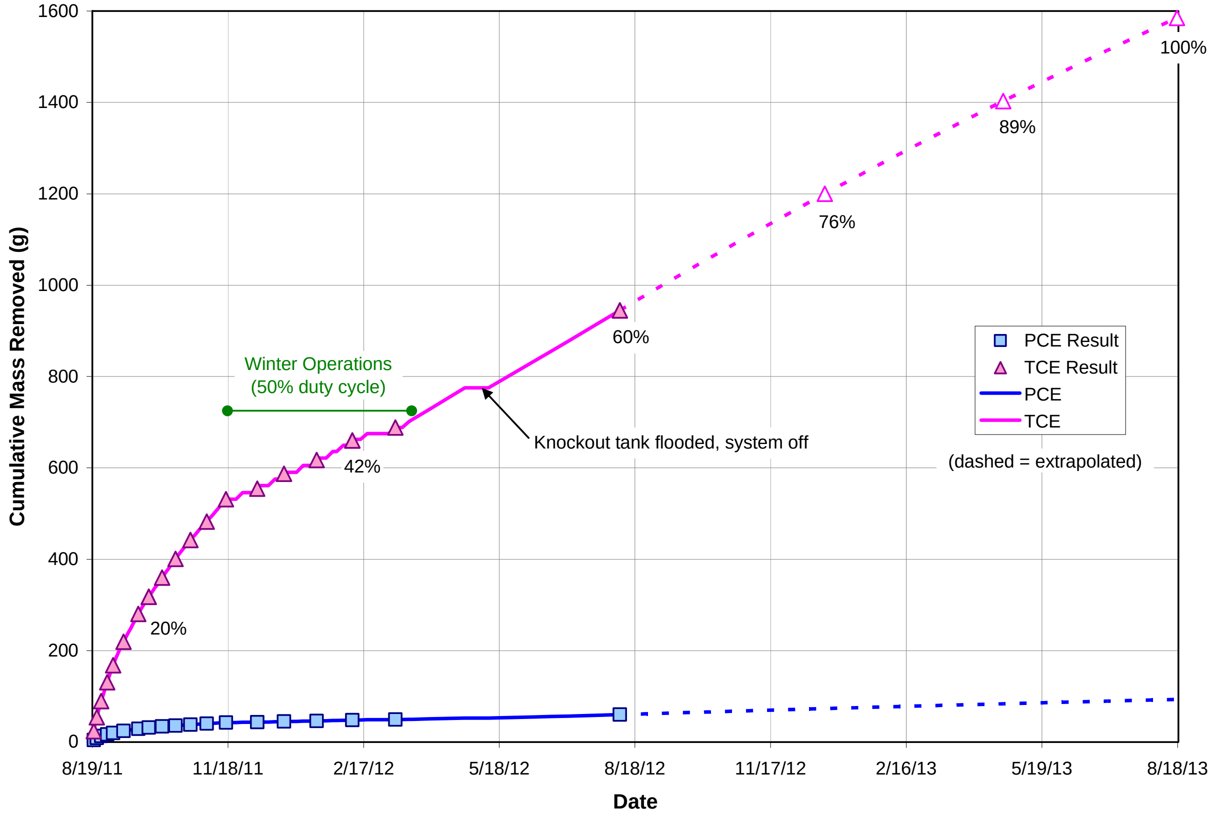


Figure 4 Projected Mass Removal over 2 Years by the Weapons Release Shop SVE System



N

0 12.5 25 50

Feet

Contour Interval = 1 foot

Coordinate System: WGS 1984 UTM Zone 6N
Vertical Datum: Not Specified

VENTILATED STOCKPILE SVE SYSTEM LAYOUT

F-22 WEAPONS RELEASE SHOP
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

	DATE:	PROJECT MANAGER:	FIGURE NO:
JACOBS	04-Oct-2012	J. Ladegard	5

Path: P:\Elmendorf\SVE\MXD\StockpileLayoutSurveyed_Qtr3&4_Fig_5.mxd User: dward

Figure 6 Measured Contaminant Concentrations in the Ventilated Stockpile SVE System

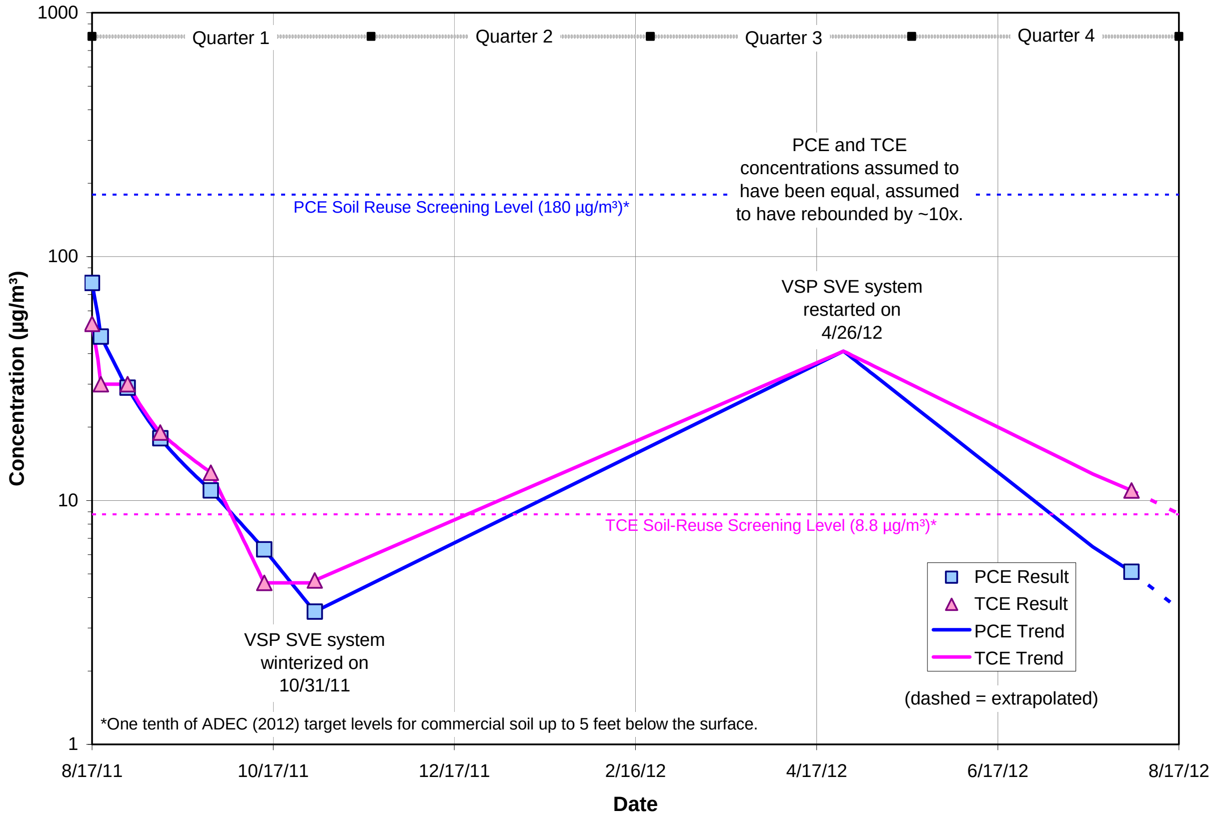


Figure 7 Predicted Mass Removal over 2 Years by the Ventilated Stockpile SVE System